EDEXCEL A-LEVEL BIOLOGY

BIOLOGY



EXAM QUESTION PACK

UNIT 2 OLD SPECIFICATION PAPERS

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Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Tuesday 7 June 2016 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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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2/3/3/3/1/

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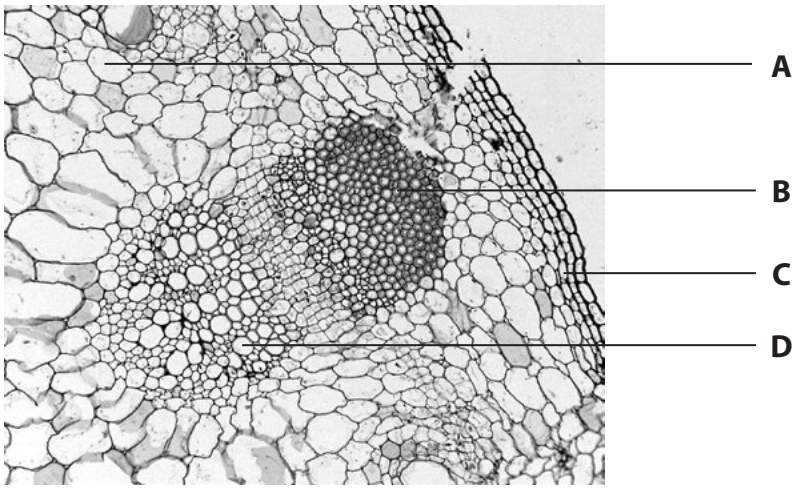
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Answer ALL questions.

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 The photograph below shows a cross-section through part of the stem of a sunflower (*Helianthus annuus*) as seen using a microscope.



Magnification × 200

(a) Give the letter that correctly identifies the plant tissues shown in the photograph above.

(2)

Sclerenchyma .....

Xylem .....

(b) Statements concerning xylem and sclerenchyma tissue are shown in the table below. Place a cross in the box ☒ to indicate whether each statement is true or false.

(4)

Statement	True	False
Both tissues have a structural function	☒	☒
Both tissues have a transport function	☒	☒
End plates are missing in xylem vessels	☒	☒
Xylem vessels have tapered ends	☒	☒

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*(c) Describe the structure of the cell wall of a xylem vessel.

(4)

(Total for Question 1 = 10 marks)

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2 (a) In the space below, draw a sperm cell. On your diagram, label each of the following structures: **nucleus**, **mitochondria**, **flagellum** and **acrosome**.

(4)

(b) Explain the function of each of the following structures of a sperm cell.

(i) Flagellum

(1)

(ii) Mitochondria

(2)

(iii) Acrosome

(2)

(Total for Question 2 = 9 marks)

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3 The electronmicrograph below shows a Golgi apparatus in part of a cell.



Magnification ×10 000

(a) Using information from the electronmicrograph, explain how this organelle can be identified as a Golgi apparatus.

(3)

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(b) Describe the role of the Golgi apparatus.

(4)

(Total for Question 3 = 7 marks)

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4 The cell cycle is involved in the production of new cells.

The table below shows the time spent in each stage for a cell with a cell cycle of 24 hours.

Stage of cell cycle	Time / hours
Production of proteins and organelles (G1 phase)	10
S phase	8
Production of proteins and organelles (G2 phase)	4
Mitosis	1
Cytokinesis	1

(a) Describe the **end result** of each of the following stages of this cell cycle.

(i) Mitosis

(2)

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(ii) S phase

(2)

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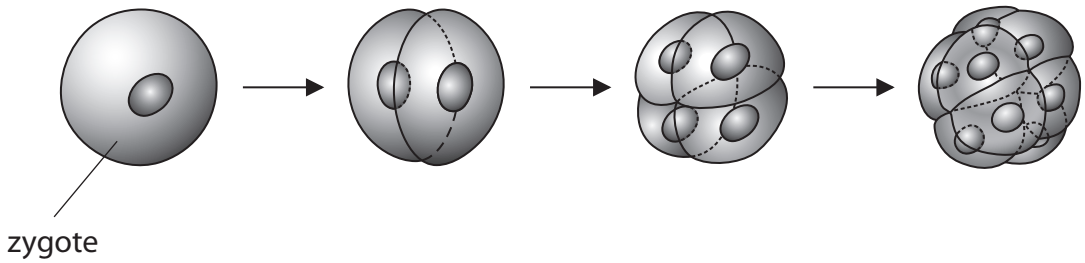
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(b) After fertilisation, a zygote divides rapidly to produce more cells.

The diagram below shows a zygote and the results of the first three cell cycles.



(i) State the number of cells that would be present after **three** more cell cycles.

Place a cross ☒ in the box next to the correct answer.

(1)

☒ **A** 16

☒ **B** 32

☒ **C** 64

☒ **D** 128

(ii) The first few cell cycles may be as short as 30 minutes. They do not have G1 or G2 phases, only alternating S phases and mitosis.

Using information from the table and your own knowledge, suggest why the cells produced become smaller after each cell cycle.

(2)

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(c) Cells stop dividing as they become specialised.

Describe the processes that take place inside a cell during specialisation.

(4)

(d) Specialised cells of an embryo become tissues and organs in the fetus.

Give **two** differences between tissues and organs.

(2)

1 .....

2 .....

(Total for Question 4 = 13 marks)

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5 The photograph below shows packaging pellets made from thermoplastic starch, which is produced from corn starch. These pellets can be produced from a sustainable resource.



Magnification × 0.5

(a) (i) Explain what is meant by the term **sustainable**.

(2)

(ii) Other packaging pellets contain polystyrene made from crude oil.

Explain why packaging pellets made from thermoplastic starch are sustainable but polystyrene pellets are not sustainable.

(2)

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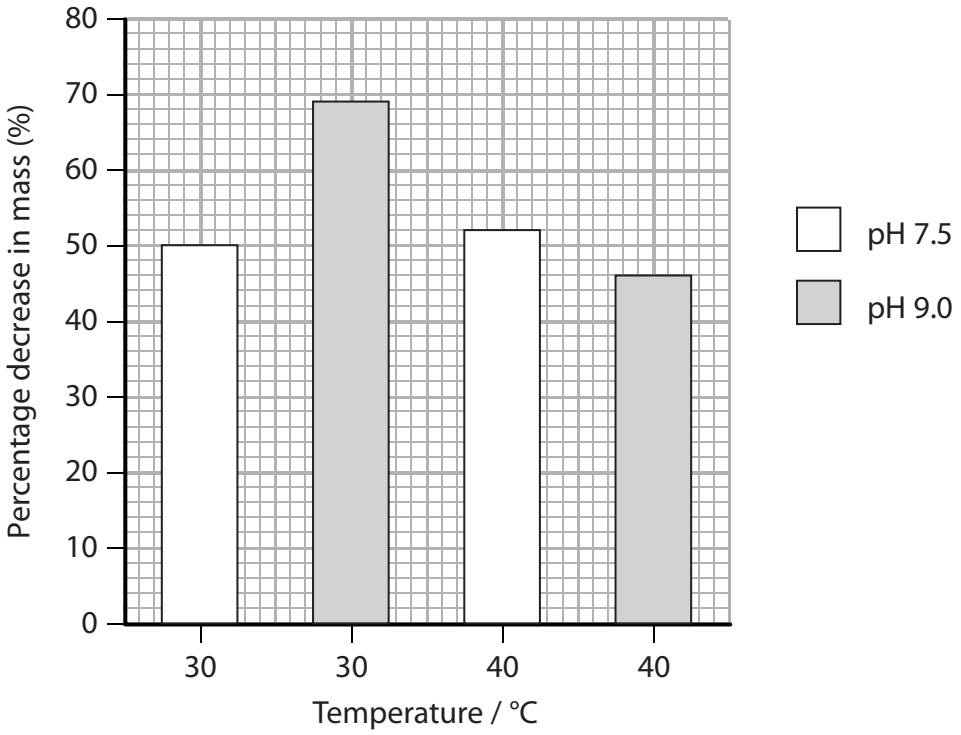
(b) Scientists investigated various factors that affect the breakdown of a starch-based plastic. They tested plastic sheets made from a starch-based plastic.

Pieces of the plastic sheet were placed in beakers containing a solution of an enzyme that breaks down starch.

In one beaker, the enzyme solution had a pH of 7.5 and in the other it had a pH of 9.0. These beakers were then incubated at 30 °C for 10 days. The percentage decrease in mass of the plastic sheet was recorded.

The investigation was then repeated at 40 °C.

The results are shown in the graph below.



(i) Using information from the graph, suggest which conditions were best for the breakdown of the plastic.

(1)

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(ii) Using information from the graph, describe the effect of temperature on the breakdown of the plastic.

(3)

(iii) Suggest **two** factors that would have been kept constant to make this a valid investigation.

(2)

1 .....

2 .....

(iv) Suggest why it would not be valid to use these data to predict what would happen at a temperature of 30 °C and a pH of 11.0.

(1)

(Total for Question 5 = 11 marks)

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6 An investigation was carried out into the effects of different plant extracts on 13 species of bacteria. This investigation was carried out in a university laboratory, using species of bacteria that cause disease in humans.

The bacteria were grown on agar in Petri dishes. Plant extracts were added to 0.5 cm^2 filter paper discs and the discs were placed on the surface of the agar.

The Petri dishes were then incubated at 37 °C for 24 hours.

After incubation, the zones of inhibition were measured. If the zone of inhibition was greater than 7 mm, the bacteria were described as sensitive to the plant extract.

The results are shown in the table below.

Plant extract	Part of the plant used to prepare extract	Number of species of bacteria showing sensitivity
Basil	Leaves and stem	1
Clove	Flower bud	8
Lemon balm	Leaves and stem	3
Rosemary	Leaves and stem	1
Sage	Leaves and stem	0
Thyme	Leaves and stem	3

(a) (i) Explain what is meant by **zone of inhibition**.

(1)

.....

.....

(ii) Suggest why the size of the zone of inhibition was used to indicate how sensitive the bacteria were to the plant extracts.

(1)

.....

.....

.....

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(b) Using the information from the table, suggest what conclusions can be drawn from these data.

(3)

(c) Suggest **one** way in which this investigation could be improved. Give an explanation for your answer.

(2)

(d) Suggest a change that would have to be made if this investigation were to be carried out **safely** in a school laboratory. Give a reason for your suggestion.

(2)

(Total for Question 6 = 9 marks)

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7 The pigment melanin affects fur colour in mammals, such as rabbits.

As a result of polygenic inheritance, some breeds of rabbit may have fur that ranges in colour from light brown to black.

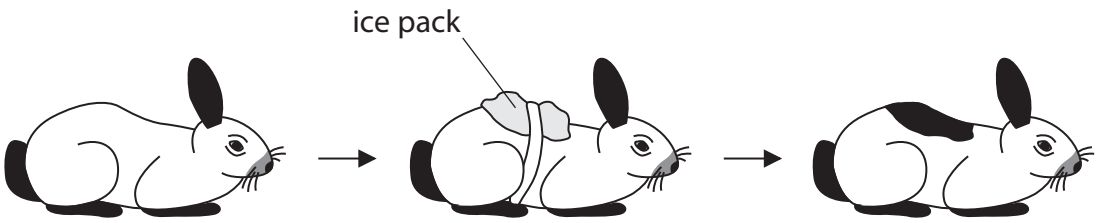
(a) Explain what is meant by the term **polygenic inheritance**.

(2)

(b) Himalayan rabbits are white with black fur on their ears, tails and feet.

An experiment was carried out to investigate the effect of temperature on the fur colour in Himalayan rabbits. An area of fur was shaved from the back of a rabbit and an ice pack taped to the area until the fur grew back.

The fur that grew back was black.



(i) Suggest a control for this experiment.

(1)

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(ii) It is thought that the expression of the gene for fur colour in Himalayan rabbits is affected by the environment.

Explain how this experiment provides evidence to support this hypothesis.

(3)

(c) The production of melanin is controlled by an enzyme called tyrosinase.

Further investigations suggested that in Himalayan rabbits the enzyme tyrosinase is inactive at temperatures above 25 °C.

Suggest how the results of this investigation support this hypothesis.

(2)

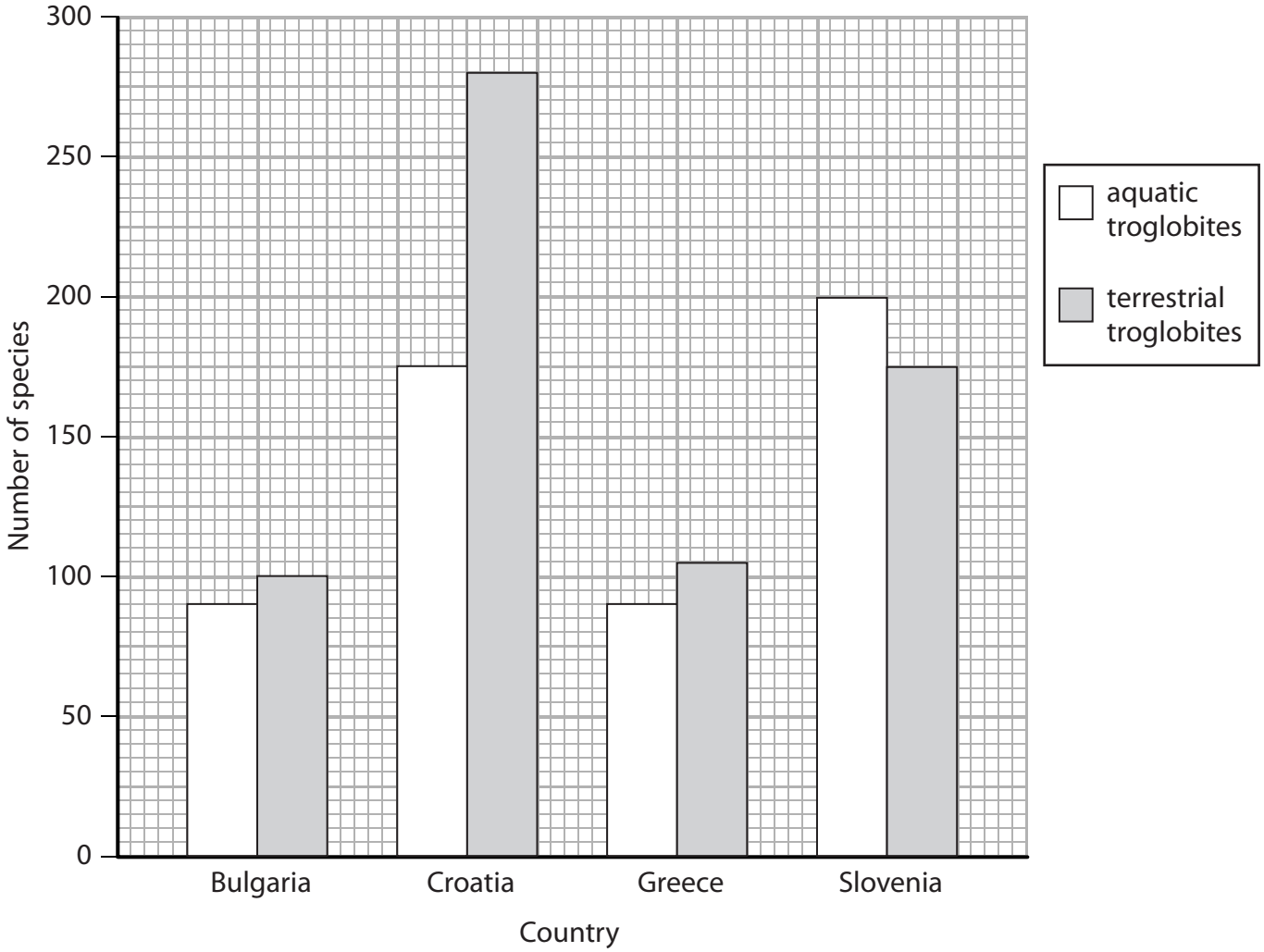
(Total for Question 7 = 8 marks)

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8 Animals that live only in underground caves are called troglobites.

Aquatic troglobites live in water in caves. Terrestrial troglobites live on the floors and walls of caves.

(a) The graph below shows the numbers of species of aquatic troglobites and terrestrial troglobites in four European countries.



(i) Using information in the graph, identify which country has the lowest biodiversity of troglobites.

(1)

.....

(ii) Place a cross ☒ in the box that corresponds to the correct ratio of aquatic troglobites to terrestrial troglobites in Croatia.

(1)

☒ **A** 5:8

☒ **B** 6:7

☒ **C** 8:7

☒ **D** 9:10

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(iii) Using the information from the graph, compare the biodiversity of troglobites in Greece and Slovenia.

(2)

(b) Troglobites occupy different niches.

Explain what is meant by the term **niche**.

(2)

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(c) An example of a troglobite is the olm, *Proteus anguinus*, as shown in the photograph below. This species is an amphibian endemic to the caves of Slovenia and Croatia.

Olms have a number of special adaptations: external gills as adults, undeveloped eyes, lack of skin pigmentation and a slow metabolic rate.



Magnification × 0.1

(i) Explain what is meant by the phrase 'endemic to the caves of Slovenia and Croatia'.

(1)

.....

.....

.....

(ii) Suggest which of the following is a physiological adaptation of olms to their habitat.

Place a cross ☒ in the box corresponding to the correct answer.

(1)

☒ **A** external gills as adults

☒ **B** slow metabolic rate

☒ **C** streamlined shape

☒ **D** undeveloped eyes

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*(iii) Olms evolved from small populations of amphibians that lived in caves. These caves became blocked off from other caves by rock barriers.

Suggest how natural selection could have led to the evolution of the olm.

(5)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

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Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCE in Biology (6BI02) Paper 01 Development, Plants and the Environment

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Summer 2016
Publications Code 46642_MS*
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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)	sclerenchyma – B ; xylem - D ;	**Allow** lower case b and d	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)	<table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>Both tissues have a structural function</td><td>☒</td><td></td></tr><tr><td>Both tissues have a transport function</td><td></td><td>☒</td></tr><tr><td>End plates are missing in xylem vessels</td><td>☒</td><td></td></tr><tr><td>Xylem vessels have tapered ends</td><td></td><td>☒</td></tr></table>		**(4)**

Question Number	Answer	Additional Guidance	Mark
1*(c)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. idea of *cellulose* (molecules) { in bundles / as *microfibrils* / held together by *hydrogen* bonds } ; 2. layers of *microfibrils* (in the primary cell wall) / mesh of *microfibrils* (in secondary cell wall) ; 3. reference to presence of *lignin* in the cell wall ; 4. distribution of *lignin* described ; 5. presence of (bordered) pits ; 6. presence of { *pectin* / *hemicellulose* } in the cell wall ;	**QWC emphasis is on correct spelling of biological terms** (Note – only penalise once for an incorrect spelling) 2. ACCEPT net or criss-cross arrangement instead of mesh 3. ACCEPT *lignified* or *lignification* 4. e.g. rings / spirals / annular / helical 5. IGNORE pores and plasmodesmata 6. IGNORE middle lamella	**(4)**

Question Number	Answer	Additional Guidance	Mark
2(a)	1. nucleus drawn in the correct position and labelled ; 2. mitochondrion or mitochondria drawn in the correct position and labelled ; 3. flagellum drawn in the correct position and labelled ; 4. acrosome drawn in the correct position and labelled ;	2. NOT just labelling of the mid-section 3. NOT a single line 4. NOT a single line across the head region	(4)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	for { movement / motility / eq } to reach the { ovum / egg } ;	ACCEPT 'swim or move or propel' sperm towards the egg	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. (aerobic) respiration ; 2. reference to { energy / ATP } for movement ;		(2)

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	1. contains { enzymes / acrosin / eq } ; 2. digestion of zona pellucida / eq ;	2. ACCEPT creation of a pathway through the follicle cells	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(a)	1. { membrane bound sacs / cisternae } ; 2. idea of { sacs/ cisternae } { in stacks / of different sizes / eq } ; 3. (cisternae) curved / flattened ; 4. smooth membranes / no ribosomes ;		(3)

Question Number	Answer	Additional Guidance	Mark
3(b)	1. (Golgi apparatus) { modifies / processes } protein ; 2. details of modification e.g addition of carbohydrate chains, trimming of carbohydrate / reference to glycoprotein ; 3. (Golgi apparatus) packages proteins in (secretory) vesicles ; 4. for (export from cells by) exocytosis / eq ; 5. reference to lysosomes ;	2. ACCEPT glycoside 3. ACCEPT idea of protein being pinched off in a vesicle	(4)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	1. chromatids separated / chromosomes decondensed / eq ; 2. nucleus divided / two nuclei present /eq ;		(2)

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	1. DNA replicated / (identical) copies of DNA produced / eq ; 2. idea that { quantity of DNA / number of chromosomes } is doubled / cell is 4n ;	1. IGNORE DNA synthesis 2. ACCEPT two sets of DNA	(2)

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	C 64 ;		(1)

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	1. no time in G1 or G2 phase / usually a cell spends { several hours / more time / 14 hours } in G1 and G2 phase ; 2. less protein synthesis / fewer organelles ; 3. idea of { cytoplasm / organelles / cell membrane } { shared / divided / halved } with each cell division ;	2. ACCEPT less cytoplasm or cell membranes produced ACCEPT no organelles produced	(2)

Question Number	Answer	Additional Guidance	Mark
4(c)	1. genes would be { activated / deactivated } / eq ; 2. active genes transcribed / mRNA produced ; 3. translation (of mRNA) to produce proteins / eq ; 4. idea that proteins { modify cell / determine function of cell } / structure of cell altered permanently ;	1. ACCEPT switching on or off of genes, NOT turned on or off DO NOT ACCEPT translation of proteins	(4)

Question Number	Answer	Additional Guidance	Mark
4(d)	1. tissues made of cells and organs made of tissues /eq ; 2. tissues made of { one type / similar types } of cells AND organs made of different tissues / eq ; 3. organs have more functions than tissues ;	Piece together the answer if necessary	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	1. a resource that can be { renewed / replaced } / not finite / will not run out ; 2. idea that it is available to future generations ;	1. IGNORE regrown or replanted as this is not in the context of plants	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	1. idea that (starch comes from plants and) more plants can be grown (to replace those used) ; 2. idea of crude oil { not being renewable / finite /eq } ; 3. idea that using packaging pellets made from starch will allow crude oil supplies to last for longer ;	1. IGNORE renewable DO NOT ACCEPT starch can be regrown 2. ACCEPT will run out	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	(pH) 9.0 or 9 **AND** 30 (ºC) ;	IGNORE units	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	1. idea of { increased breakdown / larger decrease in mass } at pH 7.5 { when temperature increased / at 40 ºC } ; 2. idea of { increased breakdown / larger decrease in mass } at pH 9.0 { when temperature decreased / at 30 ºC } ; 3. at { pH 7.5 there is 2% / pH 9.0 there is 23% } difference (between 30°- 40 ºC) ;		(3)

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	1. area of plastic sheet ; 2. thickness of plastic sheet ; 3. concentration of { enzyme / solution } ; 4. enzyme type ; 5. volume of { enzyme / solution } ;	1. IGNORE size 5. NOT amount	(2)

Question Number	Answer	Additional Guidance	Mark
5(b)(iv)	1. idea that pH 11 is outside the range of data collected 2. idea of insufficient data (to support prediction) / cannot extrapolate from two values of pH / no indication of a trend ;	1. IGNORE pH 11 not tested	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	(area or zone) where { no bacteria / bacteria not growing / bacteria killed } ;	ACCEPT bacteria not dividing / replicating / multiplying	(1)

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	1. the larger the size of zone of inhibition the { more bacteria killed / fewer bacteria grow / fewer bacteria multiply } / eq 2. idea of comparability between { species / plant extracts } ;	1. ACCEPT converse	(1)

Question Number	Answer	Additional Guidance	Mark
6(b)	1. clove has the greatest antimicrobial properties /most bacteria are sensitive to clove / eq ; 2. sage has no antimicrobial properties / no bacteria are sensitive to sage / eq ; 3. flower buds are more effective than leaves and stems ; 4. no difference between basil and rosemary AND between lemon balm and thyme ;	1. ACCEPT clove is the most effective 2. ACCEPT sage is ineffective against bacteria or is the least effective	(3)

Question	Answer	Additional Guidance	Mark

Number			
6(c)	1. repeats for each type of plant extract ; 2. to allow { mean / average } to be calculated / to increase reliability of results ; OR 3. use the same part of the plant for each extract ; 4. to control variables / to allow comparisons / to make { method / conclusions } valid ;	2. ACCEPT identify anomalies 4. IGNORE valid results	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(d)	1. idea of incubating at { temperatures below 37 ºC / a lower temperature } ; 2. prevents growth of pathogenic bacteria ; OR 3. idea of using non-pathogenic bacteria ; 4. prevent risk of infection to humans ;	2. ACCEPT idea that 37 ºC encourages growth of pathogens	**(2)**

Question	Answer	Additional Guidance	Mark

Number			
7(a)	1. idea of more than one gene for a single { characteristic / trait } ; 2. on more than one locus ; 3. idea of continuous variation ; 4. idea of genes interacting with each other ;	IGNORE phenotype	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	a Himalayan rabbit shaved (in the same place) and no ice pack (taped to bald patch);	**ACCEPT** shaved with no ice or another object taped to its back instead of an icepack	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)	1. fur grew black when exposed to cold temperatures / eq ; 2. fur remains white when not exposed to cold temperatures / eq ; 3. idea that the gene is { expressed / activated } at low temperatures ;	2. ACCEPT fur is white in warm areas	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(c)	1. fur is (only) black where { the temperature is lower than 25 ºC / ice pack is placed } ; 2. because the enzyme is active / eq ;	1. ACCEPT darker fur	(2)

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	Bulgaria ;		(1)

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	A (5:8) ;		(1)

Question Number	Answer	Additional Guidance	Mark
8(a)(iii)	1. higher biodiversity in Slovenia / lower biodiversity in Greece ; 2. correct manipulation of data to support answer ;	e.g. for Slovenia: AT+TT = 180 more 92.3%, AT = 110 more, TT = 70 more	(2)

Question Number	Answer	Additional Guidance	Mark
8(b)	1. the { role / position / eq } of a { species / organism } ; OR idea of how a { species / organism } exploits resources ; 2. within the { community / ecosystem /habitat } ;	2. ACCEPT reference to cave habitat IGNORE environment	(2)
Question	Answer	Additional Guidance	Mark

Number			
8(c)(i)	they are { found only in Slovenia and Croatia / not found in other countries / only found in these caves } ;		(1)

Question Number	Answer	Additional Guidance	Mark
8(c)(ii)	B (slow metabolic rate) ;		(1)

Question Number	Answer	Additional Guidance	Mark
8(c)(iii)	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. genetic variation in population ; 2. reference to selection pressure ; 3. description of a beneficial characteristic ; 4. idea that these organisms with beneficial characteristics survive and reproduce ; 5. passing on { beneficial alleles / eq } to offspring / eq ; 6. over { generations / time } there is a change in allele frequency ; 7. relevant reference to { geographical/ reproductive } isolation ;	**Emphasis is on clarity of expression** 3. e.g. external gills, slow metabolic rate, streamline shape 4. ACCEPT beneficial alleles 5. NOT genes 7. ACCEPT allopatric speciation (due to isolation in caves)	(5)

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Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Monday 1 June 2015 – Afternoon **Time: 1 hour 30 minutes**	Paper Reference **6BI02/01**

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 80.
- 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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P 4 5 0 6 8 A 0 1 2 8

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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 details of the ultrastructure of a cell can be seen using an electron microscope.

(a) Complete the table below. If the organelle can be present, place a tick (✓) in the box and if the organelle could not be present, place a cross (**x**) in the box.

