EDEXCEL A-LEVEL BIOLOGY

BIOLOGY



EXAM QUESTION PACK

UNIT 4 OLD SPECIFICATION PAPERS

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Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Thursday 16 June 2016 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 As part of the immune response, a B cell has to be activated. It then divides to form a clone of cells. These cells then differentiate into plasma cells, which produce antibodies.

(a) Describe how a B cell is activated.

(3)

(b) (i) Name the type of division that occurs when B cells are cloned.

(1)

(ii) Suggest how a microscope slide could be prepared to observe cell division in B cells.

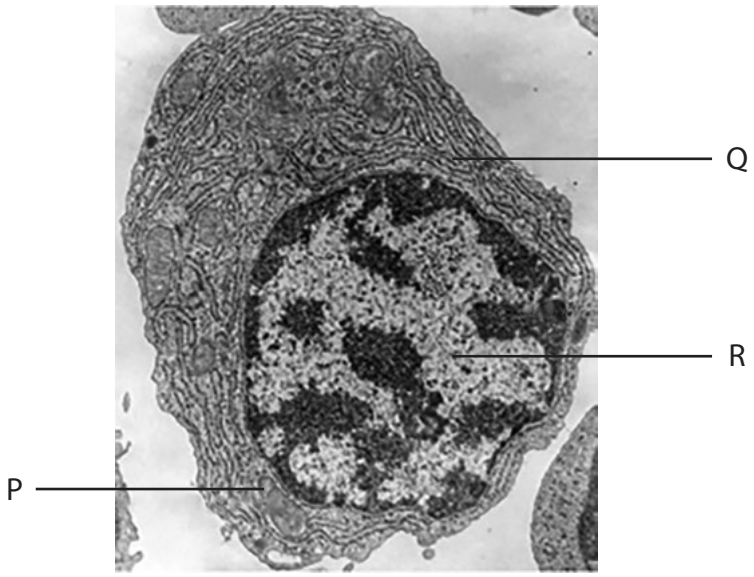
(3)

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(c) The electronmicrograph below shows a plasma cell. Some structures inside this cell have been labelled.



Magnification ×10 000

Place a cross ☒ in the box to identify each of the following structures.

(i) Structure P

(1)

☒ **A** chloroplast

☒ **B** Golgi apparatus

☒ **C** mitochondrion

☒ **D** nucleus

(ii) Structure R

(1)

☒ **A** cytoplasm

☒ **B** lysosome

☒ **C** nucleus

☒ **D** vacuole

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(iii) Name structure Q.

(1)

(iv) Describe the role of structure Q in the production of antibodies.

(3)

(Total for Question 1 = 13 marks)

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2 Infection with human immunodeficiency virus (HIV) can lead to the condition known as AIDS. Patients with AIDS are very susceptible to infections caused by bacteria and viruses.

(a) The table below shows some features of bacteria and viruses.

For each feature, place **one** cross in the appropriate box, in each row, to show whether it is found in bacteria only, in viruses only or in both bacteria and viruses.

(3)

Feature	Bacteria only	Viruses only	Both bacteria and viruses
Cytoplasm	☒	☒	☒
Nucleic acids	☒	☒	☒
Protein coat (capsid)	☒	☒	☒

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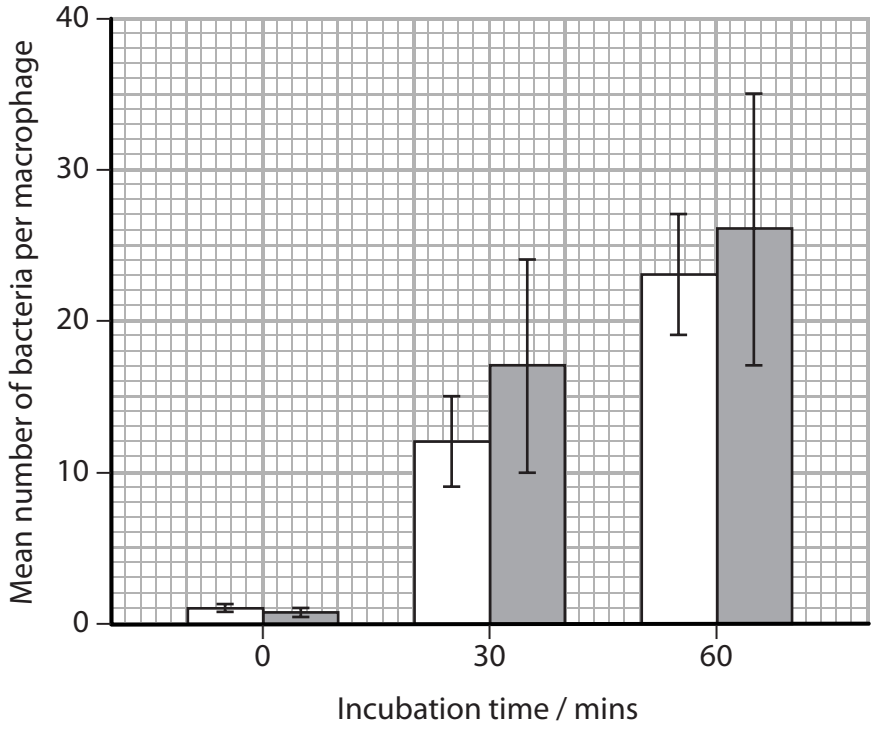
(b) Phagocytosis by macrophages is a non-specific response to infection.

The ability of macrophages to carry out phagocytosis of bacteria was investigated.

Macrophages from patients with AIDS were compared with macrophages from people who did not have AIDS.

These macrophages were obtained from the lungs of the individuals and incubated with bacteria for 60 minutes. The mean number of bacteria per macrophage was recorded at the start of the incubation period, after 30 minutes and after 60 minutes.

The results of this investigation are shown in the graph below.



Key

- Macrophages isolated from people who did not have AIDS
- Macrophages isolated from patients with AIDS

(i) It was concluded that there was no significant difference in the ability of these macrophages to carry out phagocytosis.

Using the information in the graph, suggest why this conclusion was made.

(2)

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(ii) Using the fluid mosaic model of cell membranes, explain how a macrophage carries out phagocytosis of bacteria.

(4)

(c) Antibiotics can be used to treat bacterial infections of patients with AIDS.

(i) Distinguish between a bacteriostatic antibiotic and a bactericidal antibiotic.

(2)

(ii) Suggest why antibiotics are not used to treat infections caused by viruses.

(1)

(Total for Question 2 = 12 marks)

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3 Gross primary productivity (GPP) is affected by temperature and precipitation, which includes rain and snow.

The table below shows the mean annual temperature range and mean annual precipitation range in some ecosystems. The table also shows the GPP range in these ecosystems.

Ecosystem	Mean annual temperature range / °C	Mean annual precipitation range / cm	GPP range / kJ m^{-2} $year^{-1}$
Tropical rainforest	20 to 28	240 to 440	24 500 to 29 000
Temperate forest	1 to 20	50 to 240	15 000 to 27 000
Temperate grassland	–8 to 20	20 to 130	1 700 to 11 000
Tundra	–14 to –8	10 to 110	850 to 2 500

(a) Explain the meaning of the term **gross primary productivity (GPP)**.

(2)

(b) Using the information in the table, describe and explain the effects of temperature and precipitation on GPP.

(5)

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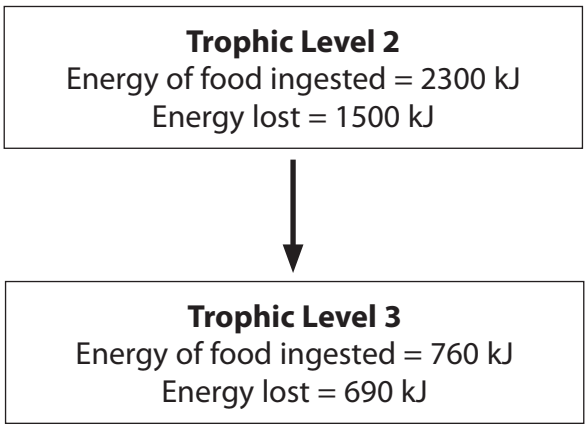
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(c) A desert has a mean annual temperature range of –8 °C to 20 °C and a mean annual precipitation range of 0 to 20 cm.

Suggest a range for the GPP in this desert. Give reasons for your answer.

(3)

(d) The diagram below shows the flow of energy in part of an ecosystem.



Calculate the percentage of energy from trophic level 2 that would be available for trophic level 4.

(3)

.....%

(Total for Question 3 = 13 marks)

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4 An experiment was carried out to investigate the effect of temperature on the activity of the enzyme RUBISCO. This enzyme is involved in the light-independent reaction of photosynthesis.

The RUBISCO was isolated from cotton plants and its activity measured.

The results of this experiment are shown in the table below.

Temperature / °C	Activity of RUBISCO / arbitrary units
25	2.3
30	3.2
35	4.2
40	5.0
45	4.4
50	1.7

(a) Using the information in the table, explain the effects of temperatures above 40 °C on the activity of RUBISCO.

(5)

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(b) Name the **two** substrates that would have been used in this experiment.

(1)

.....

(c) Place a cross ☒ in the box to complete the following sentences.

(i) The pH was kept constant to make the experiment

(1)

☒ **A** accurate

☒ **B** precise

☒ **C** reliable

☒ **D** valid

(ii) The optimum temperature of RUBISCO can be determined by

(1)

☒ **A** measuring the activity at 1 °C intervals between 35 °C and 40 °C

☒ **B** measuring the activity at 1 °C intervals between 40 °C and 45 °C

☒ **C** measuring the activity at 1 °C intervals between 35 °C and 45 °C

☒ **D** repeating the experiment at 35 °C, 40 °C and 45 °C three more times

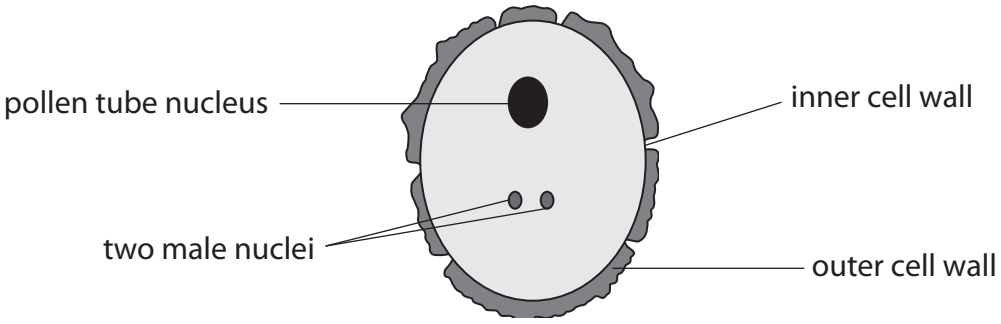
(Total for Question 4 = 8 marks)

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5 Analysis of pollen in peat bogs can provide evidence for global warming.

Peat is acidic and has low levels of oxygen. As a result, pollen is preserved in the peat for many years.

The diagram below shows the structure of a pollen grain.



The inner cell wall contains cellulose and the outer cell wall contains sporopollenin. Sporopollenin is chemically stable and very resistant to decomposition.

(a) Describe the structure of cellulose in cell walls.

(4)

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(b) Suggest why pollen in peat bogs is preserved for many years.

(4)

(c) Describe the role of each of the male nuclei in the process of fertilisation in flowering plants.

(4)

(Total for Question 5 = 12 marks)

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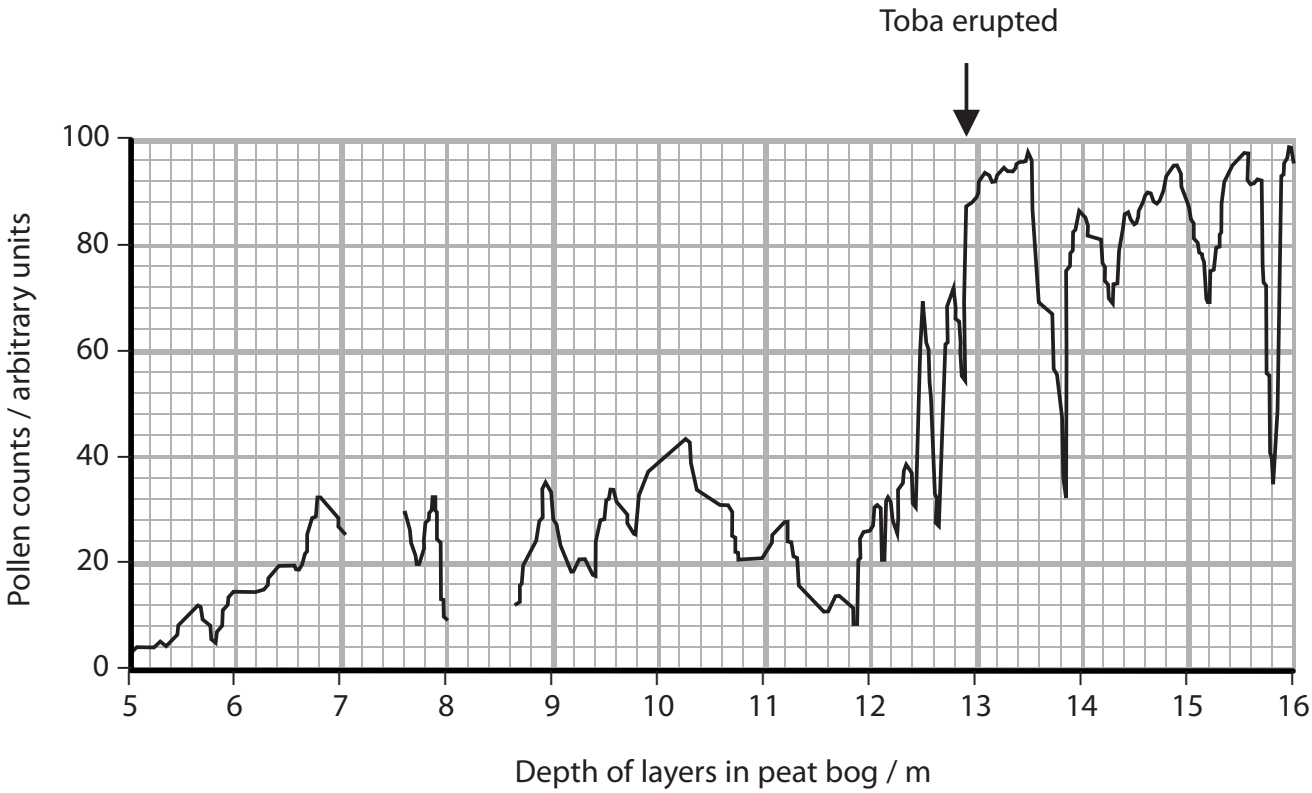
6 Volcanic eruptions have had an effect on the climate and temperature of the Earth.

Analysis of pollen in peat bogs and changes in sea levels give evidence for climate change.

Toba is a volcano in Sumatra that erupted approximately 70 000 years ago. The map below shows the location of Sumatra.



The graph below shows the result of pollen counts at different depths in a peat bog in France.



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(a) Using the information in the graph, describe the changes in the pollen count in the layers of peat from a depth of 12.5 m to a depth of 13.5 m.

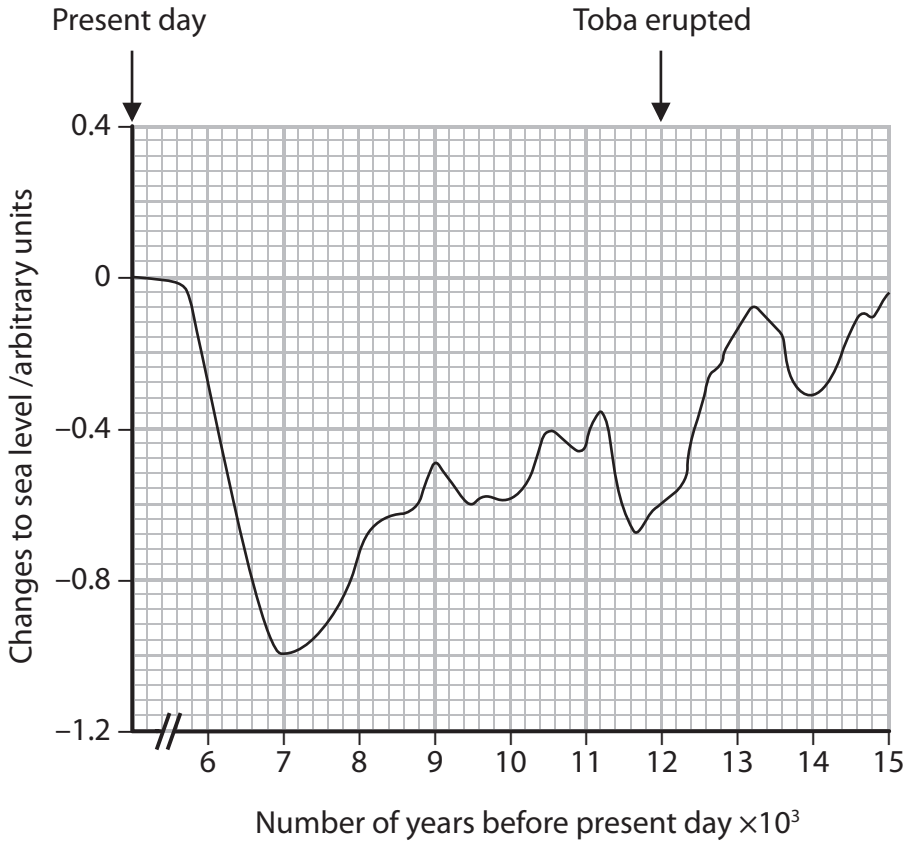
(3)

(b) Suggest why there is no data for some of the depths.

(1)

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(c) The graph below shows changes to sea levels, compared to the present day, in the oceans around Greenland.



Suggest why temperature changes affect sea level.

(2)

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(d) It is claimed that the volcanic eruption of Toba caused a change in world climate.

(i) Using the information in both graphs, describe the evidence that supports this claim.

(2)

(ii) Using the information in both graphs, suggest why this claim may not be true.

(3)

(Total for Question 6 = 11 marks)

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7 A pathologist can use a number of methods to estimate the time of death of a body found at a crime scene.

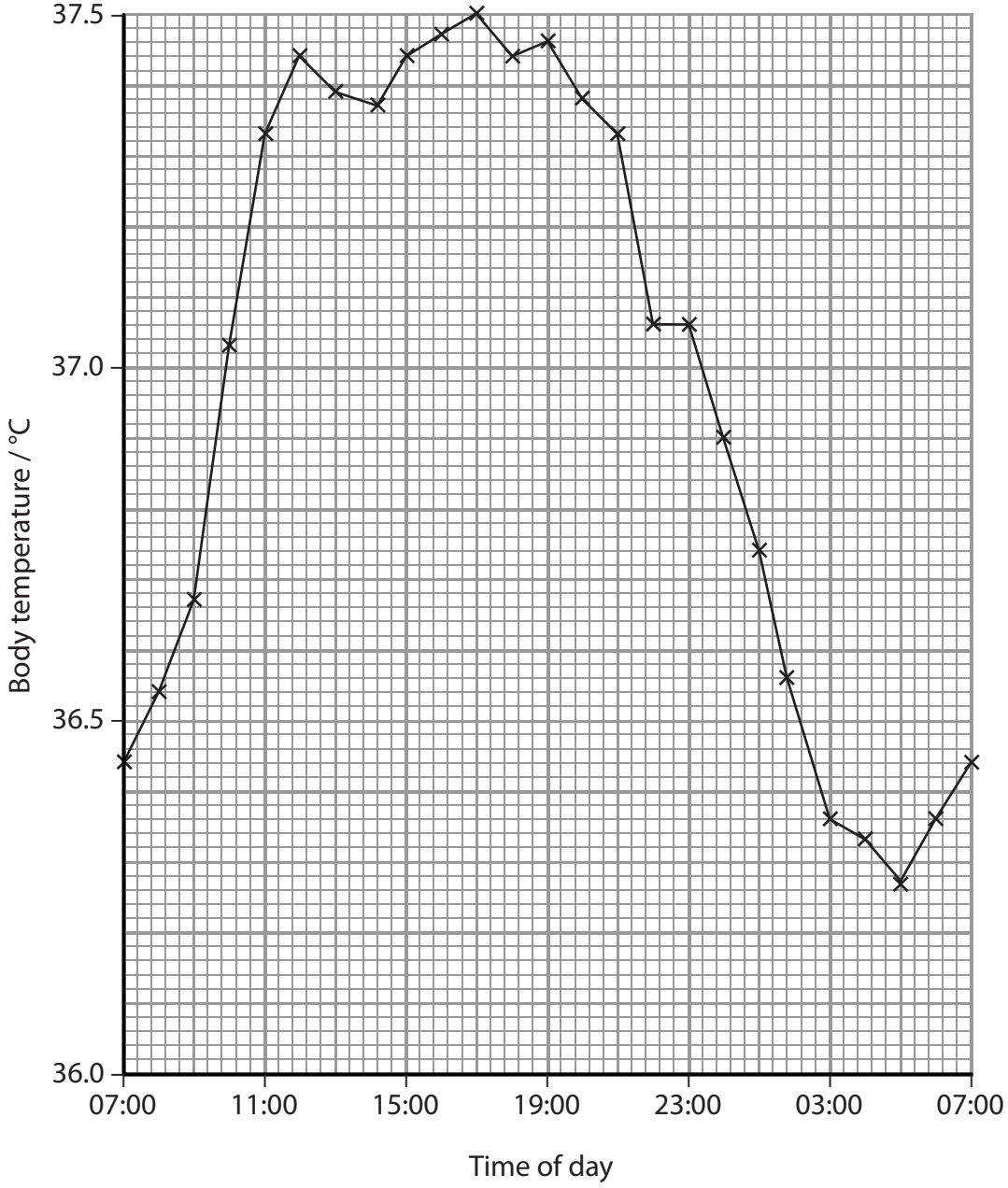
(a) The pathologist will measure the body temperature and the temperature of the surroundings.

Explain why it is necessary to take these two measurements as soon as possible.

(3)

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(b) The graph below shows variation in the body temperature of a living person over a period of 24 hours.



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(i) Using the information in the graph, calculate the maximum change in body temperature over this period of 24 hours.

(2)

..... °C

(ii) Suggest how a pathologist could use the information in this graph to estimate the time of death of a body at a crime scene.

(2)

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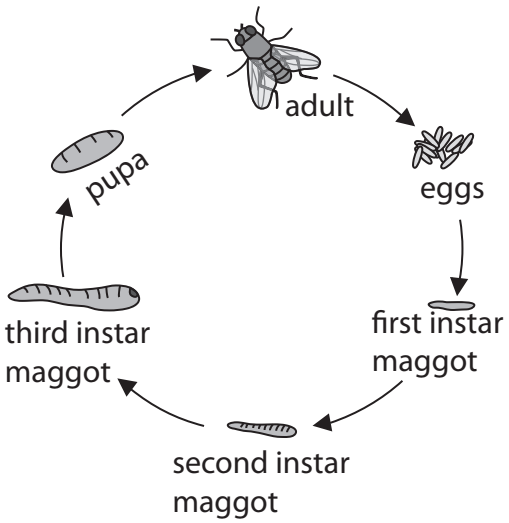
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*(c) A pathologist can also use forensic entomology to estimate the time of death of a body.

The diagram below shows the life cycle of a fly.



Describe an investigation that could be carried out to study the effect of temperature on the time taken for the first instar maggot to become a pupa.

(5)

(Total for Question 7 = 12 marks)

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8 One gene can give rise to more than one protein.

(a) Give **three** differences between fibrous and globular proteins.

(3)

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*(b) Sex determination in *Drosophila* (fruit fly) is controlled by the *Sxl* gene that codes for the Sxl protein. The *Sxl* gene is the same in female and male *Drosophila*.

The length of the protein in the female *Drosophila* is different from the length of the protein in the male *Drosophila*.

Suggest how the same *Sxl* gene can give rise to these different proteins.

(6)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCE in Biology (6BI04) Paper 01 The Natural Environment and Species Survival

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Additional Guidance	Mark
1(a)	1. {antigen / bacteria / virus / pathogen} {binds / eq} to B cell ; 2. {antigen / bacteria / virus / pathogen} {binds / eq} to MHC (antigen) ; 3. T helper {lymphocytes / cells} {bind / eq} (to B cell) ; 4. reference to cytokines (from T helper cells) ;	**1 ACCEPT** B cell is an antigen-presenting cell **3 ACCEPT** CD4 cells	**(3)**

Question Number	Answer	Mark
1(b)(i)	mitosis ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. idea of sample of B cells from lymph nodes ; 2. reference to named stain e.g. (acetic) orcein ; 3. credit correct details of method for B cells e.g. heating / add { HCl / acid } ; 4. idea of looking for mitotic features ;	**1 ACCEPT** from blood **2 ACCEPT** acetocarmine, Feulgen's, Schiff's, toluidine blue **3 ACCEPT** squashing of lymph node **4 ACCEPT** stages of mitosis	**(3)**

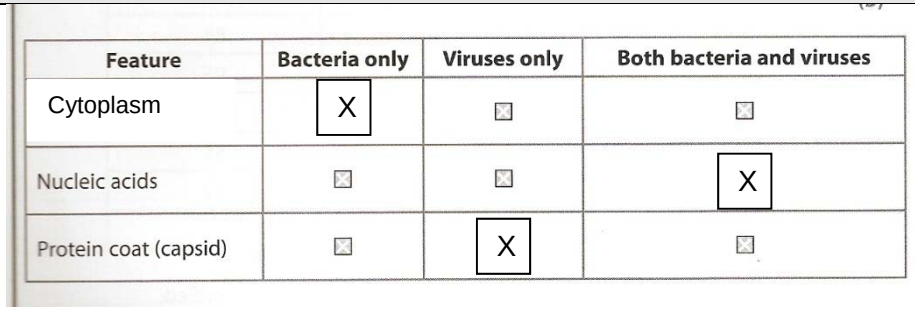
Question Number	Answer	Mark
1(c)(i)	**C** mitochondrion ;	(1)

Question Number	Answer	Mark
1(c)(ii)	**C** nucleus ;	(1)

Question Number	Answer	Additional Guidance	Mark
1(c)(iii)	endoplasmic reticulum / ER ;	**IGNORE** smooth , rough **ACCEPT** RER / SER / ribosome	(1)

Question Number	Answer	Additional Guidance	Mark
1(c)(iv)	**IF RER / SER HAS BEEN GIVEN AS ANSWER IN (iii):** 1. {protein synthesis / translation / eq} occurs ; 2. on the ribosomes ; 3. idea that {polypeptide / protein} {moves into / transported into} the ER ; 4. to the Golgi apparatus / through the cytoplasm / eq ; **IF GOLGI HAS BEEN GIVEN AS ANSWER IN (iii):** 5. it modifies the protein / eq ; 6. credit example of modification e.g. addition of carbohydrate group ;	**IF CYTOPLASM HAS BEEN GIVEN AS ANSWER IN (iii): apply either the RER OR Golgi Mps** **1 ACCEPT** description of translation **4 ACCEPT** idea of folding into {secondary / tertiary} structure	

	7. idea that antibody moved into vesicles ; 8. exocytosis / eq ; **IF RIBOSOME HAS BEEN GIVEN AS ANSWER IN (iii):** 9. {protein synthesis / translation / eq} occurs ; 10. ribosome holds mRNA / eq ; 11. ribosome holds two tRNA / eqs ; 12. so that peptide bonds can form between (adjacent) amino acids ;		**(3)**

Question Number	Answer	Mark
2(a)		(3)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	1. idea of little difference between the groups (at each incubation time) ; 2. idea of {large / eq} error bars ; 3. idea of {overlapping / eq} error bars ;	2 and 3 **ACCEPT** range bars	(2)

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. idea that membrane {receptors / proteins / glycosidic groups / eq} interacts with bacteria ; 2. idea of {pseudopodia formed around / macrophage surrounds} the bacteria ; 3. idea that membranes (of pseudopodia) {fuse / pinch off / eq} ; 4. to form a vacuole (that contains the bacteria) / eq ; 5. idea that {change in shape / fusion /movement / eq} of membrane is due to fluidity of membrane ; 6. caused by the {movement of phospholipids / presence of cholesterol / eq } ;	**1 ACCEPT** antibodies bind to both bacteria and macrophage / opsonisation **2 IGNORE** engulf **4 ACCEPT** vesicle, phagosome	**(4)**

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	1. bacteriostatic antibiotics stop the bacteria from dividing / eq ; 2. bactericidal antibiotics {kill / eq} the bacteria ;	**IGNORE** description of mechanism **1 ACCEPT** growing, replicating	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	1. idea that viruses are non-living ;	**ACCEPT** viruses do not have the target sites for antibiotics	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)	1. (rate at which) energy {incorporated / eq} into {biomass / organic matter } ; 2. by { plants / producers} ;	**1 NOT** energy produced, converted, turned into **ACCEPT** organic material, organic molecules **2 ACCEPT** by photosynthesis	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)	1. GPP {depends / eq} on photosynthesis ; 2. higher the temperature the higher the GPP / eq ; 3. enzymes in (photosynthesis / chemical reaction) {can work faster / more kinetic energy / eq } ; 4. higher the {precipitation / eq} the higher the GPP / eq ; 5. idea that water is needed for the light-dependent reaction ; 6. role of water in transport of { mineral ions / named mineral ion / amino acids / sucrose / eq } ;	1 needs to be a clear statement **2 ACCEPT** converse **3 ACCEPT** increased enzyme activity **4 ACCEPT** converse **5 ACCEPT e.g.** photolysis, H^+ donor, replacing electrons	**(5)**

Question Number	Answer	Additional Guidance	Mark
3(c)	1. credit two values that lie in the range: greater than 0 to 11000 ; 2. appropriate justification based on temperature ; 3. appropriate justification based on precipitation ;	**1NB** (actual value is 126-3100) **ACCEPT** below 850	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(d)	1. (trophic level 2) 2300 - 1500 / 800 (kJ) ; 2. (trophic level 3) 760 - 690 / 70 (kJ) ; 3. ((70 ÷ 800) x 100) = 8.8 / 8.75 (%)	**Correct answer gains three marks** **3 ALLOW** ecf for two values used	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(a)	1. idea that enzyme activity decreases ; 2. credit calculated reduction e.g. 0.6, 2.7 , 3.3 ; 3. idea that an increase in temperature results in increase in kinetic energy ; 4. causing changes in bonds (in the enzyme) / eq ; 5. idea that enzyme is denaturing (above 40 ºC) ; 6. idea that carbon fixation is reduced ;	**5 ACCEPT** fewer enzyme-substrate complexes **NOT** starts to denature	**(5)**

Question Number	Answer	Additional Guidance	Mark
4(b)	{RuBP / ribulose bisphosphate} AND {carbon dioxide / CO_2} ;	**ACCEPT** Rubp / ribulose biphosphate NOT CO / CO^2	**(1)**

Question Number	Answer	Mark
4(c)(i)	**D** valid ;	**(1)**

Question Number	Answer	Mark
4(c)(ii)	**C** measuring the activity at 1ºC intervals between 35ºC and 45ºC ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(a)	1. idea that cellulose is a {polymer / polysaccharide} of β glucose ; 2. reference to 1-4 glycosidic {bonds / eq} ; 3. idea that every other glucose is inverted ; 4. idea of cellulose molecules arranged {parallel /as microfibrils} ; 5. joined by hydrogen bonds / eq ;	**1 ACCEPT** made of β glucose monomers **3 ACCEPT** 180° angle between each glucose	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(b)	1. idea of {lack of / very slow} decomposition ; 2. due to lack of {microorganisms / bacteria / fungi / named decomposer} (involved in decomposition) / eq ; 3. as a result there are fewer enzymes / eq ; 4. low pH {reduces enzyme activity / kills microorganisms /eq} ; 5. low oxygen affects respiration (of microorganisms) / eq ; 6. idea that bacteria cannot produce enzymes to breakdown sporopollenin ;	**1 ACCEPT** breakdown, decay **2 ACCEPT** cannot survive **4 ACCEPT** acidic	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(c)	1. reference to double fertilisation ; 2. idea that one (haploid) male {gamete / nucleus } fuses with (haploid) {egg cell / egg nucleus / female gamete / female nucleus} ; 3. to produce a {diploid / 2n} {zygote / embryo} ; 4. idea that one (haploid) male {gamete / nucleus} fuses with { polar nuclei / diploid endosperm nucleus / fusion nucleus} ; 5. to produce a {triploid / 3n} endosperm (nucleus) ;	**2 ACCEPT** sperm nucleus **NOT** generative nucleus **IGNORE** ovum / egg unqualified **4 NOT** generative nucleus / polar bodies	**(4)**

Question Number	Answer	Additional Guidance	Mark
6(a)	1. (overall) increase in pollen count (as the layers get deeper) ; 2. by 28 (au) ; 3. idea that increase is {greater between 12.5 and 13 m / smaller between 13 and 13.5 m} ; 4. {22 compared to 6 / 18 compared to 10} ; 5. idea that fluctuations are {greater between 12.5 and 13 m / smaller between 13 and 13.5 m} ;	**ACCEPT 12.9 as time of eruption** **1 ACCEPT** converse **3 ACCEPT** increase is {greater after the eruption / smaller before the eruption} ACCEPT converse **5 ACCEPT** fluctuations are {greater after the eruption / smaller before the eruption}	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)	idea of layers being { destroyed / mixed together / eq } ;	**ACCEPT** area destroyed / layers are indistinct / not clear / no peat / rocks present	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(c)	1. idea that at {higher / eq} temperature {ice melts / water expands} so level rises ; 2. idea that at { lower / eq} temperatures {ice forms /eq} so level falls ;	**1 ACCEPT** more evaporation (of water) with increase in temperature so level falls	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(d)(i)	1. decrease in pollen count (in peat) after eruption / eq ; 2. decrease in sea level after eruption / eq ;		(2)

Question	Answer	Additional Guidance	Mark

Number			
6(d)(ii)	**General point:** 1. idea of {fluctuations (in the data) /only a correlation} ; Pollen data: 2. idea that other factors affected the {pollen / plants} ; OR idea that data only comes from one peat bog ; OR idea that the lowest values before the eruption are lower than th values after the eruption ; OR idea that there is data is missing so we {do not have the complet / are only assuming that values are lower} ; Sea level data: 3. idea that the sea is in only one area ; OR idea that sea levels were already falling before eruption ; OR no evidence that drop in sea level is due to temperature decrease / eq;	**1 ACCEPT** in context of either graph **2 ACCEPT** idea that the highest values after the eruption are higher than the lowest values after the eruption ;	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(a)	1. idea that {body / core / eq} temperature drops after death ; 2. (rate / extent) of temperature drop depends on {ambient / eq} temperature ; 3. idea that ambient temperature {fluctuates (over time) / does not stay constant} ; 4. idea that the sooner after death the more accurate the (estimate of) time of death ;	**2 IGNORE** body temperature drops to ambient temperature **ACCEPT** idea that if body temperature has already reached ambient temperature there will be no further fall	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	1. correct values read from graph (37.5 & 36.27) ; 2. (correct subtraction) = 1.23(°C) ;	**Correct answer only scores 2 marks** **2 IGNORE** + or – signs **ACCEPT** ECF for 36.26 to 36.28 e.g. 36.28 = 1.22(°C)	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)	1. idea that calculations of time of death are based on {average body temperature / 37° C} ; 2. body temperature at time of death will depend on time of day / eq ; 3. idea that therefore the calculated value for time of death may not be accurate ;	**3 ACCEPT** therefore the estimate will have to be a range of times **ACCEPT** take into account 1.23°C range	**(2)**

Question Number	Answer	Additional Guidance	Mark
*7(c)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. idea of using {a range / at least five} temperatures ; 2. description of temperature control e.g. water bath, incubator ; 3. idea that timing starts when eggs hatch into first instar maggots ; 4. and ends when the (third instar) maggots begin to pupate / eq ; 5. idea that several {eggs / maggots} should be used at each temperature ; 6. idea of providing food for maggots ; 7. reference to appropriate controlled variable e.g. humidity. mass of food, species ; 8. reference to plotting data on a graph of temp against time (for first instar to become a pupa);	**Emphasis is on clarity of expression** **1 ACCEPT** a min of -10°C and a max of 50°C **5 ACCEPT** minimum of 3 eggs ***/*** maggots **7 IGNORE** light, pH, amount of food, oxygen	**(5)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>8(a)</td><td>
<table>
<tr><th></th><th>Fibrous</th><th>Globular</th><th></th></tr>
<tr><td>1.</td><td>insoluble / large</td><td>Soluble / small</td><td>;</td></tr>
<tr><td>2.</td><td>hydrophobic on outside</td><td>hydrophilic on outside</td><td>;</td></tr>
<tr><td>3.</td><td>mainly secondary structure</td><td>3D /folded / compact shape / tertiary / eq</td><td>;</td></tr>
<tr><td>4.</td><td>repeated amino acid sequences</td><td>little repetition</td><td>;</td></tr>
<tr><td>5.</td><td>structural / eq</td><td>enzymes / hormones / eq</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>Do not piece together

3 ACCEPT chains / straight proteins
IGNORE quaternary</td><td>(3)</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
*8(b)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. reference to {*post-transcriptional modification* / *splicing*} (of mRNA) ; 2. reference to *spliceosomes* ; 3. reference to {removal / eq} of *introns* ; 4. idea that different {number / length} of *exons* are put together (in the different sexes) ; 5. idea that the length of the *mRNA molecules* will be different (for males and females) ; 6. idea that the longer mRNA will have more *codons* ; 7. and therefore more *amino acids* will be coded for ; 8. reference to (during) *translation* ; 9. idea of removal of some amino acids post-translation ;	**QWC emphasis is on correct spelling of biological terms** **1 ACCEPT** post-transcriptional changes **7 ACCEPT** converse **8 in the context of Mp7 ACCEPT** converse	**(6)**

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Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Monday 8 June 2015 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You must have:
Calculator, ruler, rubber and pencil.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P44530A

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1/1/1/1/

P 4 4 5 3 0 A 0 1 2 4

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 One role of the skin is to protect the body from infection.

(a) (i) Explain how skin flora protect the body from infection.

(2)

(ii) The skin produces lipids that protect the body from infection.

Place a cross ☒ in the box next to the correct explanation of how these lipids protect the body from infection.

(1)

☒ **A** they are alkali that kill bacteria

☒ **B** they have antimicrobial properties that inhibit the growth of bacteria

☒ **C** they are enzymes that destroy viruses

☒ **D** they are water soluble and prevent viruses from replicating

(b) The skin contains a fibrous protein. This protein forms a barrier to the entry of microorganisms.

(i) Place a cross ☒ in the box next to the name of this protein.

(1)

☒ **A** cytokine

☒ **B** interferon

☒ **C** keratin

☒ **D** lysozyme

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(ii) The primary structure of a protein is important in determining its final structure and properties.

Describe the structure and properties of fibrous proteins.

(4)

(iii) Describe the roles of the template (antisense) DNA strand and mRNA in determining the primary structure of a protein.

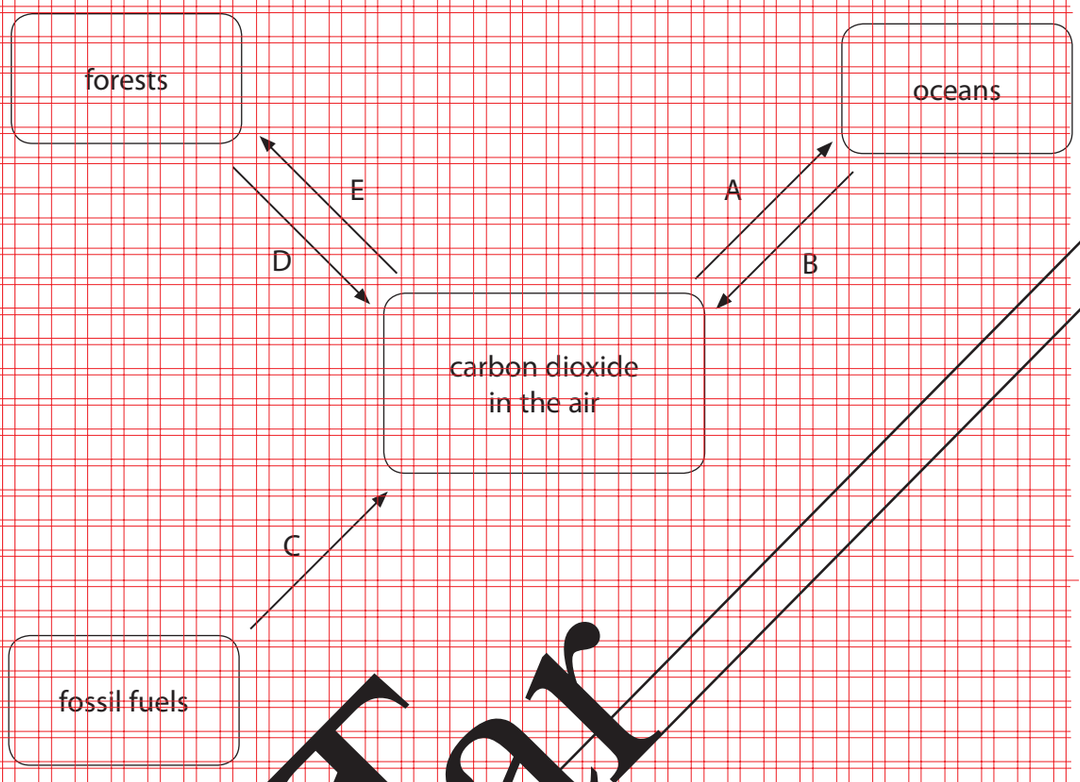
(4)

(Total for Question 1 = 12 marks)

DxEmplar

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2 The diagram below shows part of the carbon cycle. The processes A, B, C, D and E, transfer carbon.



(a) Explain how carbon dioxide is removed from the air into the oceans by process A.

(2)

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(b) Suggest how carbon dioxide is returned to the air from the oceans by process B.

(1)

(c) Place a cross ☒ in the box next to the gases produced by process C.

(1)

- ☒ **A** carbon dioxide and methane
- ☒ **B** carbon dioxide and water vapour
- ☒ **C** carbon dioxide, methane and water vapour
- ☒ **D** carbon dioxide, oxygen and water vapour

(d) Describe the role of bacteria in process D in the diagram.

(3)

(e) Place a cross ☒ in the box next to the reaction in process E that uses carbon dioxide.

(1)

- ☒ **A** light-dependent reaction
- ☒ **B** light-independent reaction
- ☒ **C** photolysis
- ☒ **D** photophosphorylation

Example

(f) The table below shows how much carbon is being transferred by each of the processes in the diagram.

Process	A	B	C	D	E
Mass of carbon transferred / au	338	332	23	444	450

(i) Calculate how much more carbon is entering the air than is leaving it.

Show your working.

(2)

Answer .....

(ii) Suggest why more carbon is entering the air than is leaving it.

(3)

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(Total for Question 2 = 13 marks)

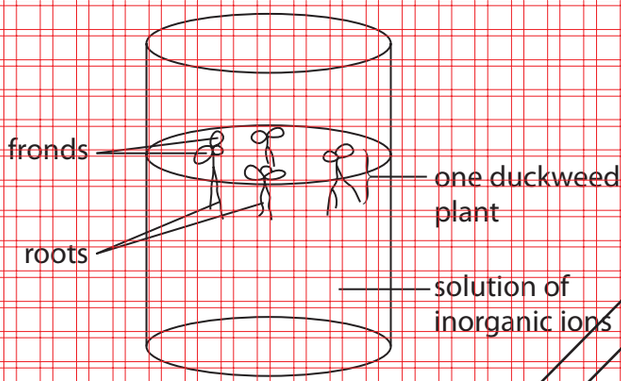
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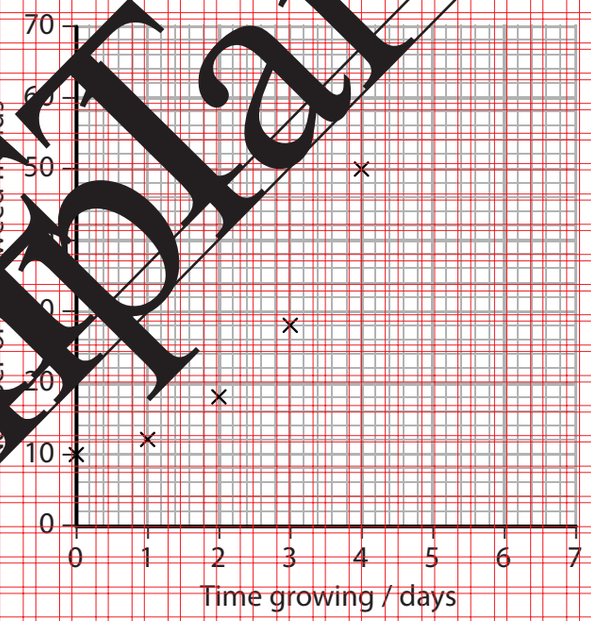
3 Duckweed is a small plant that floats on the surface of water. It could be a source of animal feed as it grows very quickly. Duckweed absorbs dissolved inorganic ions and this decreases water pollution.

Duckweed grows by producing more fronds, which then separate into new plants.

The diagram below shows some duckweed growing in a beaker containing a solution of inorganic ions.



(a) The graph below shows the growth of duckweed over a four-day period.



DxEAmplar

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(i) Explain what the solution should contain for the optimum growth of duckweed.

(3)

(ii) Explain how the information in this graph could be used to estimate the increase in growth after a further six days.

(2)

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*(b) Describe an experiment that could be carried out to investigate the effect of temperature on the growth of duckweed.

(5)

(Total for Question 3 = 10 marks)

Exemplar

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4 Phagocytosis is a non-specific response of the body to infection.

(a) Explain the meaning of each of the following terms.

(i) Phagocytosis

(2)

(ii) Non-specific response

(2)

(iii) Infection

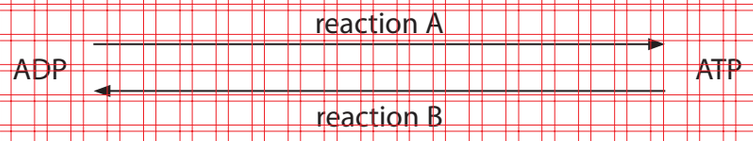
(2)

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(b) Phagocytosis requires a source of energy in the form of ATP.

The diagram below shows the relationship between ATP and ADP.



Place a cross ☒ in the box next to the name of reaction A and reaction B.

(2)

Reaction	Name of reaction				
	autolysis	**decarboxylation**	**hydrolysis**	**phosphorylation**	**polymerisation**
A	☒	☒	☒	☒	☒
B	☒	☒	☒	☒	☒

(c) ATP is synthesised in mitochondria.

(i) In the space below, draw and label a diagram to show the structure of a mitochondrion.

(4)

DxEnPlar

(ii) Name **one** other organelle that synthesises ATP.

(1)

.....

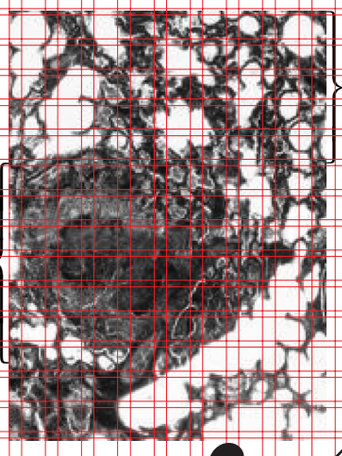
(Total for Question 4 = 13 marks)

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5 Infection of the lungs with *Mycobacterium tuberculosis* can result in a range of symptoms. These symptoms can include severe breathing problems, a persistent cough and coughing up blood.

(a) The photograph below shows a tubercle in part of a lung infected with *Mycobacterium tuberculosis*, as seen using a light microscope.

A tubercle is a solid mass of dead tissue, macrophages and bacteria.



©John Burbidge/Science Photo Library

Magnification ×50

Using the information in the photograph and your knowledge of gas exchange surfaces, suggest why this infection can result in these symptoms.

(4)

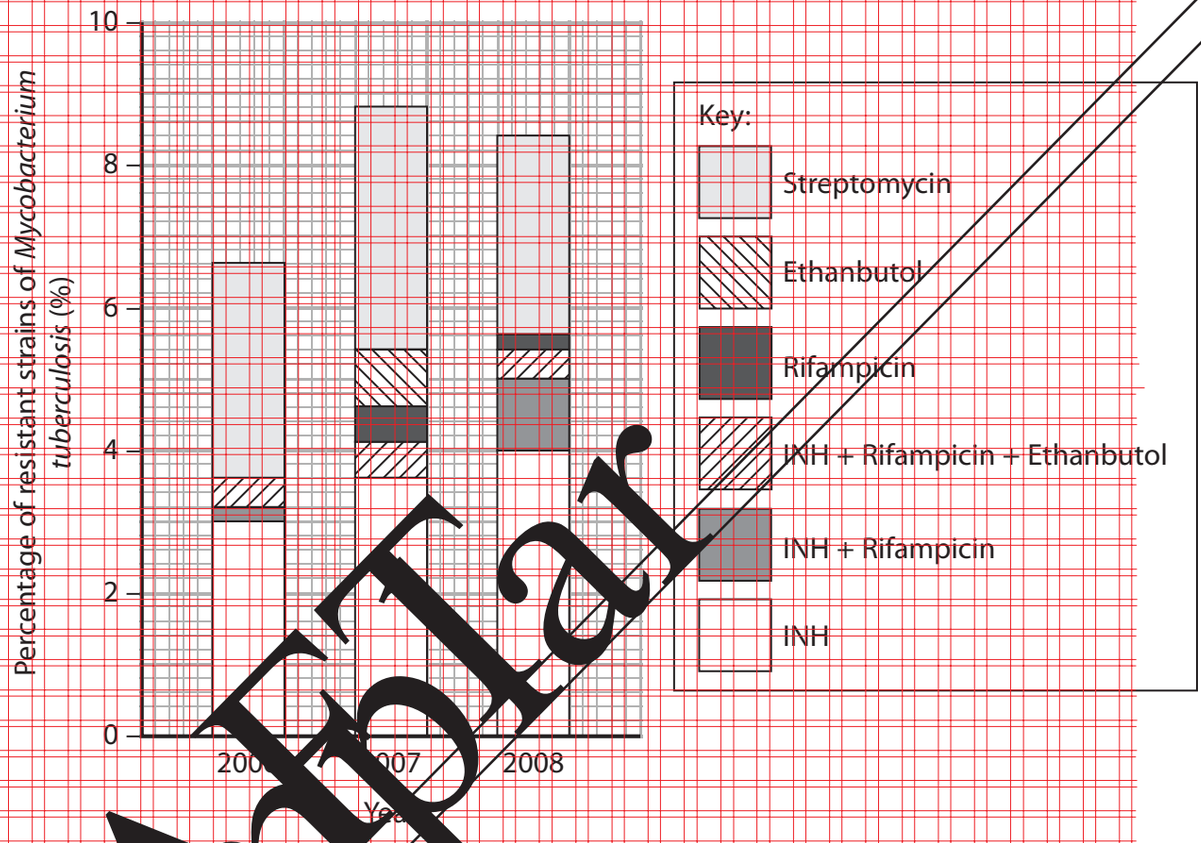
Pre Appl

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(b) Treating *Mycobacterium tuberculosis* infections can be a problem, as the bacteria are resistant to many antibiotics.

There are many strains of *Mycobacterium tuberculosis*. Different strains are resistant to different antibiotics or combinations of antibiotics.

The chart below shows the percentage of resistant strains of *Mycobacterium tuberculosis* to six different antibiotics, or combinations of antibiotics, in 2006, 2007 and 2008.



(i) Using the information in the graph, compare the types of antibiotics and combinations of antibiotics that the *Mycobacterium tuberculosis* are resistant to in 2007 with 2007.

(3)

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(ii) The percentage of strains of *Mycobacterium tuberculosis* resistant to the antibiotic INH has increased during these three years.

Suggest how natural selection could have resulted in this increase.

(3)

(iii) Suggest how hospitals could prevent an increase in the percentage of strains of *Mycobacterium tuberculosis* resistant to antibiotics.

(2)

(Total for Question 5 = 12 marks)

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6 The time of death of a person can be estimated in a number of ways. One method is to use a Henssge nomogram.

The Henssge nomogram relates the time of death to the ambient (surrounding) temperature, the core temperature and the mass of the body.

(a) Explain why the ambient temperature and the core temperature of the body are used to determine the time of death of a person.

(3)

(b) The chart shows a Henssge nomogram.

The steps below need to be followed to estimate the time of death using the Henssge nomogram:

Step 1

Draw a straight line between the core temperature of the body and the ambient temperature (line 1)

Step 2

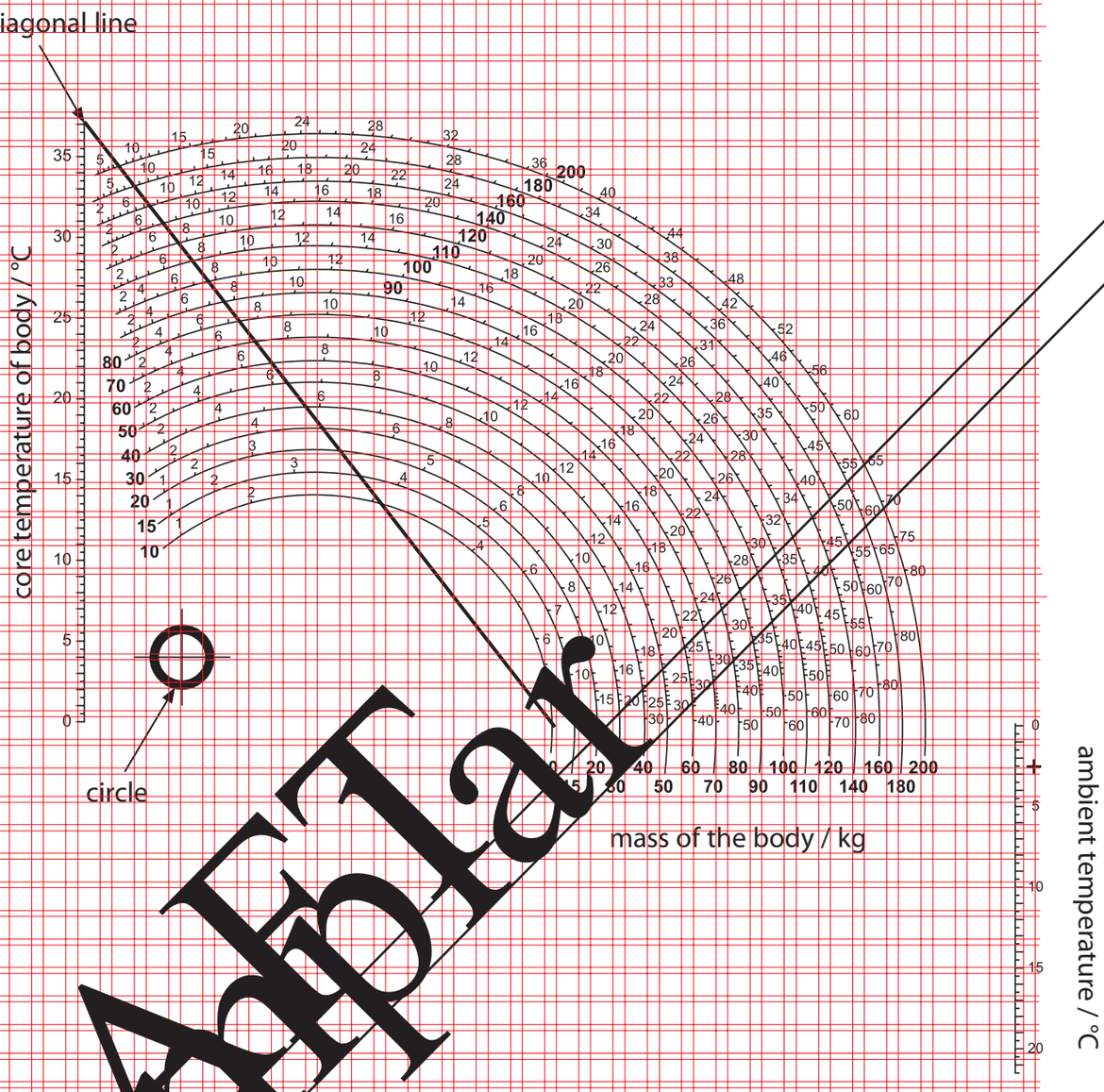
Draw a straight line that extends from the centre of the circle through the diagonal line, at the point where it crosses line 1 (= line 2)

Step 3

Read the time of death from the nomogram at the point line 2 crosses the appropriate semicircle for the mass of the body.

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Henssge nomogram



(i) A body was found. The mass of the body was 100 kg and the core temperature of the body was 25 °C. The ambient temperature was 15 °C.

Use the Henssge nomogram to estimate the time of death.

(3)

time of death = ... hours ago

PREAMBLE

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*(ii) The Henssge nomogram is used to estimate the time of death of a naked body, lying stretched out and in still air.

Suggest how a change in each of these three factors could affect the estimated time of death. Give reasons for your answer.

(6)

(Total for Question 6 = 12 marks)

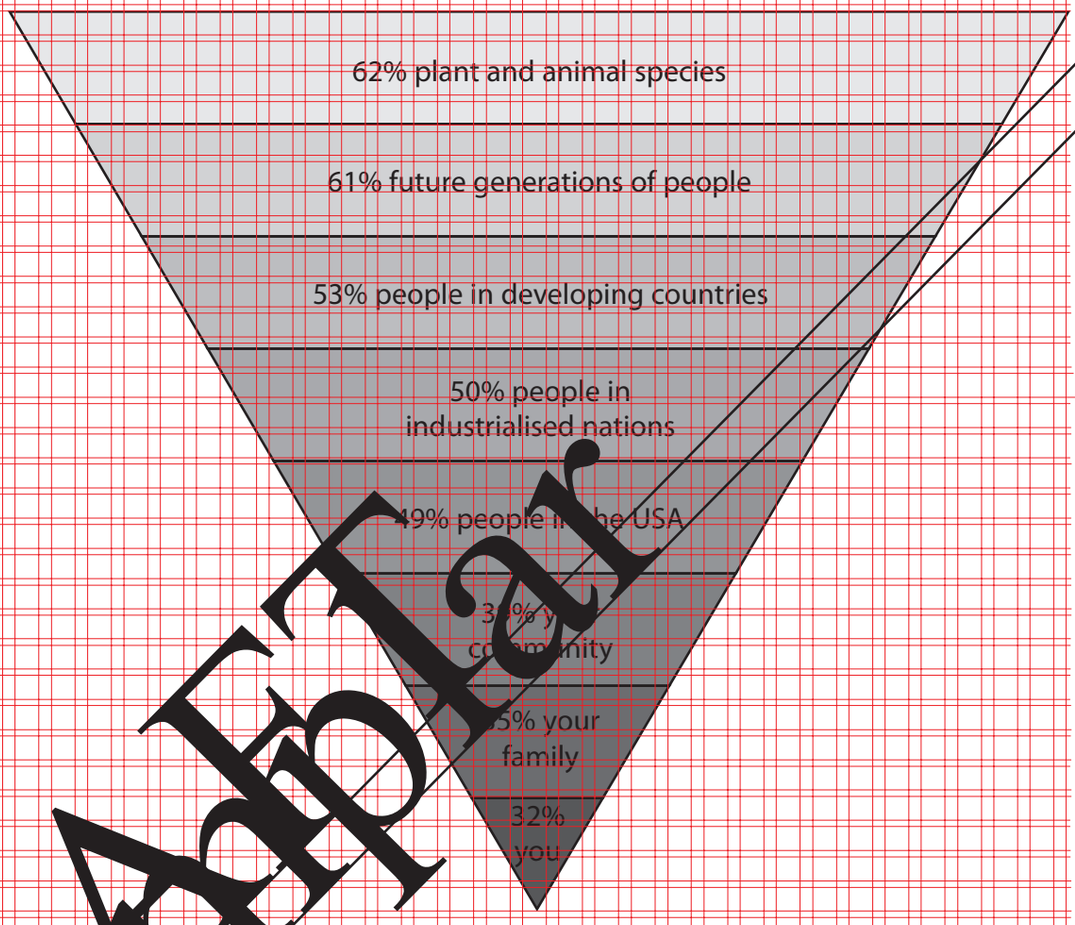
Exemplar

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7 A survey was conducted in the USA to find out what harm people thought global warming could have.

The people were asked if they thought global warming could harm the eight groups shown in the diagram.

The diagram below shows the percentage of people who thought each group would be harmed.



(a) Explain the meaning of the term **global warming**.

(2)

PREAMBLE

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(b) (i) Describe and explain how global warming could affect plant species.

(4)

(ii) Explain how the effects on plant species could affect animal species.

(3)

Exemplar

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(c) This survey shows that 61% thought future generations of people could be harmed by global warming.

Suggest why the rest of the people surveyed thought that future generations of people would **not** be harmed by global warming.

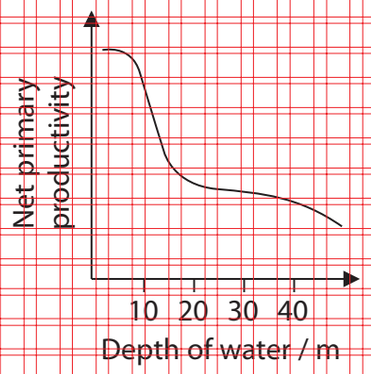
(3)

(Total for Question 7 = 12 marks)

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8 The graph below shows how the depth of water in a freshwater lake affects the net primary productivity (NPP).



(a) Place a cross ☒ in the box next to the units that should appear on the *y*-axis of this graph.

(1)

☒ **A** kg

☒ **B** kJ m^{-1}

☒ **C** kJ m^{-2} $year^{-1}$

☒ **D** kg m^{-1} $year^{-1}$

(b) Place a cross ☒ in the box next to the equation that describes the relationship between NPP, gross primary productivity (GPP) and respiration (R).

(1)

☒ **A** GPP = R − NPP

☒ **B** NPP = GPP − R

☒ **C** NPP = GPP + R

☒ **D** R = GPP − NPP

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(c) Suggest an explanation for the effect of depth of water on the NPP in this freshwater lake.

(4)

(Total for Question 8 = 6 marks)

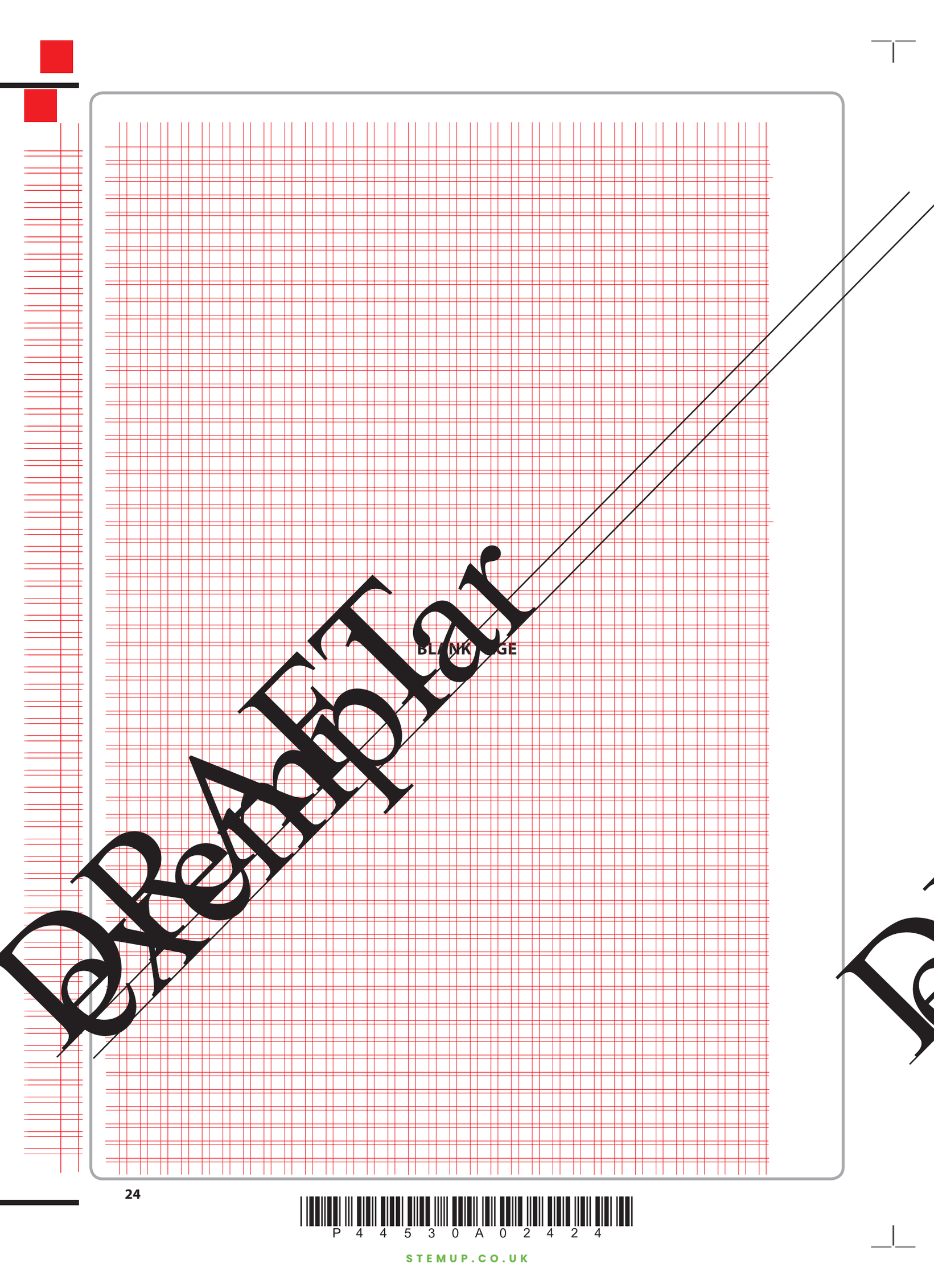
TOTAL FOR PAPER = 90 MARKS

Exemplar

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Example

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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCE in Biology (6BI04) Paper 01 - The Natural Environment and Species Survival

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	1. (skin flora) {prevent growth of / kill} {pathogens / microorganisms / bacteria / eq} ; 2. competition for {space / nutrients / water / minerals / eq} ; 3. release of {chemicals / toxins / antimicrobials / lipids / enzymes /eq } ;	**1 ACCEPT** prevent colonisation **IGNORE** antigens / viruses / infections / diseases **2 IGNORE** food / resources **3 NOT** sebum / lysozymes	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	**B** they have antimicrobial properties that inhibit the growth of bacteria		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	**C** keratin		**(1)**

uestion Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. idea of little {tertiary / quaternary } structure / eq OR mainly secondary structure ; 2. made up of {long / linear / straight / eq} {molecules / (poly)peptides / polymers }; 3. idea of cross-linking (between one polypeptide chain and another) ; 4. idea of repeating amino acid sequences / eq ; 5. insoluble / eq ; 6. tough / strong / eq ;	**3 NOT** peptide bonds **5 IGNORE** hydrophobic on outside	**(4)**

Question Number	Answer	Additional Guidance	Mark
1(b)(iii)	1. {DNA / (m)RNA} contains the {genetic code / triplet codons / base sequence coding for amino acids / eq};	**1 ACCEPT** (DNA) template	
	DNA :		
	2. idea that the DNA strand is used {in transcription / to make (m)RNA / eq} ;		
	mRNA :		
	3. (m)RNA is a copy of the DNA ;	**4 IGNORE** to cytoplasm	
	4. mRNA carries this {information / code /eq} {out of the nucleus / to the ribosomes / eq} ;		
	5. idea that amino acids {arranged in sequence / eq } ;		**(4)**

Question Number	Answer	Additional Guidance	Mark
2(a)	1. idea that carbon dioxide dissolves (in the water / in the oceans) ;	**1 ACCEPT** absorbed / reacts with /diffuses into / becomes carbonic acid	
	2. for {carbon fixation / light-independent reaction / eq} ;		
	3. by {photosynthesis / eq} of {seaweed / algae / (phyto) plankton / autotrophs / eq} ;	**3 ACCEPT** plants (that live in the sea) **IGNORE** organisms	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)	respiration / decomposition / eq ;	**ACCEPT** description **NOT** photosynthesis	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(c)	**B** carbon dioxide and water		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(d)	1. decomposition / idea of breakdown of {organic matter / plant material / biomass / eq} ; 2. idea of (bacteria) producing {enzymes (for digestion) / correctly named hydrolytic enzyme} ; 3. respiration {produces / eq} {carbon dioxide / eq} ;	**1 ACCEPT** animal material decay / rot	**(3)**

Question Number	Answer	Mark
2(e)	**B** light-independent reaction	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(f)(i)	Correct answer gains both marks {332 + 23 + 444 / 799 } and {338 + 450 / 788 } ; (799 – 788) = 11 (au) ;	**CE** applies	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(f)(ii)	1. idea that rate of production of carbon dioxide is greater than rate of removal of carbon dioxide ; 2. idea of using of {fossil fuels / named fossil fuel / forests / eq} {releasing / producing} carbon dioxide ; 3. idea that this carbon (in fossil fuels / forests) was {locked up / removed from the air } years ago ; 4. idea of deforestation resulting in less {photosynthesis / carbon fixation / light independent reaction / eq} ;	**1 ACCEPT** carbon dioxide **{**production / release} is greater than used in photosynthesis **3 ACCEPT** ref to carbon sink **4 ACCEPT** less carbon dioxide used for photosynthesis	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	1. solution should contain (all) the {mineral / ions} that duckweed needs ; 2. at the minimum concentration / eq ; Any two correctly named ion and its corresponding function : e.g. {nitrate (ions) / NO_3^{2-}} for {amino acids / protein / nucleic acid / ATP /chlorophyll / eq} {magnesium ions / Mg^{++}} for chlorophyll {calcium ions / Ca^{++}} for {cell wall / pectate / middle lamella / eq } {phosphate (ions) / PO_4^{3-}} for { nucleic acid /ADP / ATP / NAD /phospholipid / eq} ; ;	**1 IGNORE** nutrients **2 ACCEPT** in excess **IGNORE** carbon dioxide and wrong formulae **NOT** nitrogen **NOT** magnesium **NOT** calcium **ACCEPT** membrane **NOT** phosphorous	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	1. idea of {extrapolation / drawing a line of best fit / eq} (to estimate number of fronds after 10 days) ; 2. read value from graph / eq ; 3. idea of subtracting { 50 / 10} from the number of fronds after 10 days ;	**NB** Apply this mark scheme even if they describe weighing the fronds and calculating the mass increase **2 IGNORE** time refs.	**(2)**

Question Number	Answer	Additional Guidance	Mark
*3(b)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. idea of using {solution of ions / complete medium} ; 2. idea of using a {range of / minimum of 5} temperatures ; 3. idea that different temperatures will be achieved using {waterbaths / incubators / eq} ; 4. idea of determining growth over a period of time ; 5. credit appropriate named example of how growth is to be assessed eg {number / size / mass } of {fronds / plants}, length of roots ; 6. credit named control variable e.g. same concentration of (each) inorganic ions ; 7. idea of repeats to calculate a {mean / average} ;	**QWC with an emphasis on logical sequence** 2. **ACCEPT** 5 quoted temperatures in between 1°C and 70°C **IGNORE** room temp if 6 or more values given 5. **IGNORE** height / refs to germination **7 ACCEPT** for reliability	**(5)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	1. idea of binding of {bacteria / virus / pathogen / microorganism / antigen / non-self / foreign matter / eq} to (phagocytic) cell ; 2. idea that {bacteria / virus / pathogen / microorganism / antigen / eq} is {engulfed by / taken into / endocytosis into } (phagocytic) cell ; 3. idea of bacteria being inside a {vacuole / phagosome / eq} ;	**1 ACCEPT** phagocyte **2 ACCEPT** phagocyte **3 ACCEPT** vesicle	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	1. idea that the body {reacts / defends itself / responds /eq } to a {bacteria / virus / pathogen / microorganism / antigen / non-self / foreign matter / eq} ; 2. idea that the response is not dependent on the specific {bacteria / virus / pathogen / microorganism / antigen / eq} ; 3. credit named reaction e.g. lysozymes , inflammation, phagocytosis, interferon production ;	**1 NOT** reference to immune response **2 ACCEPT** idea of no previous infection / responds to any pathogen **3 IGNORE** egs of barriers	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	1. reference to {bacteria / virus / pathogen / microorganism / eq} ; 2. being inside {tissues / cells } / eq ;	**1 IGNORE** disease / infection / foreign matter / antigen **2 IGNORE** body **ACCEPT** idea that has evaded barriers, named cell or tissue **IGNORE** {infects / attaches / harms / attacks} cells	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)	reaction A = phosphorylation ; reaction B = hydrolysis ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	Diagram marks : 1. two membranes shown ; 2. inner membrane folded into cristae ; Label marks (correct) : [max 2 marks] 3. outer membrane and {inner membrane / cristae} ; 4. matrix ; 5. stalked particles / ATPase / eq (labelled on inner membrane) ; 6. DNA (circular / loop) ; 7. ribosomes ;	 **1 NOT** if cristae shown as a 3rd membrane **NB** do not choose which labels to accept eg 2 right + 1 wrong = 1 mark 2 wrong = 0 marks **5 ACCEPT** oxisome **6 ACCEPT** plasmids **7 IGNORE** size references	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	chloroplast ;	**IGNORE** chlorophyll	**(1)**

Question Number	Answer	Additional Guidance	Mark
5 (a)	1. idea that the {alveoli / air sacs / lung / tissue } have been {replaced / destroyed / eq} (by the tubercle) ; 2. idea that the (tubercle / destroyed lung tissue) has reduced the (surface) area (of the lung) ; 3. breathing problems due to { gas exchange being reduced / less oxygen in blood / eq } ; 4. idea that the coughing is { due to irritation /to remove the dead tissue / eq} ; 5. blood coughed up is due to damage of (lung) blood vessels / eq ;	**1 IGNORE** blocks **4 ACCEPT** tubercle **5 IGNORE** idea that lung damage causes bleeding	**(4)**

Question Number	Answer	Additional Guidance	Mark
5 (b)(i)	1. idea that bacteria are resistant to fewer {antibiotics / antibiotic combinations} (in 2006 than 2007) ; 2. in both years there are resistant strains to {streptomycin / INH + rifampicin + ethambutol / INH } ; 3. idea that there are resistant strains to INH + rifampicin in 2006 but not in 2007 ; 4. idea that there are resistant strains to {ethambutol / rifampicin} in 2007 but not in 2006 ;	**ACCEPT** clear abbreviations to the names of the antibiotics throughout **1 ACCEPT** a description e.g. new resistances, resistant to 4 in 2006 and 5 in 2007 **3 ACCEPT** idea that {resistance decreased to zero / no longer resistant} **4 ACCEPT** idea of resistance developing **NB** development of new resistances to {ethambutol / rifampicin} = Mp 1 and 4	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	1. bacteria have a mutation in {DNA / gene / eq } ; 2. idea that the {presence / usage of} {antibiotic (INH) / INH} acts as a selection pressure ; 3. idea that the allele (for resistance) is passed on ; 4. idea that bacteria {divide by asexual reproduction / divide by binary fission / produce clones / eq} ; 5. idea of increasing the allele frequency ; 6. idea that the more resistant bacteria there are, the more likely new strains will acquire the (resistance) gene ;	**3 NOT** gene **4 ACCEPT** divide by mitosis / conjugation / transduction / transformation / eq	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	1. reference to codes of {practice / conduct / eq } ; 2. idea that appropriate {antibiotics / named example} should be given to patients ; 3. idea of {educating patients about taking antibiotics / taking the full course of antibiotics ; 4. credit another appropriate procedure e.g. hand washing, screening ;	**1 ACCEPT** named policy /code **NB** Mp5 is for named practice **2 ACCEPT** not giving antibiotics if no necessary / not using antibiotics for prophylactic treatment / using narrow spectrum antibiotics / rotate antibioti use	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(a)	1. idea that the temperature of the {body / core} changes (with time after death) ; 2. idea that (core) temperature depends upon the {ambient / eq} temperature ; 3. idea that {other post-death changes / muscle contraction / insect life cycles / decomposition / eq} depend on (ambient / body) temperature ;	**1 ACCEPT** cooling	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	Correct answer gains all 3 marks 1. line drawn between 25°C (core) and 15°C (ambient) ; 2. line drawn from centre of circle through the intersect of line 1 with diagonal ; 3. time of death = {23 - 24} ;	**1 ACCEPT** within the next scale line **2 CE** applies **3 CE** applies	**(3)**

Question Number	Answer	Additional Guidance	Mark
*6(b)(ii)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** **Clothing** 1. for the clothed body the {estimate was too short / eq } ; 2. because the clothing would {reduce heat loss / body would cool more slowly / temperature would drop slower / eq} ; 3. idea that clothing would {insulate / trap the heat / eq} ; **Position** 4. for the body curled up the {estimate was too short / eq } ; 5. because {heat loss is reduced / body would cool more slowly / temperature would drop slower / eq} ; 6. as the (exposed) surface area was smaller/ eq ; **Air movement** 7. for the moving air {the estimate was too long / eq } ; 8. as moving air {speeds up heat loss / body would cool faster / temperature would drop faster / eq } ;	**QWC emphasis is clarity of expression** **ACCEPT** converse arguments for Mps other than 1, 4 and 7 **1 ACCEPT** time of death was earlier / died longer ago **4 ACCEPT** time of death was earlier / died longer ago **7 ACCEPT** time of death was more recent / died later **IGNORE** submersion in water	**(6)**

Question Number	Answer	Additional Guidance	Mark
7(a)	1. (gradual) increase in {average / eq } temperature ; 2. (of earth's) {surface / atmosphere} (and oceans) ;	**NB IGNORE** any explanations as to the cause **1 IGNORE** warming	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	**Effects on plants:** 1. { loss / eq } of (existing) species / extinction ; 2. idea of changes in distribution (of plants / species) ; 3. idea of changes in {numbers / size / growth / eq } (of plants / species) ; **Explanations (max 3):** 4. idea that there will be changes in rainfall patterns ; 5. idea of a change in growing seasons ; 6. idea that temperature may become too hot for some species OR credit a link made between temperature and enzyme activity ; 7. idea of increased carbon dioxide results in more {photosynthesis / GPP / NPP / biomass / eq} ; 8. idea of fall in pH in {oceans / rivers / eq} ;	**NB** any link to an affect must be correct 4 **ACCEPT** droughts 5 **ACCEPT** flowering times	**(4)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)	1. idea of reduction of {herbivore / primary consumer} ; 2. idea that this would result in a reduction of {predator / secondary consumer / tertiary consumers} ; 3. idea that a change in {distribution / numbers / types / eq} of plants could result in a change in distribution of {herbivores / eq} ; 4. idea of loss of {habitat / eq} decreasing {breeding rate / numbers / eq } ; 5. idea of loss of {shelter / camouflage / eq} provides more food for predators so they would increase in {size / number} ;	**ACCEPT** converse for increase in plant {number / size / eq} 1 **ACCEPT** idea of loss of animals because of reduction in food supply 2 **ACCEPT** idea of loss of animals that feed on the herbivores 4 **ACCEPT** named example e.g. nesting place	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(c)	1. idea that we can only {make predictions about the future / extrapolate data / work on correlations / eq } ; 2. idea that {scientists / industry / eq} are presenting {different views / insufficient evidence / eq} about global warming ; 3. idea that some people surveyed did not {understand / know about} global warming ; 4. idea that some people do not believe in {global warming / harmful effects of global warming} because they do not want it to affect their { lifestyle / named lifestyle / eq } ; 5. idea that some people think that a solution to global warming will be found ; 6. idea that some people do not want to think about the future ;	**NB just a reference to do not believe is too vague** 1 **ACCEPT** it is due to natural cycle / normal fluctuations	**(3)**

Question Number	Answer	Mark
8(a)	**C** kJ m^{-2} $year^{-1}$	**(1)**

Question Number	Answer	Mark
8(b)	**B** NPP = GPP - R	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(c)	1. idea that light is reduced by the deeper water ; 2. idea that carbon dioxide levels might be lower deeper down ; 3. idea that temperature might be lower deeper down ; 4. idea that {photosynthesis / eq} will be reduced ; 5. idea that less {glucose / hexose / GALP / GP / eq } produced to convert into {biomass / NPP / eq} ; 6. idea that GPP goes down but respiration {stays the same / increases} ;	**NB ACCEPT** converse of mp 1 - 5 if in context of shallow water **5 IGNORE** energy	

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Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Friday 13 June 2014 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You must have:
Ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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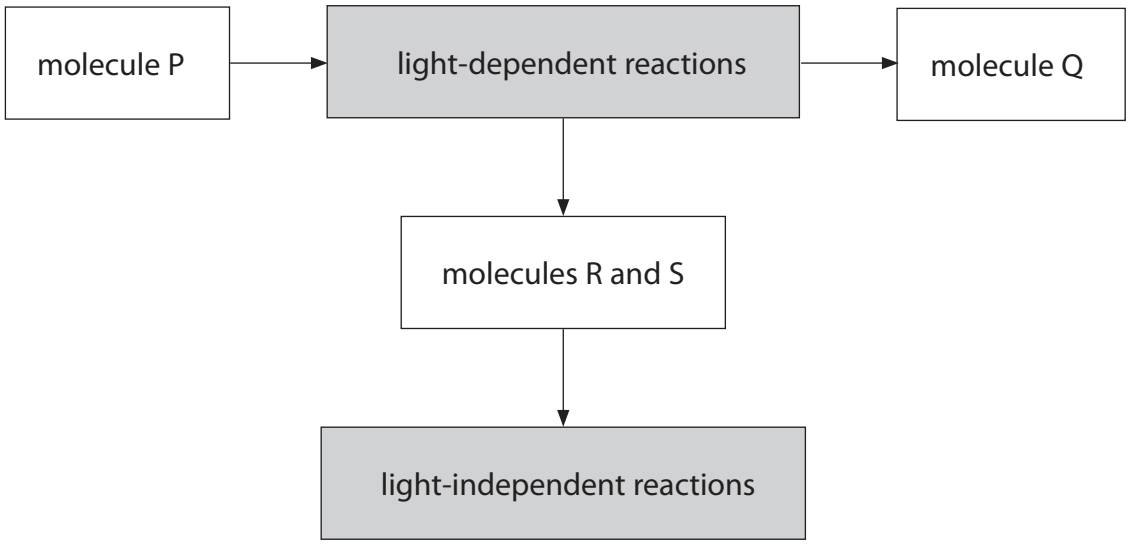
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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) The diagram below shows some of the steps in the process of photosynthesis.