(4)

Organelles	Prokaryotic cell	Eukaryotic cell
centrioles		
flagella		
Golgi apparatus		
ribosomes		

(b) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) Plant and animal cells may both contain

(1)

☒ **A** amyloplasts, centrioles and mitochondria

☒ **B** centrioles, mitochondria and rough endoplasmic reticulum

☒ **C** chloroplasts, mitochondria and rough endoplasmic reticulum

☒ **D** mitochondria, rough endoplasmic reticulum and smooth endoplasmic reticulum

(ii) The cytoplasmic connections between one plant cell and another are known as

(1)

☒ **A** middle lamellae

☒ **B** plasmodesmata

☒ **C** pits

☒ **D** tonoplasts

Pre Final

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(iii) Prokaryotic cells and plant cells both contain

(1)

- ☒ **A** a cell membrane and chloroplasts
- ☒ **B** a cell membrane and mesosomes
- ☒ **C** a cell wall and chloroplasts
- ☒ **D** a cell wall and ribosomes

(iv) Woese suggested that there are three domains based on evidence from

(1)

- ☒ **A** molecular pharmacology
- ☒ **B** molecular phylogeny
- ☒ **C** molecular physiology
- ☒ **D** phenetic taxonomy

(v) The two domains that contain prokaryotic cells are

(1)

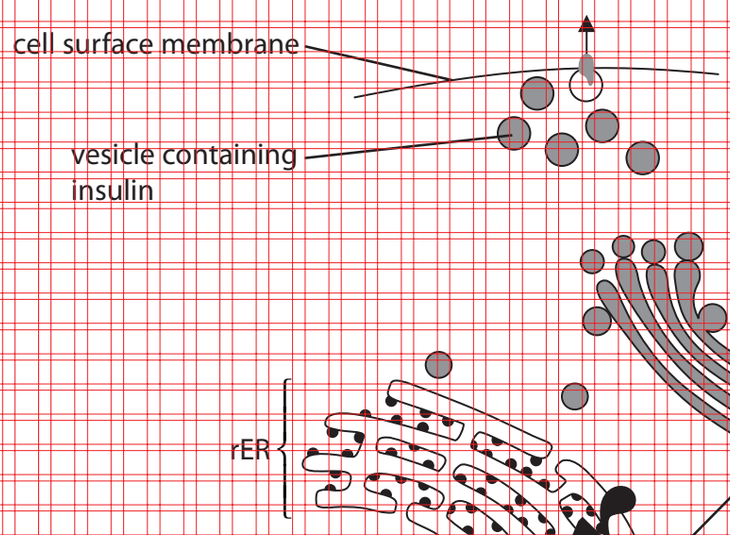
- ☒ **A** Animalia and Bacteria
- ☒ **B** Archaea and Bacteria
- ☒ **C** Bacteria and Eukarya
- ☒ **D** Bacteria and Plantae

(Total for Question 1 = 9 marks)

Exemplar

2 Insulin is a protein produced by beta cells in the pancreas. Insulin is synthesised on ribosomes, then modified and packaged in vesicles. It is stored in these vesicles until it is secreted.

The diagram below shows the organelles involved in this process of modifying and packaging the insulin in vesicles.



*(a) Using the information in the diagram, describe how insulin is modified, packaged and secreted by the cell.

(4)

PREMIER

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(b) Type 1 diabetes occurs when beta cells in the pancreas do not produce insulin.

Stem cells produced from skin cells can be used to replace these beta cells in mice. The skin cells can be stimulated to become pluripotent stem cells.

(i) Place a cross ☒ in the box next to the correct definition to complete the following statement.

Pluripotent stem cells are

(1)

☒ **A** specialised cells that can differentiate to give rise to almost any type of cell in the body, including totipotent cells

☒ **B** specialised cells that can differentiate to give rise to any type of cell in the body, excluding totipotent cells

☒ **C** unspecialised cells that can differentiate to give rise to almost any type of cell in the body, excluding totipotent cells

☒ **D** unspecialised cells that can differentiate to give rise to any type of cell in the body, including totipotent cells

(ii) The pluripotent stem cells were injected into the mice. After eight weeks, these cells had developed into insulin-secreting beta cells.

Describe how these pluripotent stem cells became specialised beta cells.

(4)

(Total for Question 2 = 9 marks)

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3 Infertility reduces the chance of successful fertilisation of the egg by a sperm cell. There are many causes of infertility in humans.

One cause of infertility is cigarette smoking. Men who smoke cigarettes have a 30% higher risk of infertility.

Cigarette smoke contains nicotine. The effects of nicotine on the quality of sperm cells have been studied in rats.

Male rats were given nicotine at levels of either 0.5 mg per kg of body mass or 1.0 mg per kg of body mass.

The sperm cells produced by these rats were compared with sperm cells produced by a control group of rats. The rats in the control group were not exposed to nicotine. The defects in the sperm cells produced were recorded and the results are shown in the table below.

Type of sperm cell	Percentage of each type of sperm cell (%)		
	Control	0.5 mg of nicotine per kg	1.0 mg of nicotine per kg
normal sperm cells	93.6	83.2	75.2
sperm cells with flagella defects	3.9		19.9
sperm cells with mid-piece defect	2.0	2.7	3.7
other defects, including missing heads	0.5	1.0	1.2

(a) (i) Complete the table to give the percentage of sperm cells with flagella defects when the rats were given 0.5 mg of nicotine per kg of body mass.

(1)

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(ii) Using the information in the table, calculate the difference in the percentage of sperm cells with defective flagella in rats given 1.0 mg of nicotine per kg of body mass compared with the control group.

(1)

.....%

(iii) Name the organelle that may be missing from the sperm cells with mid-piece defects.

(1)

.....

(iv) Using the information in the table, suggest why nicotine reduces the movement of the sperm cells.

(4)

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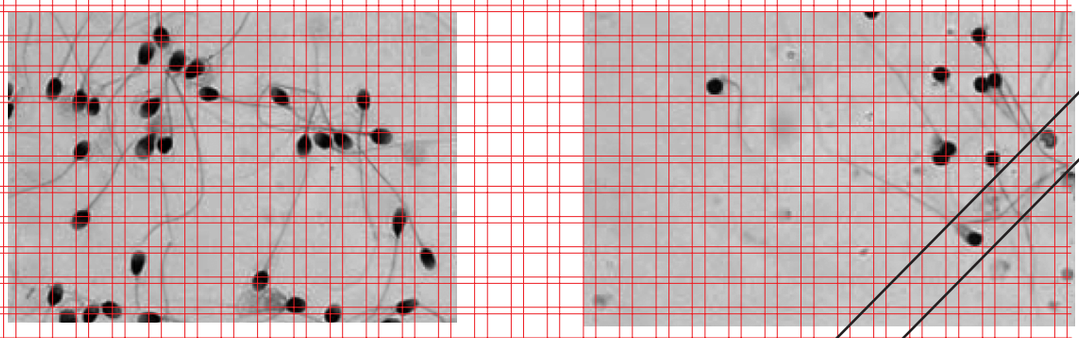
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Example

(b) A genetic cause of infertility is globozoospermia.

This condition results in round-headed sperm cells being produced. These sperm cells do not possess an acrosome.

Photograph **A** shows normal sperm cells and photograph **B** shows sperm cells from a man with globozoospermia.



A **B**

Magnification ×500

Suggest why the sperm cells in photograph **B** would not be able to fertilise an egg.

(3)

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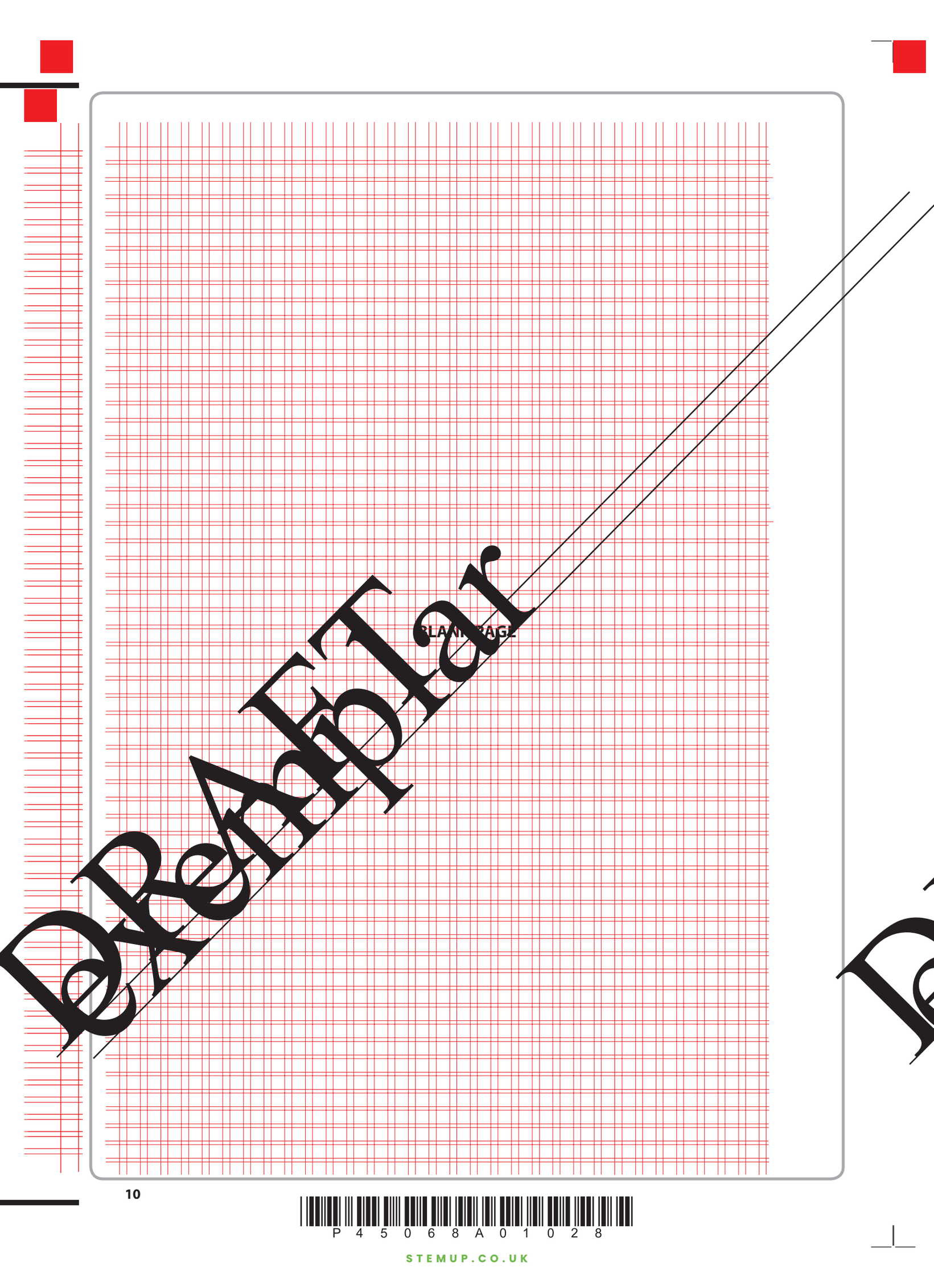
(c) Suggest why a valid study on the effects of globozoospermia on fertility would have to be carried out on non-smokers.

(3)

(Total for Question 3 = 13 marks)

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P 4 5 0 6 8 A 0 1 0 2 8

4 Almond trees can be grown from shoot tips using a tissue culture technique.

This involves removing explants (small pieces of plant tissue) from the shoot tips of adult plants. The explants are placed on a growth medium, such as agar. The explants develop roots and shoots as they grow into new plants.

Tissue culture techniques have to be carried out under conditions that prevent contamination of the explants.

(a) (i) Describe how contamination of a tissue culture is avoided.

(2)

(ii) Explain why contamination of tissue cultures has to be avoided.

(2)

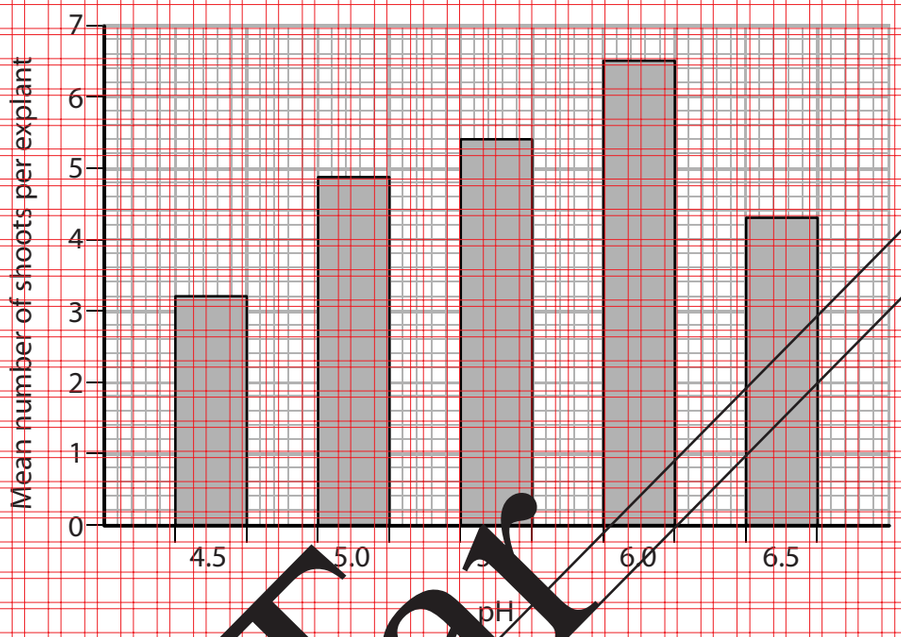
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(b) Explants of almond plant shoot tips were grown using tissue culture techniques.

The effect of pH on the development of shoots from the explants was investigated.

The graph below shows the effects of pH on the number of shoots that developed from each explant.



(i) Give **two** environmental factors that would have to be controlled when investigating the effect of pH on the development of shoots from the explants.

(2)

1 .....

2 .....

PreAPlar

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(ii) Using the information in the graph, explain the effect of pH on the development of shoots from explants of almond trees.

(3)

(Total for Question 4 = 9 marks)

Exemplar

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5 The biodiversity of species in Costa Rica is one of the highest in the world.

Costa Rica represents 0.3% of the Earth's total land area. It has 4% of all identified species of living organisms. Many of these species live in the rainforests of this country.

(a) (i) Explain what is meant by the term **biodiversity**.

(2)

(ii) Describe how the species richness of the rainforests in Costa Rica could be measured.

(1)

(b) A study was carried out to investigate the antimicrobial properties of plants found in Costa Rica. The species tested are all used in traditional medicine.

Nine of the species tested showed antimicrobial properties and six of these species are found only in the rainforest.

(i) Suggest why the results of this investigation support the need to maintain biodiversity.

(2)

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*(ii) The species tested included the Jatobá plant, *Hymenaea courbaril*.

The photograph shows leaves, flowers and seed pods of the Jatobá plant.



©Smithsonian Tropical Research Institute

Magnification ×0.3

Describe how the antimicrobial properties of the seeds of the Jatobá plant could be tested.

(5)

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(iii) Some of the plants tested could be used to develop new drugs to treat diseases caused by bacteria.

Before these drugs could be approved for use, they would have to be tested on animals and healthy volunteers.

Suggest why these drugs would have to be tested on animals and healthy volunteers.

(2)

(Total for Question 5 = 12 marks)

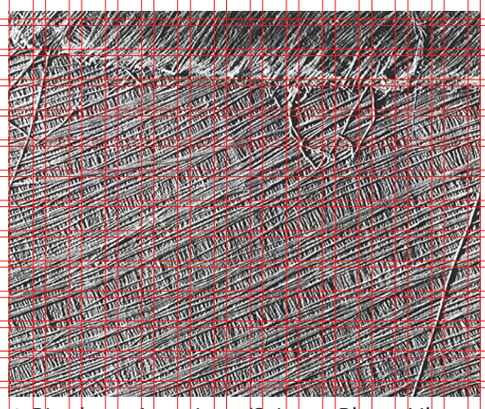
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Example

6 The photograph below shows part of a cellulose cell wall, as seen using an electron microscope.



© Biophoto Associates/Science Photo Library

Magnification ×70 000

(a) Using the information in the photograph and your own knowledge, describe the structure of a cellulose cell wall.

(3)

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(b) Cellulose can be used to produce biofuel. The xylem tissue in wood is a good source of cellulose. The cell walls of this tissue are heavily lignified.

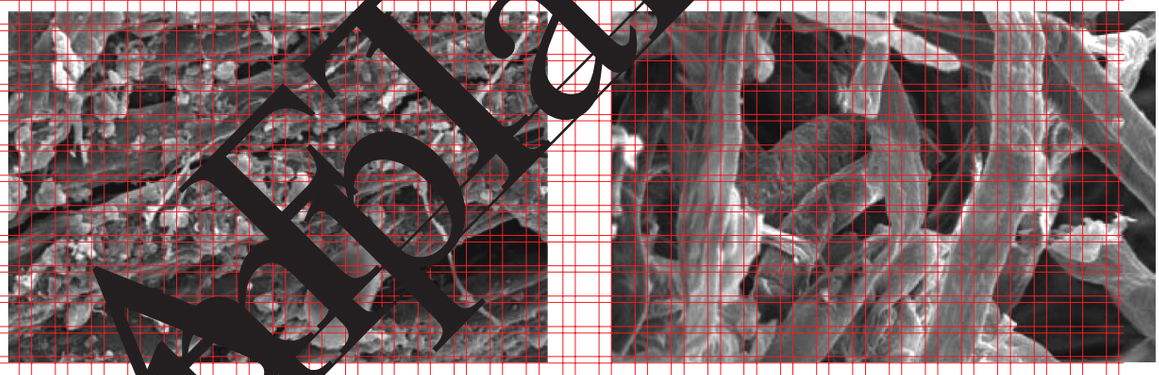
(i) Explain what is meant by the term **tissue**.

(2)

(ii) The cellulose in the xylem tissue of wood has to be broken down by enzymes before it can be used to produce biofuels.

The lignin has to be removed before the enzymes can be used to break down the cellulose.

The photographs below show fibres containing cellulose before and after the removal of lignin.



Before removal of lignin

After removal of lignin

Source: SciELO

Magnification ×500

Using the information from the photographs, suggest how lignin adds strength to xylem tissue.

(2)

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(c) Mineral ions such as calcium, nitrate and magnesium are transported in the xylem vessels. These mineral ions are dissolved in water.

(i) Describe how the structure of xylem vessels allows them to transport water.

(2)

(ii) Explain how calcium, nitrate and magnesium ions are used by plants.

(3)

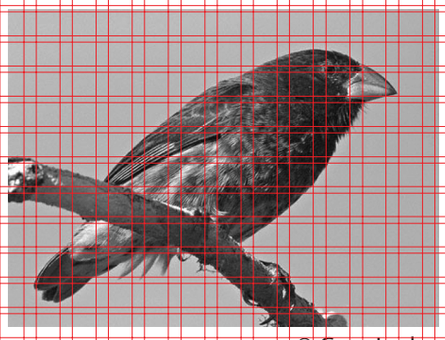
DreAmPlar

(Total for Question 6 = 12 marks)

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7 The finches of the Galapagos Islands have different shaped beaks to feed on different food sources.

The photograph below shows one of these finches, the medium ground finch, *Geospiza fortis*. The medium ground finch has a deep beak that enables it to crush seeds.

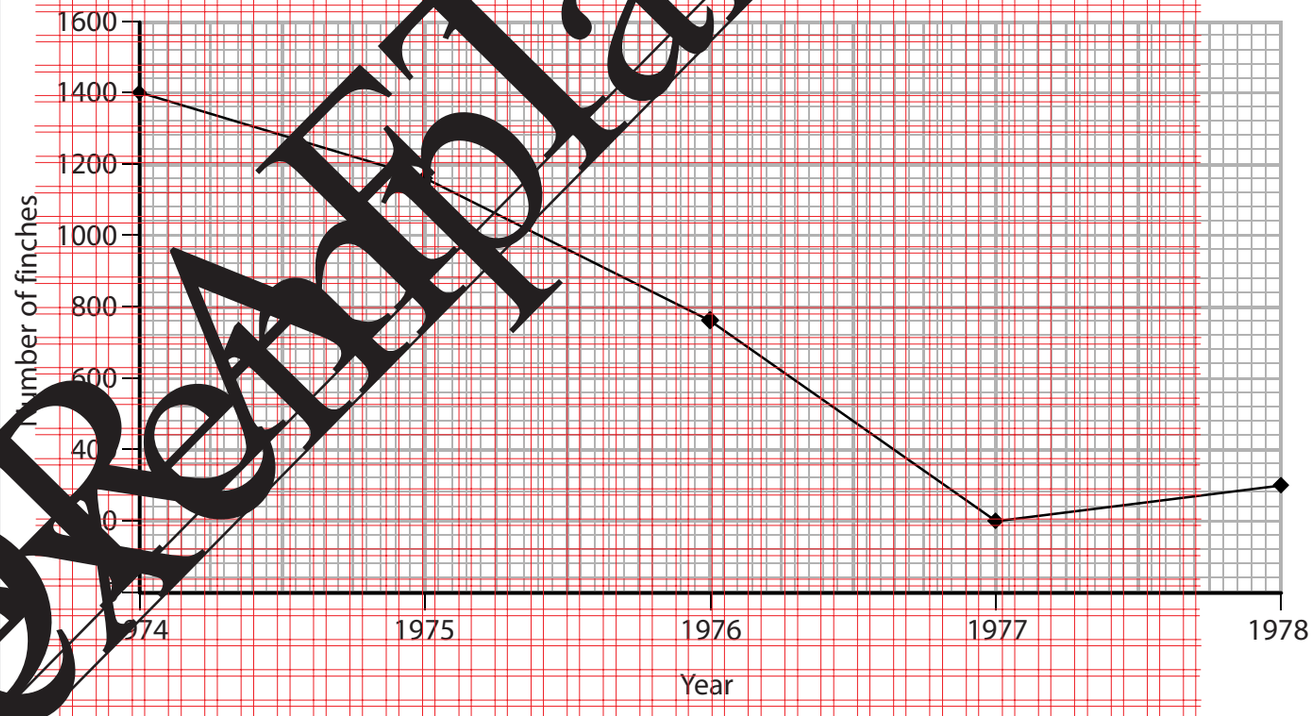


© Greg Lasley

Magnification ×0.5

In the 1970s, there was a severe drought on the Galapagos Islands. This caused a decrease in the production of the seeds eaten by this finch.

The graph below shows the number of medium ground finches, on one of the Galapagos islands, from 1974 to 1978.



Exemplar

P 4 5 0 6 8 A 0 2 1 2 8

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(a) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) The deep beak of the medium ground finch is an example of

(1)

☒ **A** anatomical adaptation

☒ **B** behavioural adaptation

☒ **C** physiological adaptation

☒ **D** selective adaptation

(ii) The number of medium ground finches fell most rapidly from

(1)

☒ **A** 1974 to 1975

☒ **B** 1975 to 1976

☒ **C** 1976 to 1977

☒ **D** 1977 to 1978

(b) Medium ground finches have a range of beak sizes.

Suggest an explanation for the variation in beak size in medium ground finches.

(2)

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(c) One of the few plants that survived during the drought produces seeds in large, tough fruits. These are very difficult to eat for birds with small beaks.

Sampling the birds that survived and those that died provided the data shown in the table below.

Mean beak size / mm	Dead birds	Survivors
length	10.69	11.07
depth	9.42	9.96

As the population of the medium ground finches recovered, the mean beak size of the offspring increased.

Using the information in the table, suggest how this increase in mean beak size was brought about by natural selection.

(4)

(Total for Question 7 = 8 marks)

DxEAmPlar

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8 In 2014 at Longleat Safari Park, a decision was made to humanely kill a female lion and four of her cubs. These lions showed violent and aggressive behaviour to other lions.

These lions had serious genetic defects caused by inbreeding.

(a) (i) Suggest how inbreeding could have led to genetic defects in these lions.

(2)

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(ii) Describe how breeding programmes at zoos are designed to reduce the risk of inbreeding.

(4)

Exemplar

(b) When the female lion was first brought to Longleat Safari Park, the zookeepers noted symptoms including tremors, uncoordinated movements and aggressive behaviour.

It was thought that these problems were due to a poor diet when she was younger.

Her cubs were given a better diet at Longleat but they had the same symptoms as their mother.

Suggest what could have been the main cause of the problems in these lions.
Give a reason for your answer.

(2)

(Total for Question 8 = 8 marks)

TOTAL FOR PAPER = 80 MARKS

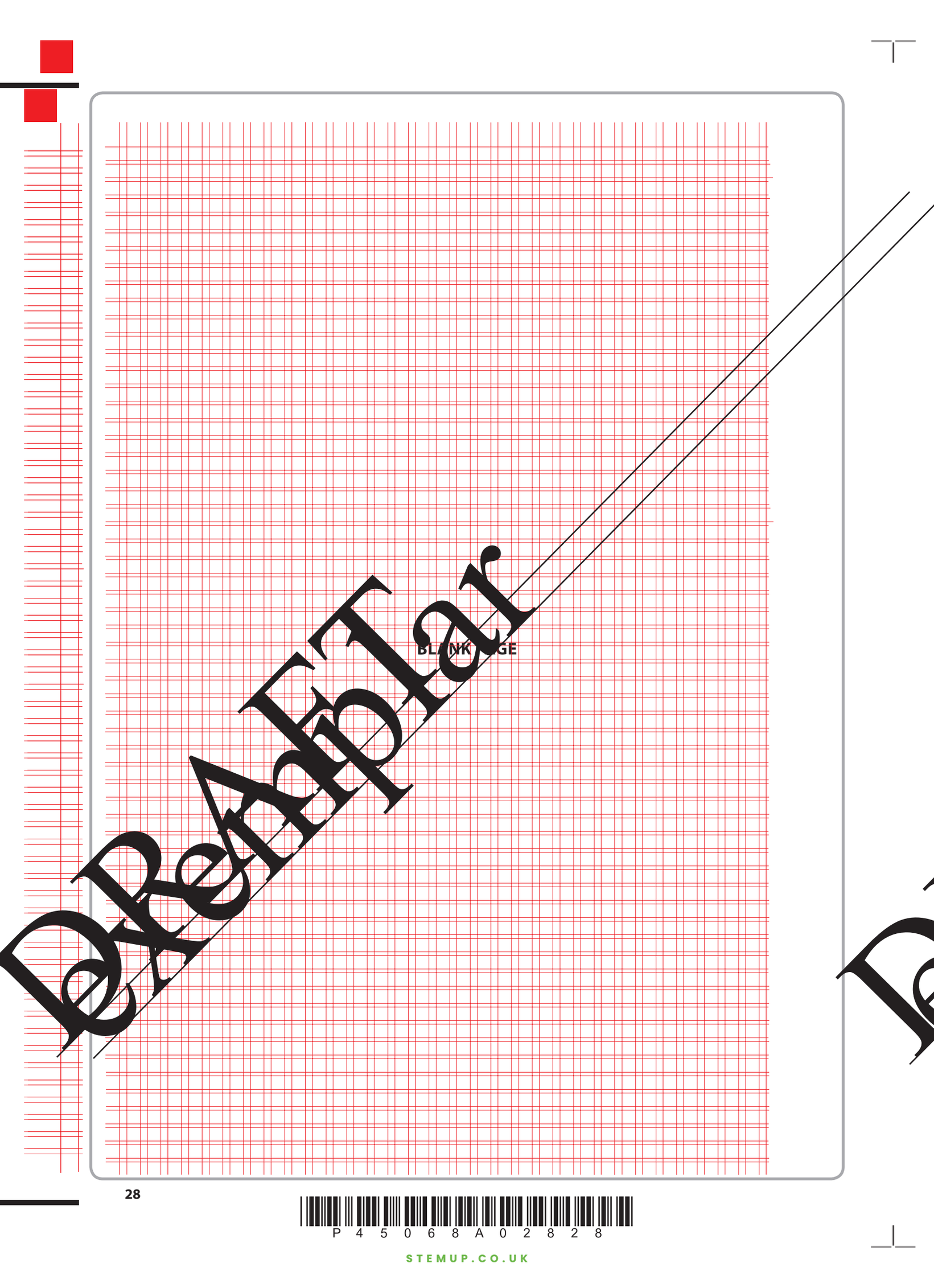
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P 4 5 0 6 8 A 0 2 7 2 8



P 4 5 0 6 8 A 0 2 8 2 8

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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCE in Biology (6BI02) Paper 01 Development, Plants and the Environment

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Summer 2015
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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.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th>Organelles</th><th>Prokaryotic cell</th><th>Eukaryotic cell</th></tr>
<tr><td>centrioles</td><td>x</td><td>✓</td></tr>
<tr><td>flagella</td><td>✓</td><td>✓</td></tr>
<tr><td>Golgi apparatus</td><td>x</td><td>✓</td></tr>
<tr><td>ribosomes</td><td>✓</td><td>✓</td></tr>
</table>
1 mark for any two correctly completed boxes ;
</td><td>Blanks are incorrect
Composite tick and cross are incorrect unless clearly replaced</td><td>(4)</td></tr>
</table>