(i) Name molecules **P** and **Q** in the diagram.

(1)

molecule P .....

molecule Q .....

(ii) Place a cross ☒ in the box next to the names of molecules **R** and **S** in the diagram.

(1)

☒ **A** ADP and oxidised NADP

☒ **B** ADP and reduced NADP

☒ **C** ATP and oxidised NADP

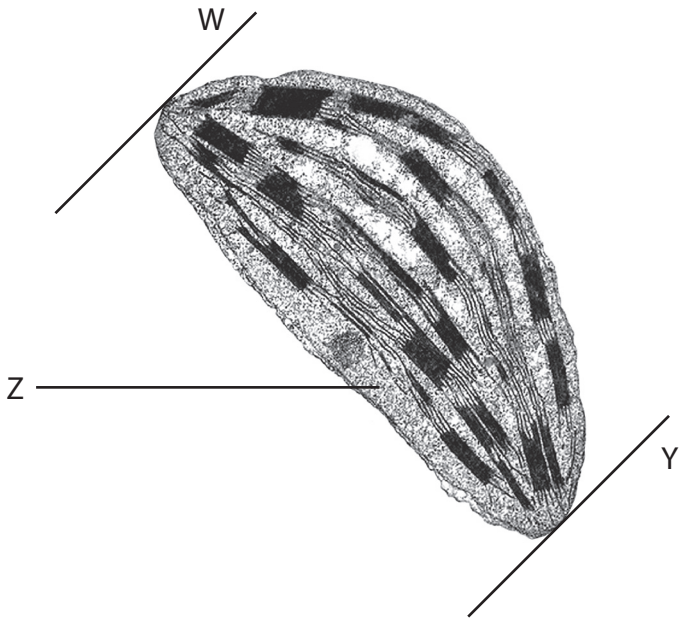
☒ **D** ATP and reduced NADP

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(iii) Describe the role of RUBISCO in the production of GALP in the light-independent reaction.

(4)

(b) The electronmicrograph below shows a chloroplast.



Magnification ×7500

(i) Place a cross ☒ in the box next to the name of the part labelled **Z**.

(1)

☒ **A** cytoplasm

☒ **B** matrix

☒ **C** stroma

☒ **D** thylakoid

P 4 2 9 2 2 A 0 4 2 4
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(ii) The equation below can be used to calculate the magnification of this chloroplast.

magnification = image length ÷ actual length

Use this equation to calculate the actual length of this chloroplast, between the lines labelled **W** and **Y**.

Show your working.

(3)

length of chloroplast = ...

(iii) Describe how the membranes inside the chloroplast are involved in photosynthesis.

(3)

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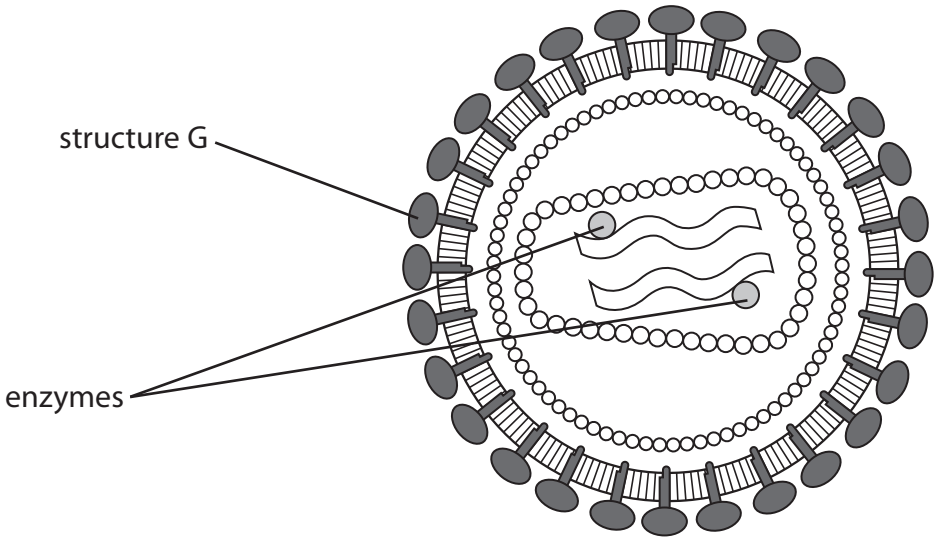
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(Total for Question 1 = 13 marks)

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2 Anti-viral drugs have been developed to treat patients infected with Human Immunodeficiency Virus (HIV).

The diagram below shows the structure of HIV.



(a) Explain how **structure G** enables HIV to infect human cells.

(3)

P 4 2 9 2 2 A 0 6 2 4
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(b) Some anti-viral drugs used to treat patients infected with HIV are inhibitors of enzymes found within HIV.

(i) Describe the structure of an enzyme.

(3)

*(ii) Suggest how these anti-viral drugs would work in the treatment of patients infected with HIV.

(5)

(Total for Question 2 = 11 marks)

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3 Grey tree frogs are found in the USA.

The photograph below shows a grey tree frog.



Magnification $\times 1$

Cope's grey tree frog and the eastern grey tree frog are both found in the USA.

These species of grey tree frog are very similar in appearance, but have different mating calls.

A number of scientists believe that the eastern grey tree frog evolved from Cope's grey tree frog during the last ice age.

These species have different numbers of chromosomes in their nuclei. Cope's grey tree frog has two copies of each chromosome. The eastern grey tree frog has four copies of each chromosome. As a result, the cells of the eastern grey tree frog are larger.

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(a) The genetic relationship between these two species of grey tree frog has been studied using DNA profiling (DNA fingerprinting).

A small sample of DNA was taken from each species of grey tree frog. This DNA was amplified, fragmented and used to produce a DNA profile (DNA fingerprint) for each species.

*(i) Describe how a DNA profile was produced from this small sample of DNA.

(6)

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(ii) Suggest how these DNA profiles were compared.

(3)

(b) Scientists in different parts of the USA are investigating the possibility that the difference in cell size is responsible for the different mating calls. This is contributing to an understanding of the evolution of grey tree frogs.

Suggest **two** ways in which the results of their investigations can be shared.

(2)

(Total for Question 3 = 11 marks)

P 4 2 9 2 2 A 0 1 0 2 4
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4 The human body responds to infection by bacteria in a number of ways.

The non-specific response includes phagocytosis and lysozyme action, which can be followed by the specific immune response. The specific immune response requires antigen presentation by macrophages.

(a) Explain how phagocytosis and lysozyme action lead to antigen presentation by macrophages.

(4)

(b) Explain how macrophages present antigens to T helper cells.

(2)

P 4 2 9 2 2 A 0 1 2 2 4
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(c) There is an 'evolutionary race' between some bacteria, such as *Mycobacterium tuberculosis* (TB), and their hosts.

Suggest how this could affect antigen presentation to T helper cells. Give an explanation for your answer.

(3)

(Total for Question 4 = 9 marks)

P 4 2 8 2 2 A 0 1 3 2 4
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5 First generation biofuels are made from sugars and vegetable oils found in food crops.

(a) Some countries are replacing small percentages of petrol and diesel with first generation biofuels to reduce the effect of greenhouse gases on global warming.

(i) Place a cross ☒ in the box next to a pair of greenhouse gases.

(1)

☒ **A** carbon dioxide and methane

☒ **B** carbon dioxide and carbon monoxide

☒ **C** carbon monoxide and nitrogen

☒ **D** methane and nitrogen

(ii) Suggest why using first generation biofuels instead of petrol and diesel could reduce global warming.

(3)

(b) Second generation biofuels are now being developed. These will use non-food parts of crops that contain the polymers cellulose and lignin.

Bacteria can be used to synthesise ethanol from these polymers. However, enzyme treatment is necessary before the bacteria can use these polymers.

(i) Name a part of a plant stem that would contain these polymers.

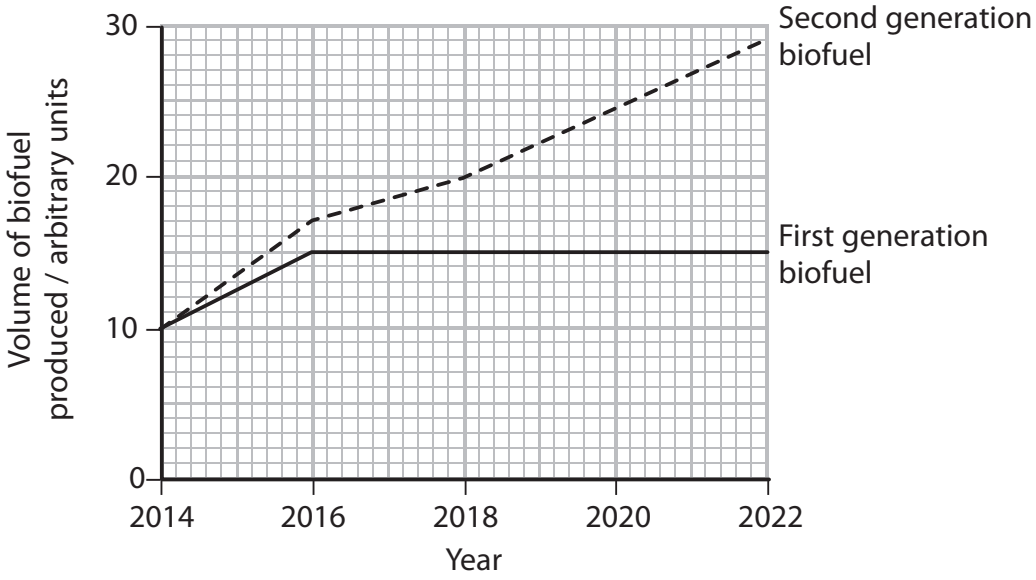
(1)

(ii) Suggest why cellulose has to be treated with enzymes before the bacteria can use it as an energy source.

(2)

P 4 2 9 2 2 A 0 1 4 2 4
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(c) The graph below shows how the global production of first generation and second generation biofuels could change in the future.



Using the information in the graph, describe the expected changes in the production of first generation and second generation biofuels. Suggest reasons for these changes.

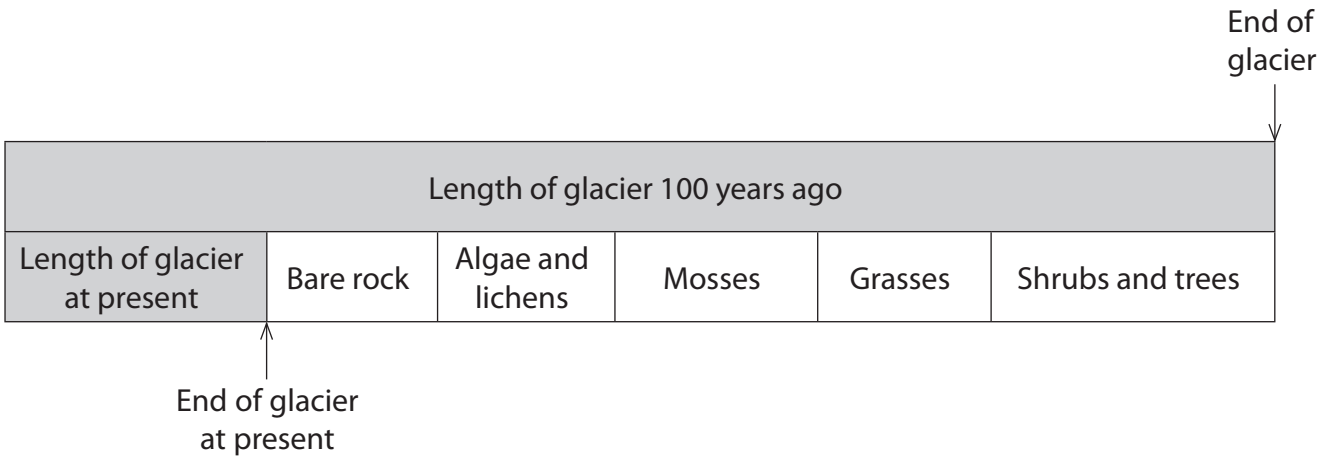
(4)

(Total for Question 5 = 11 marks)

P 4 2 8 2 2 A 0 1 5 2 4
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6 Glaciers are long, large masses of ice that formed thousands of years ago. As a result of warmer climates, more ice is melting. This is reducing the length of the glaciers. As a result, bare rock that was once covered by the glacier becomes exposed.

The diagram below shows the length of a glacier 100 years ago and the glacier at present. It also shows what is now found in a transect taken from where the front edge of the glacier is at present.



(a) Using the information in the diagram, describe and explain the changes in the distribution of organisms with distance from the front edge of this glacier.

(3)

P 4 2 9 2 2 A 0 1 6 2 4
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(b) *Epilobium latifolium* is a plant that occupies a niche in an area once covered by this glacier. It is a short flowering plant that grows in clumps.

The photograph below shows three clumps of *Epilobium latifolium*.



Magnification ×0.2

(i) Explain what is meant by the term **niche**, using the plant *Epilobium latifolium* as an example.

(3)

P 4 2 8 2 2 A 0 1 7 2 4
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(ii) Describe how to carry out a study of the distribution of *Epilobium latifolium* from the front edge of this glacier.

(4)

(iii) Suggest **one** abiotic factor that might affect the abundance of *Epilobium latifolium* and describe how this factor could be measured.

(3)

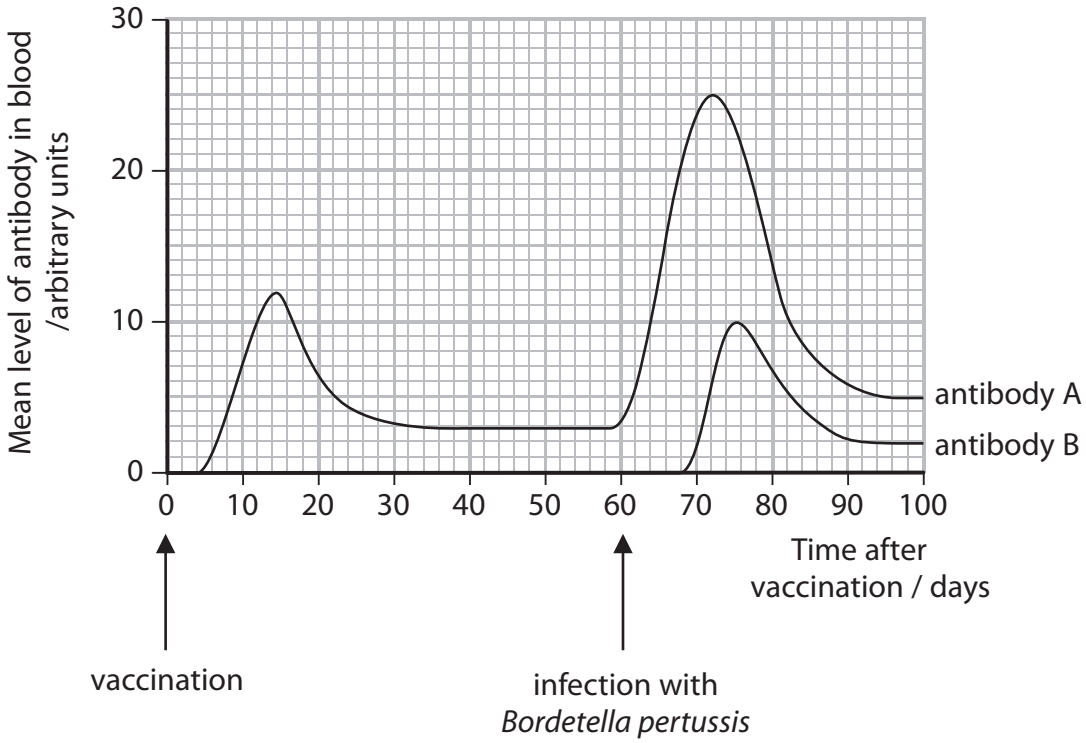
(Total for Question 6 = 13 marks)

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7 Whooping cough is a disease that is particularly serious in young children. Whooping cough is caused by the bacterium *Bordetella pertussis*. Children may be vaccinated against whooping cough.

In an investigation, a group of rats was vaccinated. Sixty days later these rats were infected with *Bordetella pertussis*. In this investigation, the levels of two antibodies in the blood of the rats were measured.

The graph below shows the mean levels of antibody A and antibody B.



(a) (i) For antibody A, compare the increase in mean level after the vaccination with the increase in mean level after infection with *Bordetella pertussis*.

(2)

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(ii) Explain the changes in mean level of antibody A after infection with *Bordetella pertussis*.

(3)

(b) (i) Suggest why antibody B was not present in the blood of these rats until after infection with *Bordetella pertussis*.

(2)

(ii) Place a cross ☒ in the box next to the term that describes the type of immunity that results in the production of antibody B.

(1)

☒ **A** artificial active

☒ **B** artificial passive

☒ **C** natural active

☒ **D** natural passive

P 4 2 9 2 2 A 0 2 0 2 4
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(c) Comment on the reliability of the data shown in the graph.

(3)

(Total for Question 7 = 11 marks)

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8 Bacteria are involved in the decomposition of organic matter.

(a) Place a cross ☒ in the box next to the type of chemical reaction that takes place in decomposition.

(1)

☒ **A** condensation

☒ **B** esterification

☒ **C** hydrolysis

☒ **D** polymerisation

(b) An investigation was carried out to study the rate of decomposition of leaves from ash trees and beech trees.

Five piles of each type of leaf were placed outside on the ground and each pile was covered with a heavy bucket. Each pile of leaves had a mass of 10 grams.

Every few weeks, one pile of each type of leaf was removed and weighed.

The table below shows the results of this investigation.

Time after falling from the tree / weeks	Mass of pile of ash leaves / g	Mass of pile of beech leaves / g
0	10.0	10.0
4	4.9	9.1
8	2.0	8.4
16	1.1	6.0
32	1.2	2.8
64	0.8	2.4

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(i) Place a cross ☒ in the box next to the reason for using five piles of ash leaves in this investigation.

(1)

☒ **A** to calculate a mean

☒ **B** to give a range of values for the independent variable

☒ **C** to make the investigation valid

☒ **D** to produce reliable data

(ii) A student made the following conclusions from these results.

Decomposition of beech leaves is faster than ash leaves.

Bacteria are needed for the decomposition of beech and ash leaves.

There is a correlation between decomposition and time.

Place a cross ☒ in the box next to the number of correct conclusions made by this student.

(1)

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(iii) Explain why there is a decrease in mass of the leaves.

(4)

(iv) Suggest what effect an increase in temperature would have on the rate of decomposition of these leaves. Give an explanation for your answer.

(4)

(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 90 MARKS

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GCE Biology (6BI04)
Paper 01

Unit 4: Natural Environment

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	1. Molecule P - water / H_2O ; 2. Molecule Q - oxygen / O_2 ;		(1)

Question Number	Answer	Mark
1(a)(ii)	D ATP and reduced NADP ;	(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	1. reference to RUBISCO as an {enzyme / catalyst} ; 2. in the Calvin cycle ; 3. involved in {carbon fixation / bonding of CO_2 to RuBP / reaction between CO_2 and RuBP / eq} ; 4. to form GP / eq ; 5. GP converted to GALP / eq ; 6. using ATP and {reduced NADP / NADPH} (CO_2 to GALP / GP to GALP) ;	1. ACCEPT catalyses 3. ACCEPT formation of 6C intermediate from RuBP 5. ACCEPT reduced to NB Award formation of GALP from reaction between CO_2 and RuBP if mp 4 not awarded	(4)

Question Number	Answer	Mark
1(b)(i)	C stroma	**(1) COMP**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. (image length) 76 / 76.5 / 77 (mm) ; 2. (correct calculation = length /7500) / eq ; 3. (correct units for given answer) µm / eq ;	Correct answer with units = 3 marks 2. CE applies 3. CE applies ACCEPT as standard form	**(3) EP**

length	answer in µm	answer in mm	answer in cm	answer in m
7.6 (cm) 76 (mm) 76000 (µm)	10 10.1 10.13	0.01 0.0101 0.01013	0.001 0.00101 0.001013	0.00001 0.0000101 0.00001013
7.65 76.5 76500	10 10.2	0.01 0.0102	0.001 0.00102	0.00001 0.0000102
7.7 77 77000	10 10.3 10.27	0.01 0.0103 0.01027	0.001 0.00103 0.001027	0.00001 0.0000103 0.00001027

Question Number	Answer	Additional Guidance	Mark
1(b)(iii)	1. idea of compartmentalisation (from stroma) ; 2. site of light-dependent reaction ; 3. credit named molecules {within / on / eq} membrane ; 4. idea of {ATPase / eq } in (thylakoid) membranes ; 5. idea that (thylakoid) membranes provide a space for accumulation of H^+ ; 6. reference to photophosphorylation ;	1. ACCEPT description of separation 3. e.g. photosynthetic pigments / chlorophyll / carotenoids / photosystems / electron carrier proteins IGNORE electron acceptors 4. ACCEPT {ATP synthase / synthetase}, NADP reductase 6. ACCEPT chemiosmosis	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(a)	1. (structure G is {glycoprotein / gp120} ; 2. used for {attachment / eq} to CD4 (molecules / receptors /antigens) ; 3. on T helper {cells / lymphocytes} ;	1. IGNORE gp 41 and gp 160 and other wrong numbers 3. ACCEPT macrophages / dendritic cells / CD4 cells	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	1. they are globular proteins ; 2. it has an active site ; 3. idea of {charged R groups on outside of molecules / composed of many small R groups} ;	2. idea of active site R groups enable binding of substrate 3. idea of hydrophilic on the outside	**(3)**

Question Number	Answer	Additional Guidance	Mark
***2(b)(ii)**	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that drugs would prevent viral replication ; 2. idea that T (helper) {cells / lymphocytes} will not be { killed / burst / destroyed}(by virus particles leaving cell) ; 3. idea of {inhibition / eq} of reverse transcriptase ; 4. idea that (viral) DNA could not be made; 5. from the (viral) RNA ; 6. idea of {inhibition / eq} of integrase ; 7. idea that (viral) DNA cannot integrate into (host) {DNA / genome} / eq ;	QWC emphasis on clarity of expression 1. ACCEPT description of virus formation 3. ACCEPT drugs prevent action of reverse transcriptase 4. reject idea that RNA is {turned into / converted into} DNA 6. ACCEPT drugs prevent action of integrase 7. ACCEPT idea that drugs would prevent {latency / formation of provirus / eq} ;	**(5)**

Question Number	Answer	Additional Guidance	Mark
*3(a)(i)	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. multiple copies of DNA made / eq ; 2. using {PCR / *polymerase chain reaction*} ; 3. credit any correct detail of PCR ; 4. reference to *restriction* {*enzymes / endonucleases*} to produce DNA {*fragments* / eq} ; 5. reference to (*gel) electrophoresis* ; 6. idea of {loading / eq} the DNA onto the {*gel* / named *gel*} ; 7. idea that an {*electric current* / charge} is applied ; 8. reference to use of {*dye / fluorescent tag / UV light / Southern blotting / gene probes / radioactive labelling* / eq};	QWC emphasis on spelling 1. IGNORE refs to amplification, large amounts 3. e.g. step 1: 90 to 95 ^{o}C, step 2: 50 to 65 ^{o}C, step 3: 70 to 80 ^{o}C, use of {*primers* / DNA *polymerase / nucleotides*}, many repetitions 6. e.g. *agarose, agar* 7. ACCEPT apply *potential difference*	**(6)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	1. idea of comparing total number of {bands / eq} ; 2. idea of comparing position of {bands / eq} ; 3. idea of comparing {size / width} of {bands / eq} ;	ACCEPT idea of comparing bands for 1 mark if mps 1, 2 or 3 cannot be awarded ACCEPT bars / blocks	(3)

Question Number	Answer	Additional Guidance	Mark
3(b)	1. {scientific / peer reviewed} {papers / journals / magazines / article} ; 2. (scientific) {conferences / lecture / forums} ; 3. media reports ;	3. e.g. TV, radio, newspaper, internet	(2)

Question Number	Answer	Additional Guidance	Mark
4(a)	1. idea that {bacteria / pathogen / virus / eq} have to be taken into macrophage / eq ; 2. idea of fusion of {phagosome / eq} with lysosome ; 3. idea that {bacteria/ pathogen / virus / eq} are {digested / broken down / eq} (by enzyme) ; 4. credit named enzyme other than lysozyme ; 5. idea that part of the {bacteria/ pathogen / virus / eq} has to be on {membrane / (outer) surface} (of the macrophage) ;	1. IGNORE phagocytosis unqualified 2. ACCEPT phagocytic vesicle 3. IGNORE destroy / killed 4. e.g. protease. 5. ACCEPT antigen / protein	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(b)	1. idea of macrophage {binding/ eq} to T (helper) {cell / lymphocyte} ; 2. reference to {MHC / major histocompatibility complex } (on macrophage) ; 3. reference to CD4 (receptor on T cell) ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)	1. idea that a mutation has occurred (in the DNA) ; 2. idea that there is a change in {antigen /outer surface / cell wall / slime layer} (of bacteria) ; 3. idea that memory (T) cells will not recognise the (new) antigen ; 4. idea that another (primary) immune response needed e.g. (new) antigen needs to be presented (to the T helper cell) ; 5. to activate (another) population of T (helper) cells / eq ; 6. idea that {phagocytes / macrophages} unable to {recognise / engulf / phagocytose / digest / destroy / eq} the {*Mycobacterium tuberculosis* / bacteria} ; 7. idea that antigen presentation is not possible ;	1. NOT a mutation of the antigen	**(3)**

Question Number	Answer	Mark
5(a)(i)	**A** carbon dioxide and methane	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	1. idea that {using / burning} {fossil fuels / petrol / diesel} releases carbon dioxide ; 2. reference to {carbon dioxide / CO_2} as a greenhouse gas ; 3. idea that carbon dioxide is taken in for {photosynthesis / light-independent reaction / carbon fixation / eq} (during production of plants for biofuels) ; 4. idea of no net change of carbon dioxide in the atmosphere when biofuels are burnt / eq ;	1. NOT methane Ignore burning biofuels releases carbon dioxide 4. ACCEPT biofuels are carbon neutral	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	(plant) fibres / woody parts / xylem (vessels / tissue) / sclerenchyma (fibres / tissue) / lignified tissue / eq ;	ACCEPT vascular bundles / tissue	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	1. idea that bacteria cannot breakdown cellulose fast enough ; 2. idea that {enzymes / cellulase} needed to break down cellulose into (β) glucose ; 3. by hydrolysing (1,4) glycosidic bonds / eq ; 4. idea of {respiration / fermentation} of {glucose / eq} (by bacteria) ;	2. NOT hydrogen bonds 3. ACCEPT breaking	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(c)	1. idea that production of first generation biofuel increases until 2016 and then level off ; 2. idea that production of second generation biofuel will continue to increase ; For second generation biofuels: 3. idea that second generation biofuels do not affect food supply ; 4. idea that made using the non-edible components ; 5. cheaper ; 6. idea that people are becoming more responsible for their environment ;	Piece mp 1 and2 together ACCEPT the converse of mps 3, 4 and 5 in context of first generation biofuel production 4. ACCEPT (cellulose and) lignin idea of less waste	**(4)**

Question Number	Answer	Additional Guidance	Mark
6(a)	1. idea that as the {distance from the front edge of the glacier / time} increases, the {complexity / biodiversity / size / eq } of the organisms increases ; 2. reference to (primary) succession ; 3. idea that {algae / lichens / pioneer species} are (the first) organisms to colonise bare rock / eq; 4. idea that {algae / lichen / pioneer species} improve conditions for plants ; 5. idea of competition (limiting species present) ;	1. ACCEPT idea that climax community only reached at distance from glacier edge 2. NOT secondary succession 4. including e.g. change rock into soil / increase humus content of soil / increase water content 5. e.g. newer species outcompete previous species	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	1. the {role / interaction / eq} of an { *Epilobium latifolium* / organism / species} within its { ecosystem / habitat / environment } ; 2. (*Epilobium latifolium*) is a producer ; 3. idea that *Epilobium latifolium* provides {food / energy} for other organisms (herbivores / primary consumers / decomposers) ; 4. idea that *Epilobium latifolium* improves soil e.g. holds soil structure together, increases nutrients ; 5. idea that *Epilobium latifolium* provides {shelter / (micro) habitat} for organisms ;	1. IGNORE community 3. NOT prey 4. IGNORE food in soil ACCEPT adds organic matter, humus 5. ACCEPT named organism e.g. insects	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	1. idea of using a transect (from front edge of glacier); 2. credit method of sampling (along transect) ; 3. credit appropriate method of selecting sample sites (along transect) ; 4. description of estimate of abundance e.g. number of plants, percentage cover 5. idea of using more than one transect ; 6. credit appropriate method of recording quantitative data ;	2. e.g. clumps touching transect, quadrat (on transect), number of plants along perpendicular 3. e.g. set distance, regular, systematic, flip-flop quadrats NOT random 5. IGNORE references to repeating investigation 6. e.g. tally chart, table, graph	**(4)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	1. credit appropriate named abiotic factor; 2. credit appropriate method of measurement of factor ; 3. credit appropriate description of where reading should be taken ; 4. idea of taking several readings and getting an average / eq ;	1. e.g. light, soil pH, water content, mineral content, temperature, salinity, wind IGNORE CO_2 , O_2, rainfall, humidity 2.CE applied e.g. light {probe / sensor / meter / data logger}, {water gauge / drying out soil samples} 3. CE applied e.g. reading taken at height of plant, soil sample around roots, quadrat	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	1. levels of antibody rise sooner after infection / eq ; 2. levels of antibody rise faster after infection / eq ; 3. levels of antibody rise higher after infection / eq ; 4. credit comparative manipulation of data ;	**do not piece together** ACCEPT converse for mps 1, 2 and 3 in context of vaccination 4. e.g. increase after infection is {10 (au) more / 1.83 times more} peak after infection is 13 (au) higher rate of increase after infection is 1.27 au day^{-1} faster	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	1. secondary (immune) response ; 2. reference to memory cells ; 3. idea that (on infection / second exposure) memory cells are {activated / cloned / stimulated / eq} ; 4. idea that (in secondary response) antibodies are released from plasma cells ;	1. ACCEPT secondary immunity 3. ACCEPT B memory cells differentiate into plasma cells	**(3)**

Question Number	Answer	**Additional Guidance**	Mark
7(b)(i)	1. idea that antibodies will only be present if antigen present ; 2. idea that antigen B is not present in vaccine ; 3. vaccination failed to stimulate immune response / eq ;		**(2)**

Question Number	Answer	Mark
7(b)(ii)	**C** natural active	**(1)**

Question Number	**Answer**	**Additional Guidance**	**Mark**
7(c)	1. idea that {a comment cannot be made / caution in interpreting results should be taken / eq} ; 2. no indication of number of rats used / eq ; 3. no data points / eq ; 4. no error bars (on graph) / no indication of variability / eq ; 5. no statistical evidence / eq ; 6. idea that no indication of {experimental details / control variables / control group / eq} ; 7. idea that mean has been used therefore there must have been some repeats / eq ;	1. IGNORE not reliable or is reliable 2. IGNORE no repeats / sample was small ACCEPT number of repeats not known / sample size not known	**(3)**

Question Number	Answer	Mark
8(a)	**C** hydrolysis	**(1)**

Question Number	Answer	Mark
8(b)(i)	**B** to give a range of values for the independent variable	**(1)**

Question Number	Answer	Mark
8(b)(ii)	**B** one	**(1)**

Question Number	Answer	Additional Guidance	Mark
8(b)(iii)	1. idea that {bacteria / fungi / decomposers / eq} release enzymes (for decomposition) ; 2. idea of the formation of {monomers / glucose / amino acids / small molecules} / eq ; 3. that {are soluble / dissolve} ; 4. idea that some (soluble) molecules {soak into the ground / taken up (by organisms) ; 5. idea of {respiration / fermentation} of {glucose / eq} (by decomposers); 6. carbon dioxide released / eq ; 7. idea of water loss ; 8. idea of {worm / appropriate named organism} activity;	1. ACCEPT external digestion / extracellular digestion 7. e.g. evaporation of water / leaves drying out 8. e.g. animals eat the leaves, leaves pulled into soil	**(4)**

Question Number	Answer	Additional Guidance	Mark
8(b)(iv)	1. idea that an increase in temperature would increase the rate of decomposition (up to an optimum temperature) ; 2. reference to enzymes (in decomposition) ; 3. idea that increased {heat / kinetic} energy results increase in {number of collisions / energy of collisions (between enzymes and substrate) / enzyme-substrate complexes} ; 4. idea that increased temperature increases rate at which bacteria increase ; 5. idea that above a certain temperature rate of decomposition would {decrease / stop} ; 6. idea that at higher temperatures enzymes become denatured OR bacteria killed ;	6. NOT enzymes start to denature NB need the term 'denaturing' or its derivative	**(4)**







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Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Tuesday 11 June 2013 – Morning
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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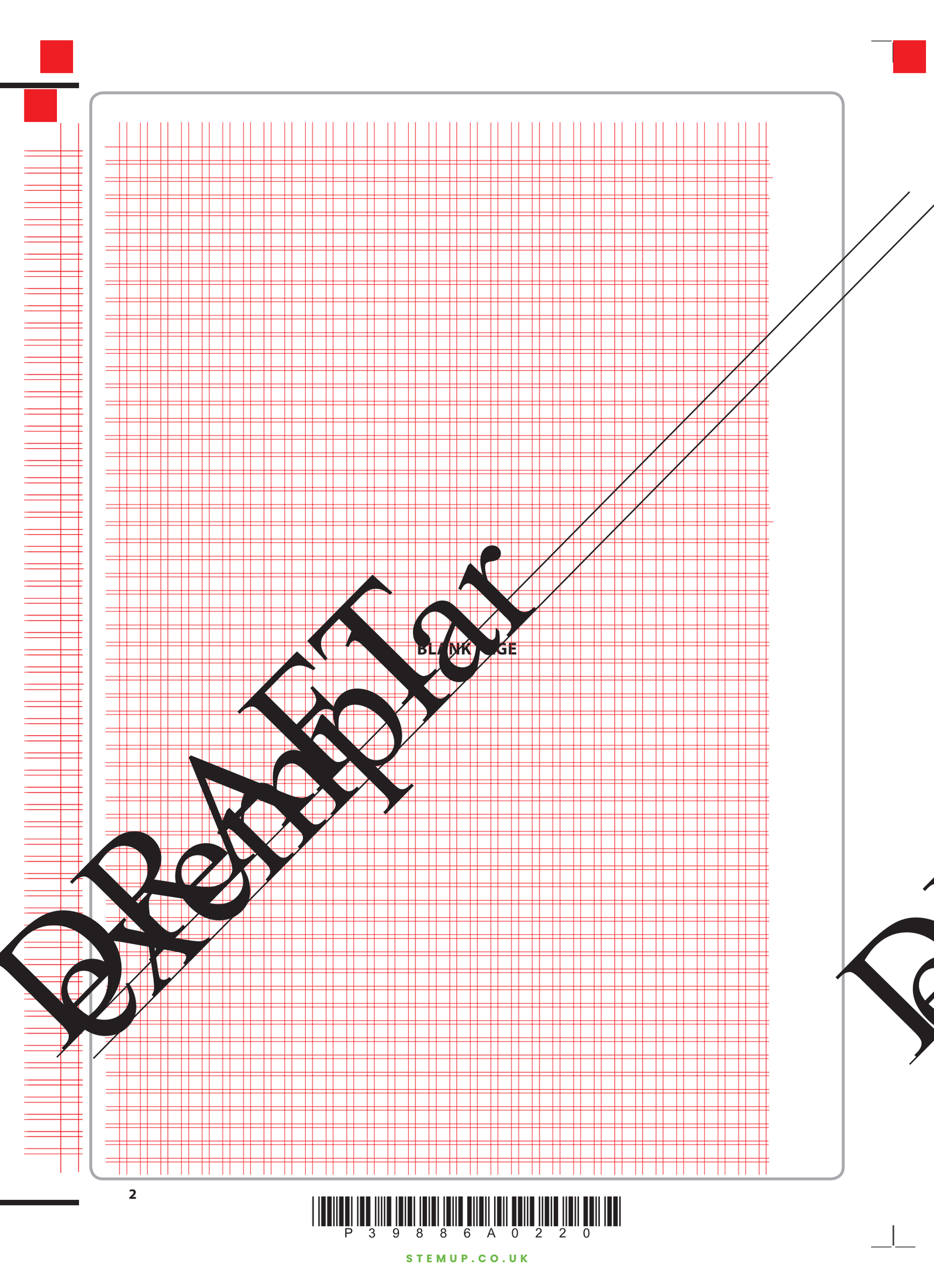
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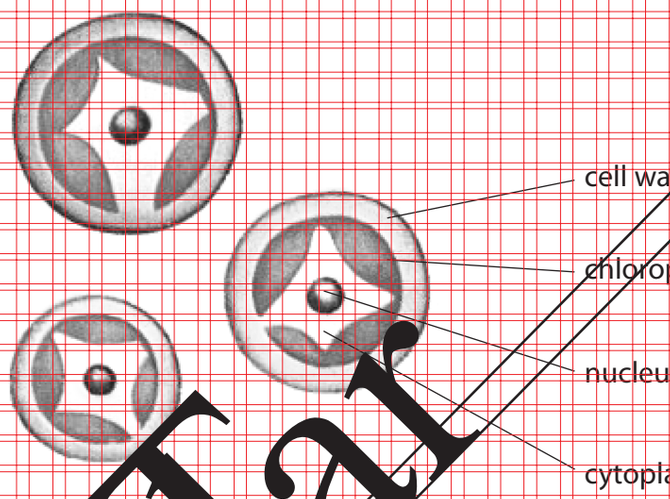
P 3 9 8 8 6 A 0 2 2 0

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 *Pleurococcus* is a unicellular organism that can be found on the bark of trees. Where *Pleurococcus* is growing, it appears as green patches on the bark. Each of the patches is a colony of genetically-identical cells of *Pleurococcus*, formed from a single original cell.