Question Number	Answer	Mark
1(b) (i)	D mitochondria, rough endoplasmic reticulum and smooth endoplasmic reticulum;	**(1)**

Question Number	Answer	Mark
1(b) (ii)	B plasmodesmata ;	**(1)**

Question Number	Answer	Mark
1(b) (iii)	D a cell wall and ribosomes ;	**(1)**

Question Number	Answer	Mark
1(b) (iv)	B molecular phylogeny ;	**(1)**

Question Number	Answer	Mark
1(b) (v)	B Archaea and Bacteria ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)	**(QWC - Take into account quality of written communication when awarding the following points)** 1. Idea that in the rER insulin is folded e.g. forms {3-D shape, secondary / tertiary structure } ; 2. idea of insulin being packaged into (transport) vesicles by the rER ; 3. vesicles { move to / fuse with / eq } the Golgi apparatus / vesicles (fuse to) form the Golgi apparatus ; 4. idea of insulin being changed in Golgi apparatus ; 5. idea of insulin being transferred in (secretory) vesicles from the Golgi apparatus to the cell (surface) membrane ; 6. vesicles (containing insulin) fuse with cell (surface) membrane / exocytosis ;	**QWC emphasis on logical sequence** ACCEPT Golgi and protein instead of insulin 4.IGNORE folded, processed ACCEPT modified, described change e.g. add / remove sugars, glycosides, carbohydrate	**(4)**

Question Number	Answer	Mark
2(b)(i)	C unspecialised cells that can differentiate to give rise to almost any type of cell in the body, excluding totipotent cells ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. idea of stimulus e.g. chemical ; 2. idea that some genes are { active / switched on / expressed } ; 3. idea of { transcription / mRNA produced } at active genes ; 4. mRNA is {translated / used} to produce protein ; 5. idea that this protein modifies cell OR idea that this protein determines { cell structure / function } ;	2. IGNORE genes being 'turned on'	**(4)**

Question Number	Answer	Mark
3(a)(i)	13.1 ;	**(1)**

Question Number	Answer	Mark
3(a)(ii)	16.0 / 16 (%) ;	**(1)**

Question Number	Answer	Mark
3(a)(iii)	mitochondria / mitochondrion ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(iv)	1. idea of more sperm (cells) with defective flagella ; 2. idea that flagella needed to move sperm (cells) ; 3. idea of more sperm (cells) with defective mid-piece ; 4. idea that if mitochondria are affected there is no { respiration / energy / ATP } (for movement of flagella) ;	1. needs to be comparative ACCEPT only 4% in control 2. ACCEPT swim 4.ACCEPT damaged or fewer mitochondria ACCEPT less energy, less respiration or less ATP	**(4)**

Question Number	Answer	Additional Guidance	Mark
3(b)	1. (acrosome contains) { acrosin / enzyme / eq } ; 2. Reference to acrosome reaction ; 3. idea that { zona pellucida / jelly layer } needs to be digested ; 4. sperm (cell) needs to { reach / fuse with } cell (surface) membrane of egg / eq ;	3. ACCEPT broken down	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(c)	1. idea that smoking causes {damage to sperm / infertility} ; 2. idea of smoking as a variable to be controlled ; 3. idea of making sure that any effects were due to globozoospermia OR idea of difficulty in distinguishing between genetic and environmental factors ;	3. e.g. difficult to tell if it was due to smoking or disease	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	1. reference to aseptic technique ; 2. using sterilised { containers / agar / growth medium / equipment / eq } / eq ; 3. idea of sealing the container ;	 2. IGNORE clean the bench ACCEPT tweezers, loops 3. ACCEPT use clingfilm, cotton wool, put lid on, foil	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	1. idea of contaminants causing {infection / disease / eq} of plant (tissue) ; 2. idea of contaminants compete (for nutrients) ; 3. idea of contaminants causing { poor growth / decay / death } / eq ;	1. ACCEPT pathogen of plant 2.NOT for light	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	1. light ; 2. temperature ; 3. humidity ; 4. sugar / glucose / sucrose ; 5. minerals / mineral ion(s) / named mineral ion ;	1. ACCEPT sunlight, wavelength 3. IGNORE water, moisture 5. e.g. nitrate	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	1. increase in number of shoots per explant { between pH 4.5 and 6.0 / up to pH 6.0 } ; 2. pH 6 is {optimum / highest number of shoots} / lowest number of shoots at pH 4.5 ; 3. idea of effect of pH on protein or enzyme ; 4. description of the consequence of this change on {metabolism / uptake of nutrients / eq} ;	1. ACCEPT positive correlation up to 6.0 2. IGNORE goes up and then down ACCEPT pH 6 is best 4. ACCEPT effect on named cell process	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	1. {number / range / variety / eq} of species ; 2. genetic variety within a species / number of different alleles in a {species / gene pool} ;	1. ACCEPT amount	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	idea of (counting) number of species in a known area of rainforest ;	ACCEPT use a quadrat to count species	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	1. idea that loss of biodiversity means fewer species ; 2. idea that the loss of endemic species leads to extinction ; 3. idea that species {lost / not yet discovered / eq} may be useful ;	3. ACCEPT plants lost may be useful	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	**(QWC - Take into account quality of written communication when awarding the following points)** 1. extract made from seeds (of Jatoba) / eq ; 2. agar plate with bacteria / culture of bacteria grown in nutrient broth / eq ; 3. description of aseptic technique ; 4. idea of extract (of Jatoba) placed on (paper) disc OR in a well cut into the agar OR added to broth ; 5. control described e.g. disc plus solvent only ; 6. incubated at temperature in range 20 to 30°C AND stated time in range 1 to 7 days ; 7. (look for) zone of inhibition / clarity of broth / eq ; 8. replication qualified e.g. { repeat the experiment / repeats to calculate mean } ;	**Clarity of expression** 1. ACCEPT description 2. ACCEPT bacterial lawn 7. ACCEPT clear area around extract 8. IGNORE repeat unqualified	**(5)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	1. idea of testing on animals for toxicity ; 2. idea of testing on healthy volunteers to determine side effects ; 3. idea of finding out how the drug is metabolised ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
6(a)	1. cellulose (molecule) is a { polymer / chain / eq } of β-glucose / eq ; 2. cellulose molecules held together { by hydrogen bonds / as microfibrils } ; 3. idea of arrangement of microfibrils in { parallel / net / mesh / criss cross / eq } ; 4. reference to { matrix / hemicelluloses /pectin / eq } ;	1. ACCEPT many β-glucose 4. IGNORE lignin	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	1. { group of / many / several / eq } cells ; 2. idea that the cells in a tissue { work together / eq } for a common function ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	1. idea that lignin holds the { fibres / microfibrils } together ; 2. lignin keeps { fibres / microfibrils } parallel / eq ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
6(c)(i)	1. { hollow / no cytoplasm / eq } ; 2. idea that vessels { have no end walls / are open at the ends } ; 3. vessels { have pits / are strong so that they do not collapse } ; 4. lignin makes the walls waterproof / eq ;	1. IGNORE dead, tube ACCEPT has a lumen 3. ACCEPT strong to keep tube open	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(c)(ii)	1. nitrate for production of { amino acids / protein / DNA / nucleic acids / bases / eq } ; 2. calcium for { pectate / pectin / middle lamella } ; 3. magnesium for chlorophyll ;	1. ACCEPT chlorophyll, enzymes	**(3)**

Question Number	Answer	Mark
7(a)(i)	A anatomical adaptation ;	**(1)**

Question Number	Answer	Mark
7(a)(ii)	C 1976 to 1977 ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)	1. genetic variation / different alleles / large gene pool ; 2. mutations ; 3. polygenic inheritance / eq ;	1. ACCEPT genetic diversity, different genotypes 3. ACCEPT more than one gene controls beak size	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(c)	1. selection pressure is { lack of food / tough food /eq} ; 2. idea of selection for the { longer / deeper} beaks ; 3. birds with shorter beaks died / reference to figures in table ; 4. birds with { advantageous/ eq } alleles (survive) to breed ; 5. { advantageous / eq} allele(s) passed onto offspring / eq ; 6. change in genotypes over generations / eq ;	2. ACCEPT they survive 4&5. IGNORE genes 6. e.g. increased frequency of alleles for longer and deeper beaks	**(4)**

Question Number	Answer	Additional Guidance	Mark
8(a)(i)	1. closely-related lions mated with each other / a small gene pool / eq ; 2. reference to inbreeding depression ; 3. idea of increased chance of homozygous recessive genotypes for genetic defects ;	 2. NOT interbreeding 3. NOT homologous ACCEPT recessive alleles more likely to be expressed	**(2)**

Question Number	Answer	Additional Guidance	Mark
8(a)(ii)	1. selection of { unrelated / genetically different } mates / eq ; 2. use of stud books / records of mating / DNA profiling / eq ; 3. exchange of animals between zoos / eq ; 4. exchange of gametes between zoos / eq ; 5. IVF / AI / eq ;		**(4)**

Question Number	Answer	Additional Guidance	Mark
8(b)	1. idea of { genetic cause / genetic mutations } ; 2. idea that a change in diet had no effect ; 3. reference to {monoamine oxidase (A) / MAOA} ; 4. idea of behaviour learnt from mother ;		**(2)**

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Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Monday 2 June 2014 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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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P 4 4 4 8 7 A 0 1 2 8

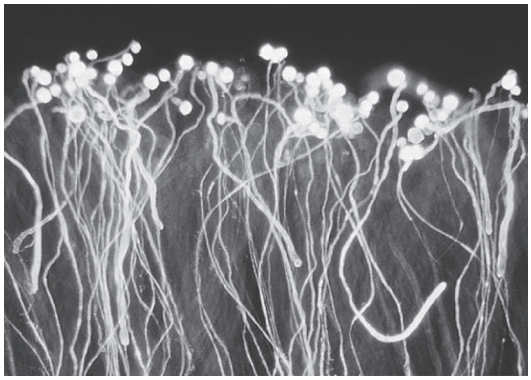
PEARSON

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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 photograph below shows pollen germinating on the stigma of a tomato flower.



Magnification ×100

(a) Explain how the pollen tubes grow through the style of the flower.

(2)

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(b) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) The tip of the pollen tube breaks through the micropyle to enter the

(1)

☒ **A** egg cell

☒ **B** embryo sac

☒ **C** ovary

☒ **D** style

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(ii) During fertilisation, nuclei from the pollen tube fuse with

(1)

☒ **A** the antipodal cells

☒ **B** the egg cell and the antipodal cells

☒ **C** the egg cell and the polar nuclei

☒ **D** the polar nuclei and the antipodal cells

(iii) During fertilisation, the following structures are produced

(1)

☒ **A** diploid zygote and diploid endosperm

☒ **B** diploid zygote and triploid endosperm

☒ **C** triploid zygote and diploid endosperm

☒ **D** triploid zygote and triploid endosperm

(c) Describe how the structure of a pollen grain differs from that of a sperm cell.

(2)

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(Total for Question 1 = 7 marks)

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2 In 1886, Sir Francis Galton claimed that the height of a child could be predicted by working out the mean height of its parents.

Scientists have since discovered that the inheritance of height is an example of polygenic inheritance.

(a) Explain what is meant by the term **polygenic inheritance**.

(2)

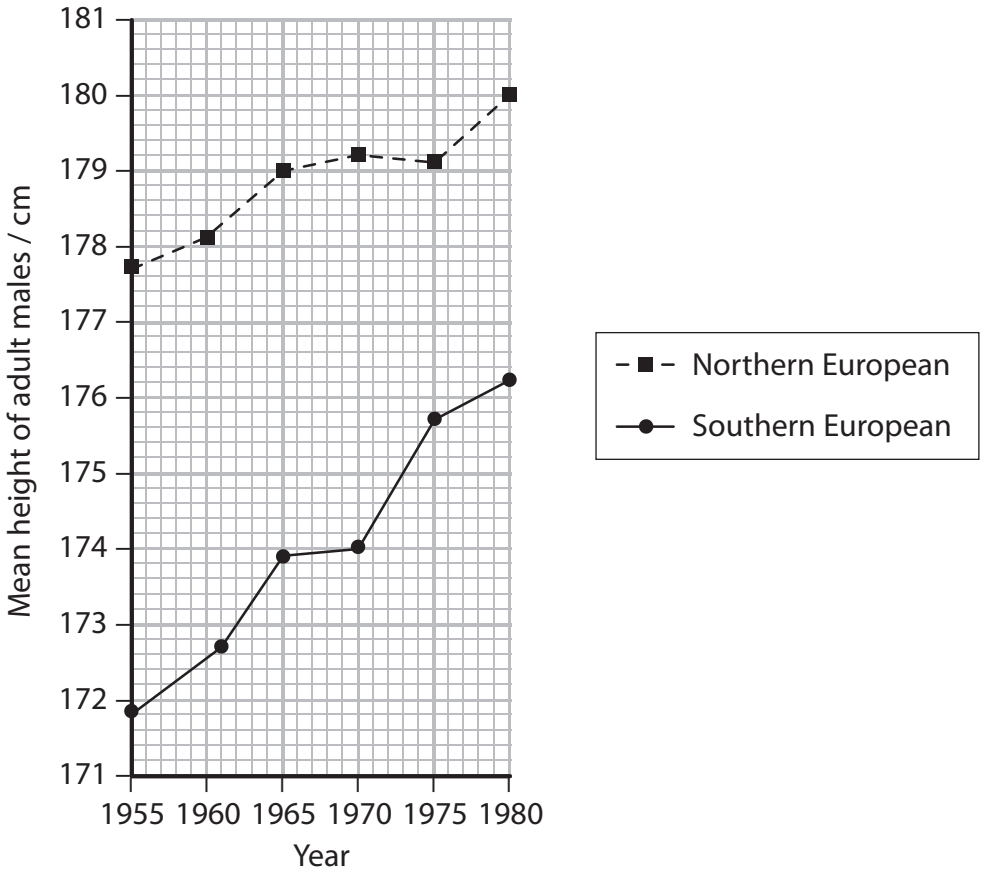
(b) Some scientists have suggested that diet may affect the growth of a child.

Explain how the height of an adult human demonstrates how environmental factors interact with genotype.

(3)

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(c) The graph below shows the mean height of populations of adult males in Northern and Southern Europe from 1955 to 1980.



(i) Using the information in the graph, describe the changes in mean height for adult European males from 1955 to 1980.

(3)

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(ii) Suggest an explanation for the changes in mean height of these two groups of adult males.

(2)

(Total for Question 2 = 10 marks)

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3 Prokaryotic and eukaryotic organisms can be classified depending on their cellular structure.

(a) Describe **three** structural differences between prokaryotic and eukaryotic cells.

(3)

(b) In 1977, Carl Woese suggested that there are three domains of living organisms: the Archaea, the Bacteria and the Eukaryota.

He used molecular phylogeny to classify organisms into different domains.

Explain what is meant by the term **molecular phylogeny**.

(3)

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(c) The table below shows some of the cellular features of organisms belonging to the three different domains.

Feature	Archaea	Bacteria	Eukaryota
Cell membrane	Branched hydrocarbon chains attached to glycerol by ether bonds	Unbranched fatty acid chains attached to glycerol by ester bonds	Unbranched fatty acid chains attached to glycerol by ester bonds
Ribosome size	70S	70S	80S
Number of protein molecules in RNA polymerase	10	5	12
Peptidoglycan in cell wall	No	Yes	No
Type of chromosome	Circular	Circular	Linear

(i) Using information from this table, give evidence that supports Woese's conclusion that the Archaea are distinct from **both** the Bacteria and the Eukaryota.

(2)

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(ii) Using information from the table, explain why the Archaea are thought to be more closely related to Eukaryota than to Bacteria.

(2)

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(Total for Question 3 = 10 marks)

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4 The root tip squash procedure can be used to observe cells undergoing mitosis.

(a) Explain the role of mitosis in the development of roots.

(2)

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(b) (i) The flow chart below describes the stages involved in staining a root tip squash to show mitosis.

Complete the flow chart by writing the most appropriate word or words on the dotted lines.

(3)

Stage 1

Carefully remove the root tip from an onion that has been grown in water

↓

Stage 2

Place the root tip in ..... acid,

which will ..... the tissue

↓

Stage 3

Rinse in distilled water and then add a few drops

of a stain such as .....

↓

Stage 4

Place the stained root tip on a .....

and then place a ..... on top

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(ii) Describe **one** safety precaution that should be taken when carrying out this procedure.

(1)

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*(c) Following mitosis, some cells undergo differentiation to become specialised tissues, such as xylem.

Explain how cells differentiate to become specialised tissues.

(4)

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(d) Similar staining techniques can be used to observe cells undergoing meiosis.

(i) Name a process that may be observed in cells undergoing meiosis but **not** mitosis.

(1)

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(ii) Explain how meiosis can give rise to genetic variation in the gametes produced.

(2)

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(Total for Question 4 = 13 marks)

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5 The photograph below shows seed pods of a Canola plant (*Brassica napus*). Canola is a plant grown as a crop because the seeds are rich in oil. The extracted oil is used in cooking and as a sustainable fuel.



Magnification ×0.1

(a) Suggest why the production of oil from Canola seeds can be described as **sustainable**.

(2)

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(b) Farmers provide the plants with fertiliser containing nitrate ions.

Explain the importance of nitrate ions for the growth of plants.

(2)

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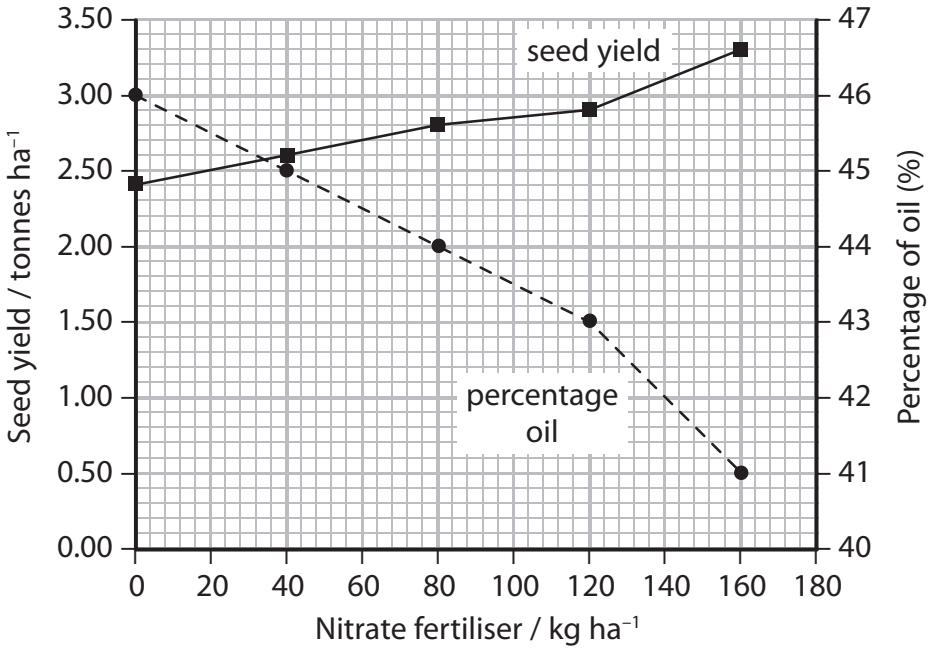
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(c) Scientists carried out an investigation into the effect of nitrate fertiliser on the yield.

The graph below shows the results of this investigation.



(i) Place a cross ☒ in the box next to the correct word or words to complete the following statement.

The mass of nitrate fertiliser added and the percentage of oil produced show

(1)

☒ **A** a negative correlation

☒ **B** no relationship

☒ **C** a positive correlation

☒ **D** a proportional relationship

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(ii) Using information in the graph, calculate the percentage change in seed yield when the level of nitrate fertiliser is increased from 0 to 160 kg ha^{-1}.

Show your working.

(3)

..... (%)

(iii) Suggest how the scientist could have ensured that this investigation was valid.

(4)

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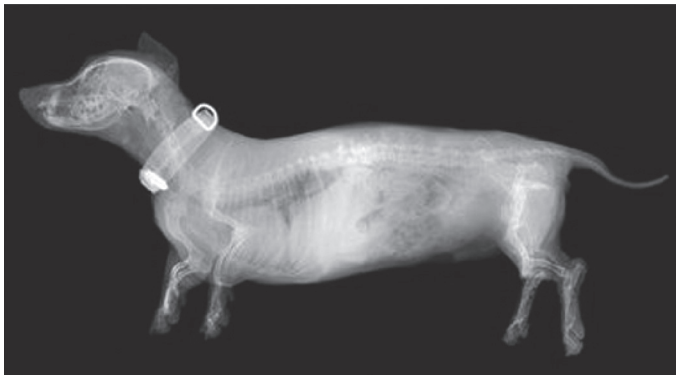
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(Total for Question 5 = 12 marks)

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6 The photograph below shows an X-ray of a dachshund. The dachshund is a breed of dog that is at higher risk of paralysis due to spinal injury.

Scientists have successfully used stem cells to reverse this paralysis.



Magnification ×0.02

(a) Suggest why stem cells can be used to reverse this paralysis.

(2)

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(b) The trial experiment was carried out on a dog that was paralysed due to a spinal injury and was unable to use its back legs.

The scientists extracted stem cells from the lining of the dog's nose. These cells were cultured for one month to increase their numbers. The stem cells were then injected into the injury site of this dog.

Suggest why stem cells were taken from this dog and not from another dog.

(2)

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(c) A further investigation was carried out on 34 dogs with spinal injuries. Some had stem cells injected into the site of the spinal injury. The others were injected with a fluid containing no stem cells. This fluid is called a neutral fluid.

Neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

The dogs that were given stem cells recovered the use of their back legs.

(i) Explain the reason for giving some of the dogs a neutral fluid instead of stem cells.

(2)

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(ii) Suggest why neither the scientists nor the owners knew which dogs had been given stem cells and which had been given the neutral fluid.

(1)

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(Total for Question 6 = 7 marks)

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7 The photograph below shows a coconut palm tree. These trees often grow on beaches near the sea. They can grow to a height of 25 metres.

The seedpod produced by the coconut tree has a thick fibrous husk that protects the seed from damage when it falls. This husk contains two types of fibre, white coir fibres and brown coir fibres.



Magnification ×0.003

(a) A student determined the mean tensile strength of white and brown coir fibres. The table below shows the mean tensile strength for the fibres and the ranges of the data.

Type of fibre	Length of fibre / mm	Tensile strength / MPa
White coir	5	192 ± 37
White coir	35	162 ± 32
Brown coir	5	343 ± 36
Brown coir	35	186 ± 55

(i) Using the data in the table, identify which type of fibre shows the lowest percentage variability in tensile strength.

Place a cross ☒ in the box next to the correct conclusion that can be drawn from the results shown in this table

(1)

☒ **A** long brown fibre

☒ **B** long white fibre

☒ **C** short brown fibre

☒ **D** short white fibre

(ii) The student concluded that brown coir fibres are stronger than white coir fibres.

Use the information in the table to comment on the validity of her conclusion.

(4)

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(b) Fibre cells in coir have a similar structure to sclerenchyma fibres.

(i) Suggest how the structure of the coir fibres makes them light, waterproof and strong.

(3)

(ii) White coir fibres are more flexible than brown coir fibres. Suggest how their structure may account for this difference in flexibility.

(1)

(Total for Question 7 = 9 marks)

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8 The photograph below shows Ethiopian wolves (*Canis simensis*). They live on isolated mountains at altitudes above 3000 metres. They are one of 19 endemic animal species living in the mountains of Ethiopia.



Magnification ×0.01

(a) Explain what is meant by the term **endemic species**.

(1)

(b) There are estimated to be only 500 Ethiopian wolves left in the wild, living in six separate populations. There are high levels of genetic diversity between these six populations.

The separate populations are geographically isolated. This prevents interbreeding between populations.

Suggest how this may affect the genetic diversity of each individual population.

(2)

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(c) Ethiopian wolves are endangered in the wild.

Some scientists have suggested that moving male wolves from one population to another may help the species survive.

Suggest how this strategy of transferring individuals from one population to another could help the species survive.

(2)

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(d) (i) The table below shows adaptations of the Ethiopian wolf that enable it to survive in its mountain habitat. Place a cross (✗) in the table that correctly describes whether the adaptation is behavioural, anatomical or physiological.

(3)

Adaptation	Behavioural	Anatomical	Physiological
Small sharp teeth widely-spaced to cope with small prey			
Narrow snout to fit into small gaps when hunting small prey			
Hunting alone, as prey are too small to share with other wolves			

*(ii) Suggest how natural selection has led to the evolution of this species of wolf, adapted for life in the mountains of Ethiopia.

(4)

(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 80 MARKS

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Mark Scheme (Results)

Summer 2014

GCE Biology (6BI02)
Paper 01

Unit 2: Development, Plants and Environment
Version Final

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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.

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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.