The diagram below shows some of the individual cells of *Pleurococcus* as they might appear using a light microscope.



(a) Place a cross ☒ in the box next to the names of the two structures that show that *Pleurococcus* would be classified as a eukaryotic organism.

(1)

☒ **A** cell wall and chloroplast

☒ **B** cell wall and cytoplasm

☒ **C** chloroplast and nucleus

☒ **D** cytoplasm and nucleus

(b) Explain how a colony of genetically-identical *Pleurococcus* cells could develop from a single original cell.

(2)

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Exemplar

(c) The distribution of *Pleurococcus* on 20 trees was investigated. The percentage cover of *Pleurococcus* was measured using a quadrat measuring 10 cm × 10 cm, divided into 100 small squares.

This quadrat was placed at eight points around the trunk of each tree. Each point on the tree faced a different direction. At each point, light intensity and moisture content were measured at mid-day.

The mean results are shown in the table below.

Point	Direction	Mean percentage cover (%)	Mean light intensity / arbitrary units	Mean moisture content / arbitrary units
1	North	89	6.6	8.8
2	North-east	86	6.4	8.6
3	East	84	6.9	8.7
4	South-east	67	7.3	7.5
5	South	46	8.7	5.2
6	South-west	51	8.4	5.1
7	West	60	8.1	7.0
8	North-west	78	7.6	8.2

(i) Suggest how this 10 cm × 10 cm quadrat was used to obtain the percentage cover of *Pleurococcus* at each point.

(2)

PREMIER

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(ii) Place a cross ☒ in the box next to the best conclusion that can be drawn from these results, about the distribution of *Pleurococcus.*

(1)

☒ **A** it is affected by both light intensity and moisture content

☒ **B** it is affected by light intensity more than moisture content

☒ **C** it is affected by moisture content more than light intensity

☒ **D** it is not affected by either light intensity or moisture content

(iii) Suggest how more evidence for the relationship between light intensity and the distribution of *Pleurococcus* could be obtained.

(3)

(iv) Name **one** biotic factor and suggest how this factor might affect the distribution of *Pleurococcus* on the trees.

(2)

Biotic factor .....

Effect .....

.....

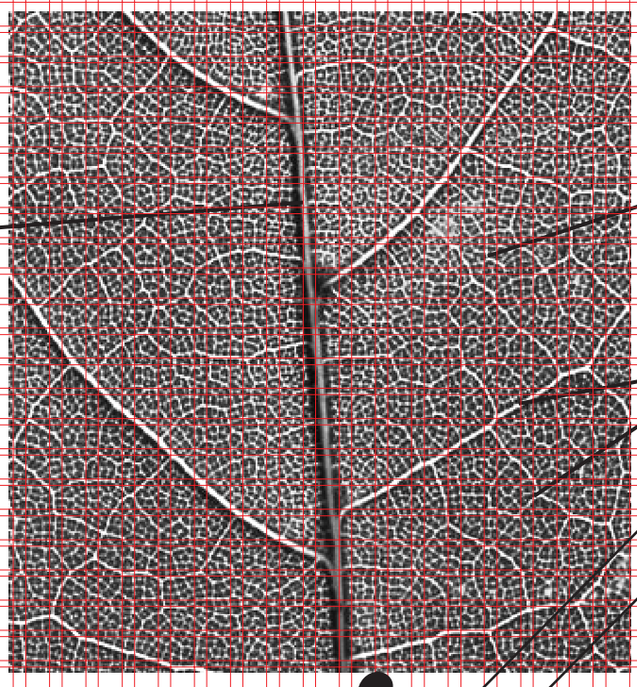
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(Total for Question 1 = 11 marks)

Exemplar

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2 The photograph below shows part of a leaf, as seen using a hand lens.



Magnification $\times 20$

(a) Suggest why each of the following is important for the production of carbohydrates in the photosynthetic cells.

(i) The thin lamina

(2)

(ii) Vessels in the midrib

(2)

PreAttempt

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(b) The photosynthetic cells contain many chloroplasts.

(i) Complete the table below by naming the part of the chloroplast where each of the reactions, **R**, **S** and **T**, takes place.

(3)

Reaction	Details	Part of the chloroplast
R	ADP + inorganic phosphate → ATP	
S	RuBP + CO_2 → 2 × GP	
T	2 × GP → 2 × GALP	

(ii) Place a cross ☒ in the box next to the name of reaction **R**.

(1)

☒ **A** carbon fixation

☒ **B** hydrolysis

☒ **C** phosphorylation

☒ **D** photolysis

(iii) Place a cross ☒ in the box next to the name of the enzyme involved in reaction **S**.

(1)

☒ **A** endonuclease

☒ **B** phosphorylase

☒ **C** RUBISCO

☒ **D** transcriptase

(iv) Suggest how GALP formed by reaction **T**, can be used to synthesise the cellulose in plant cell walls.

(4)

(Total for Question 2 = 13 marks)

Exemplar

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3 The carbon cycle describes the movement of carbon within an ecosystem.

In this cycle, carbon neutral processes do not change the concentration of carbon dioxide in the atmosphere.

The table below shows the main sources and combustion products of some fuels.

Fuel	Main sources	Main combustion products
Biodiesel	Oils from crops such as soya beans, rape seeds, palm seeds	Carbon dioxide and water vapour
Ethanol	Fermented sugars from crops such as sugar cane, sugar beet	Carbon dioxide and water vapour
Hydrogen	Catalysis of methane from fossil deposits or biogas generation using waste biomass	Water vapour
Methane	Extracted from fossil deposits or biogas generation using waste biomass	Carbon dioxide and water vapour
Propane	Refining of crude oil from fossil deposits	Carbon dioxide and water vapour

(a) Place a cross ☒ in the box next to the names of the four fuels, shown in the table, that could be considered to be biofuels.

(1)

☒ **A** biodiesel, ethanol, hydrogen, methane

☒ **B** biodiesel, ethanol, hydrogen, propane

☒ **C** biodiesel, ethanol, methane, propane

☒ **D** biodiesel, hydrogen, methane, propane

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*(b) Large areas of land may need to be cleared in order to produce biofuels. This might involve deforestation.

Discuss why the production of biofuels may not be carbon neutral.

(5)

(c) Explain how the combustion products, from the burning of fuels, may lead to global warming.

(4)

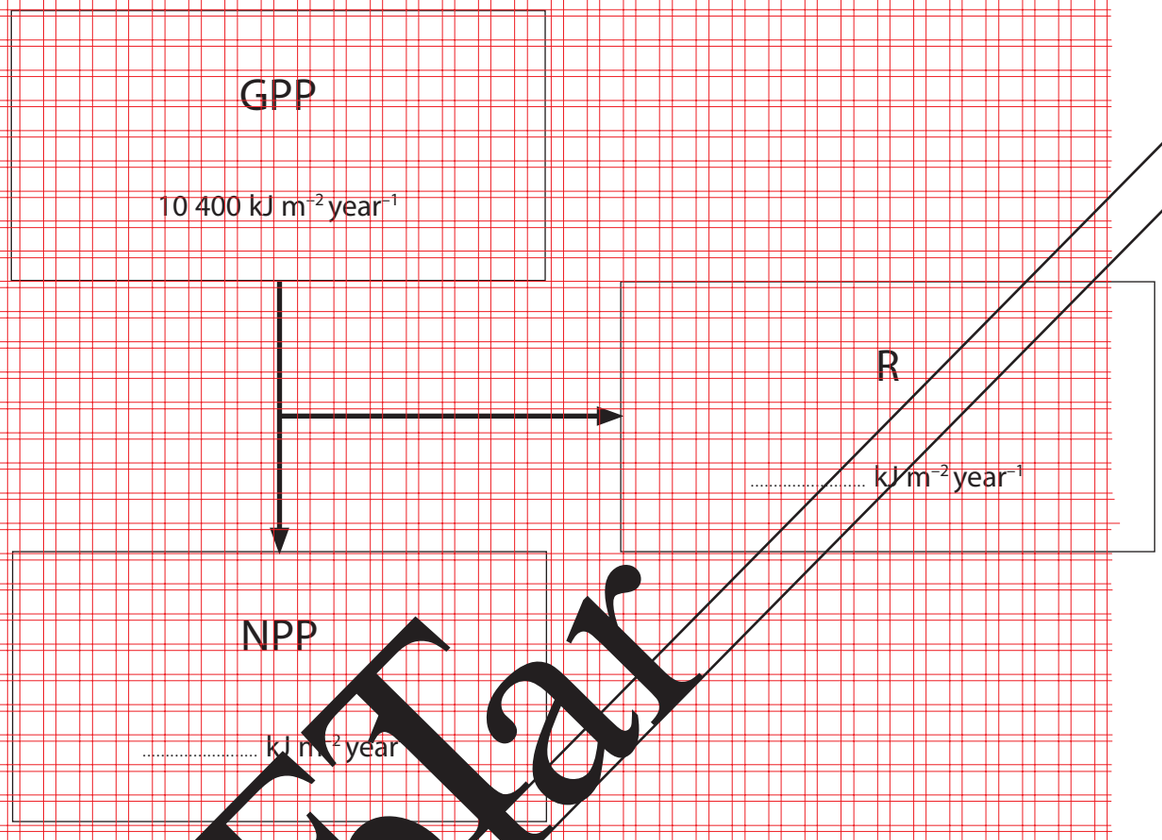
(Total for Question 3 = 10 marks)

Exemplar

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4 Farmers find it helpful to know the productivity of their land.

The diagram below shows the relationship between GPP (gross primary productivity), NPP (net primary productivity) and R (plant respiration) for an area of grassland.



(a) The efficiency of the transfer of energy from GPP to NPP for this grassland is 45%.

(i) Calculate the values for NPP and R. Write your answers in the diagram above.

(2)

Exemplar

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(ii) Using the information given, explain the relationship between GPP and NPP.

(3)

(b) Suggest why NPP values would be of use to a farmer who wanted to use this land for cattle.

(3)

(c) The units (kJ m^{-2} $year^{-1}$) used in the diagram show a rate of energy production. Suggest why this is more useful than measurements of biomass in the grassland on a particular day.

(2)

(Total for Question 4 = 10 marks)

DeAnPlar

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5 The diagram below shows the base sequence on a short section of DNA consisting of 12 mononucleotides. This base sequence contains the genetic code for a short section in the primary structure of a polypeptide.

Section of DNA	**A**	**A**	**T**	**A**	**A**	**C**	**C**	**A**	**G**	**T**	**T**	**T**
Amino acids	leucine			leucine			valine			lysine		

(a) Name each of the bases represented by the letters, **A**, **C**, **G** and **T** in the diagram.

(4)

A .....

C .....

G .....

T .....

(b) Using the sequence shown in the diagram, explain the meaning of each of the following terms.

(i) Triplet code

(2)

.....

.....

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.....

.....

(ii) Non-overlapping

(2)

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.....

.....

.....

ReAplar

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(iii) Degenerate

(2)

(c) Place a cross ☒ in the box next to the names of the two components, other than the bases, that form part of each mononucleotide in this sequence.

(1)

☒ **A** deoxyribose and nitrate

☒ **B** deoxyribose and phosphate

☒ **C** ribose and nitrate

☒ **D** ribose and phosphate

*(d) Transcription of this section of DNA forms a complementary strand of mRNA.

Describe how translation of the mRNA synthesises part of a polypeptide molecule.

(5)

(Total for Question 5 = 13 marks)

Exemplar

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6 Human diseases can be caused by many different types of organism, such as bacteria and viruses.

(a) Give **two** differences between the genetic material of bacteria and viruses.

(2)

(b) Tuberculosis (TB) is caused when droplets, containing the bacterium *Mycobacterium tuberculosis*, are inhaled into the lungs.

In the lungs, large numbers of the bacterium are formed rapidly. These can be ingested by macrophages. Eventually, tubercles (tissue masses), containing dormant bacteria inside macrophages, may form.

(i) Describe how macrophages ingest the bacteria.

(2)

(ii) Suggest why treatment with antibiotics may not be effective against the dormant bacteria in the tubercles.

(2)

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(iii) TB can be prevented by vaccination. Explain how a person can develop artificial active immunity following vaccination.

(3)

(c) In a person with TB, the dormant bacteria in tubercles may be activated after several years. The bacteria multiply rapidly, resulting in severe lung damage.

The bacteria are released from the tubercles. These bacteria can inhibit the activity of T cells and infect other organs.

Explain why the activity of these bacteria and the inhibition of T cells means that a person may quickly develop severe symptoms leading to death.

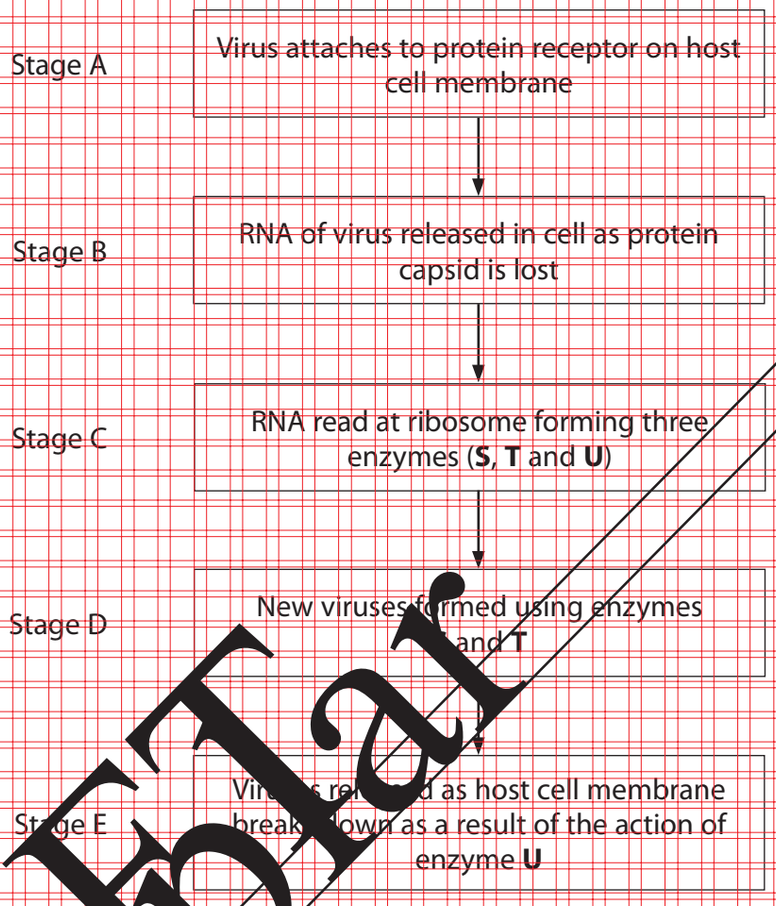
(4)

(Total for Question 6 = 13 marks)

Exemplar

7 The common cold is a disease caused by a variety of viruses.

The flow diagram below describes how common cold viruses attack the cells on the inside of the nose.



(a) Common cold viruses infect only the cells inside the nose.

(i) Suggest why common cold viruses cannot infect cells if they land on unbroken skin.

(2)

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(ii) Suggest why common cold viruses cannot infect cells if they enter the blood through a cut in the skin.

(2)

(b) Compare the action of the RNA in the common cold virus with that found in HIV.

(2)

(c) At Stage C, three enzymes are formed.

(i) Suggest how two of these enzymes, **S** and **T**, are needed at Stage D.

(2)

Exemplar

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(ii) Suggest how enzyme **U** might catalyse the breakdown of the host cell membrane at Stage E.

(3)

(Total for Question 7 = 11 marks)

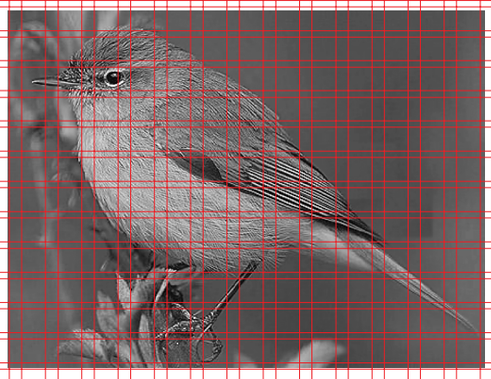
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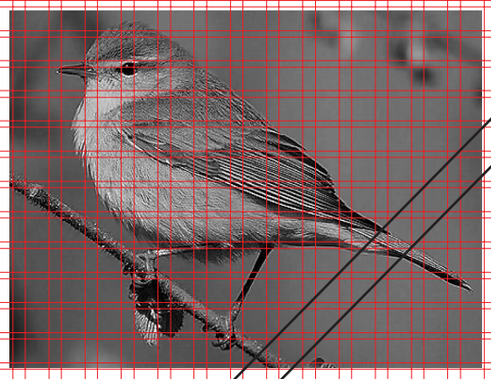
8 The group of birds, known as warblers, contains many species which are very similar in external appearance.

Two of these species, the chiffchaff, *Phylloscopus collybita*, and the willow warbler, *Phylloscopus trochilus*, are so similar that many experts can identify them only by listening to their individually-characteristic songs.
These songs are used during breeding to mark territory and attract mates.

The photographs below show these two warblers.



Chiffchaff



Willow warbler

Magnificatio × 0.75

(a) Although chiffchaffs and willow warblers are often found at the same time in the same woodlands, they do not interbreed.

(i) Suggest why successful interbreeding between chiffchaffs and willow warblers would make scientists doubt their classification as separate species.

(3)

DxRAfiar

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(ii) Suggest reasons why the two species do not interbreed.

(3)

(b) Records show that very little change in the appearance of chiffchaffs and willow warblers has occurred during the last two hundred years.

Suggest why the rate of change in the appearance of these two species is relatively slow.

(3)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)

Summer 2013

GCE Biology (6BI04)
Paper 01

Unit 4: The Natural Environment and Species Survival

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Summer 2013
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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Additional Guidance	Mark
1(a)	C;		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)	1. reference to mitosis ; 2. (followed by) cytokinesis / {cells divide into 2 cells / eq}; 3. reference to repeated (many times) ;	**Not** meiosis **Ignore** binary fission, asexual reproduction	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	1. idea that each (small) square represents 1% ; 2. {count / determine} number of squares containing *Pleurococcus* ; 3. credit an indication of how the percentage was calculated ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	A ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)(iii)	1. idea of obtaining more data (outside) ; 2. reference to processing the data eg plotting a (scatter) graph, correlation test ; 3. credit correct reference to interpretation of {test / graph}; 4. reference to an extended study eg laboratory experiments ; 5. idea that the extended study would be repeated ; 6. idea of looking at results of previous studies ;	**Do not credit** ref to collecting data at different times of day **Accept** Spearman's rank, Pearson's correlation eg draw a line of best fit	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(c)(iv)	1. suitable named factor ; 2. description of the possible effect on {numbers / distribution} ;	**Ignore** predators snails / grazers /herbivores / primary consumers — less as being eaten disease on trees — less as smaller habitat disease in *Pleurococcus* — less as being destroyed competition (from other organisms) — less due to lack of resources eg light, space	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	1. idea of {fast / maximum} {gas exchange / uptake of carbon dioxide / eq}; 2. idea of penetration of light ; 3. idea that carbon dioxide is used in the {light-independent stage / Calvin cycle / formation of GP}; **OR** idea that light is used in {light-dependent stage / photolysis / photophosphorylation / eq } ;	**Accept** CO_2 but **ignore** incorrect formula	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	1. transport (in xylem) of water (to the leaves) / eq ; 2. transport (in phloem) of {sucrose / sugar / carbohydrates } (away from the leaves) / eq; 3. (water) for {light-dependent reaction / photolysis / source of hydrogen (ions)}; **OR** idea of (transporting sugar) to make more room for more carbohydrate synthesis ;	**Accept** H_2O but **ignore** incorrect formula **Accept** phosphates but i**gnore** mineral ions **Not** glucose or any other name sugars **Accept** reducing power, NADPH **Accept** (phosphates) for ATP synthesis	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	<table><tr><th>Reaction</th><th>Details</th><th>Structure</th></tr><tr><td></td><td></td><td>{thylakoid (membrane) / grana / granum} ;</td></tr><tr><td></td><td></td><td>stroma ;</td></tr><tr><td></td><td></td><td>stroma ;</td></tr></table>	**Not** thylakoid space **Ignore** electron transport chain **Not** stoma / stomata **Not** stoma / stomata	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	C ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	C ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iv)	1. reference to conversion (of GALP) to glucose / eq; 2. (which is) β glucose ; 3. reference to formation of glycosidic bonds ; 4. between C_1 and C_4 / these bonds are 1-4 (glycosidic bonds) ; 5. by condensation ; 6. reference to {straight / unbranched} (chains of glucose) ; 7. reference to cellulose as a {polysaccharide / polymer of glucose / eq} ;	**NB** this is a question about the **formation** of cellulose, not its structure **NB** a reference to these bonds being formed must be made	**(4)**

Question Number	Answer	Additional Guidance	Mark
3(a)	A ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
3*(b)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. idea that biofuel production may (overall) results in more carbon dioxide in the atmosphere ; **OR** idea that carbon neutral means that the carbon dioxide produced equals the carbon dioxide used ; 2. idea of forests as carbon {sinks / eq} ; 3. idea that {clearing land / deforestation} results in (net) increase in carbon dioxide (in atmosphere) ; 4. (less plants means) less carbon dioxide {removed / used / eq} by photosynthesis ; 5. {burning / eq} trees produces carbon dioxide ; 6. idea that (increased) decomposition produces carbon dioxide; 7. idea of using {(fossil) fuels / petrol / diesel} by {lorries / machinery / eq}produces carbon dioxide ; 8. {burning /eq} of biofuels produces carbon dioxide ;	**QWC emphasis is clarity of expression** **Accept** stores / sumps	**(5)**

Question Number	Answer	Additional Guidance	Mark
3(c)	1. reference to production of {greenhouse gases / named greenhouse gas} ; 2. idea that these gases {build up/ remain / form a layer} in (upper) atmosphere; 3. which {absorb / trap / eq} {heat energy / infra-red / IR / eq} ; 4. reflected from earth's surface ; 5. idea that increased levels of these gases increase the greenhouse effect ; 6. idea that (mean) temperature of earth's {surface / atmosphere} is increasing ;	**Accept** carbon dioxide, water vapour, sulphur dioxide, oxides of nitrogen **Not** methane **Accept** long wavelength light	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	NPP = 4680 ; R = 5720 ;	**NB** If there are no answers in the box, look for answers in the space below question If answers are the wrong way round, award 1 mark If both answers are wrong, **accept** R = 10168.9 / 10169	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	1. NPP = GPP – R / eq; 2. 55% (GPP energy) is lost / eq ; 3. energy lost as heat / eq ; 4. to provide energy for {active transport / any other named energy-requiring process} ; 5. NPP is {(stored) energy / energy available for next trophic level / eq} ;	**Accept** correct description in words eg movement (opening of flowers, turning of leaves), glycolysis **Ignore** idea that energy is **used** for respiration unqualified **Accept** biomass	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(b)	1. cattle {are primary consumers / herbivores / eat grass / eat plants / eq} ; 2. (therefore) gain energy (available as NPP) ; 3. idea of grazing capacity of the grassland ; 4. idea of affect on yield of {meat / milk / eq} ; 5. idea of changing to a more {efficient / NPP yielding} crop ;	 **Accept** idea that farmer is ensuring that there is enough NPP available for his cattle **Accept** growth rate	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(c)	1. idea of variation over short periods of time; 2. idea that whole year gives an {average / overall / eq} value ; 3. idea that biomass includes {all / undigestible / inedible / eq} organic material ; 4. idea that rate of productivity may influence how much grazing is possible ;	eg more NPP on a sunny day, seasonal	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)	A = adenine C = cytosine G = guanine T = thymine ;	**Accept** reasonable phonetic spellings **Not:** adenosine cysteine glycine thiamine, thyosine, tyrosine	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	1. idea that each amino acid is coded for by three {nucleotides / bases} ; 2. credit quoted example / idea that 12 {nucleotides / bases} code for 4 amino acids ;	**Accept** in context of RNA AAT / AAC = leucine, CAG = valine, TTT = lysine	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	1. idea that each {triplet is discrete / each base is only used once in a triplet / eq } ; 2. idea that AAT + AAC + CAG + TTT gives 4 (distinct) {triplets / codes} ;	**Accept** a specific example eg the first T can only be used in code for first leucine **Accept** a description of how the code could be read if overlapping	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	1. idea that more than one code can be used for a {particular amino acid/ stop code} ; 2. AAT and AAC code for leucine ;	**Accept** more codes than are needed to code for all the amino acids (and stop code)	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(c)	B ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
5*(d)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. reference to mRNA with sequence UUA UUG GUC AAA ; 2. idea that ribosome is involved ; 3. idea that each tRNA molecules is attached to one (specific) amino acid ; 4. credit example of tRNA anticodon with specific amino acid 5. reference to anticodons on tRNA {bind / link to / line up against / eq} codons on mRNA ; 6. credit a specific example (from this DNA) ; 7. idea of hydrogen bonds between bases (of tRNA and mRNA) ; 8. reference to formation of peptide {bonds / links} between (adjacent) amino acids ;	**QWC emphasis is logical sequence** **NB The mps do not have to be given in this order necessarily** **Not** tRNA carries amino acids AAU /AAC = leucine, CAG = valine, UUU = lysine **Ignore** complementary eg UUA codon and AAU anticodon **Accept** between codon and anticodon	**(5)**

Question Number	Answer	Additional Guidance	Mark
6(a)	1. bacteria have DNA, viruses have DNA or RNA ; 2. idea that bacteria have {circular / eq} genetic material, viruses have {linear / straight} ; 3. bacterial DNA is double-stranded, viral {DNA / RNA} is single (or double) stranded / eq; 4. bacteria (may) have plasmids, viruses do not have plasmids / eq;	**NB** piece answers together throughout **Do not accept** in context of plasmid	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	1. reference to {phagocytosis /endocytosis / engulfing} ; 2. credit details of phagocytosis ; 3. reference to bacterium inside a {vacuole / vesicle / phagolysosome} ;	eg formation of {pseudopodia / membrane extensions around bacteria} / cytoplasmic streaming / binding to bacteria **Not** phagolysozyme	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	1. idea that bacteria need to be accessible to antibiotics ; 2. idea of bacteria inside macrophages ; 3. reference to waxy layer of (these) bacteria ; 4. idea that (bacteriostatic) antibiotics affect dividing bacteria; 5. reference to antibiotic resistance (of these bacteria) ;	**Not** bacteriocidal antibiotics	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	1. idea of {dead / attenuated / eq} {organisms / pathogen / bacterium / eq} put into person; 2. reference to (stimulation of) {specific / primary} (immune) response ; 3. credit details of T helper cell activation ; 4. credit details of B cell activation ; 5. credit details of T killer cell activation ; 6. reference to production of memory cells ;	**NB** not simply crediting ref to vaccination as in stem of question **Accept** antigen eg macrophages as APCs eg involvement of cytokines, B cells as APCs eg involvement of cytokines, infected cells as APCs	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(c)	1. reference to {<u>further</u> lung damage / severe breathing problems / eq} ; 2. idea that the *Mycobacterium* get into the {blood / lymph}; 3. idea that organ failure (leads to death) ; 4. idea of {reduced / weakened} immune response (due to a loss of T cells) ; 5. credit detail of role of T (helper) cells ; 6. credit detail of effect of no T killer cells ; 7. credit detail of effect of no B cells ; 8. ref to {secondary / opportunistic / other} infections (causing death) ;	eg cannot obtain enough oxygen eg production of cytokines eg infected cells will not be destroyed eg no antibody produced	**(4)**

Question Number	Answer	Additional Guidance	Mark
7(a)(i)	1. {skin / epidermis} is a barrier / eq ; 2. reference to keratin ; 3. reference to lack of receptors (for the virus) ;	**Accept** prevents entry but **not** prevents infection **NB** keratin in skin forms a barrier = 2 marks **Accept** skin has different receptors	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	1. idea that viruses only {infect / attach to / eq} {specific receptors / specific cells / host cells} ; 2. idea that receptors not present on {blood cells / endothelial cells / eq} ; 3. reference to {destruction / eq} of viruses by phagocytes ;	**Accept** white blood cells. neutrophils; PMN **Ignore** macrophages **Not** lymphocytes, T cells, plasma cells	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)	1. reverse transcriptase (required) in HIV, no reverse transcriptase in cold virus ; 2. DNA formed (using RNA) in HIV, {no DNA formed / RNA used to make protein / translation} in cold virus ; 3. reference to {provirus / latency / delay in virus formation / eq} in HIV infection, {no provirus / lytic cycle / (immediate) formation of virus particles / eq} in cold virus ;	**NB** answers can be pieced together but candidates still have to state both parts of mark point	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)(i)	1. to synthesise (common cold) RNA / eq ; 2. for amino acids to bind to tRNA / eq ; 3. to synthesise (common cold) protein (capsid) / eq ;	**Accept** translation	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)(ii)	1. idea of enzyme affecting {molecules in membrane / proteins / (phospho)lipids / cholesterol} ; 2. enzyme breaks {bonds / named bonds / eq} ; 3. reference to {(by) hydrolysis / hydrolytic enzymes} ; 4. credit detail of enzyme action ; 5. reference to enzyme U as {protease / lipase / cholesterase} ;	eg lowers activation energy, binding of active site to substrate (cannot credit reference to catalyst, as in stem of question) **Ignore** lysosyme	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	1. (successful interbreeding) produces offspring; 2. (same species produce) fertile (offspring); 3. credit reason why offspring of different species might be infertile ;	**Accept** converse throughout **Ignore** viable eg genetic incompatibility, different number of chromosomes, poor quality gametes , low number of gametes	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	1. reference to reproductive isolation ; 2. different breeding times; 3. do not recognise {courtship displays / songs / eq} ; 4. physically incompatible eg genitalia ;		**(3)**

Question Number	Answer	Additional Guidance	Mark
8(b)	1. idea that the two species share the same habitat ; 2. idea that the two species experience the same environmental conditions ; 3. (therefore) the same selection pressures ; 4. idea that they are both well-adapted (to their environment) ; 5. idea that no mutations have happened that {improve / change} their {phenotypes / survival}; 6. {no / few} changes in allele frequency / gene pool is stable ; 7. idea that there has been very little change in environment (over the years) ;	**Accept** similar **NB** this needs to be in the context of both species being subjected to the same selection pressures **Accept** similar	**(3)**

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Edexcel GCE

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Friday 11 January 2013 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P39880A

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P 3 9 8 8 0 A 0 1 2 4

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Antibiotics are used in the treatment of bacterial infections.

(a) (i) Cephalosporins are antibiotics that inhibit the production of bacterial cell walls.

Suggest why cephalosporins are **bactericidal** antibiotics.

(2)

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(ii) Quinolones are antibiotics that inhibit the synthesis of DNA in bacterial cells.

Suggest why quinolones are **bacteriostatic** antibiotics.

(2)

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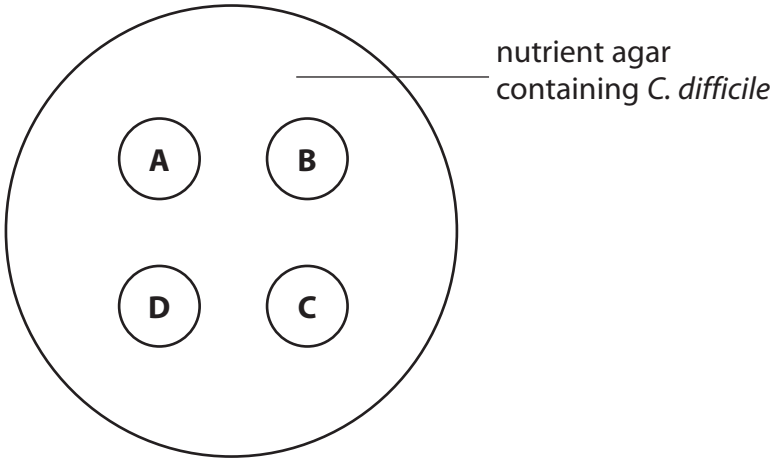
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P 3 9 8 8 0 A 0 2 2 4
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(b) An investigation of the effectiveness of different antibiotics on *Clostridium difficile* was carried out by a hospital laboratory.
Several nutrient agar plates, containing *C. difficile*, were prepared.

Four discs, A, B, C and D, were placed on the surface of each plate. Each disc contained the same concentration of a different antibiotic.

The diagram below shows the position of the four discs on each agar plate, before being incubated.



After incubation, the scientists in the laboratory concluded that *C. difficile* was completely resistant to antibiotics A and C.
They also concluded that antibiotic D was more effective against *C. difficile* than antibiotic B.

(i) Explain how the appearance of the nutrient agar plates, after incubation, would have enabled the scientists to reach these conclusions.

(3)

For each of the statements below, put a cross (☒) in the box next to the term that completes each statement.

(ii) In this investigation, several nutrient agar plates were used for

(1)

☒ **A** accuracy

☒ **B** precision

☒ **C** reliability

☒ **D** validity

(iii) In this investigation, each disc had the same concentration of antibiotic for

(1)

☒ **A** accuracy

☒ **B** precision

☒ **C** reliability

☒ **D** validity

(c) Hospital-acquired infections caused by bacteria can be a major problem for patients.

In a study in a London hospital, it was found that pillows contaminated with bacteria could spread infections between patients.

Suggest how this hospital could improve the prevention and control of the spread of infections.

(3)

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(Total for Question 1 = 12 marks)

P 3 9 8 8 0 A 0 4 2 4
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2 The Human Immunodeficiency Virus (HIV) infects cells of the human immune system.

(a) (i) Place a cross (☒) in the box next to the name of the type of cell in the human immune system that is infected by HIV.

(1)

☒ **A** B effector cell

☒ **B** B memory cell

☒ **C** T helper cell

☒ **D** T killer cell

(ii) Place a cross (☒) in the box next to the name of the enzyme used to produce DNA from viral RNA in an infected cell.

(1)

☒ **A** DNA polymerase

☒ **B** RNA polymerase

☒ **C** restriction endonuclease

☒ **D** reverse transcriptase

(b) An antibody, known as 2G12, has been isolated from the blood of an HIV patient.

(i) State **two** characteristic features of antibodies.

(2)

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*(ii) The antibody 2G12 is produced in response to part of a glycoprotein found on the surface of HIV. Synthetic molecules have been made that resemble this part of the glycoprotein. The antibody 2G12 binds to these synthetic molecules.

Using the information, suggest how this may enable scientists to develop a means of producing **active** immunity to HIV infection.

(5)

P 3 9 8 8 0 A 0 6 2 4
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(c) The table below shows some data about groups of people with HIV infection, in the United Kingdom in 2010.

Group	Numbers in the United Kingdom
People newly-diagnosed with HIV infection	6 630
People unaware of their HIV infection	21 625
People receiving treatment for HIV infection	65 000

Some of the figures shown in the table are estimates.

Suggest why data about HIV infections are often estimates.

(2)

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(Total for Question 2 = 11 marks)

3 The polar bear, *Ursus maritimus,* preys on seals and fish.
Polar bears are adapted to live in cold Arctic regions.



Polar bear
Magnification ×0.04

A recent study has shown that all polar bears are descended from populations that diverged from the Irish brown bear, *Ursus arctos*, approximately 120 000 years ago.

In this study, DNA from modern polar bears, the remains of historic polar bears and the remains of Irish brown bears was analysed.

(a) The first part of the study involved the amplification of DNA to give large enough samples for analysis.

(i) Describe how small samples of DNA can be amplified.

(4)

P 3 9 8 8 0 A 0 1 8 2 4
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(ii) Name **one** technique that could be used to analyse the amplified DNA samples.

(1)

(b) Suggest how the scientists who conducted the study had their results accepted by other scientists.

(2)

(c) Suggest how each of the following may have contributed towards the divergence of polar bears and Irish brown bears into two separate species.

(i) Separation of the Arctic and Irish regions by sea

(2)

(ii) Genetic mutation

(2)

(Total for Question 3 = 11 marks)

4 Frogs are ectothermic animals. This means that their body temperature will vary as the environmental temperature varies.

(a) Explain why body temperature affects the rate of development of animals.

(3)

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(b) Several species of the frog genus, *Rana*, can be found in North America. Many of these species inhabit areas within a range of latitudes from the colder north to the warmer south.

The table below shows data for four of these species, *R. clamitans*, *R. palustris*, *R. pipiens* and *R. sylvatica*.

Species	Body temperature of frog / °C			
	Lower lethal, below which frog dies	**Minimum to start development**	**Maximum to complete development**	**Upper lethal, above which frog dies**
R. clamitans	10.0	11.0	35.0	37.0
R. palustris	5.0	7.0	30.0	31.0
R. pipiens	3.0	6.0	28.0	30.0
R. sylvatica	0.0	2.0	24.0	25.0

Using the information, suggest why the lower and upper lethal temperatures limit the range of latitudes inhabited by each species of frog.

(2)

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(c) Complete the species names in the diagram below to show the most likely distribution of *Rana* from north to south.

(2)

North



South

Rana .....

Rana .....

Rana .....

Rana .....

(d) Populations of the different species overlap on the boundaries of each latitude range.

Suggest why interbreeding does not take place between these populations.

(3)

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(e) Suggest how global warming may affect the distribution of these species of *Rana* in North America.

(3)

(Total for Question 4 = 13 marks)

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5 Photosynthesis can be divided into two main stages, the light-dependent stage and the light-independent stage.

(a) Explain why the light-independent stage cannot take place without the light-dependent stage.

(3)

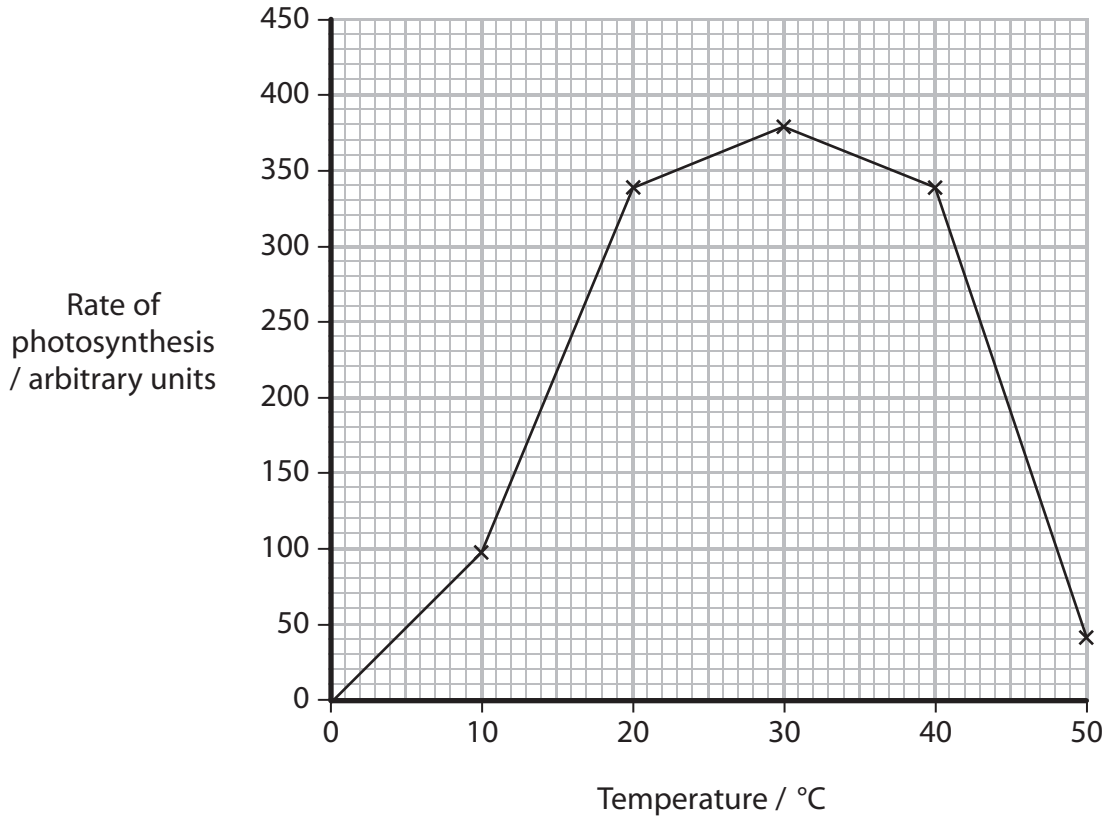
P 3 9 8 1 8 A 0 1 4 2 4
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(b) An investigation was carried out by a student, to find the effect of temperature on the rate of photosynthesis in *Elodea canadensis* (Canadian pondweed).

The rate of photosynthesis was measured over a period of two hours at a fixed temperature. This was repeated at different temperatures.

All other abiotic factors were controlled.

The results of this investigation are shown in the graph below.



(i) Place a cross (☒) in the box next to the statement that describes what could be measured to find the rate of photosynthesis in this investigation.

(1)

☒ **A** increase in mass of *Elodea*

☒ **B** mass of nitrate absorbed

☒ **C** volume of carbon dioxide produced

☒ **D** volume of oxygen produced

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(ii) The temperatures used in this investigation were 0 °C, 10 °C, 20 °C, 30 °C, 40 °C and 50 °C.

Suggest what the results of the investigation show about the minimum temperature required for photosynthesis in *Elodea*.
Give a reason for your answer.

(2)

(iii) Explain the meaning of the following statement.

"All other abiotic factors were controlled."

(2)

P 3 9 8 6 0 A 0 0 1 6 2 4
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(iv) The student, who carried out this investigation, wrote the following as part of her conclusion.

Enzymes control the rate of photosynthesis in *Elodea*.

Discuss how far the results of this investigation support her conclusion.

(4)

(Total for Question 5 = 12 marks)

P 3 9 8 7 0 A 0 0 7 2 4
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6 During the construction of a motorway in the 1970s, an area of Hampshire heathland, previously used for grazing, was abandoned. With the loss of the grazing animals, succession towards a climax community took place on this heathland.

By the 1990s, a scrubland community had developed. A characteristic of this scrubland is the presence of young trees, such as the Birch (*Betula pendula*).

(a) Explain what is meant by each of the following terms.

(i) Succession

(2)

(ii) Climax community

(2)

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(b) In the 1990s, a management strategy was put in place to conserve the rare and endangered heathland plants.

(i) Suggest why it is important to conserve rare and endangered plants.

(2)

(ii) Using the information given on page 18, suggest **one** management strategy that could have been used to conserve the heathland.

(1)

(c) A survey of the occurrence of one rare and endangered plant species, Petty Whin (*Genista anglica*) was carried out.

In this study, a line of 8 people at 2 m intervals walked across the study area. They recorded the position, height and width of each specimen of Petty Whin. The direction of the line was changed several times to ensure that the whole area was covered.

(i) Place a cross (☒) in the box next to the term that describes the method used to collect data in this survey.

(1)

☒ **A** permanent

☒ **B** random

☒ **C** systematic

☒ **D** trial-and-error

(ii) A statistical analysis of the data obtained gave a correlation value of 0.565 between height and width of Petty Whin. This correlation was not statistically significant.

Suggest reasons why the correlation was not statistically significant.

(2)

(Total for Question 6 = 10 marks)

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7 As a result of the destruction of many habitats, the numbers of some species of animals are now so low that they may not be able to survive.

The white rhinoceros, *Ceratotherium simum*, is an example of a mammal that is threatened with extinction.



White rhino
Magnification ×0.02

In southern Africa, many reserves have been set up to protect habitats and animals. These areas are governed by special legislation and monitored by wardens.

(a) Suggest why many scientists consider that the use of protected reserves is likely to be more successful for the conservation of some animals than captive breeding programmes in zoos.

(3)

*(b) The illegal killing of white rhinoceros (poaching), to obtain their horns, is a serious problem in many of the reserves in southern Africa. When the body of a white rhinoceros is discovered, determination of the time of death is an important part of the police investigation to catch the poachers.

After several days, body temperature and rigor mortis cannot be used to determine the time of death.

Suggest how the time of death of a white rhinoceros could be determined if it is discovered several days after being killed.

(5)

(Total for Question 7 = 8 marks)

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8 Histamine and the proteins interferon and lysozyme are involved in the non-specific responses to infection.

(a) (i) Describe how the production and action of interferon differs from the production and action of lysozyme.

(3)

(ii) Suggest why the protein structure of lysozyme is important to the way in which it acts against pathogens.

(4)

(b) Following a bite by an insect, the area around the bite may show signs of inflammation as histamine is released.

(i) Explain why an insect bite, which breaks the surface of the skin, may lead to inflammation around the injury.

(3)

(ii) In order to reduce inflammation, a cream containing antihistamines might be applied to the skin, around an insect bite.

Suggest why applying this cream might be better than taking tablets containing antihistamines.

(3)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)

January 2013

GCE Biology (6BI04) Paper 01
The Natural Environment and Species Survival

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General Information

The following symbols are used in the mark schemes for all questions:

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point
Eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting
/ oblique	Words or phrases separated by an oblique are alternatives to each other
{} curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point
[] square brackets	Words inside square brackets are instructions or guidance for examiners
[CE] or [TE]	Consecutive error / transferred error

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.

No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous
  e.g. for amylase, ‘ammalase’ is acceptable whereas ‘amylose’ is not
  e.g. for glycogen, ‘glicojen’ is acceptable whereas ‘glucagen’ is not
  e.g. for ileum, ‘illeum’ is acceptable whereas ‘ilium’ is not
  e.g. for mitosis, ‘mytosis’ is acceptable whereas ‘meitosis’ is not

- candidates must make their meaning clear to the examiner to gain the mark.

- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark – irrelevant material should be ignored

Question Number	Answer	Additional guidance	Mark
1(a)(i)	1. reference to {death / killing / destroying / eq } (of bacteria cells) ; 2. idea that {bacteria / cells} burst ;	**1. Ignore** reference to stopping growth **2. Accept** lysis, loss of osmotic control	**(2)**

Question Number	Answer	Additional guidance	Mark
1(a)(ii)	1. reference to cells cannot {reproduce / increase in number / produce new cells / multiply / replicate / eq} ; 2. idea of no (cell) division ;	**2. Accept** no binary fission	**(2)**

Question Number	Answer	Additional guidance	Mark
1(b)(i)	1. (A and C resistant as) no {clear zone / zone of inhibition / eq} around A and C ; 2. idea that {clear zone / eq} indicates where antibiotic {inhibits growth / kills bacteria / eq} ; 3. {clear zone / eq} around B {smaller/ eq} than clear zone around D ; 4. idea of {size / diameter / width /eq} of clear zone indicates {effectiveness / eq} ; [check diagram for appropriate labels]	**1. Accept** a clear description of this area around the disc **2. Accept** converse **3. Accept** converse	**(3)**

Question Number	Answer	Mark
1(b)(ii)	C reliability ;	**(1)**

Question Number	Answer	Mark
1(b)(iii)	D validity;	**(1)**

Question Number	Answer	Additional guidance	Mark
1(c)	1. reference to hospitals {having / changing / eq } a {code of practice / protocol / policy / standards / eq} (for dealing with hospital acquired infections) ; 2. idea of clothing rules for hospital workers ; 3. reference to <u>improved</u> laundry of bed linen e.g. {<u>increased</u> frequency / higher washing temperature / eq} ; 4. reference to use of special {pillow cases / treatment of pillow cases} e.g. microfilters, treated with antibacterials, sterilisation, disposable pillow cases ; 5. reference to use of special procedures when carrying {pillow cases / bed linen} to laundry e.g. sealed plastic bags ; 6. screening of patients / isolation of infected patients / eq ; 7. idea of hand washing regimes / eq ;	**1. Allow** references to pillows for pillow cases throughout **3. Allow** pillow cases should be washed daily **7. Allow** hands should always be washed	**(3)**

Question Number	Answer	Mark
2(a)(i)	C T helper cells ;	**(1)**

Question Number	Answer	Mark
2(a)(ii)	D reverse transcriptase ;	**(1)**

Question Number	Answer	Additional guidance	Mark
2(b)(i)	1. reference to glycoprotein ; 2. credit detail of structure e.g. specific (3D) shape, L and H regions, Y-shape, 4 (peptide) chains, disulphide bridges between peptides, hinge region ; 3. reference to {antigen-binding site / variable region / Fab (region) / eq }; 4. idea of antibodies have a {similar / constant / Fc / eq } region; 5. produced by plasma cells / present on B cells ; 6. role of antibody described e.g. opsonisation, immobilisation, agglutination, lysis ;	**1. Accept** protein, chains of amino acids **2. Ignore** active site **Accept** a Y-shaped drawing **3. Accept** references to {binding to specific antigen / antigen-specific / antigen receptors} **5**. **Accept** present on B effector cells	**(2)**

Question Number	Answer	Additional guidance	Mark
2*(b)(ii)	(QWC – answer must be organised in a clear, logical sequence) 1. reference to artificial (active) immunity ; 2. reference to {vaccine / vaccination } ; 3. containing {synthetic molecule / (synthetic) antigen / (synthetic) glycoprotein } ; 4. ref to stimulation of the {specific / humoral} immune response (to the synthetic antigen) ; 5. credit detail of process of producing effector B cells e.g. clonal expansion of B cells, involvement of cytokines, T helper cells activate B cells ; 6. reference to (production of B) memory cells ; 7. idea that (2G12) antibodies are produced {faster / in greater concentration} on {reinfection / eq} ;	Mps are awarded if the statements are clearly expressed **5. Ignore** references to production of activated T killer cells **6. Ignore** references to production of T memory cells **7. Accept** ref to secondary immune response	**(5)**

Question Number	Answer	Additional guidance	Mark
2(c)	1. idea that HIV infection does not always produce symptoms ; 2. reference to {provirus / latency } ; 3. reference to test needed to detect (symptomless) HIV ; 4. idea that only people who suspect they may have contracted HIV would have a test ; 5. idea that {some people would not want to be tested / impossible to test everyone} ; 6. idea that symptoms are common to other diseases ; 7. {new cases arising/ patients dying} all the time / eq ; 8. idea of new strains of virus arising ;	**2. Accept** virus is dormant	**(2)**

Question Number	Answer	Additional guidance	Mark
3(a)(i)	1. reference to {polymerase chain reaction / PCR} ; 2. polymerase (enzyme) {added / eq } ; 3. idea of need for primers and nucleotides ; 4. {90-98} (^{o}C) → {50-65} (^{o}C) → {70-75} (^{o}C) ; 5. idea that cycle needs to be repeated {several times / to make several copies of DNA / eq} ;	**1. Accept** as a ref to PCR machine	**(4)**

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	(DNA) {profiling / fingerprinting / (gel) electrophoresis} ;	**Ignore** Southern blotting, PCR **Accept** DNA profile / DNA fingerprint	**(1)**

Question Number	Answer	Additional guidance	Mark
3(b)	1. idea of work appearing in a (Scientific) journal or being presented at a conference ; 2. idea that validity or reliability is considered ; 3. by other scientists / ref to peer review ;	**1. Accept** publishing a paper, scientific meeting	**(2)**

Question Number	Answer	Additional guidance	Mark
3(c)(i)	1. reference to different {conditions / environments /eq} (in each region) ; 2. idea of different selection pressures ; 3. idea of {restricted gene flow / separate gene pools} ; 4. reference to reproductive isolation;	**1. Accept** appropriate named factor e.g. temperature **3. Ignore** different allele frequency	**(2)**

Question Number	Answer	Additional guidance	Mark
3(c)(ii)	1. idea of different {alleles/ gene pool} ; 2. idea that this leads to {new / different} phenotypes ; 3. idea of new {allele / gene} can be {advantage / disadvantage} ; 4. reference to (advantageous) {(mutated) gene / (new) allele} passed onto offspring ;	**1. Ignore** allele frequency **2. Accept** traits / characteristics / features	**(2)**

Question Number	Answer	Additional guidance	Mark
4(a)	1. reference to increase in {metabolic rate / enzyme activity / eq} as temperature rises ; 2. reference to increase in {kinetic / eq} energy of molecules (as temperature rises) / eq ; 3. reference to increase in {enzyme-substrate complexes / energy of collisions / eq} (as temperature rises) ; 4. idea of {inactivation at lower temperatures/ denaturation at higher temperatures} of enzymes ; 5. idea that temperature affects {differentiation / growth /division / eq} ;	**1. Accept** converse argument for mp 1 – 3 **2. Accept** movement **4.Accept** the idea that enzyme-substrate complexes cannot be made if denaturing	**(3)**

Question Number	Answer	Additional guidance	Mark
4(b)	1. idea that temperature affects {survival / development / growth / metabolism / cell division / eq} ; 2. idea that enzymes affect {development / growth / metabolism / cell division/ eq} ; 3. idea that temperature affects enzymes ; 4. idea that different frogs have different enzymes ;		**(2)**

Question Number	Answer	Additional guidance	Mark
4(c)	*sylvatica*, *pipiens*, *palustris*, *clamitans* ; ;	if order correct but reversed = 1 mark	**(2)**

Question Number	Answer	Additional guidance	Mark
4(d)	1. idea that different species are reproductively isolated ; 2. idea of different breeding {times / seasons / eq} ; 3. idea of different {breeding / courtship / eq} {behaviour / rituals / displays / colour / songs / croaks / eq} ; 4. idea that population at {northerly / southerly} limit of range may not develop (to adulthood) ; 5. idea that breeding between different species results in infertile offspring ;	**3. Accept** idea of incompatible {genitalia / gametes}	**(3)**

Question Number	Answer	Additional guidance	Mark
4(e)	1. idea that global warming will increase the temperature (at the latitudes) ; 2. idea that temperatures (at these latitudes) may become too high for any of the species ; 3. idea that new temperature may be above the maximum to complete development or above the upper lethal limit ; 4. idea that species move {north / to cooler regions / eq} ; 5. ref to change in {food source / predators / competition / eq} ;	**2.Accept** become extinct	**(3)**

Question Number	Answer	Additional guidance	Mark
5(a)	1. idea that products of light-dependent stage are {needed for / used in / eq} {light-independent stage / Calvin cycle} ; 2. reference to (products of light-dependent stage) are {reduced NADP / eq} and ATP ; 3. reference to use of {reduced NADP / eq} for {reduction / eq} of {carbon dioxide / GP / eq} ; 4. reference to use of ATP as source of energy ;	**3. Accept** source of hydrogen ions for GALP **Ignore** ref to ATP	**(3)**

Question Number	Answer	Mark
5(b)(i)	D volume of oxygen produced ;	**(1)**

Question Number	Answer	Additional guidance	Mark
5(b)(ii)	1. (minimum temperature) is {between 0 ^{o}C and 10 ^{o}C / above 0 ^{o}C but less than 10 / 10 ^{o}C} ; 2. idea of no photosynthesis at 0°C but photosynthesis is taking place at 10 ^{o}C ; 3. reference to no {data / readings / measurements / evidence / eq} between 0 ^{o}C and 10 ^{o}C ; 4. idea that at 0 ^{o}C water is frozen ;	**3. Accept** if correct temp range has been given already	**(2)**

Question Number	Answer	Additional guidance	Mark
5(b)(iii)	1. reference to abiotic factors {are non-living / non-biological / do not involve organisms / eq} ; 2. idea that other factors need to be kept constant ;	**2. Ignore** controlled	**(2)**

Question Number	Answer	Additional guidance	Mark
5(b)(iv)	**Supporting conclusion:** 1. idea that shape of graph is typical of an enzyme-temperature graph ; 2. rate increases (up to 30 ^{o}C) because more {enzyme-substrate complexes / collisions between enzymes and substrates} / eq ; 3. rate decreases (after 30°C) due to enzyme denaturation / eq ; **Not supporting conclusion:** 4. idea that other factors could be affecting photosynthesis ; 5. idea of {gas / oxygen / carbon dioxide} solubility changing with temperature ; 6. idea of {correlation / not causation} ;	**1.** idea that rate of photosynthesis is affected by temperature in a similar way to enzymes	**(4)**

Question Number	Answer	Additional guidance	Mark
6(a)(i)	1. idea of (a sequence of) changes in {a community / organisms / species / plants} ; 2. over a period of time / eq ;	**1. Accept** the idea of species replacing or succeeding each other **2. Accept** gradually	**(2)**

Question Number	Answer	Additional guidance	Mark
6(a)(ii)	1. idea of final {stage / sere / community} ; 2. feature of community described e.g. self-sustaining , stable, one dominant species, a few codominant species ;	**1. Accept** at the end of succession **2. Ignore** named example	**(2)**

Question Number	Answer	Additional guidance	Mark
6(b)(i)	1. idea of conservation of {genetic diversity / genetic variation / biodiversity} ; 2. idea of extinction ; 3. idea of aesthetic reasons ; 4. idea that these plants may be useful e.g. as medicines ; 5. idea that other animals depend on these plants as a {source of food / habitat} ;	**1. Accept** gene pool **5. Accept** part of a food chain **Ignore** survival	**(2)**

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	grazing / remove saplings / mowing / eq ;	**Accept** burning	**(1)**

Question Number	Answer	Mark
6(c)(i)	C systematic ;	**(1)**

Question Number	Answer	Additional guidance	Mark
6(c)(ii)	1. comparison (of the value) to the critical value indicates no significance / stronger correlation the nearer the value is to 1.0 / 0.565 is too low / eq ; 2. idea that sample size too small ; 3. idea that {there is no correlation between height and width / other factors affect height / other factors affect width / eq} ;	**1. Ignore** plus and minus numbers **2. Accept** not enough data	**(2)**

Question Number	Answer	Additional guidance	Mark
7(a)	1. idea of less {stress / trauma / discomfort / depressed /eq} (for the animals) ; 2. idea that animals are more likely to breed in natural environment ; 3. idea that animals may require large areas ; 4. idea that problems of releasing animals back into the wild is avoided eg habituation ; 5. idea that {disease is less likely / disease will not wipe out population} ; 6. idea of allowing (natural) {interspecific relationships / communities} to exist ; 7. idea of allowing (natural) {intraspecific relationships / family / social / eq} {structure/ behaviour} ; 8. (because) large numbers of animals needed / wider gene pool / eq ; 9. idea that (natural) {diet / food / eq} available ;	**Accept** converse argument throughout **6. Accept** reference to maintaining their niche	**(3)**

Question Number	Answer	Additional guidance	Mark
7*(b)	(QWC– Spelling of technical terms *(in italics)* must be correct) 1. reference to *succession* ; 2. reference to (*forensic) entomology* ; 3. example of {insect / eq} e.g. *fly, beetle, wasp* ; 4. idea that the {types / *species* / life cycle stages} (of insects) are used ; 5. reference to {*decomposition / decay* / eq} ; 6. idea that there are different stages of {*decomposition / decay* / eq} ; 7. detail of {*decomposition / decay* / eq} e.g. production of *gases, liquefaction* of *tissue, bloating, discolouration* ; 8. reference to rate of {*succession / insect development / decomposition*} influenced by {external factor / appropriate named factor} ; 9. idea that insect and decomposition information is used to determine time of death ;	Penalise spelling once **1. Accept** in context of either insects or decomposition **3.** Named insect must be spelt correctly **6. Accept** if 2 or more stages listed **8.** Named *factor* must be spelt correctly	**(5)**

Question Number	Answer	Additional guidance	Mark
8(a)(i)	1. idea that interferon involved in viral infections, lysozyme affects bacteria; 2. idea of interferon produced by infected cells, lysozyme present in {secretions / phagocytes / neutrophils / macrophages / eq }; 3. interferon {inhibits / eq} {replication / eq} of viruses, lysozyme {kills / destroys} bacteria;	**Piece together** throughout **Accept** lysosome throughout **Ignore** pathogen throughout **2. Accept** named secretion {produced / released} **3. Accept** a reference to lysozyme destroying cell walls	**(3)**

Question Number	Answer	Additional guidance	Mark
8(a)(ii)	1. reference to (lysozyme) is an enzyme ; 2. idea that {proteins / active sites / enzymes} have a specific shape ; 3. idea that lysozyme acts on cell wall ; 4. of bacteria ;	**Accept** lysosome in this context	**(4)**

Question Number	Answer	Additional guidance	Mark
8(b)(i)	1. reference to histamine released as a result of damaged {tissue / cells} ; 2. (histamine released from) {basophils / mast cells / platelets} ; 3. detail of effect of histamine e.g arterioles dilate, vasodilation, increased blood flow, capillaries more permeable ; 4. named effect of inflammation e.g. {oedema / swelling /redness / heat / pain / eq} ;	**2. Accept** white blood cells, macrophages and neutrophils **4. Accept** raises temperature	**(3)**

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	1. idea of (only) {a local reaction produced / histamines produced around bite area} ; 2. idea that cream {has been applied to actual site of production of histamine } ; 3. idea of {effect / treatment / relief / eq} {more rapid / immediate / eq }; 4. idea of higher concentration of antihistamine at site ; 5. idea that the antihistamines will not be {digested (by enzymes) / destroyed (by acid / enzymes) / eq} ; 6. idea that tablets may lower immune response generally / lead to side-effects ;	**2-6 Accept** converse	**(3)**

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Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Friday 15 June 2012 – Morning
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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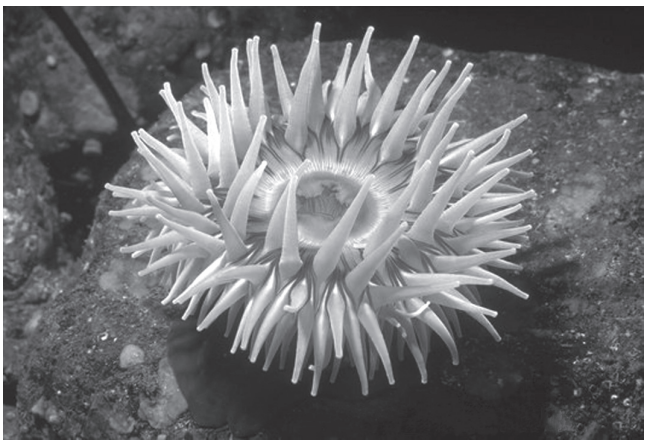
PEARSON

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The sea anemone, *Anthopleura elegantissima*, occupies a niche at the secondary and tertiary consumer levels in a food web on the shores of North America.



Neil G. Mcdaniel / Science Photo Library

Sea anemone Magnification ×1

At high tide, the sea anemone is active and feeds on a variety of small invertebrate animals and fish. It paralyses its prey using stinging cells on tentacles. The food is then passed into the gut of the sea anemone for digestion by enzymes. The anemones also form the food of various carnivores.

At low tide, the anemones are exposed on the rocks of the shore where they remain stationary until the water returns at high tide.
During this exposure, the tentacles and body of each anemone are contracted into a rounded mass.

(a) Explain what is meant by the term **niche**, using the sea anemone *Anthopleura elegantissima* as an example.

(3)

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(b) Suggest and explain why the anemones contract when exposed at low tide.

(3)

(c) Line transects were used to study the effects of abiotic factors on the distribution of *A. elegantissima* on a rocky shore. In this study, line transects were taken from the upper shore to the low water mark.

The mean results from these line transects are shown in the table below.

Quadrat	Mean height above low water mark / m	Mean rock temperature / °C	Mean number of *A. elegantissima*
1	3.9	12	0
2	3.6	12	0
3	3.7	12	0
4	3.4	13	5
5	3.2	12	10
6	3.0	12	21
7	2.9	11	32
8	2.5	12	56
9	2.4	12	68
10	2.1	13	55
11	1.7	13	76
12	1.2	12	45
13	0.9	12	25
14	0.6	12	18
15	0.0	12	21

(i) Place a cross ☒ in the box next to the term that describes the type of sampling that uses line transects to study the distribution of *A. elegantissima*.

(1)

☒ **A** controlled

☒ **B** random

☒ **C** systematic

☒ **D** trial and error

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(ii) Describe and suggest explanations for the effects of these two abiotic factors on the distribution of *A. elegantissima* on this shore.

(3)

(iii) Suggest how these data could be analysed to assess the relationship between the two abiotic factors, shown in the table, and the distribution of *A. elegantissima* on this shore.

(2)

(Total for Question 1 = 12 marks)

2 Certain herbivores, such as cows, contain bacteria in their stomachs.

These bacteria produce enzymes that can digest cellulose and other organic compounds in the plant material that the cows eat.

As a result of the bacterial activity, methane and carbon dioxide are released. These gases pass into the atmosphere as the cow burps or exhales.

(a) (i) Place a cross ☒ in the box next to the term used to describe the type of chemical reaction involved in the digestion of cellulose by enzymes.

(1)

☒ **A** autolysis

☒ **B** haemolysis

☒ **C** hydrolysis

☒ **D** photolysis

(ii) Place a cross ☒ in the box next to the most likely product of the digestion of cellulose by the bacteria.

(1)

☒ **A** amino acids

☒ **B** fatty acids

☒ **C** glucose

☒ **D** glycerol

(b) Suggest why these bacteria need to have special adaptations to live in the stomach of a cow.

(3)

P 3 9 5 7 1 A 0 6 2 8
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(c) On a farm in Wales, an investigation was carried out to assess the effect of diet on the milk yield and methane production of cows.

A herd of cows was divided into two groups, A and B. The cows in group A were fed a traditional diet and those in group B were fed the same diet with a mixture of chopped hay and straw added.

The table below shows the results of this investigation.

Group	Diet	Mean milk yield per cow / dm^3 day^{-1}	Methane emission for each dm^3 milk produced / dm^3
A	Traditional with no added material	24.0	30.0
B	Traditional with added chopped hay and straw	27.6	24.0

(i) Using the information in the table, calculate the rate of methane production per cow on each of the two diets.

(2)

Group A = ...

Group B = ...

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*(ii) Scientists have estimated that if all cattle in Britain were fed on a diet with added chopped hay and straw, there would also be an annual reduction of at least 1.6 million tonnes of carbon dioxide released into the atmosphere.

With reference to your answer in (c)(i) and the information on carbon dioxide release, suggest why the new diet may be supported by organisations that are concerned about global warming.

(5)

(Total for Question 2 = 12 marks)

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3 Clear areas with no trees can be found within many forests. These areas usually have communities of animals and plants which are different from those found in the wooded parts of the forest. These clear areas are maintained by the grazing of animals such as rabbits and deer.

(a) Describe what might happen to the clear areas in forests, over a long period of time, if the numbers of rabbits and deer decreased.

(3)

(b) The butterfly *Boloria selene* (Small Pearl-bordered Fritillary) can be found in many of the clear areas of British forests.



Small Pearl-bordered Fritillary Magnification ×1.5

This butterfly lays its eggs on low-growing plants such as *Viola riviniana* (Dog Violet), on which the caterpillars feed when they hatch.

The adult butterflies feed on nectar from plants such as *Ajuga reptans* (Bugle) and other low-growing species.

Since the plants on which the butterfly depends are able to grow only in forest clearings, small reproductively-isolated populations of *B. selene* can be identified in many forests.

(i) The distribution of plants in a forest is affected by many abiotic factors.

Name **one** of these factors and suggest how this factor could affect the distribution of the low-growing plants within the clear areas of a forest.

(3)

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(ii) Explain what is meant by the term **reproductively-isolated populations** of *B. selene*.

(3)

(iii) Suggest why it is unlikely that any individuals within a population of *B. selene* would survive if the numbers of rabbits and deer decreased.

(3)

(Total for Question 3 = 12 marks)

P 3 9 5 1 2 8 STEMUP.CO.UK

4 Photosynthesis involves the fixation of carbon dioxide in chloroplasts.

(a) Place a cross ☒ in the box next to the region of the chloroplast that would be involved in the fixation of carbon dioxide.

(1)

☒ **A** crista

☒ **B** granum

☒ **C** matrix

☒ **D** stroma

(b) An investigation was carried out into the effect of reducing the carbon dioxide available for photosynthesis. Cells of a unicellular alga were suspended in a solution containing 1.0% carbon dioxide. After 250 seconds, the carbon dioxide in the solution was reduced to 0.003%.

The cells were illuminated with a bright light and some were removed at regular time intervals for 500 seconds. The concentrations of ribulose bisphosphate (RuBP) and glycerate 3-phosphate (GP) in the cells were measured.

(i) Suggest **two** reasons why a suspension of cells of a unicellular alga, in a solution, is more suitable for this investigation than using leaves.

(2)

.....

.....

.....

.....

(ii) Suggest why it would be advisable to illuminate the cells at a high light intensity during this investigation.

(3)

.....

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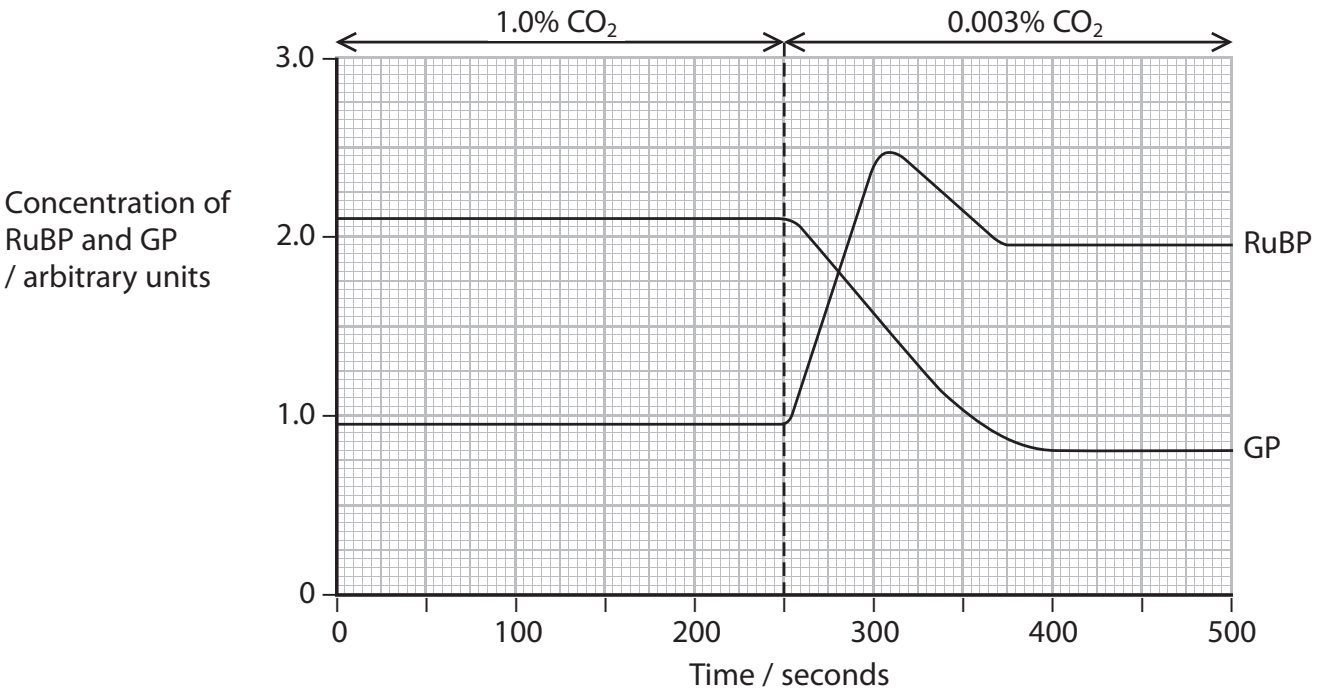
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*(iii) The graph below shows the results of the investigation.



Describe and suggest an explanation for the changes in the concentrations of RuBP and GP shown in the graph.

(6)

(Total for Question 4 = 12 marks)

5 A pathologist was called to examine the body of a young man found partly-buried in a shallow grave. The initial examination of the body provided evidence that could be used to estimate the time of death of the young man.

One source of evidence used for an estimation of the time of death was the remains of insects found on the body.

The table below describes some of the types of insect remains found and the pathologist's notes.

Type of insect	Life cycle stage	Pathologist's notes
Chrysomya rufifacies (blowflies)	Pupa cases	Pupa cases empty
Dermestes maculates (beetles)	Third stage larval skins	Good condition
Necrobia rufipes (beetles)	Adult	Active

(a) Place a cross ☒ in the box next to the term that describes the use of evidence provided by insect remains on a dead body.

(1)

☒ **A** forensic bryology

☒ **B** forensic entomology

☒ **C** forensic mycology

☒ **D** forensic neurology

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(b) The flow diagram below shows the main stages in the life cycle of blowflies and beetles.

EGG → LARVA → PUPA → ADULT

(i) Place a cross ☒ in the box next to the factor that would have the most effect on the rate of development of each stage of the life cycle of insects on this dead body.

(1)

☒ **A** interspecific competition

☒ **B** light

☒ **C** predation by birds

☒ **D** temperature

(ii) Suggest how the pathologist might use the information in the table and the flow diagram to estimate the time of death of the young man.

(3)

(c) Suggest how useful each of the following additional sources of evidence would be for the pathologist in determining the time of death of this young man. Give an explanation for each of your answers.

(i) Body temperature

(2)

(ii) State of decomposition

(2)

(Total for Question 5 = 9 marks)

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6 In the immune response, antibodies are produced that are specific to the antigens of the pathogen causing the infection.

(a) Place a cross ☒ in the box next to the type of cell that produces antibodies as part of the immune response.