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Question Number	Answer	Additional guidance	Mark
1(a)	1. idea of enzymes being {produced / released / secreted / eq} ; 2. idea of these enzymes being used to {digest / break down / eq} (tissues of style) ; 3. idea of forming a pathway ;	2. ACCEPT digest it	(2)

Question Number	Answer	Mark
1(b) (i)	B embryo sac ;	(1)

Question Number	Answer	Mark
1(b) (ii)	C the egg cell and the polar nuclei ;	(1)

Question Number	Answer	Mark
1(b) (iii)	B diploid zygote and triploid endosperm ;	(1)

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Question Number	Answer	Additional guidance	Mark
1(c)	1. pollen grain does not possess flagellum / eq ; 2. pollen grain does not have an acrosome ; 3. idea of {more / 2 / 3} nuclei in pollen grain ; 4. idea of difference in outer boundary e.g. exine in pollen grains ;	ALLOW converse points 1. ACCEPT tail or undulipodium 2. IGNORE lysosome 4. ACCEPT cell wall	**(2)**

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Question Number	Answer	Additional guidance	Mark
2(a)	1. idea of more than one gene for a single characteristic ; 2. at different loci / eq ; 3. idea of giving rise to continuous variation ;	1. IGNORE alleles ACCEPT 'a phenotype' if specific	**(2)**

Question Number	Answer	Additional guidance	Mark
2(b)	1. malnutrition / lack of { nutrients / a named nutrient e.g. protein, calcium / eq } ; 2. idea of nutrient required for specified growth e.g. muscle, bone ; 3. idea of other relevant environmental factor that affects expression of genotype for height e.g. health ; 4. idea of an environmental factor determining achievement of (genetic) potential ;	1. ACCEPT deficiency 3. ACCEPT disease	**(3)**

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<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>2(c)(i)</td>
<td>1. increased for { all / both Northern and Southern } Europeans / eq ;

2. greater increase for Southern Europeans than Northern Europeans / faster rate of increase for Southern Europeans ;

3. idea of greatest increase for Southern Europeans from 1970 to 1975 ;

4. idea of fall in height for Northern Europeans between 1970 and 1975 ;

5. manipulation of data to either show the increase of both or to show that the increase was greater for Southern Europeans than Northern Europeans ;</td>
<td>1. ACCEPT separate comments for North and South

2. ACCEPT converse

Mp2 can also gain Mp1 if height referred to

5. ACCEPT as mm
<table>
<tr><th></th><th>Increase</th><th>increase as %</th></tr>
<tr><td>Southern</td><td>4.3 - 4.4 cm</td><td>2.5-2.6%</td></tr>
<tr><td>Northern</td><td>2.3cm</td><td>1.29 or 1.3%</td></tr>
<tr><td>Difference between N and S Europeans</td><td>2 / 2.1 cm more for SE</td><td></td></tr>
</table>
</td>
<td>(3)</td>
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Question Number	Answer	Additional guidance	Mark
2(c)(ii)	1. idea of change in diet or differences in diets between Northern and Southern Europeans ; 2. difference in diet described, eg more protein ; 3. idea of improved health care or better sanitation ; 4. less effects of disease on growth / eq ; 5. differences due to migration / eq ; 6. idea of changes to gene pool as a result of migration ;	4. ACCEPT idea of vaccinations	**(2)**

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Question Number	Answer	Additional guidance	Mark
3(a)	1. presence of { membrane bound / named membrane bound } organelle in eukaryotic cells / eq ; 2. presence of { plasmids / slime capsule / pili / eq} in prokaryotic cells ; 3. size of ribosomes i.e. larger in eukaryotic cells / 70S in prokaryotes and 80S in eukaryotes / eq ; 4. DNA in a nucleus in eukaryotic cells /eq ; 5. { DNA / chromosome } linear in eukaryotic cells and circular in prokaryotic cells / eq ; 6. relevant comment regarding cell walls e.g. cell walls always present in prokaryotic cells, only in some eukaryotic cells;	ACCEPT converse where appropriate 1. ACCEPT reference to a named organelle such as mitochondria or nucleus present in eukaryotic cells and NOT in prokaryotic cells 2. ACCEPT reference to mesosomes 6. cell walls in prokaryotic cells contain{ peptidoglycan / murein} and in eukaryotic cells they contain {cellulose /chitin }	**(3)**

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Question Number	Answer	Additional guidance	Mark
3(b)	1. idea of molecular { differences / similarities } ; 2. in { DNA / RNA } ; 3. in proteins / proteomics ; 4. idea of (evolutionary) relationships between organisms ;	2. ACCEPT base sequences 3. ACCEPT amino acid sequences 4. ACCEPT idea of closely related species	**(3)**

Question Number	Answer	Additional guidance	Mark
3(c)(i)	1. idea of cell membrane being different ; 2. idea of different number of protein molecules ;	1. ACCEPT description of difference e.g. ether bonds, branched hydrocarbons 2. ACCEPT NOT same number, they have 10 protein molecules	**(2)**

Question Number	Answer	Additional guidance	Mark
3(c)(ii)	1. number of protein molecules is closer to Eukaryota than to Bacteria / eq ; 2. no peptidoglycan in cell wall ;		**(2)**

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Question Number	Answer	Additional guidance	Mark
4(a)	1. idea of increasing cell number ; 2. idea of replacing {damaged / dead } cells OR idea of repairing (damaged) tissue ; 3. to produce genetically identical cells ;	1. ACCEPT 'production of new cells' and cells divide multiply or replicate 2. NOT growth or repair of cells	**(2)**

Question Number	Answer	Additional guidance	Mark
4(b)(i)	Stage 2. { hydrochloric / acetic / ethanoic } AND { macerate / soften / separate / break up / eq } ; Stage 3. Toluidine (blue) / orcein / Feulgen / Schiff's (reagent) ; Stage 4. Slide AND { coverslip / cover slide } ;	Stage 2. ACCEPT HCl, ACCEPT break down Stage 3. ACCEPT ethanoic /acetic / proprionic orcein. ACCEPT unambiguous spellings that couldn't be anything other than the name of a stain	**(3)**

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Question Number	Answer	Additional guidance	Mark
4(b)(ii)	1. { safety goggles / safety glasses / gloves } when handling { acid / stain } 2. care (with scalpel) when cutting root tip 3. care with slide when squashing root tip ;	IGNORE lab coats protecting clothes	**(1)**

Question Number	Answer	Additional guidance	Mark
4(c)	**(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. idea of chemical stimulus e.g. signal protein, growth substance ; 2. idea of some genes {active / inactive / eq} ; 3. idea of transcription of active genes ; 4. mRNA translated / { polypeptide / protein } made / eq ; 5. idea of cell {structure / function} determined / cell modified e.g. lignin synthesised ;	**QWC emphasis is logical sequence** 1. ACCEPT hormone 2. ACCEPT genes switched on / off 3. ACCEPT mRNA synthesised	**(4)**

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Question Number	Answer	Additional guidance	Mark
4(d)(i)	chiasmata / pairing of homologous chromosomes / synapsis / formation of bivalents ;	IGNORE non-observable processes that are different ACCEPT crossing over ACCEPT spelling of chiasmata as chaismata or phonetically correct	**(1)**

Question Number	Answer	Additional guidance	Mark
4(d)(ii)	1. crossing over and { independent/ random} assortment ; 2. description of crossing over as swapping over sections of { chromatid / DNA } ; 3. description of independent assortment of maternal and paternal chromosomes ; 4. consequence described e.g. produces recombinants or new combinations of alleles ;	1. this mark can be awarded if there are no correct details provided for either process	**(2)**

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Question Number	Answer	Additional guidance	Mark
5(a)	1. renewable / eq ; 2. resources can be made available for future generations / will not run out / eq ; 3. more (Canola) plants can be grown / eq ;	2. ACCEPT not finite ACCEPT references to either oil or plants not running out	**(2)**

Question Number	Answer	Additional guidance	Mark
5(b)	1. amino acids OR proteins ; 2. idea of used in synthesis of { nucleic acids / DNA / ATP} ; 3. idea of how this organic compound is used in growth;	2. ACCEPT RNA, NAD, NADP, ADP, chlorophyll 3. (amino acids) for the synthesis of proteins, (proteins) as enzymes, (nucleic acids) for cell division, (ATP) as an energy source	**(2)**

Question Number	Answer	Mark
5(c) (i)	A a negative correlation ;	**(1)**

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Question Number	Answer	Additional guidance	Mark
5(c)(ii)	1. correct values from graph, i.e. 2.40 and 3.30 ; 2. difference divided by 2.4, e.g. (0.9 ÷ 2.4)x 100 ; 3. 37.5 (%) ;	Correct answer gains 3 marks 1. 2.4 and 3.3 2. (3.30-2.40)x100/2.40 ACCEPT (difference ÷ original value)x 100 if incorrect values selected from graph	**(3)**

Question Number	Answer	Additional guidance	Mark
5(c)(iii)	1. idea of using genetically similar plants e.g. raised from seeds from same plant, clones ; 2. idea of repeats {at each level of nitrate fertiliser / used to produce mean data / to identify outliers or anomalies} ; 3. environmental variable related to soil controlled e.g. soil pH, concentration of other mineral ions ; 4. another environmental variable controlled e.g. temperature, light (intensity), water ; 5. idea of control described, e.g. no nitrate/ soil with no extra nitrate ; 6. idea of same method of extraction of oil used ;	IGNORE reference to time as the investigation is measuring seed production 1. ACCEPT cuttings 3. ACCEPT same area, location	**(4)**

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Question Number	Answer	Additional guidance	Mark
6(a)	1. reference to stem cells being {totipotent / pluripotent} ; 2. can specialise or differentiate / can give rise to {differentiated / specialised} cells ; 3. idea that these can replace damaged cells (in spinal cord of Dachshund) / new nervous tissue can be formed / eq ; 4. capable of continuous division / no Hayflick limit ;	1. IGNORE unspecialised 2. IGNORE stem cells 'turn into' or 'become' 3. ACCEPT new nerve cells	**(2)**

Question Number	Answer	Additional guidance	Mark
6(b)	1. cells genetically identical / same genotype / eq ; 2. no rejection / avoids immune response / eq ; 3. idea of no disease transmission ;	IGNORE tumours, cancer 1. ACCEPT reference to same tissue type or same antigens – NOT the same DNA 2. NOT **reduced** risk of rejection ACCEPT idea of no need for immunosuppressant drugs 3. ACCEPT – reduced risk of infection	**(2)**

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Question Number	Answer	Additional guidance	Mark
6(c)(i)	1. reference to placebo OR idea of being used as a control ; 2. to compare with stem cell treatment / eq ;	1. IGNORE placebo effect	(2)

Question Number	Answer	Additional guidance	Mark
6(c)(ii)	1. to remove bias / eq 2. idea of making it a double blind trial ;		(1)

Question Number	Answer	Mark
7(a)(i)	C short brown fibre	(1)

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<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr>
<td>7(a)(ii)</td>
<td>1. conclusion {valid / eq} for 5mm coir fibres / eq ;

2. (valid) because {ranges/ data} do not overlap (for 5mm fibres) eq ;

3. not valid for 35mm coir fibres / eq ;

4. (not valid) because {no significant difference / there is overlap of data / eq} (for 35mm fibres) ;

5. (not valid) because 5mm white fibres are stronger than 35mm brown fibres / eq ;

6. manipulation of data to support {overlap / no overlap / difference} ;</td>
<td>ACCEPT reference to short for 5mm and long for 35 mm fibres.

6.
<table>
<tr><th></th><th>5mm white coir</th><th>35mm white coir</th></tr>
<tr><td>5mm brown coir</td><td>151 MPa</td><td>181 MPa</td></tr>
<tr><td>35mm brown coir</td><td>white fibres 6 MPa more</td><td>brown fibres 24 MPa more</td></tr>
</table>
</td>
<td>(4)</td>
</tr>
</table>

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Question Number	Answer	Additional guidance	Mark
7(b)(i)	1. they are light because of {lack of cytoplasm / hollow / no cell contents / eq} ; 2. strong due to presence of {lignin / thickened cell walls} ; 3. waterproof due to lignin ;		(3)

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	less { lignin / lignified} / thinner cell walls ;	IGNORE no lignin	(1)

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Question Number	Answer	Additional guidance	Mark
8(a)	idea of found in only one specific geographical location ;	ACCEPT reference to {one / the} area / place IGNORE habitat or environment	(1)

Question Number	Answer	Additional guidance	Mark
8(b)	1. idea that genetic diversity {will be low / decreases / stays the same } OR idea of smaller gene pool ; 2. closely related wolves mating / inbreeding / eq ; 3. risk of inbreeding depression / more chance of homozygous recessive genotypes / eq ; 4. risk of genetic drift / eq ;	2. NOT inTERbreeding Do not give this mark for "inbreeding depression" 3. ACCEPT greater risk of genetic disorders 4. ACCEPT reference to loss of alleles	(2)

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Question Number	Answer	Additional guidance	Mark
8(c)	1. idea that this increases the gene pool ; 2. idea that this increases potential for the species to { adapt / survive } ; 3. description of how this will increase survival e.g. better hunters, disease resistance ;	1. ACCEPT introduction of genetically different individuals, { new / different } alleles introduced into population 2. ACCEPT population but not individuals	**(2)**

Question Number	Answer	Additional guidance	Mark
8(d)(i)	<table><tr><th>Adaptation for the Ethiopian wolf</th><th>Behavioural</th><th>Anatomical</th><th>Physiological</th></tr><tr><td>Small sharp teeth widely spaced to cope with small prey</td><td></td><td>X</td><td></td></tr><tr><td>Narrow snout to fit into small gaps when hunting small prey</td><td></td><td>X</td><td></td></tr><tr><td>Hunting alone, as prey too small to share with other wolves</td><td>X</td><td></td><td></td></tr></table>	**ACCEPT in the cells indicated a cross or tick**	**(3)**

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Question Number	Answer	Additional guidance	Mark
8(d)(ii)	**(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. genetic variation in population / variation due to mutation / eq ; 2. description of selection pressure ; 3. idea that some individuals possessed { advantageous / beneficial / eq } characteristics ; 4. (therefore) survived to adulthood / survived to breed ; 5. passing on {advantageous alleles / eq} (to offspring) / eq ; 6. change in allele frequency (over generations) / eq ; 7. idea of {geographical / reproductive} isolation ;	**QWC emphasis is clarity of expression** 2. ACCEPT small prey 5. NOT just passing on a characteristic or genes	**(4)**

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Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Monday 3 June 2013 – Morning
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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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P 3 9 8 8 5 A 0 1 2 4

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 A student studied three different cells: an animal cell, a bacterial cell and a plant cell.

For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(a) DNA is located in the nucleus in

(1)

☒ **A** the animal cell only

☒ **B** the bacterial cell only

☒ **C** two of the cells only

☒ **D** all three cells

(b) A cell wall is present in

(1)

☒ **A** the animal cell only

☒ **B** the bacterial cell only

☒ **C** the plant cell only

☒ **D** two of the cells only

(c) Centrioles are present in

(1)

☒ **A** the animal cell only

☒ **B** the plant cell only

☒ **C** two of the cells only

☒ **D** all three cells

(d) The cell membrane is found in

(1)

☒ **A** the bacterial cell only

☒ **B** the plant cell only

☒ **C** two of the cells only

☒ **D** all three cells

Reamar

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(e) Mitochondria are found in

(1)

- ☒ **A** the bacterial cell only
- ☒ **B** the plant cell only
- ☒ **C** two of the cells only
- ☒ **D** all three cells

(f) Ribosomes are found in

(1)

- ☒ **A** the animal cell only
- ☒ **B** the bacterial cell only
- ☒ **C** two of the cells only
- ☒ **D** all three cells

(g) Smooth endoplasmic reticulum (SER) is present in

(1)

- ☒ **A** the animal cell only
- ☒ **B** the bacterial cell only
- ☒ **C** the plant cell only
- ☒ **D** two of the cells only

(h) Amyloplasts may be present in

(1)

- ☒ **A** the animal cell only
- ☒ **B** the bacterial cell only
- ☒ **C** the plant cell only
- ☒ **D** all three cells

(Total for Question 1 = 8 marks)

Exemplar

2 Several processes lead up to fertilisation in animals and plants.

*(a) Describe and explain how, in mammals, events following the acrosome reaction prevent more than one sperm fertilising an egg.

(4)

(b) Animals produce [illegible] gametes by meiosis.

Explain how meiosis [illegible] to genetic variation in gametes.

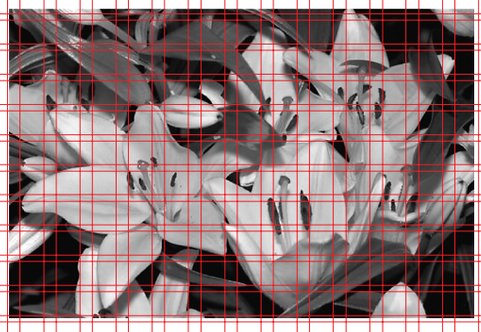
(2)

DreAMar

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(c) In flowering plants, the growth of pollen tubes is affected by many factors. An investigation was carried out to study the effect of the concentration of a chemical called methylpurine on pollen tube growth.

Pollen grains from lily flowers were exposed to 0.01 mol dm^{-3} methylpurine at pollination.



Lily flowers
Magnification × 0.2

After 48 hours, the lengths of the pollen tubes formed were measured and the mean length calculated.

This was repeated with two other concentrations of methylpurine and a control with no methylpurine.

The results are shown in the table below.

Concentration of methylpurine / mol dm^{-3}	Mean length of pollen tube after 48 hours / mm
0.0000	94
0.0001	95
0.0010	90
0.0100	28

i) The investigation was carried out at a constant temperature of 22.5 °C.

Suggest why the temperature was kept constant.

(2)

.....

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DxRatPar

(ii) Using the information in the table, describe the effect of methylpurine concentration on the mean length of pollen tubes from lily flowers.

(3)

(iii) Methylpurine can inhibit messenger RNA (mRNA) synthesis.

Suggest how this can cause the change in mean pollen tube length.

(2)

(Total for Question 2 = 13 marks)

PreAmar

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3 (a) William Withering tested the use of digitalis to treat a heart condition.
The table below describes some of the stages he could have used.

Place a tick (✓) in the box if he used this stage in his test and place a cross (✗) in the box if he did not.

(3)

Description of stage	Tick / cross
He tried to isolate digitalis from foxglove plants.	
He tested digitalis on healthy humans.	
He used a placebo to make sure digitalis worked.	

(b) (i) Explain why placebos are used to test the efficiency of new drug treatments.

(2)

(ii) Explain what is meant by a **double blind trial**.

(2)

(Total for Question 3 = 7 marks)

Dreamtar

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4 Recently, scientists have shown an interest in using plant tissue culture techniques to produce large numbers of genetically identical cotton plants. Cotton plants provide fibres used for clothing.

Plant tissue culture techniques depend on the totipotent properties of the cells used.

(a) Describe how you could use a plant tissue culture technique to show totipotency in cotton plant seedlings.

(4)

PREMIER

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(b) Scientists used similar plant tissue culture techniques to investigate the effect of the age of the seedlings on totipotency.
Seedlings were divided into four groups, each consisting of 25 seedlings. One group was grown for 7 days before the plant tissue culture technique was carried out.
The number of seedlings that showed totipotency was recorded as a percentage.

This procedure was repeated for the other three groups of seedlings, which were grown for 14, 21 and 28 days respectively before the plant tissue culture technique was carried out.

The results are shown in the table below.

Age of seedlings before plant tissue culture technique carried out / days	Percentage of seedlings showing totipotency (%)
7	76
14	56
21	40
28	60

(i) Describe the effect of age on the percentage of seedlings showing totipotency.

(2)

Exemplar

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(ii) The scientists were concerned about the reliability of the data.

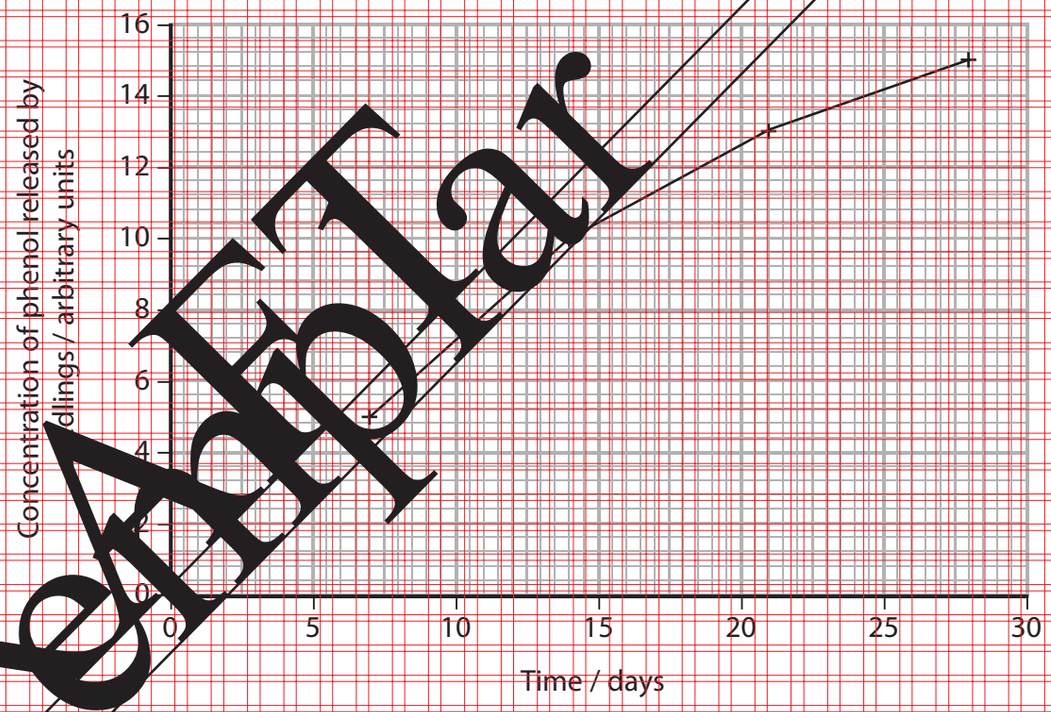
Suggest how the data could have been made more reliable.

(2)

(c) As cotton plants grow, they release a substance called phenol.

In another investigation, the scientists measured the concentration of phenol released by seedlings.

The results are shown in the graph below.



(i) Using the information in the table in part (b) and the graph, give evidence to support the hypothesis that phenol reduces totipotency.

(1)

Pearson Edexcel

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(ii) Using the information in the table in part (b) and the graph, give evidence that does **not** support the hypothesis that phenol reduces totipotency.

(1)

(d) Human stem cell research involves the use of both totipotent and pluripotent stem cells.

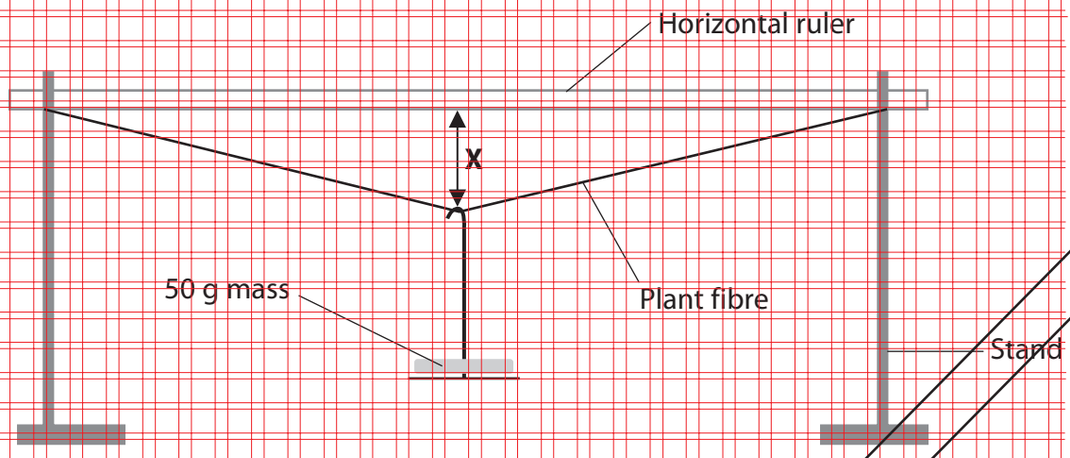
Describe the differences between a totipotent stem cell and a pluripotent stem cell.

(2)

(Total for Question 4 = 12 marks)

Example

5 (a) A student used the apparatus shown in the diagram below to investigate the tensile strength of plant fibres.



She added a 50 g mass to the middle of the fibre and measured distance **X**.
She repeated this by adding additional 50 g masses.

The results are shown in the table below.

Mass / g	Distance X / cm
0	0
50	2
100	4
150	5
200	5
250	Fibre broke

(i) Describe the effect on distance **X** of increasing the mass.

(2)

Pearson Edexcel

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(ii) Another student thought that the data did not show the mass needed to break the fibre. He suggested that it could be anywhere between 200 g and 250 g.

Suggest how a more accurate result could be determined.

(2)

(b) Suggest how you would use this apparatus to enable a valid comparison of the tensile strength of fibres from two different plants.

(5)

(Total for Question 5 = 9 marks)

Example

6 Carl Woese suggested that living organisms could be grouped into three domains.

(a) The Eukarya domain includes the plant kingdom.
Plants are different from other groups of organisms in the Eukarya domain as they have cellulose cell walls. The cellulose molecules in the cell wall are arranged in microfibrils.

The table below gives four features of a cellulose molecule and a cellulose microfibril.

If the feature is present place a tick (✓) in the box and if it is absent, place a cross (✗) in the box.

(4)

Feature	Cellulose molecule	Cellulose microfibril
Alpha (α) glucose		
1,4-glycosidic bonds		
1,6-glycosidic bonds		
Hydrogen bonds		

(b) Eukarya is one of the three domains.

Name the other **two** domains.

(2)

1. .....

2. .....

(c) Scientists classify organisms into taxonomic groups, such as the three domains.

Explain how organisms can be classified into taxonomic groups.

(2)

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Pearson Edexcel

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(d) When Carl Woese first suggested that all organisms could be classified into one of the three domains, his ideas were not accepted.

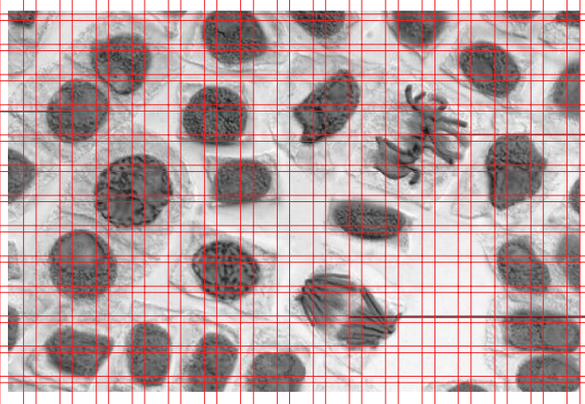
Suggest how Woese's idea was critically evaluated.

(3)

(Total for Question 6 = 11 marks)

Exemplar

7 The photograph below shows plant cells at different stages in the cell cycle.



Magnification × 600

Herve Conge,ISM / Science Photo library

(a) Name the stage of mitosis shown by each of the cells labelled **X** and **Y**.

(2)

X .....

Y .....

(b) Describe what occurs during prophase.

(4)

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PeARson

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(c) Cell **Z** is not undergoing mitosis.

Suggest which stage of the cell cycle it is undergoing.
Give a reason for your answer.

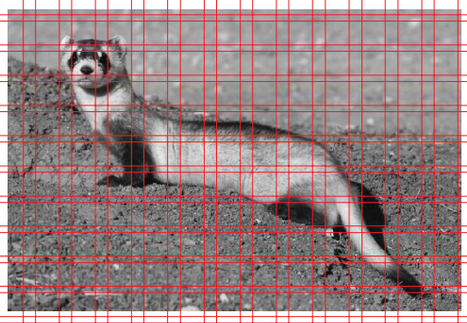
(2)

(Total for Question 7 = 8 marks)

Exemplar

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8 The black-footed ferret, shown in the photograph below, is one of North America's most endangered species. In 1986, only 18 individuals were living in the wild. These were used to start a captive breeding programme. Six zoos are now involved in this programme.



Black-footed ferret

Magnification × 0.1

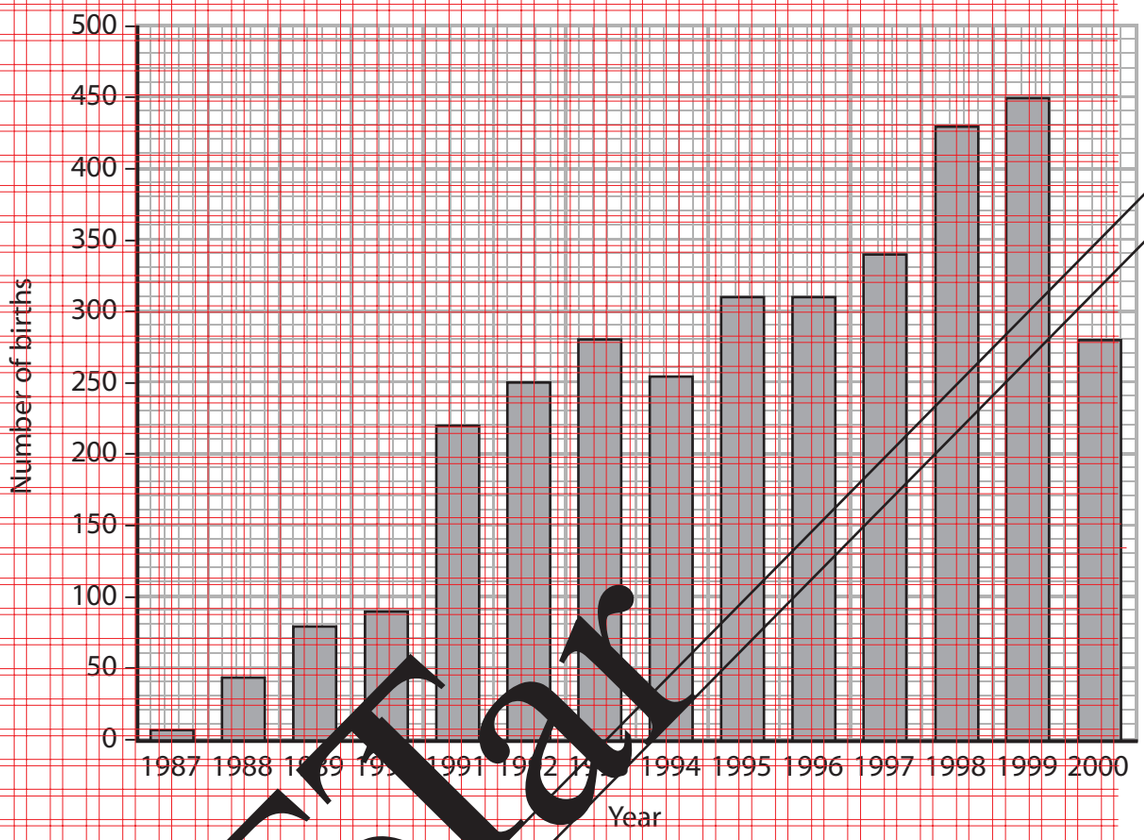
*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

(5)

Pearson

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(b) The graph below shows the number of black-footed ferrets in captivity born each year from 1987 to 2000.



(i) Each year since 1991, 200 black-footed ferrets have been released into the wild.

Suggest why no black-footed ferrets were released into the wild before 1991.

(2)

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Exemplar

P 3 9 8 8 5 A 0 1 9 2 4

Turn over ▶

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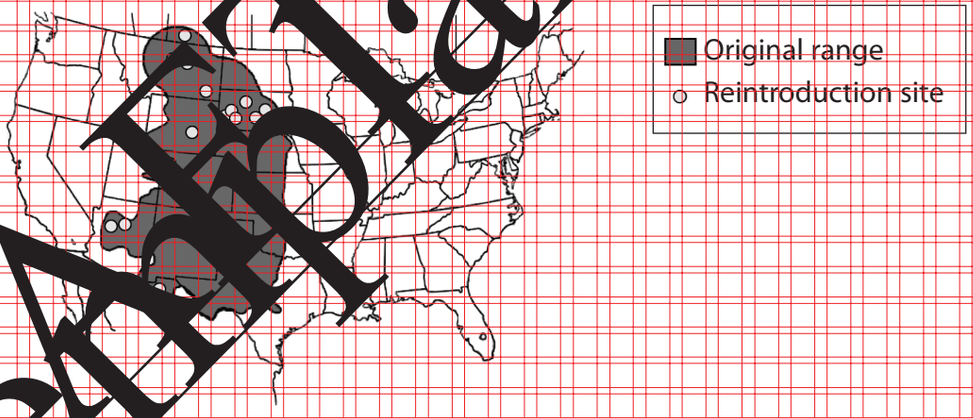
(ii) Using the information in the graph, suggest how effective the captive breeding programme was between 1991 and 2000.

(2)

(c) The map of the USA below shows the original range of the black-footed ferrets and the sites where they have been reintroduced. Their natural habitat is prairie, which is a type of grassland.

Only 1% of the prairie remains undisturbed by human activity.

Black-footed ferrets mainly prey on prairie dogs. Prairie dogs are treated as pests by farmers who may use poison to kill them.



Pearson Edexcel

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Suggest **three** factors that could affect the survival chances of black-footed ferrets when they are reintroduced to the sites shown on the map.

(3)

1 .....

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2 .....

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3 .....

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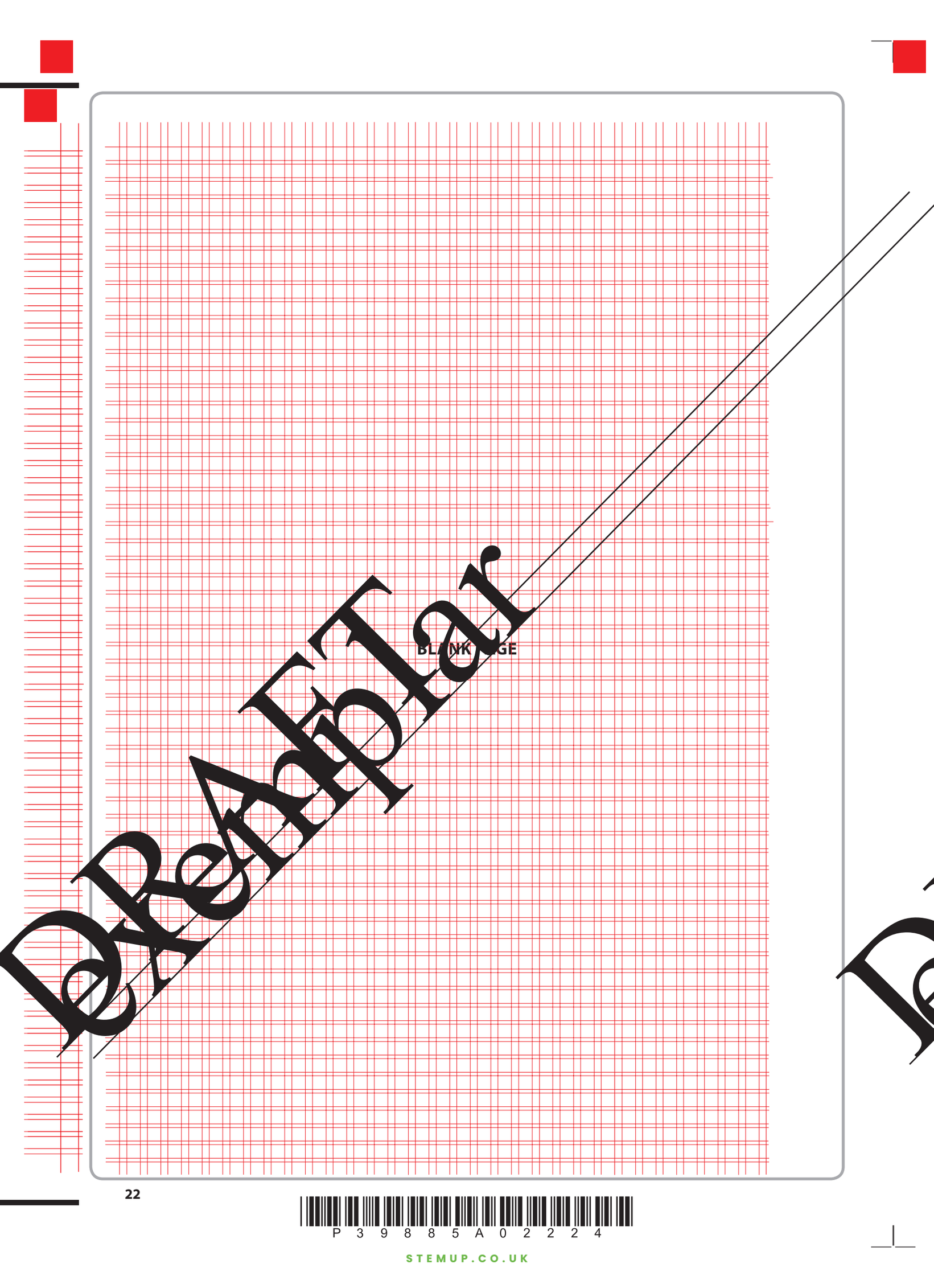
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(Total for Question 8 = 12 marks)

TOTAL FOR PAPER = 80 MARKS

Exemplar

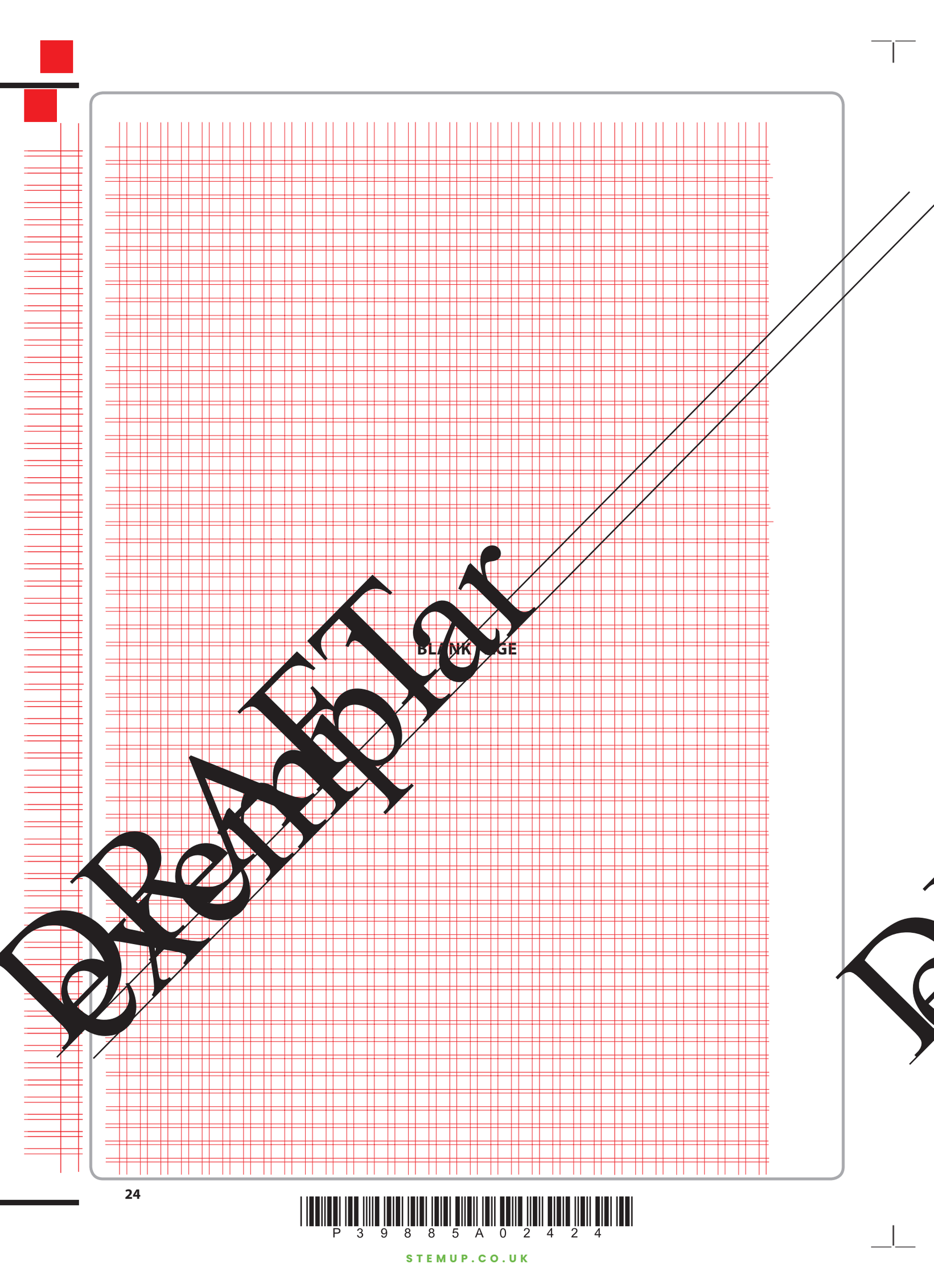
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P 3 9 8 8 5 A 0 2 2 2 4

Example

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Mark Scheme (Results)

Summer 2013

GCE Biology Unit 2 (6BI02)
Paper 01

Unit 2: Development, Plants and the Environment

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Summer 2013
Publications Code US035471
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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 Comments	Mark
1(a)	C ;		(1)

Question Number	Answer	Additional Comments	Mark
1(b)	D ;		(1)

Question Number	Answer	Additional Comments	Mark
1(c)	A ;		(1)

Question Number	Answer	Additional Comments	Mark
1(d)	D ;		(1)

Question Number	Answer	Additional Comments	Mark
1(e)	C ;		(1)

Question Number	Answer	Additional Comments	Mark
1(f)	D ;		(1)

Question Number	Answer	Additional Comments	Mark
1(g)	D ;		(1)

Question Number	Answer	Additional Comments	Mark
1(h)	C ;		(1)

Question Number	Answer	Additional Comments	Mark
2(a)	(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. sperm cell {fuses / eq} with egg cell (*membrane*) ; 2. reference to {*cortical granules* / *vesicles* / *lysosomes}* ; 3. idea of (cortical granules) {moving towards / fusing with } egg cell (surface) *membrane* ; 4. reference to *exocytosis* (of *cortical granules* / *vesicles* / *lysosomes)* ; 5. idea of contents (of *cortical granules*) {secreted /released into jelly layer / eq} OR reference to *cortical reaction* ; 6. idea of { hardening / thickening / eq } of { *zona pellucida* / jelly layer } OR formation of *fertilisation membrane* ; 7. reference to change in charge across egg cell membrane ;	QWC emphasis is on spelling of technical terms 1. NOT the fusion of the nuclei 4. NOT for description of acrosome reaction 5. ACCEPT enzymes / chemicals NOT released into ovum 6. ACCEPT fertiliZation	**(4)**

Question Number	Answer	Additional Comments	Mark
2(b)	1. reference to both { independent / random } assortment and { crossing-over/chiasma(ta) } ; 2. independent assortment gives rise to {new / different / eq} combinations of (paternal and maternal) chromosomes ; 3. crossing over involves swapping of {sections / eq} of {chromatids /chromosomes} ;	3. NOT swapping genes ACCEPT new combinations of alleles (on a chromosome) / recombinants	**(2)**

Question Number	Answer	Additional Comments	Mark
2(c)(i)	1. Idea that temperature is a controlled variable e.g. constant temperature removes this variable, so temperature does not affect {results / length of pollen tube} ; 2. idea that (pollen tube) { growth / enzymes / proteins /eq } affected by temperature ; 3. idea that at this temperature { enzymes / proteins } will not be denatured / pollen not destroyed at this temperature / 22.5°C optimum temperature ; 4. idea that the investigation is valid ;	1. ACCEPT the idea of only changing one variable and keeping all the others constant – or so that only methylpurine affecting pollen tubes NOT 'a control' 4. NOT reliable IGNORE fair test, accurate, precise	**(2)**

Question Number	Answer	Additional Comments	Mark
2(c) (ii)	1. idea of { no significant / small / 1mm / eq } increase in { mean length / growth } up to 0.0001 mol dm^{-3} ; 2. idea of negative correlation described e.g. {decrease in length of / shorter/ reduced growth of} pollen tubes as concentration increased OR over stated range from 0.0001 to 0.01 ; 3. idea of greatest { change / drop / eq } between 0.0010 and 0.0100 mol dm^{-3} / eq ; 4. credit correct manipulation of the data to illustrate decrease ;	IGNORE units. 2. ACCEPT reference to decreases at specific concentrations of methylpurine IGNORE negative correlation unqualified 3. NOT references to rapid decrease. 4. Some examples given below Conc. change / Difference (mm) / % all **decreases** *0.0000 – 0.0100 – mp2* / (94-28) 66 / 70.2 % 0.0001 – 0.0100 / (95-28) 67 / 71 / 70.5 % 0.0001 – 0.0010 / (95-90) 5 / 5 / 5.3 % *0.0010 – 0.0100 – mp3* / (90-28) 62 / 69 / 68.9 %	**(3)**

Question Number	Answer	Additional Comments	Mark
2(c)(iii)	1. { less / no } transcription / idea of inhibition of RNA polymerase ; 2. { less / no } { translation / protein synthesis/ protein made / eq } ; 3. idea that protein needed for (pollen tube) growth e.g. less protein leads to reduced growth (of pollen tubes) ;	2 & 3 ACCEPT reference to enzyme instead of protein IGNORE repair	**(2)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Comments</th><th>Mark</th></tr>
<tr><td>3 (a)</td><td>
<table>
<tr><th>Description of stage</th><th>Tick / cross</th></tr>
<tr><td>He tried to isolate digitalis from foxglove plants.</td><td>✓ ;</td></tr>
<tr><td>He tested digitalis on healthy humans.</td><td>× ;</td></tr>
<tr><td>He used a placebo to make sure digitalis worked.</td><td>× ;</td></tr>
</table>
</td><td>No marks for blank spaces.
No mark for hybrid x/✓</td><td>(3)</td></tr>
</table>

Question Number	Answer	Additional Comments	Mark
3 (b)(i)	1. inactive substance / no drug / eq ; 2. idea that it is used as a control e.g. comparison with the actual drug ; 3. idea of psychological effect of taking either a drug or a placebo ;	1. ACCEPT dummy pill, sugar pill, fake pill 3. e.g. patient believes they will improve and ALLOW reference to placebo effect	**(2)**

Question Number	Answer	Additional Comments	Mark
3 (b)(ii)	1. idea of one set of patients being given the (new) drug and one set a placebo ; 2. neither patient nor { doctor / scientist / eq } knows if the treatment contains the (new) drug or not ; 3. removal of bias from results / eq ;	1. ACCEPT pre-existing / old drug instead of placebo	**(2)**

Question Number	Answer	Additional Comments	Mark
4(a)	1. idea of using part of the seedling ; 2. idea of using agar ; 3. (agar contains) growth substances / hormones / eq ; 4. Idea of using aseptic technique ; 5. Idea of covering the top of the container to prevent contamination OR loss of water ; 6. Idea of supplying light ; 7. allow a suitable length of time for growth e.g. 1 to 6 weeks ; 8. look for { roots / leaves / (complete) plant } forming ;	1. ACCEPT cuttings, explants IGNORE cells unqualified 3. ACCEPT named plant growth substance	**(4)**

Question Number	Answer	Additional Comments	Mark
4(b)(i)	1. percentage of seedlings (showing totipotency) decreases as age increases up to 21 days / negative correlation up to 21 days / eq ; 2. as age increases { after 21 / from 21-28 / at 28} days percentage of seedlings showing totipotency increases / eq ; 3. 28 days is an anomalous result ; 4. credit correct manipulation of the data ;	4. Some examples are shown below <table><tr><td>Days</td><td>Difference (%)</td></tr><tr><td>7-28</td><td>(76-60) 16</td></tr><tr><td>7-14</td><td>(76-56) 20</td></tr><tr><td>*7-21 – mp1*</td><td>(76-40) 36</td></tr><tr><td>14-21</td><td>(56-40) 16</td></tr><tr><td>*21-28 – mp2*</td><td>(40-60) (+) 20</td></tr></table>IGNORE calculated percentage of percentage	**(2)**

Question Number	Answer	Additional Comments	Mark
4(b) (ii)	1. { repeats / larger number of seedlings } { at each age / in each group } / eq ; 2. more ages of seedlings used / use seedlings older than 28 days / test 35 day old seedlings / eq ; 3. repeat 28-day group / repeat any anomalous results / eq ;	1. ACCEPT repeated the whole experiment	(2)

Question Number	Answer	Additional Comments	Mark
4(c) (i)	as phenol concentration increases from { 7 to 21 / 7 to 14 / 14 to 21 } days, percentage of seedlings showing totipotency decreases / negative correlation up to 21 days / eq ;		(1)

Question Number	Answer	Additional Comments	Mark
4(c) (ii)	(as phenol concentration increases) at 28 days percentage of seedlings showing totipotency increases / eq ;	ACCEPT reference to after 21 days	(1)

Question Number	Answer	Additional Comments	Mark
4(d)	1. totipotent cells can { give rise to / differentiate to become } { any cell / extra embryonic tissues / eq } ; 2. pluripotent cannot { give rise to / differentiate to become } { all cells in the body / extra embryonic tissues / eq } ; 3. idea that only totipotent cells can give rise to other totipotent cells ; 4. idea that totipotent cells can give rise to an entire human being, pluripotent cells cannot ;	NOT 'turns into', 'becomes', 'develops into' but penalise once only 1. ACCEPT specialised for differentiated 1 & 2 IGNORE reference to embryonic cells/tissues unless it makes the response incorrect, ACCEPT placental cells/tissues 2. ACCEPT can give rise to most cells	(2)

Question Number	Answer	Additional Comments	Mark
5(a) (i)	1. increasing mass increased the distance up to 150 (g) ; 2. 150 (g) to 200 (g) / after 150 (g) the distance did not change ; 3. relationship is linear to 100(g) and non-linear above 100 (g) ; 4. greatest change in 0 to 100 (g) range ;	IGNORE UNITS 1. ACCEPT weights instead of masses	**(2)**

Question Number	Answer	Additional Comments	Mark
5(a) (ii)	1. add smaller masses / add 10 g or 5 g masses ; 2. from 200 g / between 200 and 250 g ;	1. ACCEPT masses of any value less than 50g, e.g. 20g. Must state units.	**(2)**

Question Number	Answer	Additional Comments	Mark
5(b)	1. **two** different fibre variables taken into account e.g. length, width, age, mass, hydration level, part of plant extracted from ; 2. environmental variable controlled, e.g. temperature, humidity, ; 3. named procedural variable controlled, e.g. size of masses used, retting method used to extract fibres ; 4. idea of adding masses until fibre breaks /measure the mass [that breaks the fibre / that the fibre can hold before breaking / eq } ; 5. repeat and find the { mean / average } ; 6. reference to action taken in case of { anomalous result / outlier } ; 7. reference to safety procedure ;	2. IGNORE light intensity 3. ALLOW descriptions of methodology, e.g. the way in which the masses are added to the fibre	**(5)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Comments</th><th>Mark</th></tr>
<tr><td>6(a)</td><td>
<table>
<tr><th>Feature</th><th>Cellulose molecule</th><th>Cellulose microfibril</th></tr>
<tr><td>Alpha (α) glucose</td><td>×</td><td>×</td></tr>
<tr><td>1,4- glycosidic bonds</td><td>✓</td><td>✓</td></tr>
<tr><td>1,6- glycosidic bonds</td><td>×</td><td>×</td></tr>
<tr><td>Hydrogen bonds</td><td>×</td><td>✓</td></tr>
</table>
Any 2 correct for 1 mark ;;;;
</td><td>No marks for blank spaces.
No marks for hybrid x/✓</td><td>(4)</td></tr>
</table>

Question Number	Answer	Additional Comments	Mark
6(b)	1. Archaea ; 2. Bacteria ;	Either way around 1. ACCEPT Archaeobacter	**(2)**

Question Number	Answer	Additional Comments	Mark
6(c)	1. idea that organisms with { specific / particular / shared / common / similar / eq } { characteristics / features / traits / eq } are placed in a group ; 2. detail of how characteristics assessed, e.g. observable characteristics, behavioural similarities, similarities in DNA, molecular phylogeny ;		**(2)**

Question Number	Answer	Additional Comments	Mark
6(d)	1. scientific findings published e.g. in a journal ; 2. idea of presented at scientific conference / eq ; 3. idea of peer review ; 4. (other scientists) repeat experiments (to confirm or validate findings / test reliability of data) ;	IGNORE 'critically evaluated' as it is in the stem of the question 3. 'peer reviewed journal' gains Mp1 as well 4. must be an indication of further testing being carried out	**(3)**

Question Number	Answer	Additional Comments	Mark
7 (a)	X – metaphase ; Y – anaphase ;		**(2)**

Question Number	Answer	Additional Comments	Mark
7 (b)	1. { chromatin / DNA } condenses / eq ; 2. chromosomes { condense /become visible /eq } ; 3. idea of nuclear { membrane /envelope } breaking down ; 4. nucleolus {disappears /eq} ; 5. reference to centrioles moving to poles or opposite ends of cell ; 6. reference to formation of spindle (fibres) ;	1. ACCEPT coiling of DNA, not supercoiling 2. ACCEPT shorten or thicken 5. NB – part (b) does not specify plant cells, therefore reference to centrioles is acceptable	**(4)**

Question Number	Answer	Additional Comments	Mark
7 (c)	1. interphase; 2. chromosomes not visible / nucleus is visible / eq ;	1.ACCEPT/ G1 / G2 / S 2. Must be a detail seen in the photograph ACCEPT converse e.g. not mitosis as chromosomes not visible	**(2)**

Question Number	Answer	Additional Comments	Mark
8 (a)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that 18 individuals is a small population / small gene pool / low genetic diversity / may have been closely related / eq ; 2. captive breeding will increase population ; 3. studbooks /records kept of breeding programme / eq ; 4. (zoos) select mates ; 5. inter-zoo exchange of animals for breeding / eq ; 6. idea of the need to prevent inbreeding ; 7. idea of avoiding genetic drift ; 8. use of { IVF / AI / use of surrogates } ; 9. process for measuring genetic diversity described, e.g. DNA profiling / eq ;	QWC emphasis is clarity of expression ACCEPT reference to 'species' instead of ferret which may arise due to the wording of question. 4. Must refer to human intervention – not just the ferrets choosing their mates 6. NOT 'interbreeding' in place of 'inbreeding'. ACCEPT 'encourage outbreeding' e.g. ferrets not mated with closely related ferrets	**(5)**

Question Number	Answer	Additional Comments	Mark
8 (b)(i)	1. (captive) population not large enough / number of births is low / eq ; 2. individuals not mature enough / eq ; 3. zoos preparing ferrets for release / eq ; 4. idea of maintaining a population in zoos ;		**(2)**

Question Number	Answer	Additional Comments	Mark
8 (b)(ii)	1. number of <u>births</u> is rising / eq ; 2. increase in population : 3. idea that more are born than are released e.g. at least 200 births each year ; 4. identification of years when number of <u>births</u> fell, i.e. 1994 or 2000 ; 5. correct manipulation of data ;	3. Or some understanding that the increases outweigh the decreases, e.g. between 1991-1999 it increased by 230, but only fell by 170 to 2000 from 1999 5. Some examples are shown below Year / Difference / % *1991-2000 – mp3* / *(220-280) 60* / *(+) 27 / 27.3* 1991- 1999 / (220-450) 230 / (+) 105 / 104.5 1999-2000 / (450-280) 170 / (-) 38 / 37.8	**(2)**

Question Number	Answer	Additional Comments	Mark
8 (c)		Factors provided may either improve or reduce survival chances	
	1. idea of habitat as a factor, e.g. loss of habitat / wider range of habitats / eq ;	1. climate change can be accepted here as a factor affecting availability of suitable habitat ACCEPT description of human activity that could lead to loss or gain of habitat	
	2. availability of { prey / food / prairie dogs /eq };		
	3. competition with other ferrets (for resources) ;	3. Intraspecific competition	
	4. competition with other species (for resources) / eq ;	4. Interspecific competition	
	5. effect of eating { poisoned prairie dogs / poison put out for prairie dogs } / eq ;		
	6. presence of { predators / hunters } / eq ;		
	7. preparation for living in the wild improves chance of survival / if reliant on humans would not survive ;	7. e.g. kept in semi-wild conditions initially and hunting behaviour encouraged	
	8. idea of too few to be a viable breeding population ;		
	9. idea of presence of disease ;		**(3)**

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Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary
Unit 2: Development, Plants and the Environment

Monday 21 May 2012 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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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1/1/1/1/1/

P 3 9 5 1 0 A 0 1 2 4

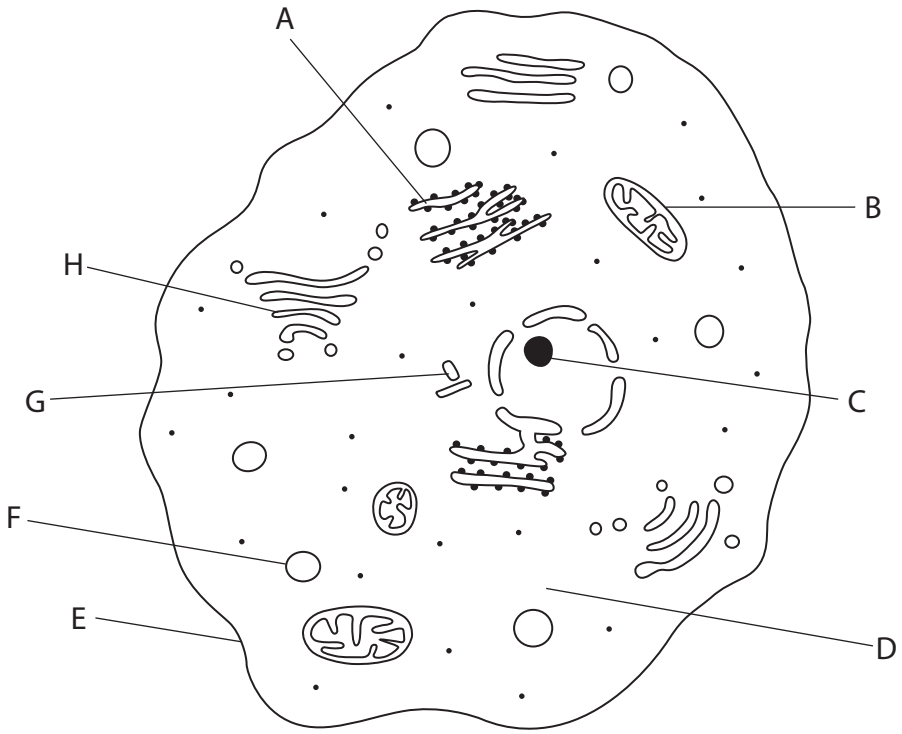
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Answer ALL questions.

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 The diagram below shows a typical animal cell as seen using an electron microscope.



(a) Name the organelles labelled A, B and C shown on the diagram.

(3)

A .....

B .....

C .....

(b) Give the letter of the organelle that doubles just before mitosis and then separates to opposite poles of the cell during mitosis.

(1)

.....

P 3 9 5 7 0 A 0 2 2 4
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(c) Give the letter of the organelle that would **not** be present when this cell is undergoing mitosis.

(1)

.....

(d) Place a cross (☒) in the correct box next to the following statements.

(2)

Statement	Yes	No
The structure labelled D is present in both animal and plant cells.	☒	☒
The structure labelled E is the outermost layer in both animal and plant cells.	☒	☒

(Total for Question 1 = 7 marks)

2 Read through the following passage about plant cell walls and transport. Write on the dotted lines the most appropriate word or words to complete the passage.

(5)

Many β (beta) ..... molecules join together to

form ..... , the polysaccharide found in plant cell walls.

When these polysaccharides are next to each other, ... bonds

form and a microfibril is made.