(1)

- ☒ **A** erythrocyte
- ☒ **B** macrophage
- ☒ **C** plasma cell
- ☒ **D** thrombocyte

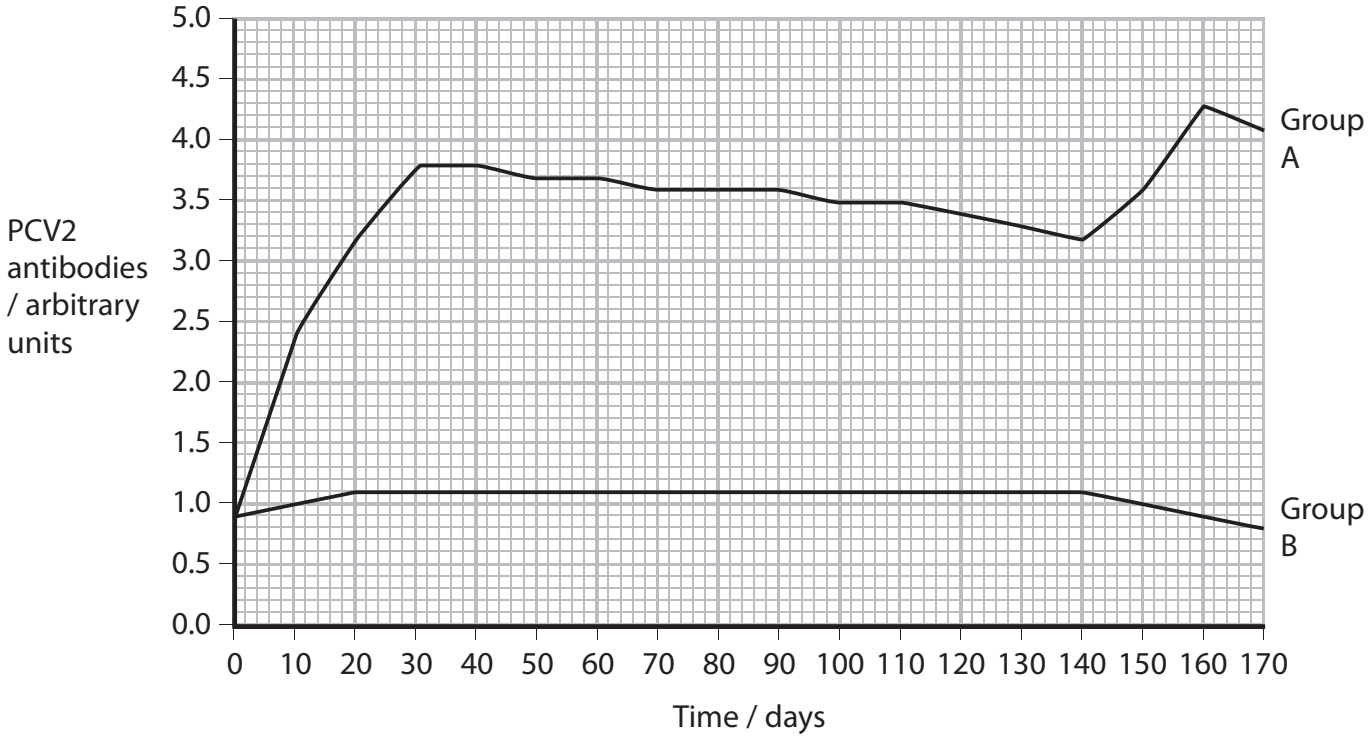
(b) In pigs, the disease known as post-weaning multisystematic syndrome (PWMS) is caused by the PCV2 virus. Common symptoms of PWMS include weight loss, breathing difficulties and enlargement of the lymph nodes. Most pigs diagnosed with PWMS will have to be destroyed.

A new vaccine has been developed to give gilts (female pigs having their first pregnancy) active immunity against PWMS. To test this vaccine, gilts were divided into two groups, A and B.

Group A gilts were vaccinated against PWMS on day 0, at the start of pregnancy. A second vaccination was given on day 20. A final vaccination was given on day 140, approximately 20 days before they were due to give birth.

Group B gilts were given no vaccine.

The graph below shows the results of blood tests to measure the concentration of PCV2 antibodies in these two groups.



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(i) Describe how the vaccine gives **active immunity** against PWMS.

(3)

(ii) Apart from having no vaccine, suggest how group B should be treated during the test. Give reasons for your answer.

(3)

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(iii) Compare the changes in concentrations of PCV2 antibodies in the blood of the two groups of gilts during pregnancy.

(3)

(iv) The table below shows the concentration of PCV2 antibodies detected in the piglets produced by the two groups of gilts, during the first 40 days after birth.

Age of piglets / days	Concentration of PCV2 antibodies / arbitrary units	
	Group A piglets	Group B piglets
0	3.9	0.7
10	3.2	0.8
20	3.0	2.6
40	2.9	2.9

Suggest reasons for the changes in the concentrations of PCV2 antibodies in group A and group B piglets.

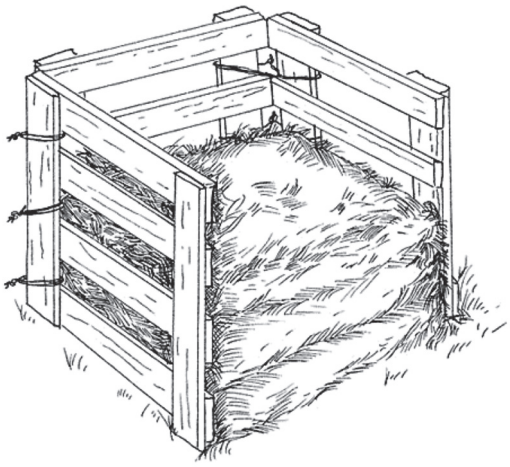
(3)

(Total for Question 6 = 13 marks)

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7 Waste plant material from gardens can be turned into a bulk organic fertiliser known as compost. Compost consists of semi-decomposed material which can add texture and mineral nutrients to the soil.

The diagram below shows a typical garden compost bin.



(a) Place a cross ☒ in the boxes next to the **two** types of organism that would be able to decompose organic compounds in waste plant material.

(2)

☒ **A** algae

☒ **B** bacteria

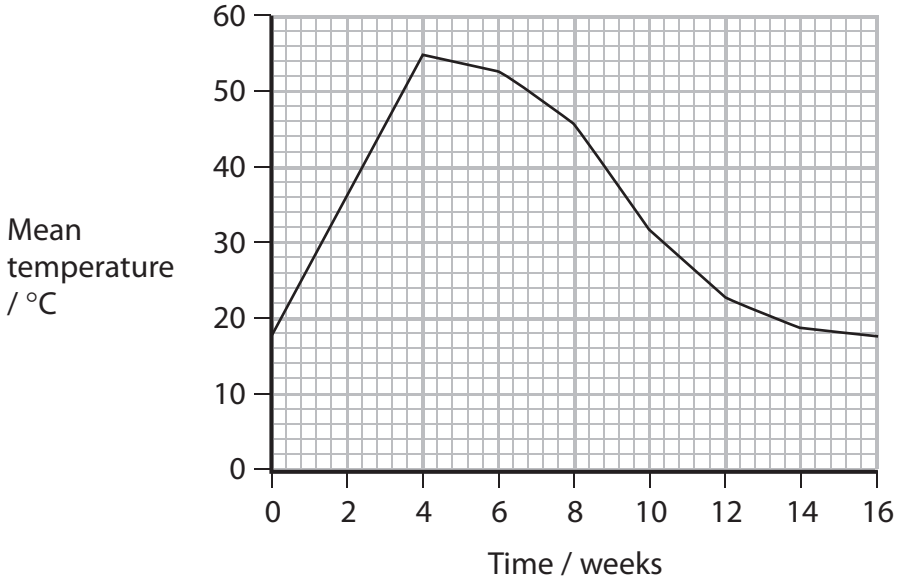
☒ **C** fungi

☒ **D** viruses

(b) As part of a study of compost formation, a student monitored the temperature in a compost heap for several weeks. A compost heap was set up using a mixture of leaves, straw and other plant material.

The student added some nitrate fertiliser and watered the compost heap. The temperature was measured in the compost heap by inserting a long thermometer at several points. The temperature readings were repeated for a further 16 weeks.

The graph below shows the results of this part of the study.



The table below shows statements that the student wrote in her report on the study. Place a tick (✓) in each row to indicate whether the statement is true or false.

(3)

Statement	True	False
Compost formation involves respiration by microorganisms.		
I added nitrate fertiliser so that the microorganisms could synthesise nucleic acids.		
There is only one trophic level in my compost heap.		

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(c) Describe the changes in temperature shown in the graph.
Suggest explanations for these changes.

(4)

(d) Suggest why the student took temperature measurements by using **a long thermometer at several points**.

(3)

(Total for Question 7 = 12 marks)

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8 DNA is found in chromosomes and consists of double-stranded polynucleotide molecules. The sequence of bases in DNA forms the basis of what is known as the genetic code.

(a) Explain why a molecule of DNA can be described as a **double-stranded polynucleotide**.

(3)

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*(b) Describe how the sequence of bases in a DNA molecule would be used to form the primary structure of a protein.

(5)

(Total for Question 8 = 8 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)

Summer 2012

GCE Biology (6BI04) Paper 01
The Natural Environment and Species Survival

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Mark
1(a)	1. idea of the {role / purpose / interaction / eq} of {organism / sea anemone / species / eq} ; 2. reference to trophic level(s) ; 3. it is a predator/ controls population of prey / eq ; 4. it is prey / provides food for other animals / eq ; 5. provide {shelter / home /eq} for some animals / eq ;	**(3)**

Question Number	Answer	Mark
1(b)	1. idea of reduces surface area (to volume) ; 2. idea of less water loss e.g. dehydration, drying out ; 3. idea of reduces visibility (to predators) ; 4. idea of protection from {predators / carnivores / named eg} ; 5. idea that there is no need for the tentacles to be exposed ; 6. energy {will be conserved /will not be wasted/ eq} ;	**(3)**

Question Number	Answer	Mark
1(c)(i)	C – systematic ;	**(1)**

Question Number	Answer	Mark
1(c)(ii)	1. idea of no indication that temperature has an effect e.g. little variation, only 2°C ; 2. idea that distribution is influenced by height (above low water mark) ; 3. idea of more likely to dry out at higher levels ; 4. idea of food availability differs e.g. less at higher levels, more at lower levels ; 5. idea of more likely to be eaten at lower levels ;	**(3)**

Question Number	Answer	Mark
1(c)(iii)	1. plot graph(s) of numbers of anemones against {height and temperature / abiotic factors / eq} ; 2. reference to correlation ; 3. idea of using statistical analysis ; 4. named appropriate statistical test ;	**(2)**

Question Number	Answer	Mark
2(a)(i)	C – hydrolysis ;	**(1)**

Question Number	Answer	Mark
2(a)(ii)	C – glucose ;	**(1)**

Question Number	Answer	Mark
2(b)	1. reference to {low pH / (hydrochloric) acid / HCl / eq} ; 2. idea that acid destroys bacteria ; 3. reference to {low / no} oxygen ; 4. reference to using anaerobic respiration ; 5. idea of resistant to {(stomach) enzymes / protease / named protease} ; 6. idea of bacterial cell resistant to digestion ; 7. ref to adaptation to cow's temperature ;	**(3)**

Question Number	Answer	Mark
2(c)(i)	1. group A = 720 and group B = {662 / 662.4} ; 2. units correct = {dm^3 day^{-1} / dm^3 per day} ;	**(2)**

Question Number	Answer	Mark
*** 2(c)(ii) QWC**	**Take into account quality of written communication when awarding the following points.** 1. reference to less {*greenhouse gas* / *methane* / *carbon dioxide*} ; 2. *carbon dioxide* and *methane* are (both) {*greenhouse gases* / cause *greenhouse effect*} ; 3. (that can) {*absorb* / trap / eq} {*heat* / *infra red* / longer *wavelengths*} (*radiation*) ; 4. {*reflected* / eq} from the Earth / eq ; 5. reference to decrease in {these gases / *carbon dioxide* / *methane*} leads to {reduced / eq} *greenhouse* effect ; 6. idea of *methane* having a greater *greenhouse* effect than *carbon dioxide* ; 7. idea of *temperature* of {Earth's surface / *atmosphere*} less likely to rise ; 8. reference to reduced possibility of *climate* change ; 9. description of example of effect of this (e.g. ice caps melting, crop failure) ;	**(5)**

Question Number	Answer	Mark
3(a)	1. idea of taller (growing) plants could {develop / grow} in the clear areas ; 2. idea of loss of {low-growing plants / clear zones} ; 3. idea that different animals appear ; 4. reference to (secondary) succession ; 5. reference to climax community (of the taller plants) ;	**(3)**

Question Number	Answer	Mark
3(b)(i)	1. named abiotic factor ; 2. appropriate description of how named factor affects the {number / distribution / growth / eq} of these plants ; 3. appropriate explanation ;	**(3)**

Question Number	Answer	Mark
3(b)(ii)	1. idea of no {(inter) breeding / reproduction / mating / eq} (between the *B. Selene*); 2. (because) {geographical / physical} barrier / eq ; 3. idea of different behaviour ; 4. idea of incompatible genitalia ; 5. idea of each population having a {discrete / eq} gene pool e.g. restricted gene flow, different mutations, different alleles ;	**(3)**

Question Number	Answer	Mark
3(b)(iii)	1. {low-growing plants would die out / eq } / {taller plants would outgrow the low-growing plants / eq} ; 2. idea of (*B. Selene*) unable to feed e.g. no nectar (for the adults) ; 3. (*B.selene*) unable to lay eggs / eq ; 4. no suitable plants for {caterpillars / eq } to feed on / eq ; 5. idea of very little {variation / genetic diversity / eq} in a small population ;	**(3)**

Question Number	Answer	Mark
4(a)	D - stroma;	**(1)**

Question Number	Answer	Mark
4(b)(i)	1. idea that samples (of cells) can be taken {easily / eq} ; 2. reference no damage to {plant / leaf / other cells} (during sampling) / eq ; 3. idea of carbon dioxide level (in water) can be {adjusted / maintained / changed / eq} (easily) ; 4. idea of {RuBP / GP / products / eq} cannot pass into {other cells / rest of plant} ; 5. reference to only one kind of cell / eq ; 6. idea of controlling the {mass / number/surface area} of cells ; 7. idea that genetically-similar cells used ;	**(2)**

Question Number	Answer	Mark
4(b)(ii)	1. light is needed for light-dependent reaction ; 2. light (intensity) will not be a limiting factor / eq ; 3. idea that {the effect of carbon dioxide concentration can be seen / carbon dioxide (concentration) is (only) limiting factor / eq } ; 4. {ATP / NADPH / eq} produced during light-dependent reactions ; 5. {ATP / NADPH / light-dependent products / eq} required for {light-independent reactions / Calvin cycle / carbon dioxide fixation} ;	**(3)**

Question Number	Answer	Mark
4(b)(iii)	1. both RuBP and GP levels constant until carbon dioxide {lowered / eq} ; 2. ref to (RuBP and GP in) Calvin cycle ; **RuBP** 3. (at lower carbon dioxide levels) the RuBP increases and drops (and then stays constant) ; 4. rises because being regenerated / eq ; 5. falls as being used to {fix / eq} carbon dioxide ; 6. idea that RuBP level remains constant once (new) equilibrium reached ; **GP** 7. (at lower carbon dioxide levels) the GP drops (and then stays constant) ; 8. drops because less {carbon dioxide available to convert into GP) / less carbon fixation / eq} ; 9. levels out at a lower level as carbon dioxide still available but at lower level; 10. credit correct manipulation of figures for a description of either RuBP or GP ;	**(6)**

Question Number	Answer	Mark
5(a)	B – forensic entomology ;	**(1)**

Question Number	Answer	Mark
5(b)(i)	D – temperature ;	**(1)**

Question Number	Answer	Mark
5(b)(ii)	1. idea that the body has been dead for a while ; 2. (because) more than one species of insect present / eq ; 3. reference to succession (of insect species) ; 4. idea that life cycle {times / stages} of the insects are {known / used / eq} ; 5. idea that life cycle times depend on (environmental) temperature ; 6. credit specific ref to information in table e.g. blowfly cycle complete ;	**(3)**

Question Number	Answer	Mark
5(c)(i)	1. idea that a drop in body temperature is linked to time after death e.g. algor mortis ; 2. idea that factors affect temperature drop e.g. environmental temperature, body size, clothing ; 3. (useful because) time of death can be calculated if (ambient) temperature known / eq ; 4. only useful for short period of time following death e.g. 24 hours, a day ;	**(2)**

Question Number	Answer	Mark
5(c)(ii)	1. idea that body decomposes in a specific sequence (with time) ; 2. idea that factors affect decomposition e.g. environmental temperature, wounds ; 3. (not useful) if all the body has decomposed / eq ;	**(2)**

Question Number	Answer	Mark
6(a)	C – plasma cell ;	**(1)**

Question Number	Answer	Mark
6(b)(i)	1. idea of using {virus / PCV2} as vaccine ; 2. which is {modified / attenuated / harmless / similar / part of / eq} ; 3. idea that the vaccine contains the antigen ; 4. idea of {activation / proliferation} of (specific) {B cell / T cell / lymphocyte} ; 5. reference to production of (B / T) memory cells ; 6. idea that body now able to produce (specific) antibody {faster / at higher concentration / eq} on another exposure to PCV2 ;	**(3)**

Question Number	Answer	Mark
6(b)(ii)	1. reference to giving a placebo (to group B) ; 2. idea that all (other) {conditions / factors / variables} should be {controlled / same as group A} ; 3. stated example e.g. food, temperature of housing / eq ; 4. reference to group B is a control group ; 5. (so that) only the (effect of) {vaccine / vaccination} is tested / eq ; 6. ref to {valid / validity} ;	**(3)**

Question Number	Answer	Mark
6(b)(iii)	1. {Greater change / higher / eq} in group A (than B) / eq ; 2. group A rises for first 30 days, group B rises (slightly) for first 20 days / eq ; 3. (this) rise for group A is {faster / greater} than for group B / eq ; 4. (after the rise) group A falls, group B levels off / eq (until day 140) ; 5. after day 140, group A rises, group B falls / eq ; 6. credit use of comparative manipulated figures (with units) ;	**(3)**

Question Number	Answer	Mark
6(b)(iv)	1. idea that (antibodies present at birth as) both groups received antibodies from mother ; 2. via {placenta / blood / milk / breast feeding} ; 3. reference to passive immunity ; 4. group A concentration falls because {piglets not infected by (PCV2) virus/ antibodies excreted / passive immunity is short term} /eq ; 5. group B concentration rises because {PCV2 / virus} present / eq ;	**(3)**

Question Number	Answer	Mark
7(a)	B – bacteria ; C – fungi ;	**(2)**

Question Number	Answer	Mark
7(b)	<table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>Compost formation involves respiration by microorganisms.</td><td>✓</td><td></td></tr><tr><td>I added nitrate fertiliser so that the microorganisms could synthesise nucleic acids.</td><td>✓</td><td></td></tr><tr><td>My compost heap only contains one trophic level only.</td><td></td><td>✓</td></tr></table> 1 mark each correct row ;;;	**(3)**

Question Number	Answer	Mark
7(c)	1. ref to increase in temperature for first 4 weeks ; 2. idea of heat (energy) related to temperature change ; 3. ref to {metabolism / respiration / named metabolic reaction} ; 4. appropriate comment on changes in numbers of microorganisms ; 5. ref to decrease in temperature after 4 weeks ; 6. comment on {enzymes denaturing / eq} ; 7. idea that {substrate / eq} {is running out / has run out} ;	**(4)**

Question Number	Answer	Mark
7(d)	1. idea that {heat is lost from outer surface of compost heap / temperature will vary in different parts of the compost heap} ; 2. idea that long thermometer measures {internal / core / eq} (temperature) of heap ; 3. this improves validity (of the method) ; 4. repeated readings to obtain {mean / average} ; 5. this improves reliability (of the results) ;	**(3)**

Question Number	Answer	Mark
8(a)	1. (Double-stranded because made of) two strands ; 2. (strands joined) by hydrogen bonds (between bases) ; 3. (polynucleotide) of {many / eq} nucleotides ; 4. (nucleotides) linked by phospho(di)ester bonds / eq ;	**(3)**

Question Number	Answer	Mark
***8(b) QWC**	**Take into account quality of written communication when awarding the following points.** 1. idea of sequence of bases {forming the genetic code / determines the amino acid sequence} ; 2. idea that one triplet codes for an amino acid; 3. ref to (DNA) acting as a template ; 4. reference to transcription OR detail of transcription e.g. DNA unzips, mRNA synthesis ; 5. idea that mRNA moves from nucleus to cytoplasm / eq ; 6. reference to translation OR detail of translation e.g. role of ribosome, codon-anticodon interaction ; 7. idea that tRNA carries an amino acid ; 8. ref to formation of peptide bonds between amino acids ; 9. idea that primary structure is the {sequence /order / eq} of amino acids ; 10. comment on post-transcriptional modification of mRNA (between transcription and translation)e.g. removal of introns, splicing ;	**(5)**

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Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Wednesday 25 January 2012 – Morning
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P39505RA

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1/1/1/1/1/C1/

P 3 9 5 0 5 R A 0 1 2 4

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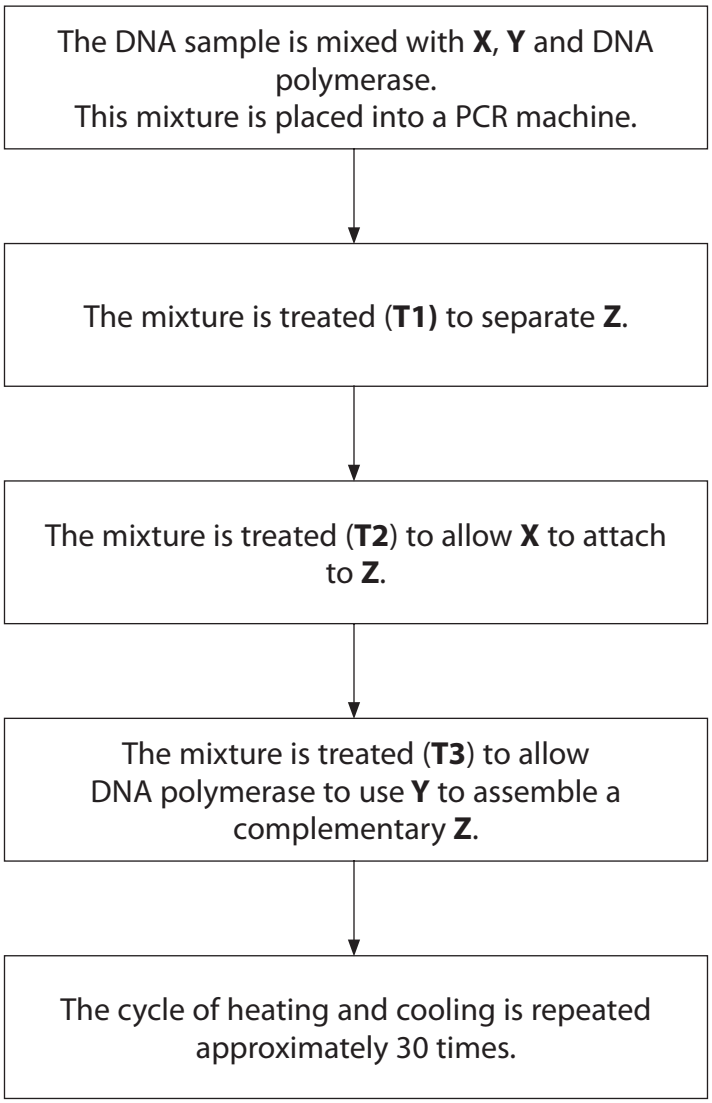
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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 During DNA profiling, the polymerase chain reaction (PCR) can be used to amplify a sample of DNA.

The diagram below shows how substances **X**, **Y** and **Z** are involved in the PCR.
It also gives the temperature treatments **T1**, **T2** and **T3** at various stages.



P 3 9 5 1 0 5 A 0 2 2 4
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(a) Name substances **X**, **Y** and **Z**.

(3)

Substance **X** .....

Substance **Y** .....

Substance **Z** .....

(b) Place a cross ☒ in the box next to the correct statements for treatments **T1**, **T2** and **T3**.

(3)

(i) Treatment **T1**

☒ **A** heated to 90–95 °C

☒ **B** heated to 75 °C

☒ **C** cooled to 55–60 °C

☒ **D** cooled to 4 °C

(ii) Treatment **T2**

☒ **A** heated to 90–95 °C

☒ **B** heated to 75 °C

☒ **C** cooled to 55–60 °C

☒ **D** cooled to 4 °C

(iii) Treatment **T3**

☒ **A** heated to 90–95 °C

☒ **B** heated to 75 °C

☒ **C** cooled to 55–60 °C

☒ **D** cooled to 4 °C

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(c) Suggest reasons for each of the following.

(i) DNA polymerase from human sources is not suitable for use in a PCR machine.

(2)

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(ii) Species of plants cannot be identified from woody (xylem) material using PCR and DNA profiling.

(2)

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(Total for Question 1 = 10 marks)

P 3 9 5 0 5 R A 0 4 2 4
STUDYPROAUK

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2 The diagram below summarises the interconversion of ATP and ADP.



(a) Place a cross ☒ in the box that identifies each of the following.

(3)

(i) Substance **W**

☒ **A** carbon dioxide

☒ **B** an electron

☒ **C** inorganic phosphate

☒ **D** a proton

(ii) Reaction **S**

☒ **A** carboxylation

☒ **B** hydrolysis

☒ **C** phosphorylation

☒ **D** photolysis

(iii) Reaction **T**

☒ **A** carboxylation

☒ **B** hydrolysis

☒ **C** phosphorylation

☒ **D** photolysis

P 3 9 5 0 5 R O A U 0 6 2 4
STUDYPROAU

(b) Reaction **T** occurs in a chloroplast.
Describe the structures in a chloroplast that are involved in this reaction.

(3)

(c) The energy released by reaction **S** is used to form GALP (glyceraldehyde 3-phosphate) during the Calvin cycle.
Plant cell walls contain cellulose molecules.

Suggest how GALP may be used to synthesise cellulose.

(5)

(Total for Question 2 = 11 marks)

P 3 9 5 0 5 R A 0 7 2 4
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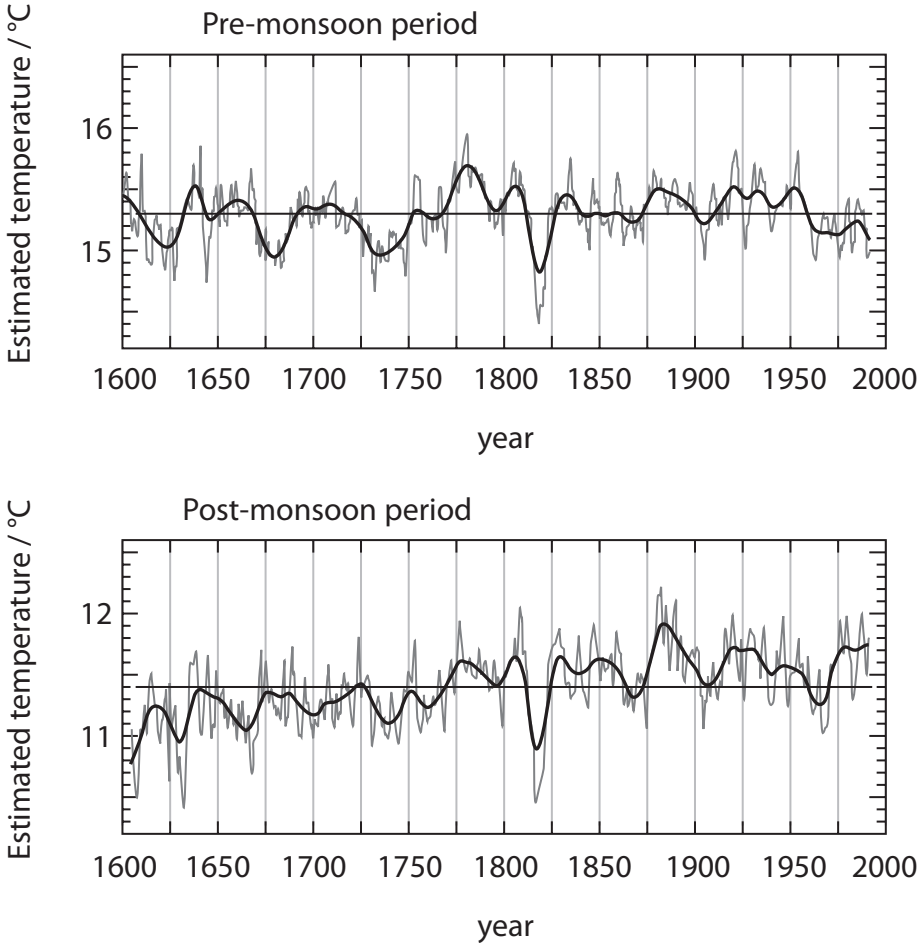
3 If a tree trunk is cut across horizontally, growth rings can be seen in the cut surface. The most significant factor that affects the formation of growth rings is environmental temperature. In regions where there is an annual cycle of seasonal temperature changes, it is possible to estimate the year in which a particular ring was formed.

In Nepal, there is an annual seasonal cycle of three distinct periods that is shown in the table below.

Period	Months	Description
Pre-monsoon	February to June	Relatively warm temperature, greater than 15 °C
Monsoon	July to September	Heavy rainfall
Post-monsoon	October to January	Relatively cool, usually less than 12 °C

Data from growth ring studies and other sources have been used to estimate the changes in environmental temperature in Nepal during the past 400 years.

The estimated temperatures for the pre-monsoon and post-monsoon periods are shown in the graphs below.



P 3 9 5 1 0 5 R O A U K 0 8 2 4
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(a) Place a cross ☒ in the box next to the term used to describe the scientific study of tree growth rings.

(1)

- ☒ **A** climatology
- ☒ **B** dendrochronology
- ☒ **C** ecology
- ☒ **D** ethnobiology

(b) Compare the changes in mean environmental temperature between the pre-monsoon and the post-monsoon periods from 1600 to 2000.

(3)

(c) (i) Suggest how scientists could use these data to predict future climate change.

(3)

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(ii) Suggest why some scientists may not be convinced that these data can be used to predict future climate change.

(3)

(d) Suggest **one** source of evidence, apart from growth ring studies, that could be used to estimate changes in mean environmental temperature in Nepal during the past 400 years.

(1)

(Total for Question 3 = 11 marks)

P 3 9 5 0 5 R A 0 1 0 2 4
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4 Nuthatches are small, colourful birds belonging to the genus, *Sitta*.
Many varieties of the species *Sitta europaea* (European nuthatch) can be found throughout mainland Europe.
These varieties form overlapping populations in different regions. These birds eat small invertebrates, living in tree bark, throughout the year.



European nuthatch. Magnification x0.5
Leslie J Borg/Science Photo Library

However, in the colder mountain forests on the island of Corsica, a small population of approximately 2500 pairs of nuthatches can be found. These birds are classified as the species *Sitta whiteheadi* (Corsican nuthatch). For most of the year, they feed on pine seeds. During the summer breeding season they also feed on small invertebrates.

Members of the two species, *S. europaea* and *S. whiteheadi*, are so similar in appearance and behaviour that they can usually only be distinguished by expert observation and research.

(a) Place a cross ☒ in the box next to the best definition of a species.

(1)

☒ **A** individuals can interbreed to produce fertile offspring

☒ **B** individuals can interbreed to produce hybrid offspring

☒ **C** individuals can interbreed to produce sterile offspring

☒ **D** individuals can interbreed to produce viable offspring

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*(b) In mountainous regions of mainland Europe, only *S. europaea* is found. Suggest how a distinct species of nuthatch, *S. whiteheadi*, has evolved in the mountainous regions of the island of Corsica.

(5)

(c) (i) Suggest how environmental changes, such as those caused by global warming, are more likely to cause extinction of *S. whiteheadi* than *S.europaea*.

(3)

P 3 9 5 0 5 R A 0 1 2 2 4
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(ii) Suggest why *S. whiteheadi* might be able to survive an environmental change such as global warming.

(2)

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(d) Explain how the work of zoos could be important to the survival of *S. whiteheadi*.

(2)

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(Total for Question 4 = 13 marks)

P 3 9 5 0 5 R A 0 1 3 2 4
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5 (a) The table below gives some of the features of bacteria and viruses.

Place **one** tick (✓) in each row to indicate whether the feature is found in bacteria only, viruses only or both bacteria and viruses.

(3)

Feature	Found in		
	Bacteria only	**Viruses only**	**Both bacteria and viruses**
Nucleic acid			
Cytoplasm			
Protein capsid			

(b) In human populations, the bacterium, *Helicobacter pylori*, is associated with the development of severe chronic atrophic gastritis (SCAG) in the stomach. SCAG is the first step that can lead to the most common form of stomach cancer.

The table below shows the reported new cases of stomach cancer in 2006 in the UK.

The mean rate of stomach acid secretion for each age group is also shown.

Age group / years	Mean acid secretion / mg hour^{-1}	New cases of stomach cancer
11–15	170	0
16–20	160	0
21–25	150	0
26–30	120	0
31–35	100	4
36–40	90	10
41–45	60	55
46–50	60	95
51–55	60	183
56–60	50	263
61–65	40	424
66–70	40	633

P 3 9 5 0 5 R A 0 1 4 2 4
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(i) Suggest why patients with SCAG may be given antibiotics as part of their treatment.

(2)

*(ii) Using the information about SCAG and the data, describe and suggest explanations for the trends shown in the table.

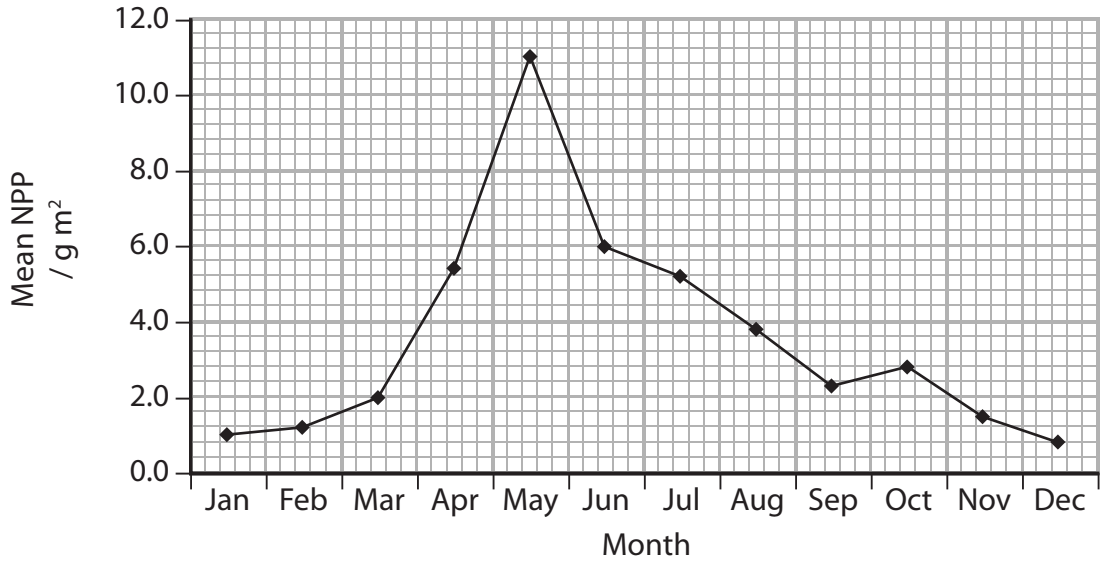
(5)

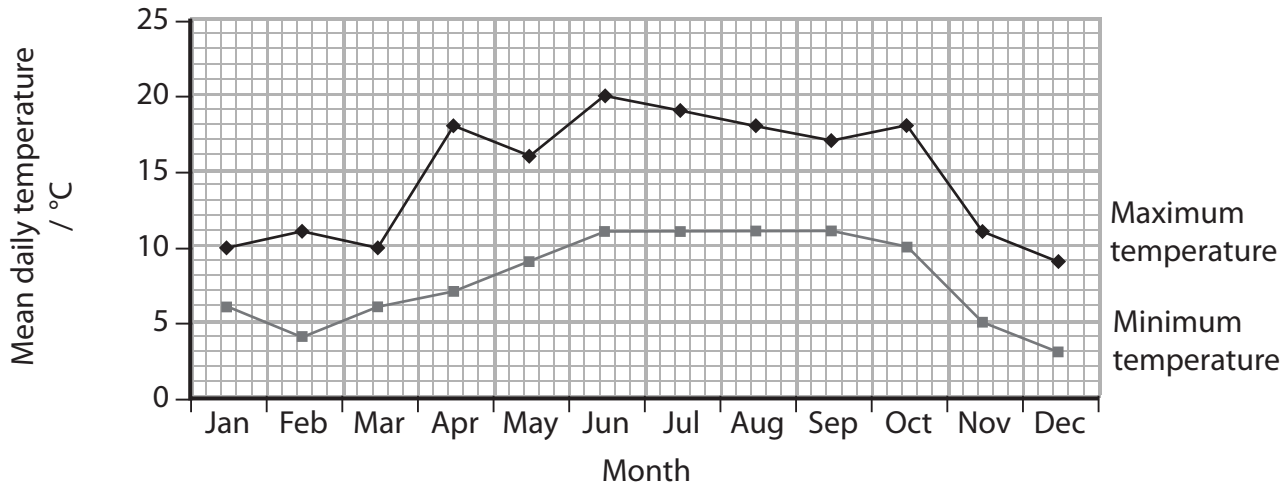
(Total for Question 5 = 10 marks)

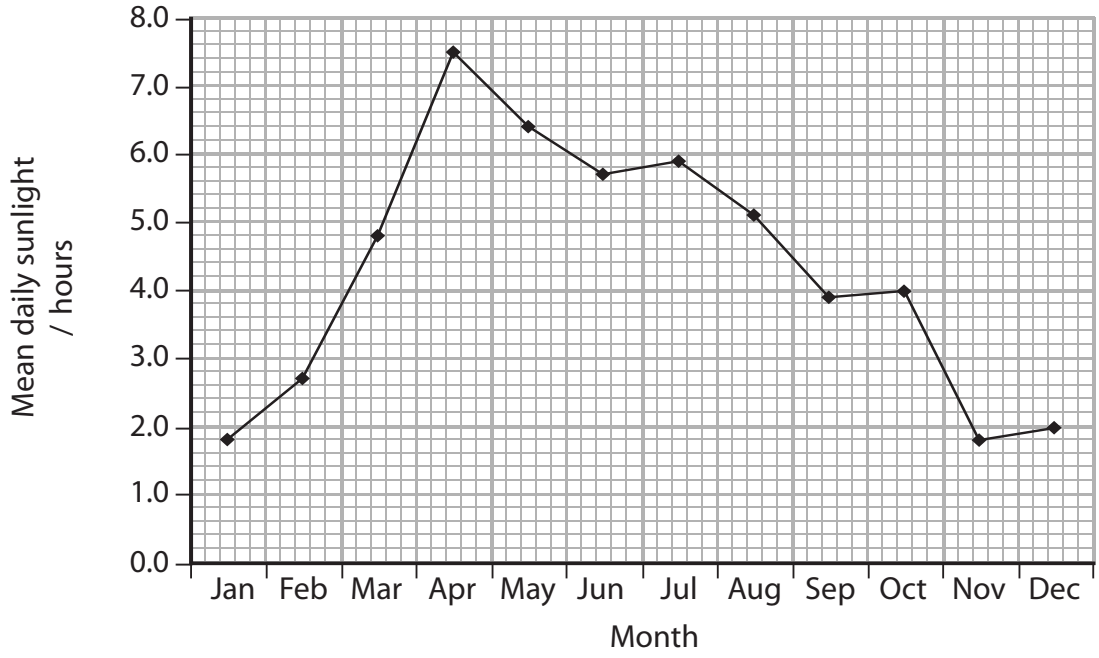
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6 The graphs below show data collected at a weather station in North Wales during 2007.

The monthly means of net primary productivity (NPP), daily maximum and minimum temperatures and sunlight hours are shown for grassland at this weather station.







P 3 9 5 0 5 R.CA.UK 1 6 2 4

(a) (i) Explain what is meant by the term **net primary productivity**.

(2)

(ii) Calculate the overall percentage increase in the mean NPP from January to May.

(3)

Answer ..... %

(b) Suggest why an increase in temperature may cause an increase in NPP.

(2)

P 3 9 5 0 5 R A 0 1 7 2 4
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(c) Using information from the graphs, describe and explain the relative effects of temperature and hours of sunlight on NPP in this grassland.

(4)

(d) Temperature and hours of sunlight are abiotic factors.
Suggest **two** biotic factors that may influence NPP in this grassland.

(2)

(Total for Question 6 = 13 marks)

P 3 9 5 0 5 R A 0 1 8 2 4
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P 3 9 5 0 5 R A 0 1 9 2 4
S I E M U P . C O . U K

7 Infection with human immunodeficiency virus (HIV) can lead to the condition known as AIDS. In this condition, part of the immune system is destroyed.

(a) The genetic material in HIV consists of two strands of RNA.

Place a cross ☒ in the box next to the term used to describe each of the sub-units in a molecule of RNA.

(1)

☒ **A** amino acid

☒ **B** inorganic phosphate

☒ **C** nucleotide

☒ **D** saccharide

(b) (i) Name **two** types of cell that HIV enters in the immune system.

(2)

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(ii) Explain how HIV is able to enter these cells.

(3)

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P 3 9 5 0 6 R A 0 1 0 2 0 2 4
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(iii) Describe the sequence of events following infection of these cells by HIV, that may lead to the death of the patient.

(6)

(Total for Question 7 = 12 marks)

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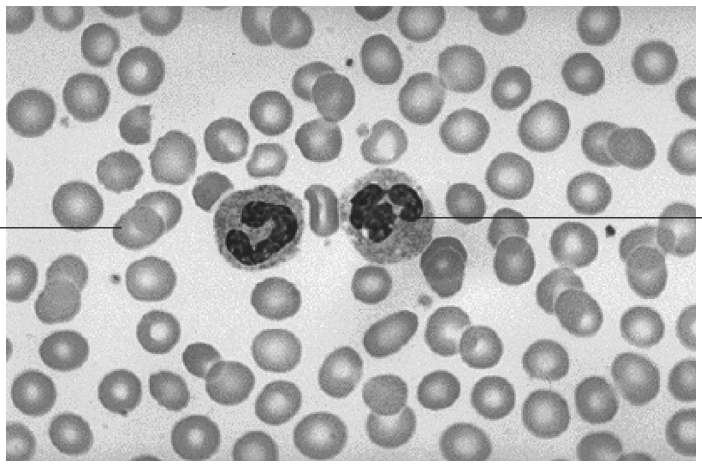
8 (a) The table below describes some features of the lymphocytes that are involved in the immune system.

Place a tick (✓) in the appropriate column to indicate whether the description is true or false.

(4)

Description	True	False
B and T cells are formed in the bone marrow		
B cells stimulate T cells to produce clones of memory cells		
T helper cells produce chemicals that destroy pathogens		
B and T cells are able to form clones by mitosis		

(b) A sample of blood was taken from a person with a bacterial infection.
The photograph below shows some of the cells in this blood sample.



Suggest **two** reasons why the bacteria that caused the infection are not visible in the photograph.

(2)

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P 3 9 5 0 5 R A 0 2 2 2 4
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(c) Suggest how a further sample of blood, taken a few days later, might differ from the one shown in the photograph, in each of the following circumstances. Give a reason for each answer.

(i) If the person is treated with antibiotic drugs.

(2)

(ii) If the person is given a placebo.

(2)

(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)

January 2012

GCE Biology (6BI04) Paper 01
The Natural Environment and Species Survival

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GENERAL INFORMATION

The following symbols are used in the mark schemes for all questions:

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point
Eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting
/ oblique	Words or phrases separated by an oblique are alternatives to each other
{} curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point
[] square brackets	Words inside square brackets are instructions or guidance for examiners
[CE] or [TE]	Consecutive error / transferred error

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.

No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous
  e.g. for amylase, 'ammalase' is acceptable whereas 'amylose' is not
  e.g. for glycogen, 'glicojen' is acceptable whereas 'glucagen' is not
  e.g. for ileum, 'illeum' is acceptable whereas 'ilium' is not
  e.g. for mitosis, 'mytosis' is acceptable whereas 'meitosis' is not

- candidates must make their meaning clear to the examiner to gain the mark.

- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark – irrelevant material should be ignored

Question Number	Answer	Mark
1(a)	Substance X = (DNA)primer(s) ; Substance Y = (mono)nucleotide(s) ; Substance Z = DNA strand(s) ;	**(3)**

Question Number	Answer	Mark
1(b)(i)	A ;	**(1)**

Question Number	Answer	Mark
1(b)(ii)	C ;	**(1)**

Question Number	Answer	Mark
1(b)(iii)	B ;	**(1)**

Question Number	Answer	Mark
1(c)(i)	1. Idea that human enzymes will not work at {high / these/ above 37°C eq} ; 2. reference to {denaturation /change in shape of active site}(at temperatures in PCR) ;	**(2)**

Question Number	Answer	Mark
1(c)(ii)	1. (xylem / wood) made of dead material / has no {living material / cytoplasm / cell contents / nuclei / mitochondria} / eq ; 2. no {DNA / nucleic acid} present / eq ;	**(2)**

Question Number	Answer	Mark
2(a)(i)	C ;	**(1)**

Question Number	Answer	Mark
2(a)(ii)	B ;	**(1)**

Question Number	Answer	Mark
2(a)(iii)	C ;	**(1)**

Question Number	Answer	Mark
2(b)	ACCEPT any mark point from a clearly annotated diagram 1. reference to {granum / grana} ; 2. reference to (a granum is) a stack of {thylakoids / membranes} OR grana are connected by lamellae ; 3. reference to (thylakoids contain) {electron carriers / eq} / chlorophyll / photosystems ; 4. reference to (membranes contain) {ATPase / ATPase channel} ; 5. idea that {electron carriers / ATPase /eq} are associated with {thylakoid / thylakoid membranes} ;	**(3)**

Question Number	Answer	Mark
2(c)	1. GALP is a 3C molecule / eq ; 2. reference to formation of {glucose / hexose/ 6C sugar} (from GALP) ; 3. idea of enzymes involved in the synthesis of {glucose / cellulose} ; 4. idea that cellulose consists of {ß-glucose / beta glucose } ; 5. joined by glycosidic bonds / eq; 6. reference to 1-4 (bonds) ; 7. reference to condensation reactions (between glucoses) ; 8. idea that cellulose is a long chain molecule e.g. polysaccharide, polymer ; 9. {unbranched / eq} molecule ;	**(5)**

Question Number	Answer	Mark
3(a)	B ;	**(1)**

Question Number	Answer	Mark
3(b)	1. {no / little / eq} change in pre-monsoon temperature, post-monsoon has risen / eq ; 2. idea that both {fluctuate / eq } ; 3. idea that {fluctuations / eq} match each other ; 4. reference to {fluctuations / changes} {within / less than / eq} 1°C ; 5. reference to a particular change in both e.g. both decreased between 1800 to 1850 ; 6. Credit correct manipulation of figures to compare pre-monsoon and post-monsoon changes units needed ; 7. idea that the range of (mean) temperatures is greater OR greater fluctuations, in post-monsoon period ;	**(3)**

Question Number	Answer	Mark
3(c)(i)	1. idea of {extrapolating / eq} data ; 2. idea of use for {modelling / investigation of correlations} ; 3. idea of providing evidence for global warming ; 4. idea of using this data along with data from other sources ;	**(3)**

Question Number	Answer	Mark
3(c)(ii)	1. Idea that there is not enough data ; 2. idea that data has only been collected from Nepal ; 3. reference to {no way of confirming data / no proof / not reliable} ; 4. idea of { fluctuations too great / no real trend} ; 5. idea that means are a poor representation of raw data ; 6. reference to {scatter / spread / eq} (of raw data) is indicator of reliability ; 7. idea that method of estimated temperature from growth rings is questionable / eq ; 8. other environmental changes (affecting trees)not taken into account / eq ;	**(3)**

Question Number	Answer	Mark
3(d)	Any **one** from: 1. (estimates of) carbon dioxide levels (in air) 2. (pollen) from peat 3. temperature records ;	**(1)**

Question Number	Answer	Mark
4(a)	A ;	**(1)**

Question Number	Answer	Mark
***4(b) QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea of *geographical isolation e.g. physical barrier* between Corsican and mainland birds / *allopatric speciation* ; 2. idea that there are different *selection pressures* (between Corsica and the mainland) ; 3. an example of selection pressure e.g. food source, different habitats ; 4. idea that *mutations* occurred ; 5. Idea that this results in *adaptation* to the conditions **;** 6. these {*alleles /genes*} passed on (to *offspring*); 7. idea of change in *gene pool* e.g. increasing *frequency* of (these) *alleles,* changes in *gene pool* ; 8. reference to *reproductive isolation* (of Corsican nuthatches from mainland nuthatches) ; 9. idea that birds on mainland could live in all regions as there is no restriction on *gene flow* ;	**(5)**

Question Number	Answer	Mark
4(c)(i)	ACCEPT the converse in the context of *S. europaea*, if clearly expressed 1. reference to *S. whiteheadi* adapted to {colder / mountainous} regions ; 2. (if climate warms) {food supply / pine seeds / invertebrates} less available ; 3. idea of {small population / only 2500 pairs} (of *S whiteheadi*) ; 4. idea of limited {gene pool / genetic diversity / variety of alleles} ; 5. idea that all the *S. whiteheadi* will be adversely affected ; 6. idea that the *S. whiteheadi* cannot fly to other regions ;	**(3)**

Question Number	Answer	Mark
4(c)(ii)	1. idea that S. whiteheadi have a variety of food sources e.g. can change their feeding habits, eat seeds and invertebrates} ; 2. idea that {more / different} {invertebrates /seeds / food / eq} might become available ; 3. idea that they have another allele that gives a survival advantage ; 4. idea that they could migrate (NOT south, somewhere warmer) ;	**(2)**

Question Number	Answer	Mark
4(d)	1. idea of captive-breeding programmes ; 2. reference to {conserve / preserve / eq} {alleles /genes / gene pools} ; 3. reference to {re-introduction / releasing of S. *whiteheadi* into suitable habitats} ;	**(2)**

Question Number	Answer	Mark
5(a)	<table><tr><th>Feature</th><th>Bacteria only</th><th>Viruses only</th><th>Both bacteria and viruses</th></tr><tr><td>Nucleic acid</td><td></td><td></td><td>✓</td></tr><tr><td>Cytoplasm</td><td>✓</td><td></td><td></td></tr><tr><td>Protein capsid</td><td></td><td>✓</td><td></td></tr></table> 1 mark each correct row ;;;	**(3)**

Question Number	Answer	Mark
5(b)(i)	1. idea of (SCAG is) caused by {a bacterium / bacteria} ; 2. antibiotics {kill / stop reproduction / eq} of bacteria / are {bactericidal / bacteriostatic} ;	**(2)**

Question Number	Answer	Mark
***5(b)(ii) QWC**	Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. as age increases, acid secretion decreases / eq ; 2. as age increases (above 30) , stomach cancer increase / eq ; 3. as acid secretion decreases (below 120), stomach cancers increases / eq ; 4. idea that the {higher age groups (51+) have low acid and high cancer / lower age groups (up to 30) have high acid and low cancer} ; 5. Idea of {acid / low pH} (in stomach) kills {bacteria / *Helicobacter}* ; 6. reference to development of SCAG {inhibited / prevented / eq} (by low pH / more stomach acid) ; 7. idea of age affects the immune system ; 8. idea that the older you are acid-producing cells are less effective e.g. fewer acid-producing cells / cancer cells replace the acid-producing cells ; 9. idea that {acid / low pH} destroys cancer cells ; 10. idea that mutations (leading to cancer) more likely to occur with age ;	**(5)**

Question Number	Answer	Mark
6(a)(i)	1. (rate of) {production of / energy incorporated into / eq} {biomass / organic material / organic molecules / tissue} ; 2. reference to {losses in respiration / GPP- R } ; 3. in {producers / plants / eq } ;	**(2)**

Question Number	Answer	Mark
6(a)(ii)	1. correct readings from graph indicated e.g. (11 and 1) ; 2. correct subtraction e.g. (11-1 / 10) ; 3. correct division (by 1) x 100/1 to give 1000% ; [correct answer = 3 marks]	**(3)**

Question Number	Answer	Mark
6(b)	1. idea that the rate of {(bio)chemical / metabolic / photosynthetic / named} reactions increases ; 2. idea of increase in {movement / kinetic energy} of {enzyme / substrate / molecules / particles} / eq ; 3. idea of (increase in reaction rate) because of more enzyme substrate interaction ;	**(2)**

Question Number	Answer	Mark
6(c)	1. (between January and April) NPP increases as light increases ; 2. idea of a correlation between NPP and light ; 3. idea that the changes in NPP are occurring after the changes in light / peak light is April and peak NPP is May ; 4. reference to increase in light increases {(rate of) photosynthesis / (ATP) energy available for Calvin Cycle / eq} ; 5. credit correct details of photosynthesis e.g. light results in excitation of electrons ; 6. idea that there is no real correlation between temperature and NPP / reference to temperature fluctuating ; 7. idea that the temperature affects how quickly enzymes work ; 8. reference to NPP falling (from May) but temperature remaining high ; 9. reference to (light / temperature) limiting factor ;	**(4)**

Question Number	Answer	Mark
6(d)	Any **two** biotic factors e.g. 1. grazing / {consumers / herbivores / named herbivore} / eq ; 2. trampling / eq ; 3. shading by {plants / named plant} / eq ; 4. competition from other plants / eq ; 5. disease / eq ;	**(2)**

Question Number	Answer	Mark
7(a)	C ;	**(1)**

Question Number	Answer	Mark
7(b)(i)	1. {T helper / CD4 (positive)} (cell / lymphocytes) ; 2. phagocytic cells e.g. macrophages, dendritic cell ;	**(2)**

Question Number	Answer	Mark
7(b)(ii)	1. reference to (HIV) binds to (CD4) receptors on cell (surface) ; 2. ref to CD4 (receptors on cells) ; 3. reference to {glycoprotein / gp120} on virus (surface) ; 4. reference to fusion of virus (envelope) with (cell surface) membrane ; 5. idea of phagocytosis (in macrophage / eq) ;	**(3)**

Question Number	Answer	Mark
7(b)(iii)	1. reference to viral RNA ; 2. reference to production of (viral) DNA (using viral RNA as a copy) ; 3. correct ref to reverse transcriptase ; 4. reference to incorporation of viral DNA into host cell's {DNA /genome } / reference to provirus / eq ; 5. correct ref to integrase ; 6. reference to production of {viruses / viral RNA and proteins} / eq ; 7. idea of infection of further (T helper) cells ; 8. reference to destruction of (T helper) cells by T killer cells OR reference to cell lysis / eq ; 9. reference to lowering of immunity ;(to other diseases ; 10. credit reference to role of T helper cells in immune response e.g. produce cytokines, activate B cells / killer cells ; 11. death is caused by e.g. opportunistic disease, pneumonia , TB, Kaposi's sarcoma, cancer, dementia, extreme weight loss, meningitis, toxoplasmosis ;	**(6)**

Question Number	Answer	Mark
8(a)	<table><tr><th>Description</th><th>True</th><th>False</th></tr><tr><td>B and T cells are formed in the bone marrow</td><td>✓</td><td></td></tr><tr><td>B cells stimulate T cells to produce clones of memory cells</td><td></td><td>✓</td></tr><tr><td>T helper cells produce chemicals that destroy pathogens</td><td></td><td>✓</td></tr><tr><td>B and T cells are able to form clones by mitosis</td><td>✓</td><td></td></tr></table> 1 mark each correct row ;;;;	**(4)**

Question Number	Answer	Mark
8(b)	1. (bacteria are) too small / reference to limitation of {magnification / resolution} ; 2. (bacteria) not stained ; 3. idea of bacteria already {removed / destroyed} e.g. phagocytosis ; 4. idea that bacteria are not present in the blood e.g. only a small {region / sample} shown, reference to local infection ;	**(2)**

Question Number	Answer	Mark
8(c)(i)	Either: 1. idea of fewer {lymphocytes / eq} ; 2. reference to {lymphocytes / eq} no longer needed / eq ; 3. (as) {antibiotics / drugs} {kill / destroy / eq} bacteria ; Or: 4. more {lymphocytes / eq} ; 5. idea of clonal expansion (of lymphocytes) / eq ; 6. idea that the antibiotics have not killed all the bacteria yet ;	**(2)**

Question Number	Answer	Mark
8(c)(ii)	1. idea that a placebo has no effect ; 2. (therefore there will be) more bacteria / eq ; 3. (therefore there will be) more {lymphocytes / eq} ; 4. (more lymphocytes due to) clonal expansion / eq ;	**(2)**

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced

Unit 4: The Natural Environment and Species Survival

Monday 13 June 2011 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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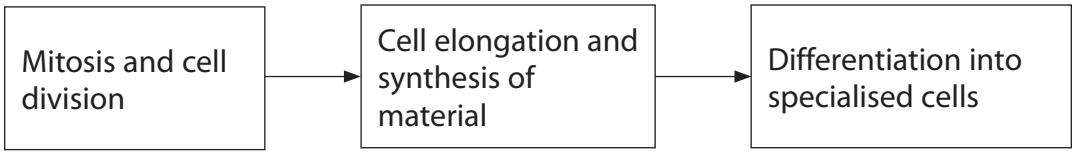
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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Plant growth involves mitosis, cell division and cell differentiation and is influenced by environmental factors such as temperature.

(a) The diagram below shows the stages in the growth of a root in a plant seedling.



(i) Place a cross ☒ in the box next to the correct sequence of stages in mitosis.

(1)

☒ **A** Metaphase, anaphase, prophase, telophase

☒ **B** Prophase, anaphase, metaphase, telophase

☒ **C** Prophase, metaphase, anaphase, telophase

☒ **D** Telophase, metaphase, anaphase, prophase

(ii) Place a cross ☒ in the box next to the material that would be synthesised to form the cell wall of the seedlings.

(1)

☒ **A** Cellulose

☒ **B** Cholesterol

☒ **C** Glycogen

☒ **D** Thrombin

(iii) Place a cross ☒ in the box next to the tissue that would form the vessels in a root, following differentiation.

(1)

☒ **A** Chorion

☒ **B** Endothelium

☒ **C** Sclerenchyma

☒ **D** Xylem

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(b) A student carried out an investigation into the effect of temperature on the growth of plant seedlings. The two species that she chose for the study were sea plantain, *Plantago maritima* and bog sedge, *Kobresia simpliciuscula*.

Sets of seeds from each of these species of plant were germinated at 18 °C. As soon as they germinated, the seedlings were placed in three temperature-controlled rooms at 10 °C, 14 °C and 18 °C. They were allowed to grow for 50 days. Samples of seedlings were taken at 5-day intervals and their mean dry masses were recorded.

The results of this investigation are shown in the tables below.

Table 1 – Sea plantain

Day	Mean dry mass / mg		
	10 °C	14 °C	18 °C
5	2	2	2
10	3	4	6
15	4	6	12
20	7	12	20
25	10	19	34
30	13	25	47
35	17	31	85
40	20	40	109
45	24	55	164
50	28	80	210

Table 2 – Bog sedge

Day	Mean dry mass / mg		
	10 °C	14 °C	18 °C
5	1	1	1
10	1	1	1
15	1	2	2
20	1	2	2
25	2	2	3
30	2	3	5
35	2	4	8
40	3	5	12
45	4	6	16
50	5	7	22

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(i) Suggest how these results could be displayed in order to compare the effect of temperature on the growth of seedlings of these two species.

(3)

(ii) Suggest why all of the seeds were germinated at 18 °C before being placed in the temperature-controlled rooms.

(2)

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(iii) Use the data in the tables to suggest which of the two species is better adapted for growth at a wide range of latitudes (distance from the equator). Give reasons for your choice.

(4)

(Total for Question 1 = 12 marks)

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2 Many scientists think there is a link between global warming and increased levels of carbon dioxide and methane in the upper atmosphere. Most organisms are found in regions where the temperature range is between 0 °C and 40 °C at the Earth's surface.

(a) (i) Suggest why temperatures below 0 °C or above 40 °C would be unsuitable for most organisms.

(2)

(ii) Explain how this range of temperatures has been maintained by the presence of carbon dioxide and methane in the upper atmosphere.

(3)

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(iii) Place a tick (✓) in the box in each row to indicate whether each technique could provide evidence of climate change having occurred in the past.

(2)

Technique	Could provide evidence	Would not provide evidence
Amniocentesis		
Dendrochronology		
Peat-bog pollen analysis		
Potassium-argon dating		

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*(b) It has been suggested that a reduction in the use of fossil fuels is necessary if further global warming is to be prevented. Some scientists disagree with this suggestion.

Suggest why these scientists do not agree that a reduction in the use of fossil fuels will prevent further global warming.

(6)

(Total for Question 2 = 13 marks)

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3 Following the extraction of coal from the ground in the United Kingdom, the unwanted material was usually deposited in large heaps known as bings. Most of the material in a bing is shale fragments composed of minerals and clay.

There have been a number of studies of the colonisation and the development of plant communities on bings. In these studies, the approximate age of the bing can be estimated by reference to the type of plant community growing on the bing. This is shown in the table below.

Type of plant community	Approximate age of bing / years
Lichens and mosses	3 – 15
Grasses and small herbs	15 – 40
Grasses, small herbs and large herbs	40 – 70
Small trees and shrubs	60 – 80
Large trees, small trees and shrubs	80 – more than 100

(a) Place a cross ☒ in the box next to the mineral ion that would need to be present if plants, such as grasses and herbs, are to grow successfully on a bing.

(1)

☒ **A** Copper

☒ **B** Nitrates

☒ **C** Sodium

☒ **D** Sulphites

(b) Place a cross ☒ in the box that describes the gradual change in the type of plant community growing on a bing.

(1)

☒ **A** Endemism

☒ **B** Evolution

☒ **C** Phylogeny

☒ **D** Succession

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*(c) With reference to the information in the table, suggest why the type of plant community growing on a bing changes over time.

(5)

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(d) After 100 years, the community on a bing becomes stable.
State the term used to describe this type of community and explain why it is stable.

(4)

(Total for Question 3 = 11 marks)

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4 Muscle contraction in mammals involves two fibrous proteins, actin and myosin. These slide over each other to reduce the length of the muscle.

(a) State **two** differences between fibrous proteins, such as actin and myosin, and globular proteins, such as enzymes.

(2)

1 .....

.....

2 .....

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(b) During the first few hours after the death of a mammal, the muscles undergo a characteristic contraction known as rigor mortis.

(i) Place a cross ☒ in the box next to the factor that might influence the rate of progress of rigor mortis in a muscle immediately after death.

(1)

☒ **A** Degree of decomposition of the muscle

☒ **B** Oxygen concentration of the atmosphere

☒ **C** Presence of drugs in the body

☒ **D** Presence of egg laying insects

(ii) Suggest **two** environmental factors that influence the rate of progress of rigor mortis in a muscle immediately after death.

(2)

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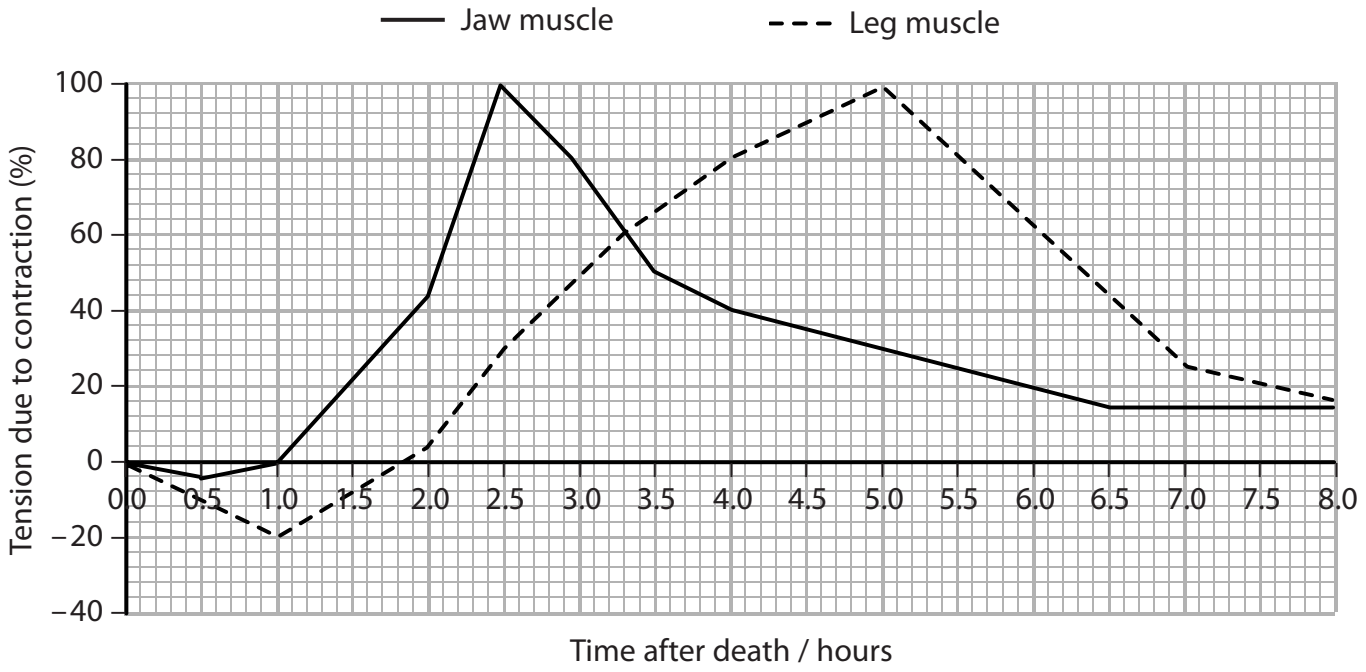
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(c) In an investigation of rigor mortis in rats, the tension due to contraction was measured in leg muscles and jaw muscles at intervals of 30 minutes after death. The tension was recorded as a percentage of the normal full contraction of each muscle in the live animal.

The graph below shows the results of this investigation.



Using the data in the graph, suggest why a forensic scientist would need to consider rigor mortis in several muscles of a body when estimating the time of death.

(4)

(Total for Question 4 = 9 marks)

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5 The skin has an important role in protecting the body from infection by pathogenic bacteria. Human skin has a community of microorganisms, called the skin flora, living on it. Most of these microorganisms are harmless bacteria that feed on dead skin cells and secretions.

(a) (i) State **two** ways in which the skin flora can help to protect a person from infection by pathogenic bacteria.

(2)

1 .....

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2 .....

.....

(ii) Place a cross ☒ next to the part of the skin that forms a physical barrier against infection by pathogenic bacteria.

(1)

☒ **A** Epidermis

☒ **B** Erector pili

☒ **C** Malpighian layer

☒ **D** Sebaceous gland

(b) Influenza (flu) is caused by a virus.
Sometimes antibiotics are used as part of the treatment for a person with influenza.

Suggest why antibiotics may be used as part of the treatment for influenza.

(2)

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(c) The overuse of antibiotics is causing concern.
The table below shows the number of prescriptions for antibiotics per 10 000 population in the USA, given during treatment for influenza, from 2000 to 2006.

Year	Number of prescriptions per 10 000 population
2000	226
2002	164
2004	172
2006	142

(i) Calculate the overall percentage reduction in the number of prescriptions per 10 000 population in the USA from 2000 to 2006.
Show your working.

(2)

Answer ..... %

(ii) The target set by health authorities in the USA for the number of prescriptions per 10 000 population by 2012 is 128, an overall reduction of 43.4% since 2000.

Suggest whether this target will be achieved.
Give an explanation for your answer.

(3)

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(iii) Suggest why health authorities in the USA are encouraging the reduction in the number of prescriptions of antibiotics.

(2)

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(Total for Question 5 = 12 marks)

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6 Osteocalcin is a structural protein found in the bones of mammals.
The sequence of the amino acids in osteocalcin can be determined using mass spectrometry.

The sequences of the first 20 amino acids in the primary structure of osteocalcin from the bones of humans and some apes are shown in the table below.
Each amino acid is represented by a capital letter.

Mammal	Amino acid number																			
	1				**5**					**10**					**15**					**20**
Human	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Chimpanzee	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Orang utan	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	K	R
Gorilla	Y	L	Y	Q	W	L	G	A	O	V	P	Y	P	D	P	L	E	P	K	R

(a) Place a cross ☒ next to the most appropriate answer that completes each of the following statements about these sequences of amino acids.

(i) The number of nucleotides in the gene for osteocalcin production used for each of these sequences is

(1)

☒ **A** 20

☒ **B** 40

☒ **C** 60

☒ **D** 80

(ii) The type of bond that links the amino acids in the primary structure of osteocalcin is

(1)

☒ **A** disulphide

☒ **B** hydrogen

☒ **C** ionic

☒ **D** peptide

(iii) The structure in which the amino acids in the primary structure of osteocalcin would be linked together is a

(1)

☒ **A** centriole

☒ **B** lysosome

☒ **C** nucleolus

☒ **D** ribosome

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(b) (i) Using the data in the table, suggest with reasons what conclusions scientists might make about the ancestral relationships of humans and apes.

(4)

(ii) Suggest how DNA analysis could give further evidence for their conclusions.

(2)

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(iii) Describe how gel electrophoresis can be used to analyse DNA.

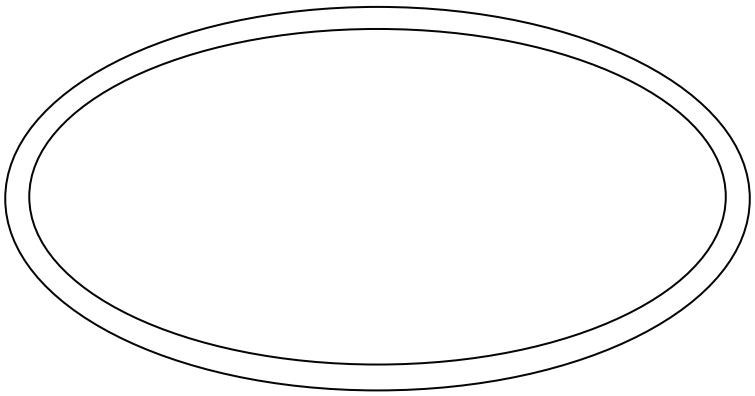
(3)

(Total for Question 6 = 12 marks)

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7 In seaweeds that are found on shores around Britain, photosynthesis occurs during the time that they are submerged at high tide. Seaweeds found near the top of the shore are submerged for short periods in shallow water. Seaweeds found lower down the shore are submerged for longer periods in deeper water.

(a) The diagram below shows the double-membrane envelope of a chloroplast.



(i) Complete the diagram to show the structures involved in the light-dependent reactions of photosynthesis. Label these structures.

(2)

(ii) The table below shows two statements taken from a student's essay about the light-dependent reactions of photosynthesis.
Complete the following table by placing a tick (✓) in the correct column next to each statement to show whether it is true or false.

(2)

Statement	True	False
Electrons in chlorophyll are excited as light energy is absorbed		
The energy absorbed by chlorophyll is used to generate ADP and NADP		

(iii) Explain how oxygen is produced during the light-dependent reactions of photosynthesis.

(2)

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(b) As light penetrates deeper water, red, orange and yellow wavelengths are absorbed by the seawater, whereas in shallow water most wavelengths penetrate.

The table below shows the relative rates of photosynthesis in a green seaweed, *Ulva lactuca*, and a red seaweed, *Schizymenia dubyi*, at different wavelengths of light.
The relative rates of photosynthesis are compared with the rate in light with a wavelength of 660 nm (red).

Seaweed	**Relative rate of photosynthesis / arbitrary units**		
	430 nm (blue)	**540 nm (green)**	**660 nm (red)**
Ulva lactuca	0.94	0.17	1.0
Schizymenia dubyi	0.38	3.40	1.0

(i) Using the data in the table, suggest where each of these two seaweeds is most likely to be found on a seashore. Place a tick (✓) in the most appropriate box in each column.

(2)

Position on shore	***Ulva lactuca***	***Schizymenia dubyi***
Top of the shore		
Middle of the shore		
Lower down the shore		
All regions		

(ii) Give reasons for your answers.

(4)

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(Total for Question 7 = 12 marks)

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8 Human immunodeficiency virus (HIV) causes the condition known as acquired immunodeficiency syndrome (AIDS) in humans.

(a) Complete the following table by placing a tick (✓) in the correct column next to each statement to show whether it is true or false.

(3)

Statement	True	False
HIV infects b-lymphocytes in the human immune system		
The genetic material in HIV is a form of RNA		
The enzyme, reverse transcriptase, is used by HIV		

(b) Following infection by HIV, the genetic material will be copied as the virus reproduces. A single virus reproduces at a very fast rate giving rise to billions of viruses in just one day.

During reproduction of HIV, many genetic mutations are produced. This means that many new strains of HIV can develop quickly within an infected person.

(i) Explain what is meant by the term **genetic mutation**.

(2)

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(ii) Suggest why effective treatment of HIV in human populations will require the continual development of a mixture of many new drugs.

(4)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)

June 2011

GCE Biology (6BI04) Paper 01
The Natural Environment and Species Survival

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

- Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

GENERAL INFORMATION

The following symbols are used in the mark schemes for all questions:

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point
Eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting
/ oblique	Words or phrases separated by an oblique are alternatives to each other
{} curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point
[] square brackets	Words inside square brackets are instructions or guidance for examiners
[CE] or [TE]	Consecutive error / transferred error

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.
No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous
  e.g. for amylase, 'ammalase' is acceptable whereas 'amylose' is not
  e.g. for glycogen, 'glicojen' is acceptable whereas 'glucagen' is not
  e.g. for ileum, 'illeum' is acceptable whereas 'ilium' is not
  e.g. for mitosis, 'mytosis' is acceptable whereas 'meitosis' is not

- candidates must make their meaning clear to the examiner to gain the mark.

- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark – irrelevant material should be ignored

Question Number	Answer	Mark
1(a)(i)	C ;	**(1)**

Question Number	Answer	Mark
1(a)(ii)	A ;	**(1)**

Question Number	Answer	Mark
1(a)(iii)	D ;	**(1)**

Question Number	Answer	Mark
1(b)(i)	1. reference to graph ; 2. line (graph) / eq ; 3. {Y / vertical} and {X / horizontal} axes correctly described. e.g. mass versus time / rate versus temperature ; 4. idea of using same scale for axes (for both plants) ; 5. idea of plotting each {temperature / species (plant)} separately ;	**(3)**

Question Number	Answer	Mark
1(b)(ii)	1. idea of controlling a variable ; 2. reference to {optimum / suitable / eq} temperature (for germination) ; 3. idea of using {viable / live / eq} seedlings OR making sure that seeds {germinate / eq} ; 4. reference to validity of the investigation ;	**(2)**

Question Number	Answer	Mark
1(b)(iii)	1. sea plantain / *Plantago maritima* / *Plantago* ; Any **three** from: 2. idea of different latitudes have different (mean) temperatures ; 3. {sea plantain / *Plantago maritima* / *Plantago*} grows {better / eq} at all (three) temperatures / eq ; 4. {bog sedge / *Kobresia simpliciuscula*/ *Kobresia*} does not grow very well at {lower temperatures / 10°C and 14°C} / eq ; 5. credit appropriate comparative manipulated figures ;	**(4)**

Question Number	Answer	Mark
2(a)(i)	1. reference to {metabolism / named example / eq} {stops / is slow / eq} ; (below 0°C) 2. enzymes are inactive / cells disrupted / eq ; 3. reference to cause of {inactivity / cell disruption} e.g. water freezes, lower kinetic energy ; (above 40°C) 4. enzymes {denature / change 3D shape / eq} ; 5. reference to consequences of denaturation e.g. fewer enzyme-substrate complexes possible, change in active site, change in bonding ;	**(2)**

Question Number	Answer	Mark
2(a)(ii)	1. (carbon dioxide and / or methane) are greenhouse gases / eq ; 2. which {absorb / trap / eq} {heat / infra red / IR / long wave} (radiation) / eq ; 3. {reflected / (re)radiated} from the Earth's surface / eq ; 4. prevent {heat / infra red / IR / long wave / eq} (radiation) escaping ; 5. idea of temperatures maintained higher (than they would be) ;	**(3)**

Question Number	Answer	Mark
2(a)(iii)		**(2)**

Technique	Could provide evidence	Would not provide evidence
Amniocentesis		✓
Dendrochronology	✓	
Peat-bog pollen analysis	✓	
Potassium-argon dating		✓

Question Number	Answer	Mark
*** 2(b) QWC**	(QWC – Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. carbon dioxide produced {by using / in production of / eq} fossil fuels / eq ; 2. no (direct) evidence that increased carbon dioxide leads to global warming / eq ; 3. reference to carbon dioxide released from {other processes / named process} ; 4. idea of removal of {carbon sinks / named example / eq} (also) leads to increase in carbon dioxide ; 5. stated example of any other greenhouse gas released from another source e.g. CFC, water vapour, methane ; 6. description of source e.g. ruminant animals, paddy fields, melting ice, clearance of peat land ; 7. idea of natural {cycles / events / phenomena / eq} may be involved (in global warming) e.g. solar, volcanoes ; 8. idea of evidence from past is being used ; 9. idea of {(past evidence) is not in indicator of future events / limitations of (climatic) models} ; 10. idea that scientists may be biased ; 11. description of bias e.g. employed by {company / country} with vested interest, self promotion ; 12. specific example of problem with / disadvantage of} alternative source of energy ;	**(6)**

Question Number	Answer	Mark
3(a)	B ;	**(1)**

Question Number	Answer	Mark
3(b)	D ;	**(1)**

Question Number	Answer	Mark
***3(c) QWC**	(QWC – Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) succession described: 1. reference to lichens and mosses as <u>pioneer</u> community ; 2. able to grow in {little / no} soil / eq ; 3. (that) breaks up (rock) fragments / forms {thin / shallow / eq} soil; 4. reference to {plants / eq} with {small / short / eq} roots ; 5. (able to) grow in {thin / shallow / eq} soil / eq ; 6. idea that changes in soil structure enable {trees / shrubs} to grow / eq ; general points: 7. reference to soil able to {hold / retain / contain / eq} {water / minerals} ; 8. as plants {lose leaves / die / decay / eq} ; 9. reference to {organic matter / humus / eq} {increases / released / eq} ; 10. reference to competition effects ;	**(5)**

Question Number	Answer	Mark
3 (d)	1. climax (community) ; Any **three** from: 2. includes (both) animals and plants / has many species / has high biodiversity / eq ; 3. reference to {interaction / eq} between species / eq ; 4. idea of balanced equilibrium of species ; 5. reference to {dominant / codominant} (plant or animal) species ; 6. reference to stable if no {change to environment / human influence} ;	**(4)**

Question Number	Answer	Mark
4(a)	1. fibrous – long / linear / straight (chains), globular – compact / spherical / eq ; 2. globular are folded and fibrous are not / eq ; 3. globular are soluble and fibrous are not / eq ; 4. fibrous –involved in {structural / eq} and globular are not ; 5. globular – involved in {catalysis / metabolism / eq} and fibrous are not ;	**(2)**

Question Number	Answer	Mark
4(b)(i)	C ;	**(1)**

Question Number	Answer	Mark
4(b)(ii)	Any **two** from: 1. physical damage / eq ; 2. immersion in water / eq ; 3. (external) temperature / eq ; 4. burning / eq ; 5. electrocution / eq ; 6. reference to {clothing / eq} ; 7. wind / air movements / eq ;	**(2)**

Question Number	Answer	Mark
4(c)	1. reference to not {all / both / eq} muscles {contract / relax / reach (full) rigor / eq} at same {time / rate / eq} ; 2. idea of jaw muscle contracting before leg muscle / eq ; 3. idea of jaw muscle reaches {full contraction / rigor} before leg muscle / eq ; 4. jaw starts contraction {0.5 / 0.8 / 0.9} hours before leg OR jaw reaches (full) rigor 2.5 hours before leg ; 5. reference to {full contraction / rigor} in muscle does not last very long ; 6. idea of leg is still contracting while jaw is relaxing / eq ;	**(4)**

Question Number	Answer	Mark
5(a)(i)	1. {competition / eq} for nutrients ; 2. {competition / eq} for space ; 3. {secretion / eq} {chemicals / substances / lysozyme / eq} OR affects {pH / eq} ; 4. {stimulation / eq} of (skin) immune system / eq ;	**(2)**

Question Number	Answer	Mark
5(a)(ii)	A ;	**(1)**

Question Number	Answer	Mark
5(b)	1. idea that influenza may allow development of other diseases e.g. opportunistic infections ; 2. antibiotics will {kill / inhibit growth of / eq} bacteria ;	**(2)**

Question Number	Answer	Mark
5(c)(i)	correct answer 37.2 / 37.17 / 37 (%) gains 2 marks 1. (226 – 142) / 84 ; 2. ÷ 226 to give 37.2 / 37.17 / 37 (%) ;	**(2)**

Question Number	Answer	Mark
5(c)(ii)	1. yes ; 2. idea that if current rate continues / eq ; 3. idea of achieving lower than the target / eq; 4. credit use of supporting figures ;	**(3)**

Question Number	Answer	Mark
5(c)(iii)	1. reference to some bacteria {can resist / are resistant to} antibiotics ; 2. idea of {resistance being genetic / can be passed on} ; 3. reference to MRSA / other named example ;	**(2)**

Question Number	Answer	Mark
6(a)(i)	C ;	**(1)**

Question Number	Answer	Mark
6(a)(ii)	D;	**(1)**

Question Number	Answer	Mark
6(a)(iii)	D ;	**(1)**

Question Number	Answer	Mark
6(b)(i)	1. humans more closely related to chimp (than to orang utan and gorilla) / eq ; 2. reference to humans and chimps more closely related to orang utan than gorilla ; 3. reference to similarity of sequence indicates closeness of ancestral relationship / eq ; 4. human and chimp sequence identical / eq ; 5. orang utan has one difference, gorilla has two differences / eq ; 6. reference to {number 19 for orang utan / number 9 and 19 for gorilla} different ;	**(4)**

Question Number	Answer	Mark
6(b)(ii)	1. reference to similarity (of DNA) indicates closeness of relationship ; 2. because genes are sections of DNA / eq ; 3. genes are the codes for protein / eq ;	**(2)**

Question Number	Answer	Mark
6(b)(iii)	1. reference to source of DNA sample, e.g. blood, saliva, semen ; 2. reference to small samples of DNA can be amplified by PCR ; 3. reference to use of (restriction / eq) enzymes to {break / eq} DNA ; 4. reference to use of {electro potential / potential difference / eq} ; 5. reference to {treatment / staining / eq} ; 6. show up as {bands / bars / eq} ; 7. reference to the {number of bands / eq} that match indicates similarity of the DNA ;	**(3)**

Question Number	Answer	Mark
7(a)(i)	1. drawing mark - recognisable {granum / grana} with clear stacks (of thylakoids / eq) shown / eq; 2. label mark - {granum / grana / thylakoids} labelled / eq ;	**(2)**

Question Number	Answer	Mark
7(a)(ii)	<table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>Electrons in chlorophyll are excited as light energy is absorbed</td><td>✓</td><td></td></tr><tr><td>The energy absorbed by chlorophyll is used to generate ADP and NADP</td><td></td><td>✓</td></tr></table> 1 mark each correct row ;;	**(2)**

Question Number	Answer	Mark
7(a)(iii)	1. reference to energy from light ; 2. reference to photolysis ; 3. of water ;	**(2)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>7(b)(i)</td><td>
<table>
<tr><th>Position on shore</th><th>Ulva lactuca</th><th>Schizymenia dubyi</th></tr>
<tr><td>Top of the shore</td><td>✓</td><td></td></tr>
<tr><td>Middle of the shore</td><td></td><td></td></tr>
<tr><td>Lower down the shore</td><td></td><td></td></tr>
<tr><td>All regions</td><td></td><td>✓</td></tr>
</table>
OR
<table>
<tr><th>Position on shore</th><th>Ulva lactuca</th><th>Schizymenia dubyi</th></tr>
<tr><td>Top of the shore</td><td></td><td></td></tr>
<tr><td>Middle of the shore</td><td></td><td></td></tr>
<tr><td>Lower down the shore</td><td></td><td></td></tr>
<tr><td>All regions</td><td>✓</td><td>✓</td></tr>
</table>
1 mark each correct column ;;
</td><td>(2)</td></tr>
</table>

Question Number	Answer	Mark
7(b)(ii)	general points: 1. idea of (rate of) growth is linked to (rate of) photosynthesis ; 2. idea of top of the shore is shallower water where most wavelengths are available / lower shore is deeper water where only green (and blue) available ; 3. idea that red weeds {reflect / do not absorb} red light OR green weeds {reflect / do not absorb} green light ; *Ulva lactuca* / green seaweed*:* 4. high(est) rates in {red / blue} light / eq / {very low / lowest} in green light ; 5. would grow well if {all / (blue and) red} light available ; *Schizymenia dubyi* / red seaweed: 6. high(est) rate in green light / eq ; 7. can grow where only green light available / any light available / eq ;	**(4)**

Question Number	Answer	Mark
8(a)	<table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>HIV infects b-lymphocytes in the human immune system</td><td></td><td>✓</td></tr><tr><td>The genetic material in HIV is a form of RNA</td><td>✓</td><td></td></tr><tr><td>The enzyme, reverse transcriptase, is used by HIV</td><td>✓</td><td></td></tr></table> 1 mark each correct row ;;;	**(3)**

Question Number	Answer	Mark
8(b)(i)	1. change in the {nucleotides / bases} / eq ; 2. in {RNA / DNA} / eq ; 3. which leads to change in the {sequence / eq} of amino acids in (primary structure of) a {polypeptide / protein} / eq ;	**(2)**

Question Number	Answer	Mark
8(b)(ii)	1. idea that HIV has {many / variety of / new / eq} {strains / types /antigens / protein coats / eq} (in infected person) ; 2. some strains {are / become} resistant to {an individual / a specific / a particular / eq} drug / eq ; 3. these would survive if (only one drug used) / eq ; 4. {mixture of drugs / eq } has more chance of getting rid of {all / more} (strains / types / eq) / eq ; 5. reference to drugs used together because of mutation ; 6. reference to rapid rate of mutation ; 7. reference to rapid rate of {multiplication / eq} of virus ;	**(4)**

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Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary

Unit 4: The Natural Environment and Species Survival

Wednesday 16 June 2010 – Morning
Time: 1 hour 30 minutes

Paper Reference
6BI04/01

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Forensic scientists use several different types of evidence to estimate the time of death of a body.

(a) Place a cross ☒ in the boxes next to the **two** types of evidence that could be used by a forensic scientist to estimate the time of death of a body.

(2)

☒ Degree of muscle contraction

☒ Length of fingernails

☒ Signs of decomposition

☒ Skin pigmentation

(b) The core temperature of a body can also be used to estimate the time of death. This can be recorded by measuring the temperature of the rectum.

The table below shows the mean core temperature, measured at 2-hour intervals after death, using data from a large number of bodies. The standard deviation from each of the means is also shown.

Time after death / hours	Mean core temperature / °C	Standard deviation from the mean / °C
2	36.7	0.9
4	36.0	1.1
6	35.3	1.3
8	31.3	1.5
10	29.6	1.7
12	28.1	2.0
14	26.7	2.3
16	25.5	2.6
18	25.0	2.9
20	23.6	3.1
22	22.8	3.3
24	22.3	3.4
26	21.8	3.4

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Explain what the data indicates about the reliability of using core temperature to estimate the time of death.

(4)

(c) Suggest **three** factors that could influence the rate at which a body cools after death.

(3)

1 .....

2 .....

3 .....

(Total for Question 1 = 9 marks)

N 3 7 0 9 5 A 0 3 2 4

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2 It has been estimated that only 5% of the light energy hitting the surface of a leaf reaches the chloroplasts to be used in the synthesis of organic material. The total energy used in this synthesis is known as the gross primary productivity (GPP).

(a) Suggest **two** reasons why 95% of the light hitting the surface of a leaf is not used by the chloroplasts.

(2)

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(b) The mean GPP for plants on Earth is 24.4×10^6 J m^{-2} $year^{-1}$.

The plants use 3.7×10^6 J m^{-2} $year^{-1}$ of this energy in metabolic processes. The energy in the remaining organic material is known as net primary productivity (NPP).

(i) Explain what is meant by the unit **J m^{-2} $year^{-1}$**.

(1)

.....

.....

(ii) Calculate the percentage of the mean GPP that remains as NPP within plants on Earth.
Show your working.

(2)

Answer..... %

N 3 7 0 9 5 A 0 4 2 4

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(iii) Place a cross ☒ in the box next to the metabolic process that best describes the process that accounts for most of the difference between GPP and NPP in plants.

(1)

☒ **A** Chemosynthesis

☒ **B** Respiration

☒ **C** Photosynthesis

☒ **D** Protein synthesis

*(c) With reference to the structures in a chloroplast, explain how the energy from light is made available in ATP molecules for the synthesis of organic materials.

(6)

(Total for Question 2 = 12 marks)

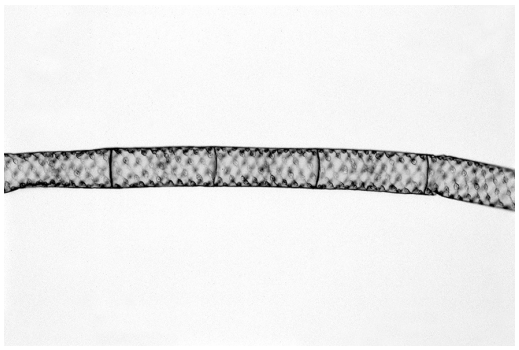
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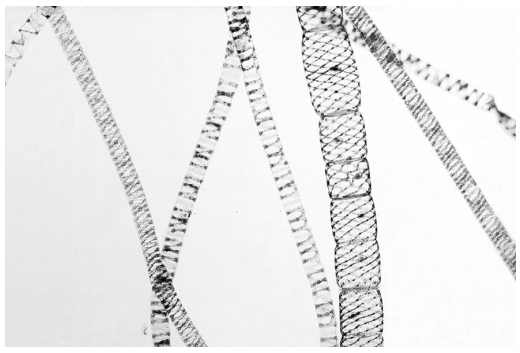
N 3 7 0 9 5 A 0 6 2 4

3 Filamentous algae are simple photosynthetic organisms that consist of long strands of very similar eukaryotic cells. Each of the cells in the strand is enclosed within a cellulose cell wall. The strand increases in length as the cells divide and elongate.

The photographs below show some cells in strands of a filamentous alga, as seen using a light microscope.



Magnification ×200



Magnification ×200

(a) (i) Put a cross ☒ in the box next to the term that describes the process involved in the cell divisions in a filamentous alga.

(1)

☒ **A** exocytosis

☒ **B** meiosis

☒ **C** mitosis

☒ **D** osmosis

(ii) Put a cross ☒ in the box next to the structure that would **not** be found in a cell from the strand of a filamentous alga.

(1)

☒ **A** lysosome

☒ **B** mitochondrion

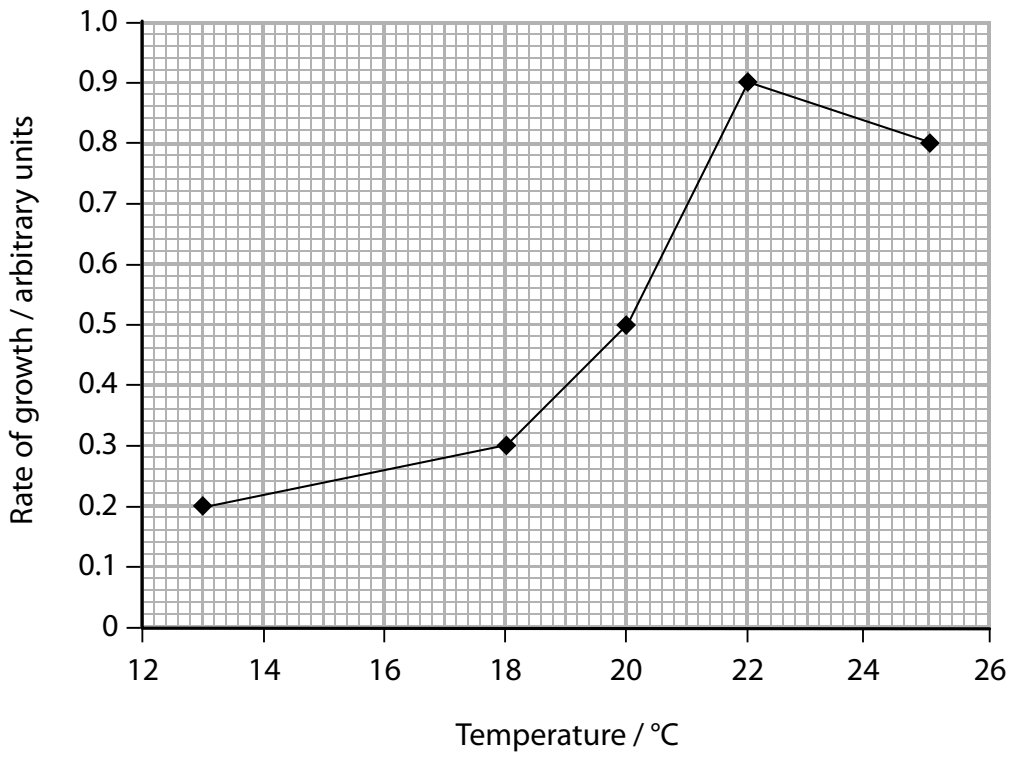
☒ **C** plasmid

☒ **D** ribosome

(b) An investigation was carried out into the effect of temperature on the rate of growth of a filamentous alga. Several short strands of the alga were placed into culture solutions which were kept at five different temperatures and at a high light intensity.

The number of cells in the strands, in each culture solution, was counted at the beginning of the time period and again after 18 days.
The rate of growth was then calculated.

The results of this investigation are shown in the graph below.



(i) Name the **independent** variable in this investigation.

(1)

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(ii) Using the information in the graph, describe and suggest explanations for the effect of temperature on the rate of growth of the filamentous alga.

(4)

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N 3 7 0 9 5 A 0 8 2 4

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(iii) Suggest why it was important that this investigation was carried out at a high light intensity.

(3)

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(iv) Suggest **two** abiotic factors, other than light intensity, that would need to be controlled in this investigation.

(2)

1 .....

2 .....

(Total for Question 3 = 12 marks)

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N 3 7 0 9 5 A 0 1 0 2 4

4 Various non-specific responses of the body are involved in resistance to bacterial infections.

(a) Histamine, interferon and lysozyme are three substances involved in non-specific responses to infection.

For each of the following statements, put a cross ☒ in the box next to the name of the substance involved.

(i) Enzyme released in secretions that break down the cell walls of bacteria.

(1)

☒ **A** Histamine

☒ **B** Interferon

☒ **C** Lysozyme

(ii) Inflammation caused by a chemical released by white cells in connective tissue.

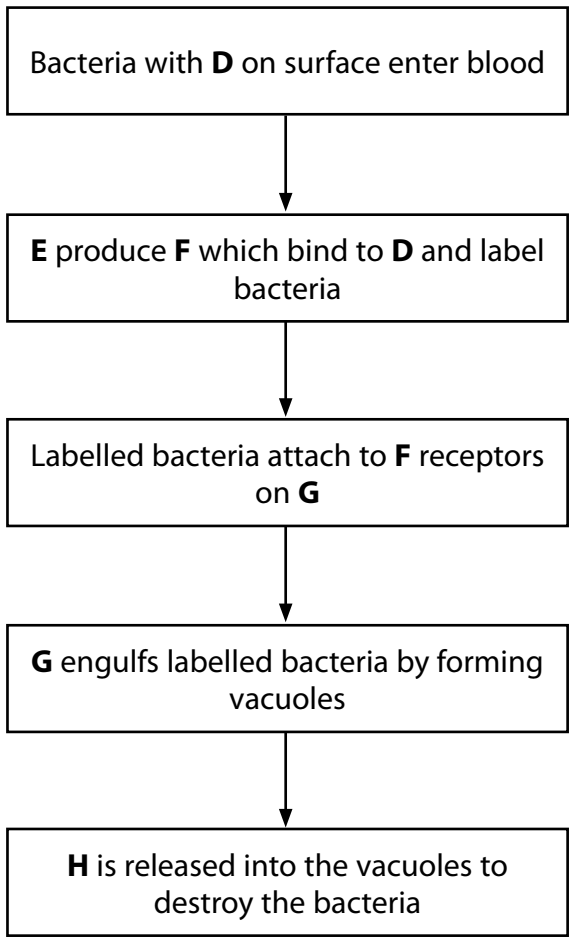
(1)

☒ **A** Histamine

☒ **B** Interferon

☒ **C** Lysozyme

(b) The flow diagram below summarises some of the stages of phagocytosis, a non-specific response to a bacterial infection.



(i) Identify **D**, **E**, **F**, **G** and **H** by writing appropriate terms in the spaces below.

(5)

D .....

E .....

F .....

G .....

H .....

N 3 7 0 9 5 A 0 1 2 2 4

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(ii) Explain why the processes shown in the flow diagram will only happen in response to some types of bacteria.

(3)

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(Total for Question 4 = 10 marks)

N 3 7 0 9 5 A 0 1 3 2 4

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5 Protein synthesis in cells involves molecules of DNA and RNA.

(a) The table below describes some features of the molecular structure of DNA and RNA. Place a tick (✓) in the box next to each statement to show whether it applies to DNA only, RNA only or to both DNA and RNA.

(2)

Description	DNA only	RNA only	Both DNA and RNA
Polymer formed from a single strand of nucleotides			
Pentose present in the nucleotides			
Adenine, cytosine, guanine and thymine present			
Nucleotides linked by phosphodiester bonds			

(b) The diagram below shows the sequence of the **last** six amino acids in a protein molecule.

The tRNA anticodon that corresponds to each amino acid is also shown.

amino acids	Alanine	Glutamine	Glycine	Asparagine	Proline	Valine
tRNA anticodon	CGA	GUU	CCA	UUA	GGA	CAA

Using this information, explain how each of the following processes leads to the synthesis of this sequence of amino acids.

(i) The formation of mRNA during transcription in the nucleus

(3)

N 3 7 0 9 5 A 0 1 4 2 4

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(ii) The translation of mRNA into the sequence of amino acids in a ribosome

(3)

(c) Suggest why the final triplet of nucleotides, on the strand of mRNA involved in the synthesis of this sequence of amino acids, did not correspond with any anticodon on tRNA.

(2)

(Total for Question 5 = 10 marks)

6 Rhododendrons are shrubby plants that are widely distributed throughout the northern hemisphere.
The flowering periods and habitats of two species of rhododendron, found on Yakushima Island in Japan, are shown in the table below.

Species	Flowering period	Main flowering period	Habitat
Rhododendron eriocarpum	April to July	May	Rocky areas in lowland regions
Rhododendron indicum	May to July	June	High mountainous regions

Where these populations overlap, hybrid plants are found that have arisen as a result of cross-fertilisation between these two species. These hybrid plants are capable of flowering and producing viable seeds.

(a) Suggest why some scientists might prefer to classify *Rhododendron eriocarpum* and *Rhododendron indicum* as varieties within the same species rather than as two separate species.

(3)

(b) (i) Explain what is meant by the term **genetic diversity** in a species.

(2)

N 3 7 0 9 5 A 0 1 6 2 4

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(ii) Explain why there is likely to be a greater genetic diversity in the hybrid plants than in either of the two separate species.

(2)

*(c) Explain how the two different species of Rhododendron on Yakushima Island may have evolved from a single population of an ancestral species.

(6)

(Total for Question 6 = 13 marks)

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7 Several species of woodlice can be found in most gardens in Britain. Woodlice have bacteria in their digestive system that secrete enzymes required for the digestion of plant cell walls. Woodlice are decomposers of dead plants.

The photograph below shows one of the common species of woodlouse found in gardens in Britain.



Magnification x10
Amateur Entomologists Society / Kieren Pitts

(a) Suggest how woodlice are involved in the recycling of carbon.

(3)

N 3 7 0 9 5 A 0 1 8 2 4

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(b) A student was watching woodlice in her garden. She noticed that woodlice on an area of paving slabs were fairly active and running about. When she lifted some of the stones near the slabs, the woodlice under these stones were relatively inactive at first. However, within a very short time these woodlice started to run about. After a few minutes, almost all of the woodlice that were under the stones had disappeared from view.

(i) The student thought that the behaviour and distribution of the woodlice were being influenced by an abiotic factor in her garden.

Place a cross ☒ in the box next to the term that describes this type of idea.

(1)

☒ **A** Hypothesis

☒ **B** Observation

☒ **C** Prediction

☒ **D** Theory

(ii) Suggest **two** examples of abiotic factors that might influence the behaviour and distribution of the woodlice in her garden.

(2)

1 .....

2 .....

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(c) She decided to investigate the behaviour of the woodlice. She collected ten woodlice and released them into the centre of the area of paving slabs. She took photographs immediately after the woodlice were released (time 0) and each minute for ten minutes. This was repeated twice. Using the photographs, she recorded the number of woodlice on the paving slabs at one-minute intervals.

Her results are shown in the table below.

Time after release / minutes	**Number of woodlice on paved area**			
	1st release	**2nd release**	**3rd release**	**Mean**
0	10	10	10	10
1	10	9	9	9
2	9	8	9	9
3	7	7	7	7
4	7	6	5	6
5	6	6	6	6
6	4	5	4	4
7	4	3	4	4
8	3	3	2	
9	0	2	1	
10	1	1	0	

(i) Complete the table by calculating the mean for each of the final three minutes.

(1)

N 3 7 0 9 5 A 0 2 0 2 4

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(ii) Suggest why taking photographs is a suitable method to count the woodlice.

(2)

(iii) Explain why it would be difficult to determine which abiotic factor is influencing the behaviour and distribution of the woodlice in a garden environment.

(3)

(Total for Question 7 = 12 marks)

N 3 7 0 9 5 A 0 2 1 2 4

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8 Antibiotics are used to treat bacterial infections in eukaryotic organisms.

(a) The table below describes some of the structures that are found in cells. Complete the table by writing the name of each of the structures described and stating whether it is found in prokaryotic cells only **(P)**, eukaryotic cells only **(E)** or both types of cell **(B)**.

(3)

Description	Name of structure	P, E or B
Enclosed by outer smooth membrane; inner membrane folded forming cristae		
Long strand-like structure extending out from the cell; used for locomotion		
Small, circular loop of double-stranded DNA		

(b) Vancomycin is an antibiotic that kills bacterial cells by preventing the synthesis of peptidoglycan, a component of bacterial cell walls.

(i) State the term used to describe antibiotics, such as vancomycin, that kill bacterial cells.

(1)

.....

(ii) Suggest how bacterial cells are killed by vancomycin.

(2)

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N 3 7 0 9 5 A 0 2 2 2 4

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(iii) Explain why doctors have been advised to limit the prescription of antibiotics.

(2)

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(c) Describe how you could investigate the effect of different antibiotics on bacteria.

(4)

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(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 90 MARKS

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Mark Scheme (Results)
June 2010

GCE

GCE Biology (6BI04/01)

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Summer 2010

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

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GENERAL INFORMATION

The following symbols are used in the mark schemes for all questions:

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point
eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting
/ oblique	Words or phrases separated by an oblique are alternatives to each other
{} curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point
[] square brackets	Words inside square brackets are instructions or guidance for examiners
[CE] or [TE]	Consecutive error / transferred error

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.

No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous
  e.g. for amylase, 'ammalase' is acceptable whereas 'amylose' is not
  e.g. for glycogen, 'glicojen' is acceptable whereas 'glucagen' is not
  e.g. for ileum, 'illeum' is acceptable whereas 'ilium' is not
  e.g. for mitosis, 'mytosis' is acceptable whereas 'meitosis' is not

- candidates must make their meaning clear to the examiner to gain the mark.

- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark – irrelevant material should be ignored

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Question Number	Answer	Mark
1(a)	cross next to degree of muscle concentration ; cross next to signs of decomposition ;	**(2)**

Question Number	Answer	Mark
1(b)	1. idea of SD {measures / shows} {spread / range / eq} of data ; 2. Idea of most readings are within {± 1 x SD / ± 2 x SD} e.g. approx 60% readings within (±)1 x SD / approx 90% readings within (±) 2 x SD ; 3. idea that as length of time increases, SD increase / eq ; 4. idea of more variability (in temperature) as time increases / eq ; 5. comment on change in reliability of time of death with time / eq ; 6. estimate (of time of death) can only be within a {4 / 5 / 6 / 7} hour period ; 7. use of manipulated data ;	**max (4)**

Question Number	Answer	Mark
1(c)	**three from the following:** {(body) mass/ BMI / weight / eq} {(subcutaneous) fat /eq} surface area, {ambient / eq } temperature immersion in water age (of person at death) skin colour thickness of hair gender clothing blood loss humidity air movement {core / body} temperature at time of death ;;;	**(3)**

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Question Number	Answer	Mark
2(a)	1. idea of reflection ; 2. reference. to {incorrect / eq } {wavelength / colour / frequency} ; 3. idea of {not hitting the {chloroplast / chlorophyll}} / it is transmitted ; 4. idea of light being in excess e.g. at max. photosynthesis so more light can be used ;	**max (2)**

Question Number	Answer	Mark
2(b)(i)	{joules / energy} per {square metre / metre squared /(unit) area} per {year / unit time} ;	**(1)**

Question Number	Answer	Mark
2(b)(ii)	Award 2 marks for correct answer (84.8 / 84.84) 1. correct subtraction (24.4 – 3.7 / 20.7) ; 2. correct multiplication by 100 ÷ 24.4 ; [consequential errors apply]	**(2)**

Question Number	Answer	Mark
2(b)(iii)	B ;	**(1)**

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Question Number	Answer	Mark
2(c) [QWC]	(QWC – Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. reference to {*thylakoids* / *thylakoid* (membranes)} ; 2. in {*granum* / *grana*} ; 3. (light energy) raises energy level of *electrons* / {*chlorophyll* / *electrons*}excited / eq ; 4. *electrons* released from {*chlorophyll* /photosystem / eq} / eq ; 5. reference to *electron* {carrier / eq} ; 6. reference to series of {redox / oxidation & reduction / eq} reactions ; 7. reference to energy level of *electrons* {falls / eq} ; 8. reference to {synthesise ATP from ADP +P / phosphorylate ADP} ; 9. reference to *photophosphorylation* ; 10. reference to ATP {*synthetase* / *synthase* / *ase*} ; 11. reference to {*chemiosmosis* / eq} ; 12. idea of *electrons* from {*photolysis* / eq} used to replace those lost ; 13. reference to involvement of {accessory pigments / named example} ;	**max (6)**

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Question Number	Answer	Mark
3(a)(i)	C ;	**(1)**

Question Number	Answer	Mark
3(a)(ii)	C ;	**(1)**

Question Number	Answer	Mark
3(b)(i)	temperature ;	**(1)**

Question Number	Answer	Mark
3(b)(ii)	1. rate of growth increases as temperature increases {between 13°C and 22°C / up to 22°C} ; 2. rate of growth decreases {between 22°C and 25°C / above 22°C} ; 3. use of manipulated data to support above e.g. increases by {0.7 (a.u.) / 4.5 times}, decreases by 0.1 (a.u.) ; 4. reference to enzymes involved (in growth) ; 5. molecules {move about more / have more kinetic energy}, as temperature increases ; 6. (therefore) {enzyme and substrate (molecules) collide more / rate of enzyme-substrate complexes formation increases} as temperature increases ; 7. correct reference to denaturation of some {enzyme / protein / eq} (molecules) ; 8. (therefore) rate of {growth / reactions} decreases as fewer enzyme molecules available ;	**max (4)**

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Question Number	Answer	Mark
3(b)(iii)	1. idea that (each temperature) has same light intensity ; 2. correct reference to must be above {threshold / compensation point} ; 3. (below which) no net photosynthesis takes place / eq ; 4. reference to {so light is not limiting factor / so temperature is the limiting factor}; 5. photosynthesis produces {material / eq} needed for growth / eq ;	**max (3)**

Question Number	Answer	Mark
3(b)(iv)	1. {wavelength / colour / frequency} of light ; 2. CO_2 concentration / eq ; 3. pH / eq (of solution) ; 4. reference to {mineral / eq} ;	**max (2)**

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Question Number	Answer	Mark
4(a)(i)	C ;	**(1)**

Question Number	Answer	Mark
4(a)(ii)	A ;	**(1)**

Question Number	Answer	Mark
4(b)(i)	**D** = antigens / (glyco)proteins ; **E** = B {lymphocytes / cells} / plasma cells ; **F** = antibodies / immunoglobulins ; **G** = macrophage / phagocyte / eq ; **H** = enzymes / lysozyme ;	**(5)**

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Question Number	Answer	Mark
4(b)(ii)	1. reference to protein nature of {antigens / antibodies} ; 2. antigens are specific (to each bacteria) / eq ; 3. antibodies need to be {complementary / specific} (to the antigen) ; 4. idea that {binding / eq} can take place ; 5. (some bacteria) have {different / changed} antigens / eq ; 6. idea that this is a primary infection ; 7. reference to {mucus / slime} {coat /capsule} (of bacterial cells) ; 8. idea that some bacteria are inside body cells ; 9. idea of antibodies already present e.g. from passive immunity or breast feeding ;	**max (3)**

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Question Number	Answer	Mark
5(a)	<table><tr><th>Description</th><th>DNA only</th><th>RNA only</th><th>Both DNA and RNA</th></tr><tr><td>Polymer formed from a single strand of nucleotides</td><td></td><td>✓</td><td></td></tr><tr><td>Pentose present in the nucleotides</td><td></td><td></td><td>✓</td></tr><tr><td>Adenine, cytosine, guanine and thymine present</td><td>✓</td><td></td><td></td></tr><tr><td>Nucleotides linked by phosphodiester bonds</td><td></td><td></td><td>✓</td></tr></table> **all rows correct 2 marks** **two or three rows correct 1 mark**	**(2)**

Question Number	Answer	Mark
5(b)(i)	1. DNA strands {separate / unzip / eq} ; 2. idea that one DNA {strand / eq} used as template (to form mRNA) / eq ; 3. from free nucleotides / eq ; 4. reference to complementary base pairing ; 5. reference to hydrogen bonding ; 6. correct reference to {RNA-polymerase / DNA helicase} ; 7. credit correct sequence of bases on {mRNA / DNA} ;	**max (3)**

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Question Number	Answer	Mark
5(b)(ii)	1. reference to specific amino acid attachment to tRNA ; 2. idea that anticodon (on tRNA) {attaches / binds / lines up / eq} to the {codon / triplet} on mRNA ; 3. example quoted using the information in the diagram e.g. tRNA with alanine has CGA anticodon which binds to GCU on mRNA ; 4. idea that two tRNA held in ribosome (at any one time) ; 5. reference to formation of peptide {bonds / links} (between adjacent amino acids) ; 6. reference to peptidyl transferase ;	**max (3)**

Question Number	Answer	Mark
5(c)	1. <u>stop codon</u> ; 2. used to end the {sequencing / further attachment of tRNA / eq} ; 3. release of the {polypeptide / ribosome} /eq ;	**max (2)**

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Question Number	Answer	Mark
6(a)	1. idea that individuals of a species can {interbreed / eq} ; 2. to produce fertile {offspring / eq} ; 3. the {hybrids / offspring} can flower and produce viable seeds / eq ;	**max (3)**

Question Number	Answer	Mark
6(b)(i)	1. {variety / eq} of alleles ; 2. in a gene pool / eq ;	**(2)**

Question Number	Answer	Mark
6(b)(ii)	1. different alleles in each of the two {populations / eq} ; 2. each {population / species} is adapted to live {in different environmental conditions / at different altitudes / eq} ; 3. there will have been different mutations in each population ; 4. reference to alleles from different {species /eq } will mix / hybrids receive alleles from both { species / eq} ;	**max (2)**

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Question Number	Answer	Mark
***6(c) QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to original population increasing in size and spreading into a wider diversity of {habitats / eq} ; 2. reference to mutations ; 3. leading to diversity in flowering times / eq ; 4. (and) other plant features / eq ; 5. reference to reproductive isolation ; 6. restriction in gene flow / eq ; 7. between extremes of population / eq ; 8. reference to different environmental factors in each region ; 9. each region has different selection pressures / eq ; 10. idea of plants adapted to a region ; 11. reference to survival and breeding ; 12. reference to change in allele frequencies (over time) ; 13. (leads to) differences between gene pools / eq ;	**max (6)**

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Question Number	Answer	Mark
7(a)	1. reference to {carbon / organic / eq} compounds in plant material ; 2. idea that digestion provides respiratory substrates ; 3. carbon dioxide released (from respiration) ; 4. (this carbon dioxide is) available for photosynthesis ; 5. reference to woodlice {eaten / decompose} ;	**max (3)**

Question Number	Answer	Mark
7(b)(i)	A ;	**(1)**

Question Number	Answer	Mark
7(b)(ii)	1. {wavelength / colour / frequency} of light ; 2. light intensity / shading ; 3. temperature ; 4. moisture content of {air / substratum / eq} / humidity ; 5. {pH / chemical composition / eq} of {substratum / eq} ; 6. air currents / wind / eq ; 7. texture of substratum / eq ; 8. reference to {oxygen / carbon / methane} ;	**max (2)**

Question Number	Answer	Mark
7(c)(i)	<table><tr><td>8</td><td>3</td></tr><tr><td>9</td><td>1</td></tr><tr><td>10</td><td>1</td></tr></table> All three answers correct to 1 significant figure ;	**(1)**

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Question Number	Answer	Mark
7(c)(ii)	1. woodlice move about / eq ; 2. (therefore) difficult to count / eq ; 3. some might be {counted more than once / missed out} / eq ;	**max (2)**

Question Number	Answer	Mark
7(c)(iii)	1. for results to be (scientifically) valid ; 2. only one factor needs to be varied / eq ; 3. other factors need to be kept constant / eq ; 4. reference to {many / biotic / eq} factors (in a garden) ; 5. (these factors are) {difficult to control / eq} ; 6. reference to difficult to set test factor values ;	**max (3)**

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Question Number	Answer	Mark
8(a)	<table><tr><th>Description</th><th>Name of structure</th><th>P, E or B</th></tr><tr><td>Enclosed by outer smooth membrane inner membrane folded forming cristae</td><td>Mitochondrion / mitochondria</td><td>E / eukaryotic</td></tr><tr><td>Long strand-like structure extending out from the cell Used for locomotion</td><td>Flagellum / flagella</td><td>B / both</td></tr><tr><td>Small, circular loop of double-stranded DNA</td><td>plasmid</td><td>P / prokaryotic</td></tr></table> 1 mark for any two correct cells ;;;	**(3)**

Question Number	Answer	Mark
8(b)(i)	bactericidal ;	**(1)**

Question Number	Answer	Mark
8(b)(ii)	1. cell wall {weaker /cannot form properly / eq} ; 2. {cell / cell wall} bursts (easily) / eq ; 3. during division /eq ;	**max (2)**

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Question Number	Answer	Mark
8(b)(iii)	1. reference to antibiotic acting as selective pressure ; 2. reference to some bacteria resistant (to antibiotic) ; 3. idea that resistant bacteria survive and {reproduce / pass on resistance / pass on gene / eq}; 4. idea that antibiotic no longer effective ; 5. reference to some infections cannot be treated with antibiotics ;	**max (2)**

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Question Number	Answer	Mark
8(c)	1. idea of bacteria distributed evenly / description of technique e.g. lawn spreading ; 2. description of method used to apply different antibiotics at known positions e.g. multidisks, wells in agar ; 3. reference to control of antibiotic concentration ; 4. reference to {sterile / aseptic} technique ; 5. reference to incubation at a suitable temperature ; 6. description of how effect is assessed e.g. measure {clear area / inhibition zone / eq} ; 7. reference to replication (with same bacterium) ; 8. reference to repetition with different bacteria ;	**max (4)**

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