To aid transport of materials from one plant cell to the next cell, there are areas

with reduced cell walls called ..... and areas with no cell

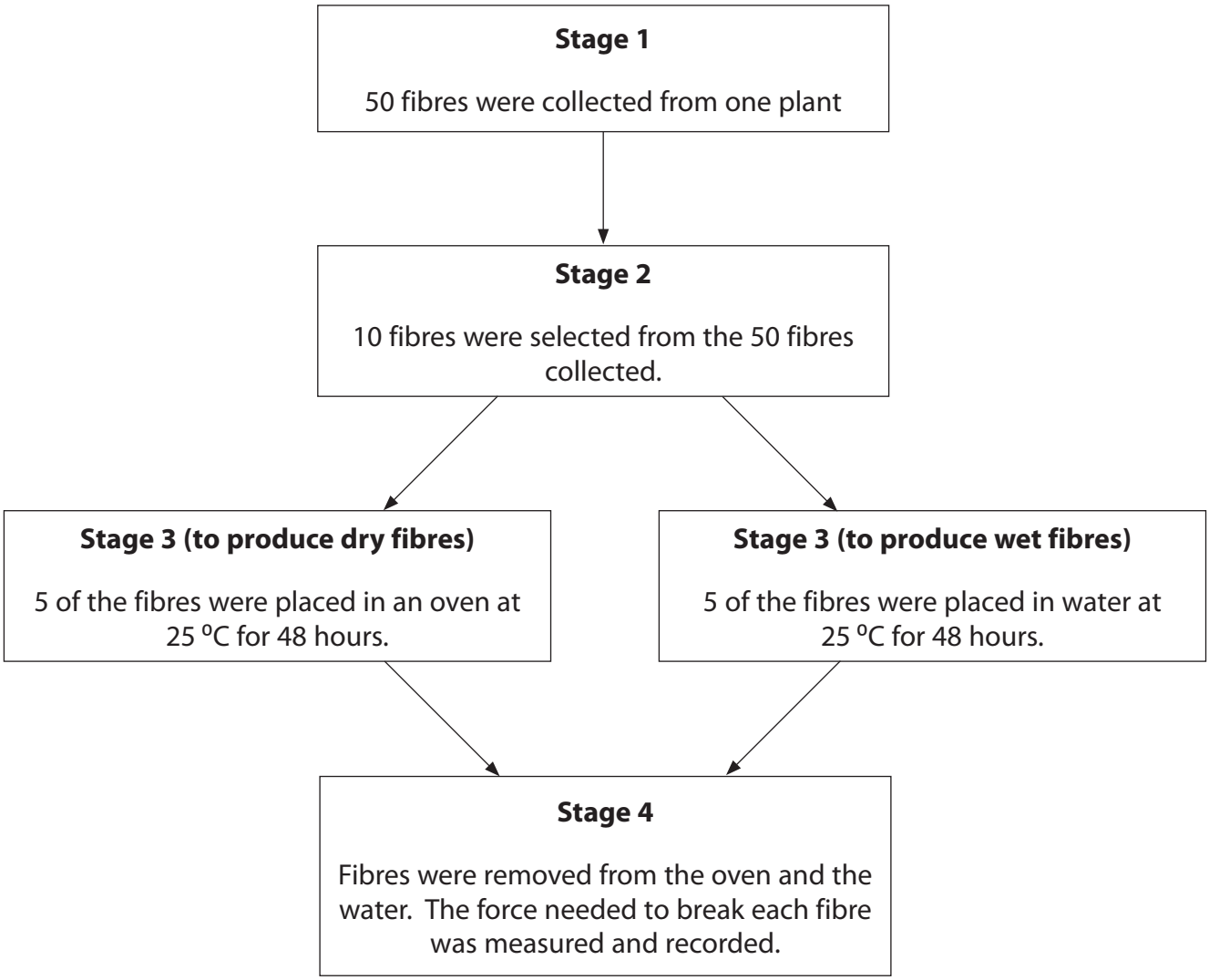
walls called ..... .

(Total for Question 2 = 5 marks)

P 3 9 5 5 0 A 0 4 2 4
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3 An investigation was carried out to measure the force needed to break wet and dry plant fibres.

The diagram below shows some of the stages involved in this investigation.



(a) (i) Explain why the fibres were collected from only one plant in stage 1.

(1)

.....

.....

(ii) Suggest **two** factors that should be kept constant when selecting the 10 fibres from the 50 in stage 2.

(2)

1 .....

2 .....

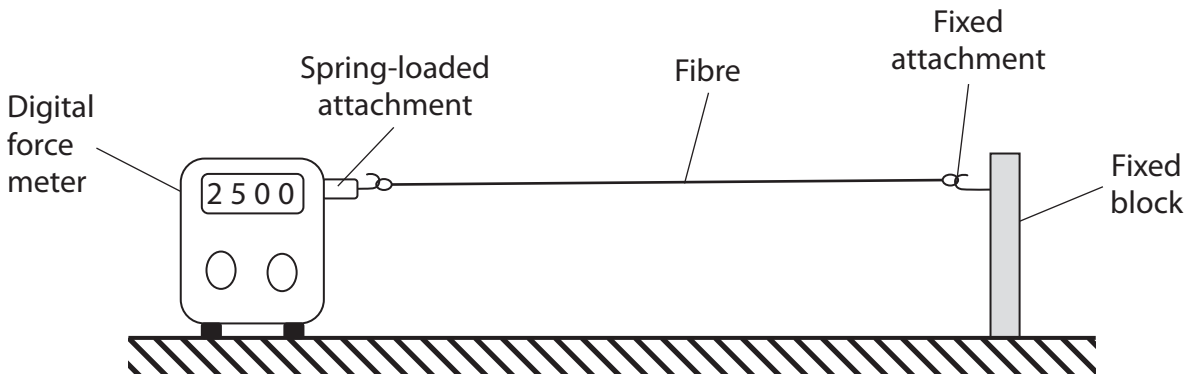
(iii) Suggest why all fibres were kept at the same temperature in stage 3.

(1)

.....

.....

(b) The diagram below shows the equipment used in stage 4 to find the force needed to break each fibre.



Suggest why safety glasses should be worn when using the apparatus shown in the diagram.

(1)

.....

.....

P 3 9 5 7 0 A 0 6 2 4
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(c) The table below shows the results of this investigation.

Sample	Force needed to break each fibre / arbitrary units	
	Wet	Dry
1	4200	2800
2	3800	2900
3	4100	2600
4	4100	2700
5	3100	2800
Mean	3860	2760

(i) Compare the mean force needed to break the wet fibres with the mean force needed to break the dry fibres.

(2)

.....

.....

.....

.....

(ii) State which of these two sets of data is less reliable. Give reasons for your answer.

(3)

.....

.....

.....

.....

.....

.....

(d) A student observed that dry fibres 3, 4 and 5 each had a knot in the middle of their length and that they broke at the knot. She used this observation to state that the recorded force needed to break these three dry fibres was an underestimate.

(i) Suggest **one** piece of evidence from the table that supports her statement.

(1)

.....

.....

(ii) Suggest **one** piece of evidence from the table that does **not** support her statement.

(1)

.....

.....

(Total for Question 3 = 12 marks)

P 3 9 5 5 0 A 0 8 2 4
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4 Meiosis is involved in the production of gametes such as human egg cells and sperm cells.

(a) An investigation was carried out to study the effect of changing the temperature on spindle fibre formation in human egg cells during meiosis.

Five human egg cells undergoing meiosis at 37 °C were incubated at 25 °C for 10 minutes and then returned to 37 °C. After 20 minutes, the number of egg cells showing spindle fibre formation was recorded.

The investigation was repeated at three different incubation temperatures.

The results are shown in the table below.

Incubation temperature / °C	Number of human egg cells used	Number of human egg cells showing spindle fibre formation
25	5	0
28	5	2
33	5	5
37	5	5

(i) Suggest why some of the human egg cells were incubated at 37 °C throughout this investigation.

(1)

.....

.....

(ii) Using the information in the table, describe the effect of temperature on spindle fibre formation in human egg cells.

(2)

.....

.....

.....

.....

.....

.....

(b) A student made the statement that all 5 cells would have shown spindle fibre formation if the incubation temperature had been either 35 °C or 31 °C.

(i) Using the information in the table, give evidence to support part of this statement.

(2)

.....

.....

.....

.....

(ii) Using the information in the table, give evidence that may **not** support part of this statement.

(2)

.....

.....

.....

.....

P 3 9 5 1 0 A 0 0 1 0 2 4
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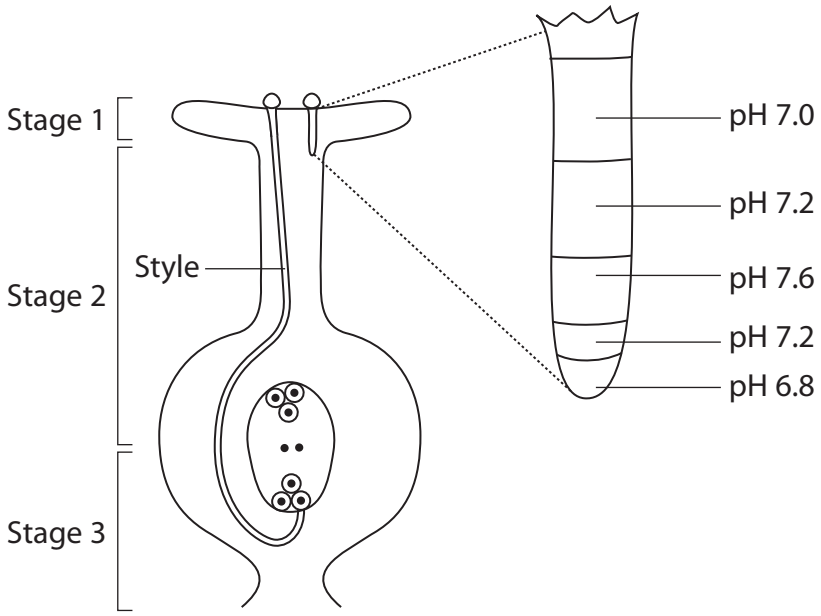
*(c) Describe and explain **three** ways in which a human sperm cell is specialised for its function.

(6)

(Total for Question 4 = 13 marks)

5 Sexual reproduction in plants includes the transfer and fusion of gametes.

The diagram below shows part of a flower with two pollen grains and their pollen tubes.
The diagram also shows an enlargement of one of the pollen tubes and the pH of the cytoplasm in each region of this tube.



(a) At stage 1, the pollen grain contains the haploid generative nucleus.
Explain what is meant by the term **haploid nucleus**.

(2)

.....

.....

.....

.....

(b) Describe the changes in the pH of the pollen tube shown in the diagram.

(2)

.....

.....

.....

.....

P 3 9 5 1 0 A 0 0 1 2 2 4
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*(c) At stage 2, amino acids are absorbed into the cytoplasm of the pollen tube. These amino acids are used to synthesise proteins such as enzymes. These enzymes are transported through the cytoplasm and then secreted into the style.

Suggest what happens to the amino acids from when they are absorbed into the cytoplasm until they are secreted as enzymes into the style.

(5)

(d) During stage 3, the generative nucleus divides to form two male nuclei and the pollen tube fuses with the embryo sac.

Describe what happens to each of these two male nuclei.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 11 marks)

P 3 9 5 4 1 0 A 0 0 1 4 2 4
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6 Before a new drug can become available for use it has to pass a contemporary drug testing protocol. This includes three-phased testing.

(a) A drug may fail at any of the three phases.

Place a cross (☒) in the box next to the phase at which the drug would have failed.

(2)

(i) The drug did **not** improve the condition it was designed to treat in humans.

☒ **A** Phase 1

☒ **B** Phase 2

☒ **C** Phase 3

(ii) The effect of the drug was different in humans from its effect in animals.

☒ **A** Phase 1

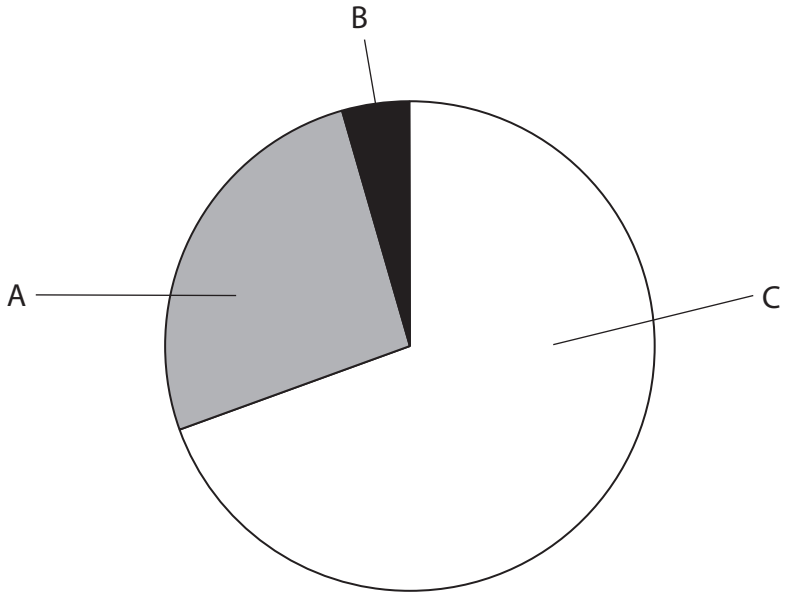
☒ **B** Phase 2

☒ **C** Phase 3

P 3 9 5 2 4 STEMUP.CO.UK 5 2 4

(b) The number of people tested is different in each phase.

The pie chart below shows the number of people tested in each phase of a drug trial.



Suggest which of the letters A, B or C, represents phase 3.
Give a reason for your answer.

(2)

Letter .....

Reason .....

.....

.....

P 3 9 5 6 0 A 0 0 1 6 2 4
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(c) The table below shows the mean percentage improvement of a condition in humans, when given one of three different treatments.

Treatment	Percentage improvement of a condition (%)	
	Range	Mean
Placebo	18 – 22	20
Drug P	45 – 51	49
Drug Q	41 – 51	46

Both drugs P and Q passed the three-phased testing protocol. However, only drug P was made available for use.

Using the information in the table, suggest reasons why **only** drug P was made available.

(4)

P 3 9 5 7 0 A 0 0 7 2 4
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(d) The table below gives three statements about William Withering's use of digitalis and contemporary drug testing protocols.

If the statement is correct for **both** of these place a tick (✓) in the box, and if it is not correct for **both**, place a cross (✗) in the box.

(3)

Statement	**Tick (✓) or cross (✗)**
Correct dosage investigated	
Tested on animals	
A double blind trial undertaken	

(Total for Question 6 = 11 marks)

P 3 9 5 8 1 0 A 0 0 1 8 2 4
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7 Plants are complex organisms that contain different tissues and organs.

(a) Explain what is meant by the term **tissue**.

(2)

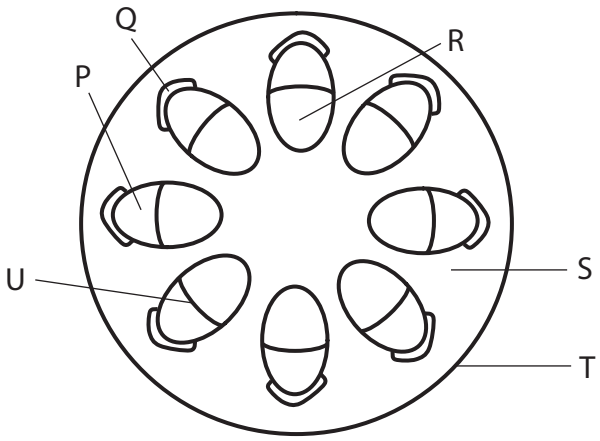
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(b) The diagram below shows a section through one organ of a plant and some of its tissues labelled P to U.



For each of the following statements place a cross (☒) in the box next to the correct answer.

(2)

(i) The organ shown in the diagram is a

☒ **A** leaf

☒ **B** root

☒ **C** stem

☒ **D** vascular bundle

(ii) **Two** tissues that contain lignin are labelled

☒ **A** P and Q

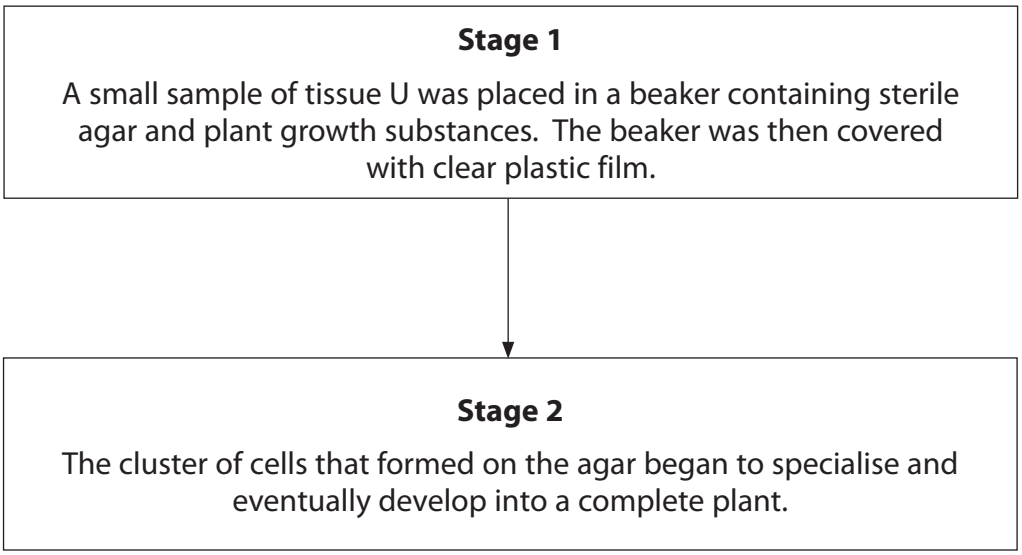
☒ **B** Q and R

☒ **C** R and S

☒ **D** S and T

P 3 9 5 1 0 A 0 0 9 2 4
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(c) The diagram below shows two of the stages in a plant tissue culture technique, used to demonstrate totipotency in the plant tissue labelled U on the diagram on page 19.



(i) Suggest **one** safety reason for covering the beaker with clear plastic film in stage 1.

(2)

.....

.....

.....

.....

(ii) Suggest **one** reason, other than for safety, for covering the beaker with clear plastic film.

(1)

.....

.....

.....

P 3 9 5 1 0 A 0 0 2 0 2 4
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(iii) No plant would develop if the plant tissue labelled R, on page 19, was used instead of plant tissue U.

Suggest reasons why no plant would develop if tissue R was used.

(3)

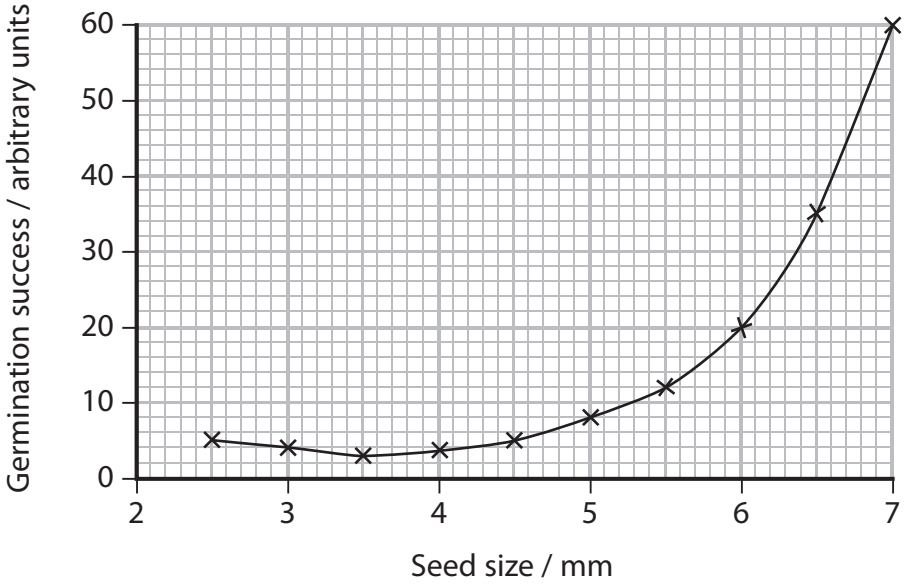
(Total for Question 7 = 10 marks)

P 3 9 5 1 2 A 0 0 1 2 4
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8 Seedbanks help in the long-term conservation of rare plant species by conserving the seeds of these species.

(a) Seedbanks carry out a variety of tests to select the best individual seeds to conserve. The germination success of the seeds is one of the tests that is carried out.

The graph below shows the effect of seed size on germination success for one species of plant.



(i) Using the information in the graph, suggest which seed size would be considered the best for the seedbank to conserve, giving a reason for your answer.

(1)

.....

.....

.....

(ii) Using the information in the graph, calculate the percentage change in germination success when seed size increases from 3 mm to 6 mm.
Show your working.

(3)

Answer ..... %

P 3 9 5 1 0 A 0 0 2 2 4
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(iii) Seed size may be determined by the genotype of the seeds.
Suggest advantages of selecting seeds of different sizes for long-term storage.

(3)

(b) The best seeds will be selected for the seedbank.
Describe what the seedbank will do with these seeds to ensure the long-term conservation of the species.

(4)

(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

P 3 9 5 3 0 A 0 2 3 2 4
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P 3 9 5 3 0 A 0 2 4 2 4
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Mark Scheme (Results)

Summer 2012

GCE Biology (6BI02) Paper 01
Development, Plants & 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.

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. A = rough endoplasmic reticulum / RER / rER ; 2. B = mitochondrion / mitochondria ; 3. C = nucleolus ;	**(3)**

Question Number	Answer	Mark
1 (b)	G ;	**(1)**

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

Question Number	Answer	Mark
1 (d)		**(2)**

Statement	**Yes**	**No**
The structure labelled D is present in both animal and plant cells	☒	
The structure labelled E is the outermost layer in both animal and plant cells		☒

Question Number	Answer	Mark
2	1. glucose ; 2. cellulose ; 3. hydrogen / H ; 4. pits ; 5. plasmodesmata/ plasmodesma ;	**(5)**

Question Number	Answer	Mark
3 (a) (i)	Idea of removing genetic variation e.g. same genotype OR fibres {grown in same conditions / same composition /same age} OR to give {comparison/ results} that are valid ;	**(1)**

Question Number	Answer	Mark
3 (a) (ii)	1. (fibre) length / eq ; 2. (fibre) diameter / width/ thickness / circumference / SA of cross section / eq ; 3. (fibre) mass / weight ; 4. age (fibre) / collected at same time / eq ; 5. idea that came from same region of the plant / eq ;	**(2)**

Question Number	Answer	Mark
3 (a) (iii)	the idea that temperature is a variable e.g. results reliable, same effect on structure of fibre;	**(1)**

Question Number	Answer	Mark
3 (b)	idea that protect eyes from fibre when it breaks ; NOT just to protect eyes – must state what they are protected from.	**(1)**

Question Number	Answer	Mark
3 (c) (i)	1. idea that (mean) force needed to break wet fibres was greater (than dry fibres) / eq ; 2. correct manipulation of the mean data for example 1100 au difference / 40% (39.8%) more force needed to break wet fibres compared to dry fibres/ 28.5% less to break dry fibres compared with wet fibres / 1.4 times more force required to break wet fibres ;	**(2)**

Question	Answer	Mark

Number		
3 (c) (ii)	1. wet (fibres) / eq ; 2. wet fibre data has a wide range / eq ; 3. correct manipulation of data e.g. 1100 (au) for wet AND 300 (au) for dry OR wet range is 800 (au) more than dry ; 4. wet {sample 5 / 3100} may be {anomalous / outlier} ;	**(3)**

Question Number	Answer	Mark
3 (d)(i)	Idea of lower values for 3 AND 4 compared to 1 AND 2 ;	**(1)**

Question Number	Answer	Mark
3 (d)(ii)	idea that sample 1 (without a knot) was the same as sample 5 ;	**(1)**

Question Number	Answer	Mark
4 (a) (i)	as a comparison / as a control / to show that it is {incubation temperature / not some other factor} affecting spindle fibre formation ;	**(1)**

Question Number	Answer	Mark
4 (a) (ii)	1. as temperature increases (from 25°C) to 33°C the number of cells showing spindle fibre formation increases / positive correlation between 25°C and 33°C ; 2. as temperature increases from 33°C (to 37°C) there is no effect on number of cells showing spindle fibre formation / same values at 33°C and 37°C ; 3. credit correct manipulation of the data e.g. with a rise in temperature of 5°C (between 28 and 33°C) the number of cells showing spindle formation rises by 3 ;	**(2)**

Question Number	Answer	Mark
4 (b) (i)	1. idea that (only) 35°C statement is supported ; 2. idea that data either side of 35°C both show all 5 (cells undergoing spindle fibre formation) ; 3. idea that only from 33°C do all 5 (cells show spindle fibre formation) ;	**(2)**

Question Number	Answer	Mark
4 (b) (ii)	1. idea that 31°C statement may not be supported ; 2. idea that it could be between 2 and 5 ;	**(2)**

Question Number	Answer	Mark
*** 4 (c) QWC**	Take into account quality of written communication when awarding the following points. **Mark as pairs** 1. shape qualified e.g. hydrodynamic, streamlined ; 2. idea of reduced resistance ; 3. {*acrosome* / *vesicle*} containing {*enzyme* / *acrosin*} ; 4. involved in {digestion / break down} of the {*zona pellucida* / jelly layer} ; 5. {*haploid* / eq} *nucleus* ; 6. allows restoration of {diploid / full complement / 46 / eq} *chromosomes* at *fertilisation* ; 7. *mitochondria* qualified e.g. large number, correct location ; 8. to supply {ATP / energy} for {movement / eq} ; 9. {*flagellum* / eq} present ; 10. for propulsion / swimming / motility / eq ; 11. {markers / receptors} in cell surface *membrane* ; 12. to bind to egg cell surface *membrane* / detect chemicals released by *ovum* / eq ;	**(6)**

Question Number	Answer	Mark
5 (a)	1. idea of half the number of chromosomes found in a {normal body cell/somatic cell / eq} ; 2. idea of containing one chromosome from each homologous pair; 3. the type of nucleus found in {gametes / sex cells / eq} ; 4. a nucleus is (an organelle / (double) membrane-bound structure / eq) ;	**(2)**

Question Number	Answer	Mark
5 (b)	1. idea that pH increases then decreases; 2. correct manipulation of figures in an appropriate context e.g. overall 0.2 change / eq ;	**(2)**

Question Number	Answer	Mark
*** 5 (c) QWC**	**Take into account quality of written communication when awarding the following points.** 1. idea of amino acids transported to rER e.g. tRNA {binding to/ transporting} amino acids (in cytoplasm) ; 2. reference to involvement of ribosomes ; 3. amino acids {being joined by peptide bonds / forming polypeptide chains / forming primary structure of protein / eq} ; 4. {folded into 3-D shape / secondary or tertiary structure} in rER ; 5. packaged into vesicles at the end of the rER / eq ; 6. vesicles {move to / transported to / fuse with / eq} the Golgi apparatus ; 7. idea that protein modified in Golgi apparatus ; 8. (modified protein / enzyme / eq) packaged into (secretory) vesicles (by Golgi apparatus) eq ; 9. vesicles {move towards / fuse with} cell surface membrane / correct reference to exocytosis / eq ;	**(5)**

Question Number	Answer	Mark
5 (d)	1. one (nucleus) fuses with the {egg nucleus / female gamete } / eq ; 2. one (nucleus) fuses with the (two) polar nuclei / eq ;	**(2)**

Question Number	Answer	Mark
6 (a) (i)	B ;	**(1)**

Question Number	Answer	Mark
6 (a) (ii)	A ;	**(1)**

Question Number	Answer	Mark
6 (b)	1. C ; 2. largest group / <u>most</u> people involved / eq ;	**(2)**

Question Number	Answer	Mark
6 (c)	1. mean (improvement of) drug P greater than drug Q / drug P has the highest mean (improvement) / eq ; 2. credit correct manipulation of the data e.g. 3% greater improvement with drug P compared to drug Q ; 3. narrower range of data (for drug P); 4. idea that this range suggests better {reliability / consistency} for drug P ;	**(4)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>6 (d)</td><td>
<table>
<tr><th>Statement</th><th>Tick (✓) or cross (✗)</th></tr>
<tr><td>Correct dosage investigated</td><td>✓ ;</td></tr>
<tr><td>Tested on animals</td><td>✗ ;</td></tr>
<tr><td>A double blind trial was undertaken</td><td>✗ ;</td></tr>
</table>
</td><td>(3)</td></tr>
</table>

Question Number	Answer	Mark
7 (a)	1. idea of a {group / number / collection / eq} of cells ; 2. idea of working together to carry out the {same / specific / one / eq} function ;	**(2)**

Question Number	Answer	Mark
7 (b) (i)	C ;	**(1)**

Question Number	Answer	Mark
7 (b) (ii)	B ;	**(1)**

Question Number	Answer	Mark
7 (c) (i)	1. idea of preventing {microbes / bacteria / fungi} FROM {contaminating / escaping / entering / eq} ; 2. reference to {harmful / pathogenic / eq} {micro-organisms / eq} ;	**(2)**

Question Number	Answer	Mark
7 (c) (ii)	idea of allowing light in (for photosynthesis) / reducing water loss / prevent entry of organisms (that would affect plant growth) ;	**(1)**

Question Number	Answer	Mark
7 (c) (iii)	1. (tissue R) is xylem ; 2. (tissue R) is dead / eq ; 3. no genetic material / DNA /genes / no nucleus present ; 4. (tissue R) is not totipotent / eq ; 5. it is already {differentiated / specialised) ; 6. unable to {divide / undergo mitosis} / eq ;	**(3)**

Question Number	Answer	Mark
8 (a) (i)	(7mm / largest seed size) because has greatest germination success ;	**(1)**

Question Number	Answer	Mark
8 (a) (ii)	1. correct values from graph, i.e. 4 (au) and 20 (au) ; 2. correct subtraction e.g. 20 - 4 = 16 ; 3. (change ÷ original) X 100 to give correct answer, e.g. (16 / 4) x 100 = 400% ; For correct answer of 400% - 3 marks	**(3)**

Question Number	Answer	Mark
8 (a) (iii)	1. idea of maintaining or increasing {genetic diversity / size of gene pool / genetic variation} ; 2. idea of more chance of having beneficial alleles / eq ; 3. increases chance of future survival {if environment changes / due to higher adaptability } / eq ; 4. less chance of all being susceptible to a disease / eq ;	**(3)**

Question Number	Answer	Mark
8 (b)	1. details of assessment of seed viability e.g. only select seeds with a living embryo, use of X ray (to detect embryo presence) / eq ; 2. idea of {cleaning seeds / surface sterilisation / eq} ; 3. idea of drying (of the seed) ; 4. idea of storing at low temperatures ; 5. idea of regularly testing viability (during storage of seed) ; 6. idea of what to do if viability decreases, e.g. if less than 75% germinate collect fresh seed for storage ;	**(4)**

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Edexcel GCE

Biology

Advanced Subsidiary

Unit 2: Development, Plants and the Environment

Wednesday 18 January 2012 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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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P 3 9 5 0 4 A 0 1 2 4

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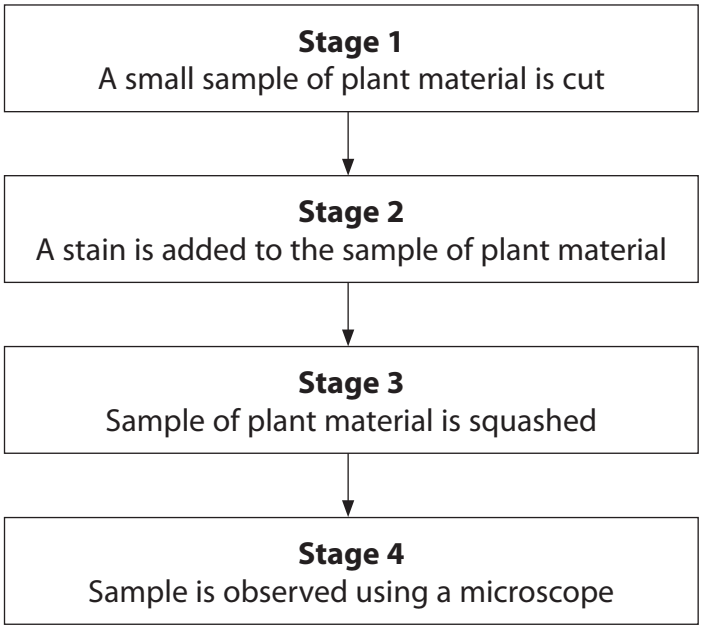
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Answer ALL questions.

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 Mitosis can be studied using plant material.

(a) The diagram below shows some stages in a process that allows mitosis to be studied in plant material.



Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(5)

(i) In stage 1, the small sample of plant material is cut from

☒ **A** a leaf edge

☒ **B** a root tip

☒ **C** sclerenchyma fibres

☒ **D** xylem vessels

P 3 9 5 0 4 A 0 2 2 4
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(ii) In stage 1, the most sensible safety precaution is to

☒ **A** cut away from oneself

☒ **B** cut towards oneself

☒ **C** wear safety goggles

☒ **D** wear a lab coat

(iii) In stage 2, the most sensible precaution to protect clothes from the stain is to

☒ **A** keep the stain in a waterbath

☒ **B** wear a lab coat

☒ **C** wear gloves

☒ **D** wear safety goggles

(iv) The function of the stain in stage 2 is to

☒ **A** make the chromosomes visible

☒ **B** make the cytoplasm visible

☒ **C** separate the genes from the nucleus to make them more visible

☒ **D** separate the chromosomes from the nucleus to make them more visible

(v) In stage 3, the sample is squashed between

☒ **A** the objective lens of the microscope and the coverslip

☒ **B** the objective lens of the microscope and the slide

☒ **C** the slide and coverslip

☒ **D** two coverslips

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*(b) Prophase is one of the stages of mitosis that could be seen using this process.

The two diagrams below show prophase in an animal cell.
Diagram 1 shows early prophase and diagram 2 shows late prophase.

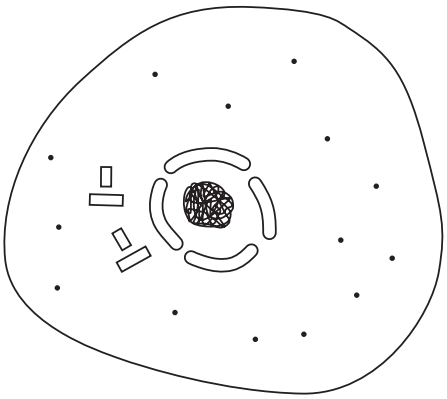


Diagram 1 (early prophase)

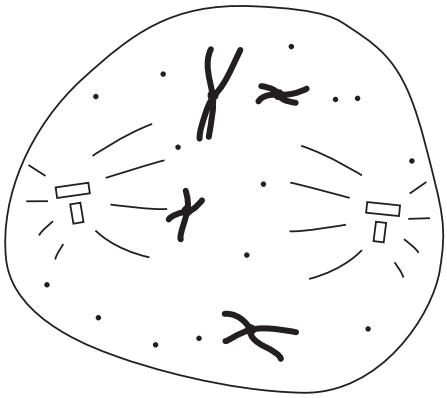


Diagram 2 (late prophase)

Using the two diagrams, describe the changes that occur from early prophase to late prophase.

(5)

(Total for Question 1 = 10 marks)

P 3 9 5 0 4 A 0 0 4 2 4
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2 Organisms are adapted to their environment which increases their chances of survival.

(a) Read through the following passage about adaptations to the environment. Write on the dotted lines the most appropriate word or words to complete the passage.

(3)

The process of ..... selection can lead to adaptation, survival and

..... .

There are three types of adaptations to the environment: physiological, anatomical

and ..... .

(b) The table below describes some adaptations in humans. Complete the table by stating whether the adaptation is physiological or anatomical.

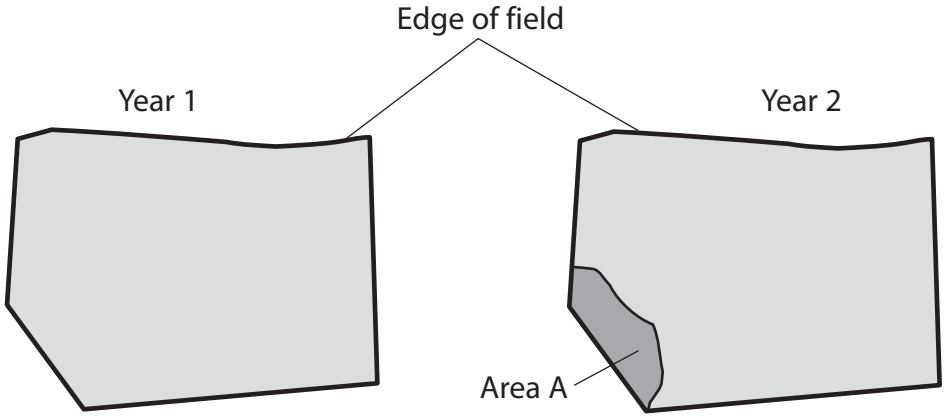
(3)

Description	Adaptation
Hearing becoming temporarily less sensitive after listening to loud music for a few hours	
Heart beats faster when the hormone adrenaline is released	
People living in a cold climate have a shorter neck than people living in a hot, dry climate	

(Total for Question 2 = 6 marks)

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3 A student studied one field in two different years.
She recorded some information, shown in the diagram below.



25 different species of plant found in field
All species abundant in field

18 different species of plant found in field
4 species very abundant,
12 species abundant and
2 species rare

(a) Using the information in the diagram, suggest in which year the species richness was greater. Give a reason for your answer.

(2)

.....

.....

.....

.....

(b) Buttercup plants were found in this field in both years. Buttercup plants can produce new plants by asexual reproduction.

(i) Name the type of cell division required for asexual reproduction.

(1)

.....

P 3 9 5 0 4 A 0 6 2 4
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(ii) The genetic diversity of buttercup plants in the field is low.
Describe and explain why asexual reproduction results in low genetic diversity.

(2)

*(c) Another student noted that several species of plant did not grow as well in area A as they did in the rest of the field. He suggested this was due to a shortage of nitrate ions in the soil in this area.

The effect of varying nitrate ion concentration on the growth of one plant species can be investigated in a laboratory.

Describe how this investigation can be carried out to produce **reliable** results.

(5)

(Total for Question 3 = 10 marks)

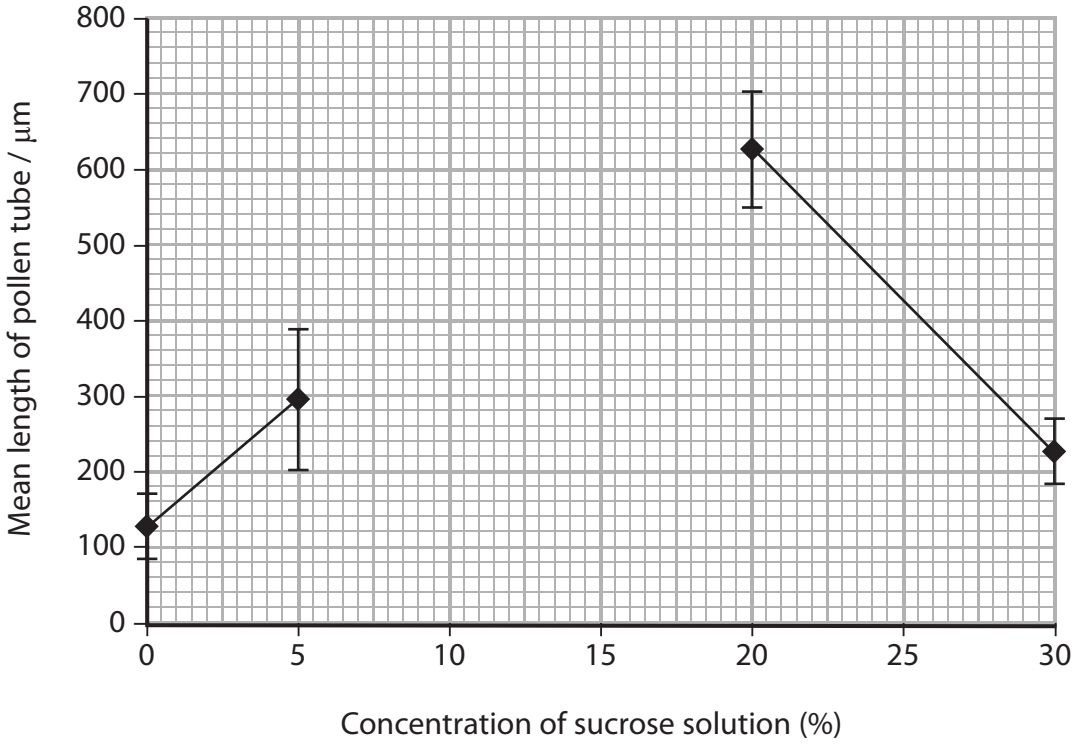
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4 A student investigated the effect of sucrose concentration on the growth of pollen tubes.

Four pollen grains were placed in a small dish containing water. The pollen grains were left for two hours and the lengths of the pollen tubes produced were measured. The mean length was then calculated.

This procedure was repeated using dishes containing sucrose solutions at concentrations of 5%, 10%, 20% and 30%.

The graph below shows the mean lengths of the pollen tubes from four of the five sets of results. Error bars showing the range are also shown.



(a) The table below shows the results for the pollen grains placed in the 10% sucrose solution.

Grain number	Length of pollen tube / µm
1	690
2	680
3	720
4	710
Mean	700

P 3 9 5 0 4 A 0 0 8 2 4
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(i) Using the information in the table, plot the mean length of pollen tubes and the error bar showing the range of data for the 10% sucrose solution and complete the graph.

(3)

(ii) Using the completed graph, describe the effect of increasing sucrose concentration on the mean length of pollen tubes over the two-hour period.

(3)

(b) Explain the function of the pollen tube in fertilisation in flowering plants.

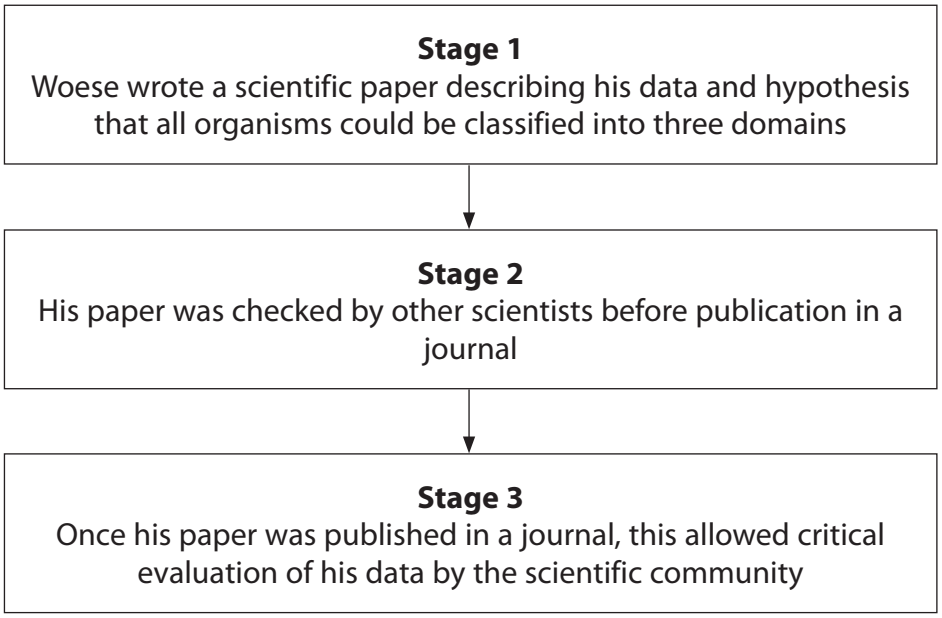
(3)

(Total for Question 4 = 9 marks)

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5 Woese, a scientist, collected data that allowed him to propose the hypothesis that all organisms could be classified into three domains.

(a) The diagram below shows some of the stages Woese used to publicise his new data and hypothesis.



(i) In stage 1, Woese suggested three domains, including the Bacteria and the Eukaryota (Eukarya). Name the third domain.

(1)

.....

(ii) In stage 2, Woese's paper was checked by scientists before publication. Explain why his paper was checked by scientists at this stage.

(1)

.....

.....

.....

(iii) Suggest **two** ways, other than publication in a journal, that scientists can use to present their data to the **scientific** community.

(2)

1 .....

2 .....

P 3 9 5 0 4 A 0 0 2 4
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(iv) Explain what is meant by the phrase 'allowed critical evaluation of his data by the scientific community' in stage 3.

(2)

.....

.....

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.....

(b) The table below compares some features of two domains.
Complete the table by placing a tick (✓) in the box, if the feature may be present in the domain or a cross (✗) if it is absent.

(4)

Feature	Domain	
	Bacteria	**Eukaryota**
Ribosomes		
Smooth endoplasmic reticulum		
Cell (surface) membrane		
Slime capsule		

(Total for Question 5 = 10 marks)

P 3 9 5 0 4 A 0 1 1 2 4
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6 Plants produce a variety of material useful to humans, such as starch, cellulose and fibres.

(a) Starch can be used to form packaging.
Explain why it may be better to make packaging from starch rather than from oil-based products.

(2)

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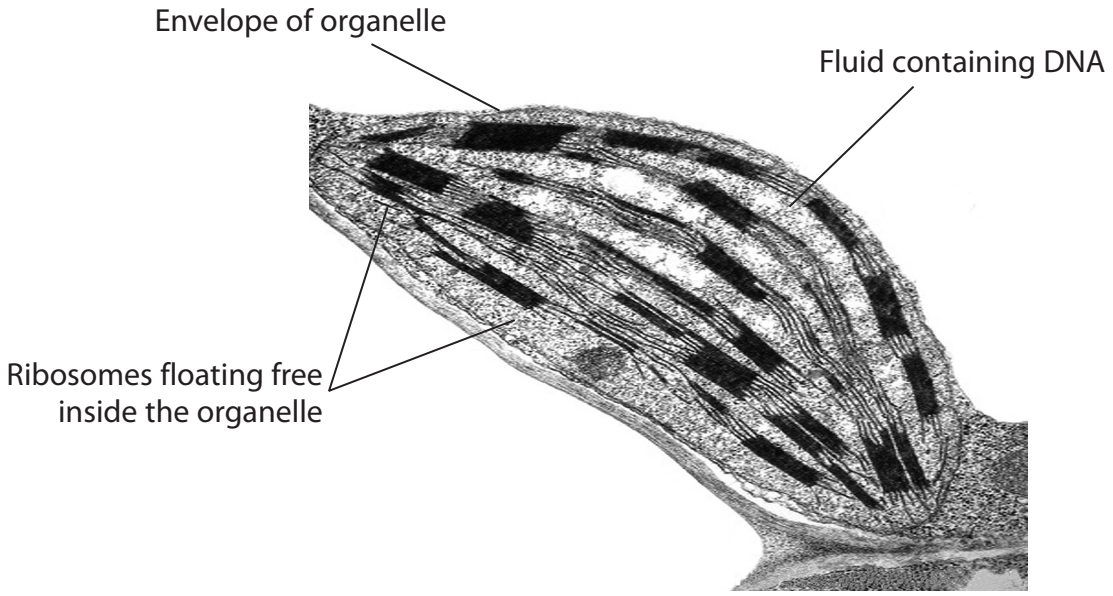
(b) The table below gives three statements about starch and cellulose.
Complete the table by placing a tick (✓) in the box, if the statement is correct, and if the statement is incorrect, place a cross (✗) in the appropriate box.

(3)

Statement	Starch	Cellulose
Consists of microfibrils held together by hydrogen bonds		
Found in amyloplasts		
Made up of β-glucose monomers		

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(c) The organelle, shown in the electron microscope image below, contains the monomers of starch.



Magnification x10 000

Dr. Jeremy Burgess / Science Photo Library

A student incorrectly identified this organelle as rough endoplasmic reticulum because it had ribosomes inside it.

(i) Name this organelle.

(1)

.....

(ii) Using the labels on the diagram and your own knowledge, give **two** reasons why it is **not** rough endoplasmic reticulum.

(2)

Reason 1 .....

.....

Reason 2 .....

.....

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(d) The stem of a plant contains xylem vessels and sclerenchyma fibres.
Compare the functions of xylem vessels with the functions of sclerenchyma fibres.

(3)

(Total for Question 6 = 11 marks)

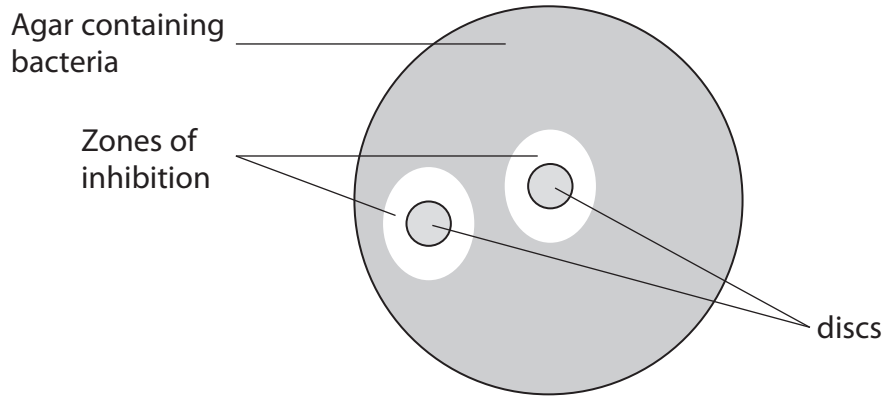
P 3 9 5 3 4 A 0 1 4 2 4
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7 An investigation was carried out to study the antimicrobial properties of garlic.

A piece of garlic was crushed with 5 cm^3 of sterile water to form a full-strength extract.

Two sterilised paper discs were each soaked in the full-strength extract. Both discs were placed on an agar plate covered in the bacterium *Micrococcus luteus*. This plate was incubated at 25 °C for 24 hours.

After this time, the diameter of the zone of inhibition around each disc was measured and the mean diameter was calculated.



This procedure was repeated using different dilutions of the full-strength extract.

The results of the investigation are shown in the table below.

Concentration of extract as a percentage of the full-strength extract (%)	Mean diameter of zone of inhibition / mm
100	18
80	17
60	16
40	12
20	8

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(a) Using the information in the table, describe the effect of the concentration of garlic extract on the mean diameter of the zone of inhibition.

(3)

(b) Suggest which concentration of garlic extract has the strongest antimicrobial properties. Give an explanation for your answer.

(3)

(c) Suggest a suitable control for this investigation.

(1)

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(d) The discs were sterilised by being placed in alcohol and then left to dry before being soaked in the extract.

Suggest why the discs should be sterilised before being soaked in the extract.

(2)

(e) Suggest how the results in the table might have been different if the discs had not been allowed to dry after being placed in alcohol. Explain your answer.

(2)

(Total for Question 7 = 11 marks)

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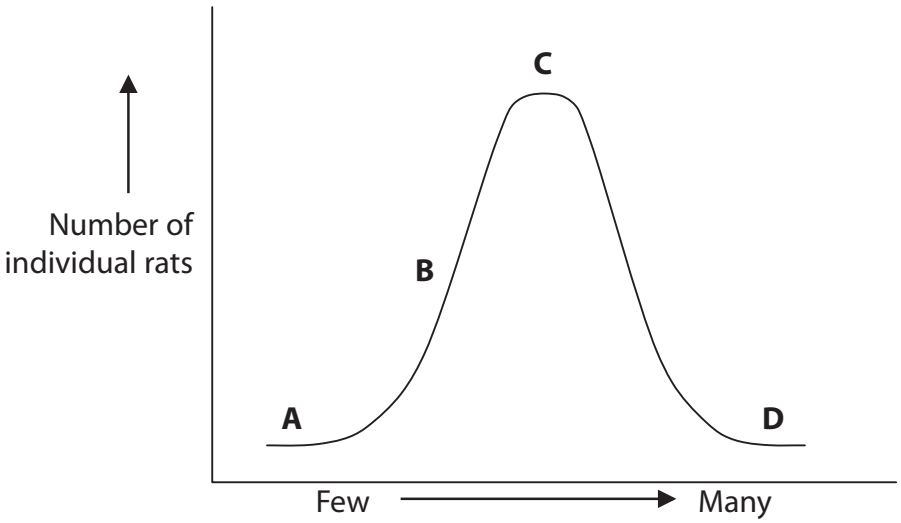
8 A series of studies on rats have shown that the phenotype of an organism is the result of an interaction between the genotype and the environment.

(a) An investigation was carried out to study the ability of rats to run through a maze.



A rat was placed at the start of the maze and the number of errors it made was recorded as it ran through the maze.

This was repeated using many rats and the results are shown in the graph below.



(i) Using the information in the graph, place a cross ☒ in the box that correctly identifies rats that are **least** good at running through a maze.

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

P 3 9 5 0 4 A 0 0 1 8 2 4
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Place a cross ☒ in the box next to the correct word to complete each of the following statements.

(ii) The shape of this graph suggests that the type of variation shown is

(1)

☒ **A** categoric

☒ **B** continuous

☒ **C** discontinuous

☒ **D** discrete

(iii) The distribution of the data in this graph is

(1)

☒ **A** causal

☒ **B** irregular

☒ **C** normal

☒ **D** proportional

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(b) In another investigation, rats that were very good at running through mazes (maze-bright) were selected. These were allowed to breed amongst themselves for several generations to produce more maze-bright rats.

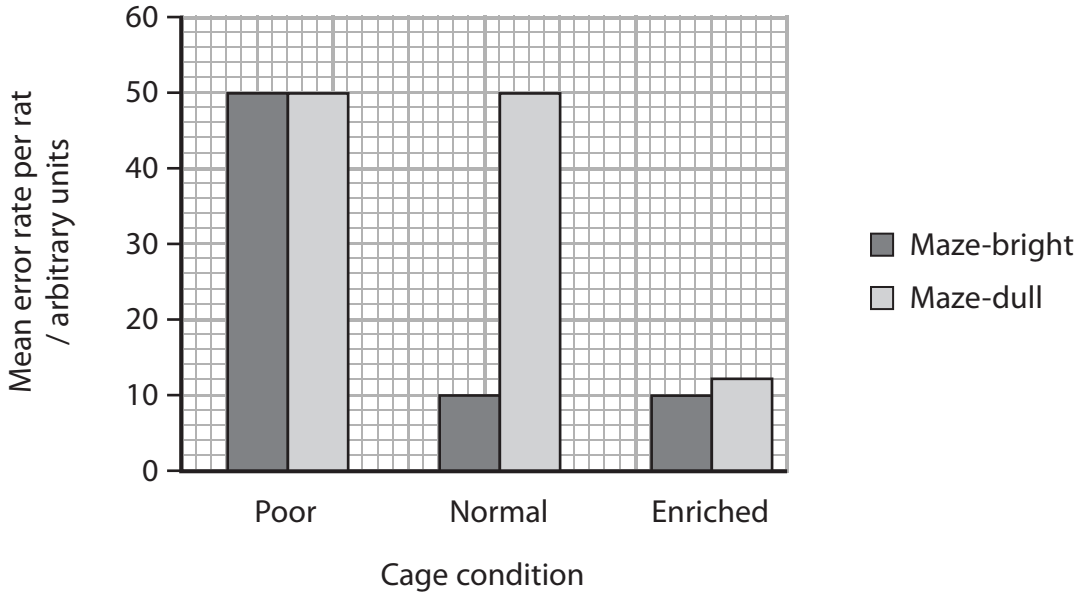
When these rats were young, they were split into three groups.
Each group was raised in one of three cage conditions. These conditions are described in the table below.

Cage condition	Description
Poor	Cages with no toys
Normal	Cages with a few toys
Enriched	Cages with many toys

When adult, these rats then ran through a maze and the number of errors made was recorded. The mean error rate per rat was calculated.

This investigation was repeated with rats that were least good at running through mazes (maze-dull).

The results are shown in the graph below.



(i) State the phenotype of the rats being studied in this investigation.

(1)

P 3 9 5 0 4 A 0 2 0 2 4
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(ii) Suggest **two** factors that need to be controlled in this investigation.

(2)

1 .....

2 .....

(iii) Compare the mean error rate per rat for maze-bright rats and maze-dull rats in poor cage conditions and enriched cage conditions.

(3)

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(iv) Describe and explain the differences in the mean error rate per rat for maze-dull rats when they grew up in normal cage conditions and enriched cage conditions.

(2)

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(v) Describe and explain the effect on the mean error rate per rat for maze-bright rats when they grew up in normal cage conditions and enriched cage conditions.

(2)

(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

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Mark Scheme (Results)

January 2012

GCE Biology (6BI02) Paper 01
Development, Plants & Environment

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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) (i)	B ;	**(1)**

Question Number	Answer	Mark
1(a) (ii)	A ;	**(1)**

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

Question Number	Answer	Mark
1(a) (iv)	A ;	**(1)**

Question Number	Answer	Mark
1(a) (v)	C ;	**(1)**

Question Number	Answer	Mark
***1(b)QWC**	(QWC – **Spelling** of technical terms must be correct and the answer must be organised in a logical sequence) 1. *nucleolus* {disappears / breaks down} / eq ; 2. *nuclear {envelope/membrane}* breaks down / eq ; 3. *centrioles* move to (opposite) poles / *centrioles* separate / eq ; 4. {*spindle* / *spindle* fibres / asters} form / are visible / are produced by *centrioles* / eq ; 5. *{chromosomes / chromatids}* become visible / eq ; 6. *{chromosome / chromatid /chromatin }* condenses / DNA coils / eq ; 7. (chromosomes can be seen as) {pairs of /sister } *chromatids* / eq ; 8. correct reference to *centromere* (holding chromatids in pairs);	**(5)**

Question Number	Answer	Mark
2 (a)	1. natural ; 2. evolution / speciation / reproduction; 3. behavioural ;	**(3)**

Question Number	Answer	Mark
2 (b)		**(3)**

Description	Adaptation
Hearing becoming temporarily less sensitive after listening to a loud music for a few hours	Physiological ;
Heart beats faster when the hormone adrenaline is released	Physiological ;
People in a cold climates having a shorter neck than people living in hot, dry conditions	Anatomical ;

Question Number	Answer	Mark
3 (a)	1. year 1 ; 2. {more / eq } species present (in year 1) / greater variety of species ; Ignore references to abundance.	**(2)**

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

Question Number	Answer	Mark
3 (b)(ii)	1. low genetic diversity is {few / low number of / less / eq} different alleles in the {gene pool / population / species} / small gene pool / eq ; 2. (asexual reproduction leads to) all offspring being {genetically identical / clones / same genotype / same alleles } ; 3. no meiosis/ no recombination of genetic material / eq; 4. idea of variation only possible as a result of mutation ;	**(2)**

Question Number	Answer	Mark
*** 3 (c)**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. (description of how to vary the independent variable) Idea of at least 5 different nitrate (ion) concentrations ; 2. Reference to repeats at each concentration ; 3. (measuring of dependent variable) Increase in {length/mass/ height} ; 4. use plants that are genetically {similar / same} / same age / same original {height/ size / mass} of plant ; 5. & 6. Controlling abiotic factors, maximum 2 from list: • time (at least a week) allowed for growth • other mineral ions constant • temperature • light (intensity) • water provided • pH of {solution / soil} • CO_2 concentration ;; 7. idea of control described, e.g. no nitrate/ soil with no extra nitrate ;	**(5)**

Question Number	Answer	Mark
4 (a) (i)	1. centre of point added to graph at 700µm for 10% ; 2. error bar from 720 µm to 680 µm ; 3. points correctly joined by neat ruled straight lines ;	**(3)**

Question Number	Answer	Mark
4 (a) (ii)	1. up to 10% sucrose, {an increase in sucrose increases (mean) length of pollen tube / positive correlation } / eq ; 2. greatest increase between 5% and 10%/ eq ; 3. greatest (mean length of pollen tube) at 10% / eq ; 4. idea that above 10% the pollen tubes are shorter e.g. negative effect or correlation ; 5. credit correct manipulation of the data e.g. 570-580 µm longer when grown in 10% sucrose compared to 0% sucrose ; 6. appropriate comment on significance of overlapping {error / range} bars between {5% and 30% / 10% and 20%} ;	**(3)**

Question Number	Answer	Mark
4(b)	1. idea of {forms a pathway/ grows down } through the style / eq ; 2. grows towards { ovary / ovule / micropyle / egg cell / eq} ; 3. reference to digestive enzymes; 4. transports {generative nucleus / haploid nuclei / male gametes / eq} / eq ; 5. fuses with embryo sac (membrane) / tip breaks down when it enters the micropyle / allows male nuclei to enter embryo sac /eq ;	**(3)**

Question Number	Answer	Mark
5 (a) (i)	Archaea / Archaebacteria / eq ;	**(1)**

Question Number	Answer	Mark
5 (a)(ii)	Peer review / conclusions drawn from data are { logical / valid / eq } / data are {acceptable / reliable} / check for plagiarism ;	**(1)**

Question Number	Answer	Mark
5 (a)(iii)	Any **two** from: 1. (scientific) conference/ poster / presentation/ seminar / lecture ; 2. internet / eq, e.g. websites – blogs ; 3. book / scientific magazine ;	**(2)**

Question Number	Answer	Mark
5 (a)(iv)	1. idea of {checking his methods / repeating experiments / eq} ; 2. to collect more data /review his data / test his results / eq ; 3. to see if his results could be replicated / check reliability of data / eq ;	**(2)**

Question Number	Answer	Mark
5 (b)	<table><tr><th rowspan="2">Feature</th><th colspan="2">Domain</th></tr><tr><th>Bacteria</th><th>Eukaryota</th></tr><tr><td>Ribosomes</td><td>✓</td><td>✓</td></tr><tr><td>Smooth endoplasmic reticulum</td><td>×</td><td>✓</td></tr><tr><td>Cell (surface) membrane</td><td>✓</td><td>✓</td></tr><tr><td>Slime capsule</td><td>✓</td><td>×</td></tr></table> ;;;; Any two correct for one mark	**(4)**

Question Number	Answer	Mark
6 (a)	1. plants can be {re-grown / sustainable / eq} OR starch {renewable / sustainable} OR oil is { non- sustainable / non-renewable eq} ; 2. idea of biodegradability ; 3. idea of cheapness ;	**(2)**

Question Number	Answer	Mark
6 (b)	<table><tr><th>Statement</th><th>Starch</th><th>Cellulose</th></tr><tr><td>Consists of microfibrils held together by hydrogen bonds</td><td>×</td><td>×</td></tr><tr><td>Found in amyloplasts</td><td>✓</td><td>×</td></tr><tr><td>Made up of ß-glucose monomers</td><td>×</td><td>✓</td></tr></table> 1 mark for each correct row ;;;	**(3)**

Question Number	Answer	Mark
6 (c)(i)	1. chloroplast (s) ;	**(1)**

Question Number	Answer	Mark
6 (c)(ii)	1. (it has) ribosomes {floating / inside membrane / eq}/ in rER {ribosomes not floating / are attached (to membranes) / not inside} / eq ; 2. it has DNA / rER does not contain DNA / eq ; 3. idea of presence of internal membranes e.g. thylakoid membrane, grana ; 4. (it has) a {double membrane / envelope}/ rER does not have a {double membrane / envelope} / eq ; 5. no {flattened sacs / cisternae} / eq ; 6. contains starch / eq ;	**(2)**

Question Number	Answer	Mark
6 (d)	1. <u>both</u> are used for (structural) support / eq ; 2. only xylem (vessels) transport water / eq ; 3. only xylem (vessels) transport mineral ions / eq ; allow converse for 2nd and 3rd marking points	**(3)**

Question Number	Answer	Mark
7 (a)	1. positive correlation (between concentration of extract and diameter of zone of inhibition / eq ; 2. decrease small between 100 and 60% / larger decrease {between 60 and 20% / below 60%} / eq OR idea of difference in gradient before and after 60% ; 3. idea of direct proportionality {above / below} 60% e.g. linear {above / below} 60% ; 4. correct manipulation of the data (e.g. diameter decreased by 10mm as concentration of extract drops by 80% / from 100% to 20%) ; allow converse statements referring to increase in concentration of extract Ignore reference to rate	**(3)**

Question Number	Answer	Mark
7 (b)	1. 100% /full strength / eq ; 2. largest zone of inhibition / eq ; 3. means most bacteria {killed / not reproducing / prevented from growing } / fewer bacteria able to grow / eq ; 4. faster diffusion at higher concentration / eq ;	**(3)**

Question Number	Answer	Mark
7 (c)	(disc) {soaked (only) in water / with no garlic extract on it / 0% garlic extract } / eq ;	**(1)**

Question Number	Answer	Mark
7 (d)	1. so no { bacteria/ fungi / microbes } (alive) on them / prevents contamination by microbes/ eq ; 2. that could be {harmful / pathogenic / eq} ; 3. idea that could compete with {*Micrococcus luteus* / those on the plate} / affect growth of *Micrococcus luteus* / eq ;	**(2)**

Question Number	Answer	Mark
7(e)	1. reference to increase in zone of inhibition / reference all results would have shown an equal zone of inhibition ; 2. alcohol would have killed {the bacteria in the plate / named bacteria} / alcohol is antimicrobial / eq ; OR 1. reference to decrease in zone of inhibition; 2. extract may have been { diluted / effectiveness reduced by the alcohol / eq } ;	**(2)**

Question Number	Answer	Mark
8 (a) (i)	D ;	**(1)**

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

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

Question Number	Answer	Mark
8 (b) (i)	maze dull/ maze bright / eq ; ACCEPT maze running ability	**(1)**

Question Number	Answer	Mark
8 (b) (ii)	Any **two** from: 1. breed of rat / eq ; 2. age of rats / eq ; 3. sex of rats / eq ; 4. physiological state / provided with same diet / eq ; 5. maze (arrangement) / eq ; 6. number of attempts at maze / eq ; 7. environment conditions e.g. temperature, lighting ; 8. (type of) toy / eq ;	**(2)**

Question Number	Answer	Mark
8 (b) (iii)	1. same (for both) in poor conditions / eq ; 2. {improved / fewer errors} for both in enriched conditions (compared with poor) / eq ; 3. In enriched conditions, {improved / fewer errors} made by maze-bright (than maze dull) / little difference / eq ; 4. correct manipulation of the data e.g. 40 arbitrary units fewer errors in maze-bright rats from enriched compared to poor conditions OR 2 arbitrary units better for maze-bright than maze-dull in enriched conditions ;	**(3)**

Question Number	Answer	Mark
8 (b) (iv)	1. idea of fewer errors ; 2. idea that this is due to the environment e.g. more toys, more stimulating environment ;	**(2)**

Question Number	Answer	Mark
8 (b)(v)	1. no difference / eq ; 2. idea of having {maximum potential / genetic potential / eq} ;	**(2)**

Write your name here

Surname	Other names

Centre Number | Candidate Number

Edexcel GCE

Biology

Advanced Subsidiary

Unit 2: Development, Plants and the Environment

Thursday 26 May 2011 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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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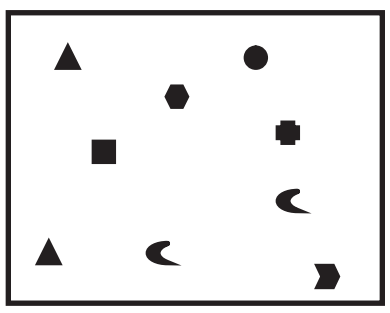
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Answer ALL questions.

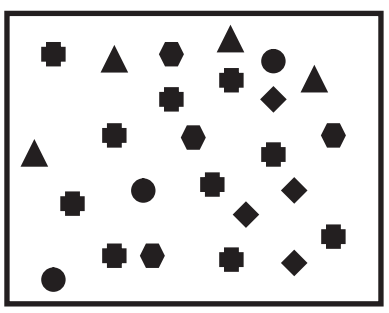
Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Biodiversity is an important concept in conservation.

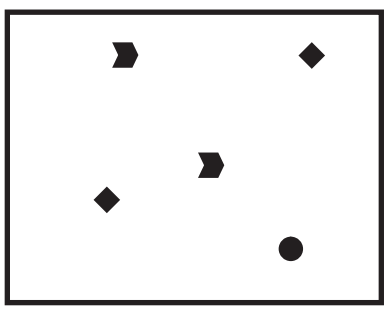
(a) The diagrams below show four identically sized areas A, B, C and D.
Different shapes represent different species.



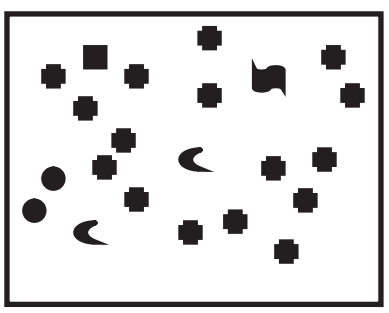
Area A



Area B



Area C



Area D

Place a cross ☒ in the box next to the correct letter to complete each of the following statements.

(i) The area with the highest species richness is

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

(ii) The area with the lowest species richness is

(1)

☒ **A** ☒ **B** ☒ **C** ☒ **D**

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(iii) State which area contains an endemic species, giving reasons for your answer.

(3)

Area.....

Reasons.....

.....

.....

.....

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.....

.....

(b) Zoos help to conserve rare endemic species through captive breeding programmes and reintroduction programmes.

* Describe how zoos use these programmes to help conserve rare species.

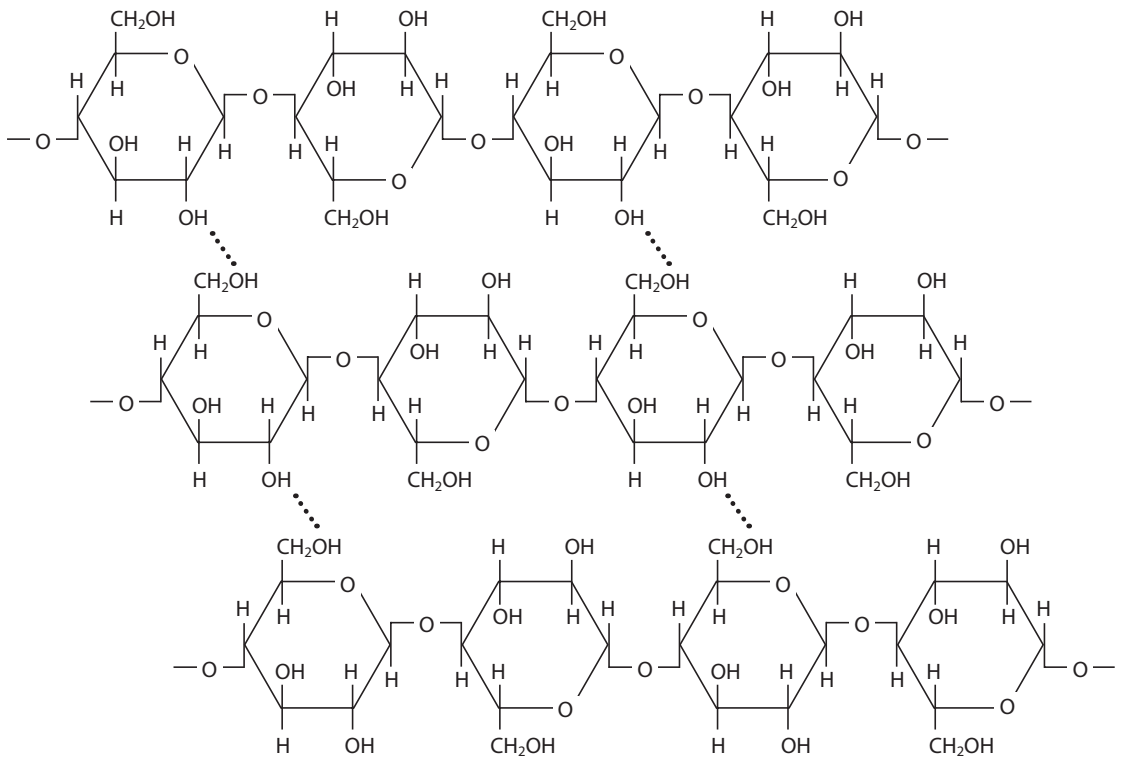
(5)

(Total for Question 1 = 10 marks)

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2 Cellulose and mineral ions are important components of a plant.

(a) The diagram below shows part of a cellulose microfibril.



(i) On the diagram above, draw a circle labelled **G** round **one** of the glycosidic bonds.

(1)

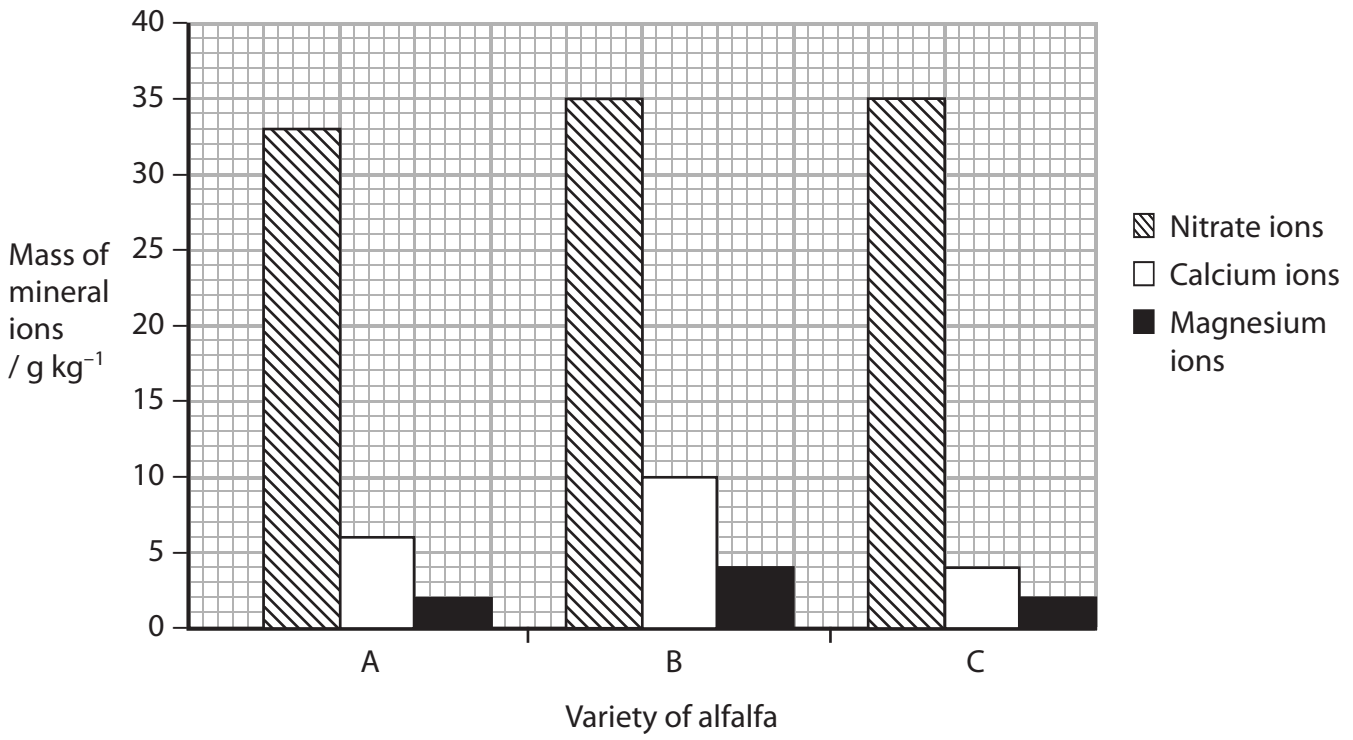
(ii) On the diagram above, draw a circle labelled **H** round **one** of the hydrogen bonds.

(1)

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(b) An investigation was carried out to find the mass of mineral ions in three varieties (A, B and C) of the alfalfa plant.

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



(i) Using the information in the graph, suggest which variety of alfalfa could have the highest concentration of chlorophyll. Give a reason for your answer.

(2)

Variety .....

Reason .....

.....

.....

(ii) Using the information in the graph, suggest which variety of alfalfa could have the strongest cell walls. Give an explanation for your answer.

(3)

Variety .....

Explanation .....

.....

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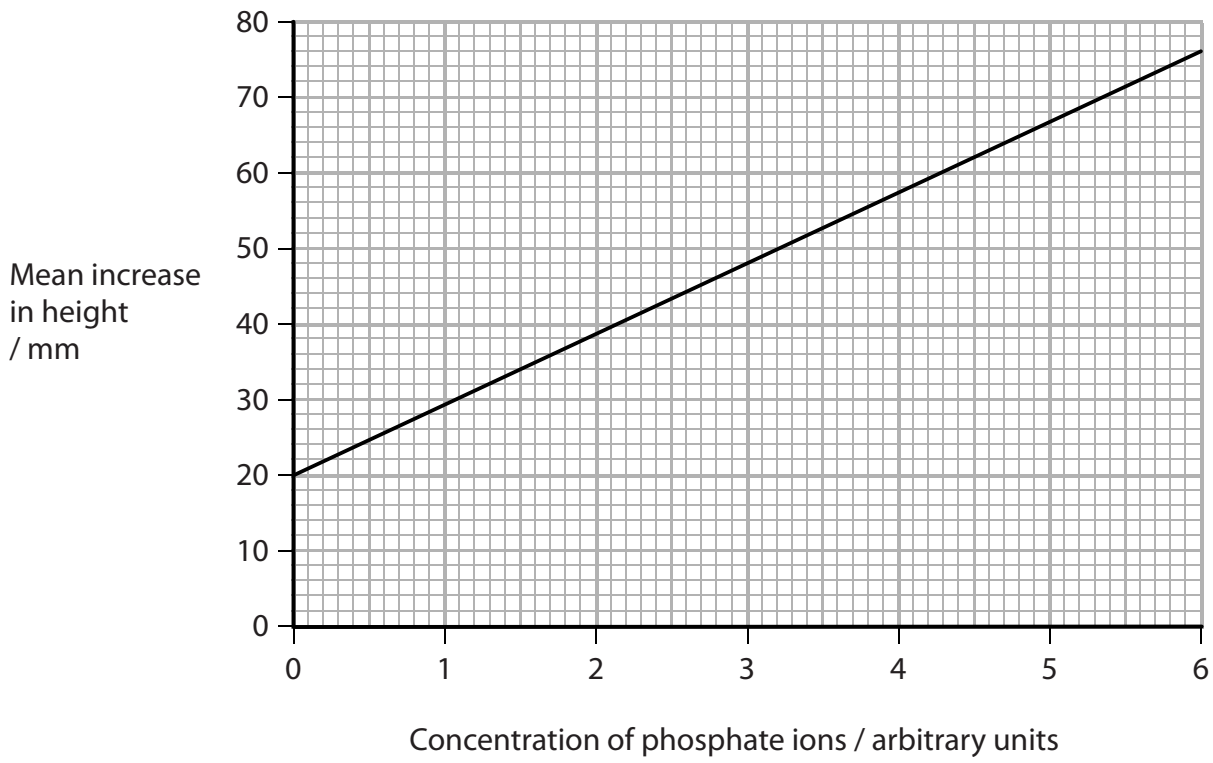
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(c) An investigation was carried out to find the concentration of phosphate ions in a soil sample.

Five wheat seedlings were grown in a solution containing all necessary mineral ions, except for phosphate ions. After three weeks, the increase in height of each seedling was measured and the mean increase in height was calculated.

This procedure was repeated for solutions containing different concentrations of phosphate ions.

The results are shown in the graph below.



(i) Another five wheat seedlings were grown in a sample of soil for three weeks and their mean increase in height was found to be 45 mm.

Use the graph to estimate the concentration of phosphate ions in this sample of soil.

(1)

Answer ..... arbitrary units

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(ii) In this investigation, all the seedlings were grown from seeds from the same wheat plant. Suggest why this would improve the validity of the results.

(1)

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.....

.....

.....

(iii) Suggest **two** factors, other than the time for growth and the source of the seeds, that should have been kept constant in this investigation.

(2)

1 .....

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2 .....

.....

(Total for Question 2 = 11 marks)

P 3 8 1 7 2 A 0 8 2 8

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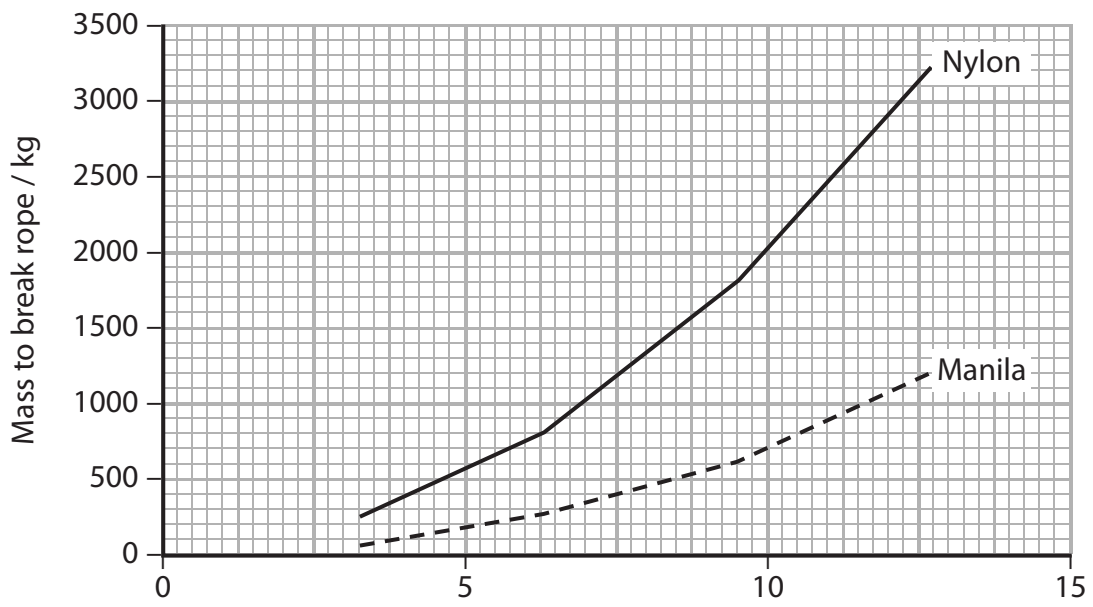
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3 Ropes can be made from many substances including nylon and manila.
Nylon is a synthetic fibre. Manila is made of fibres from the *Musa textilis* plant, shown in the photograph below.



Malkolm Warrington / Science Photo Library

(a) The mass required to break ropes, of different diameters, made from nylon and manila was investigated.
The results of this investigation are shown in the graph below.



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Compare the effect of increasing the diameter on the mass needed to break nylon rope rather than manila rope.

(3)

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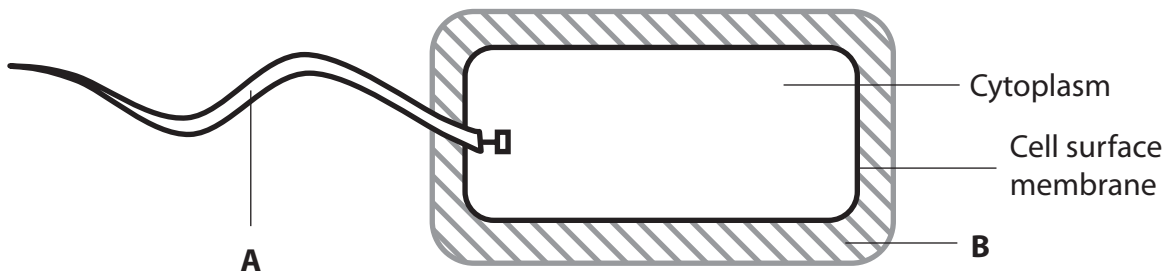
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(b) In the process of making rope, waste material is produced. Some of these waste materials can be broken down by prokaryotic cells such as bacteria.

The diagram below shows the structure of a prokaryotic cell.



(i) Name the parts labelled **A** and **B** on the diagram.

(2)

A .....

B .....

(ii) On the diagram, draw and label **two** structures present in the cytoplasm.

(2)

(Total for Question 3 = 7 marks)

4 Mitosis and meiosis are both forms of nuclear division. Mitosis can be observed in root tip squashes from a plant such as garlic.

(a) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) The stain used in a root tip squash can be intensified by

(1)

☒ **A** adding acid

☒ **B** adding alkali

☒ **C** gently heating

☒ **D** squashing the tip

(ii) Mitosis occurs in

(1)

☒ **A** plant fibres

☒ **B** sclerenchyma fibres

☒ **C** stem cells

☒ **D** xylem vessels

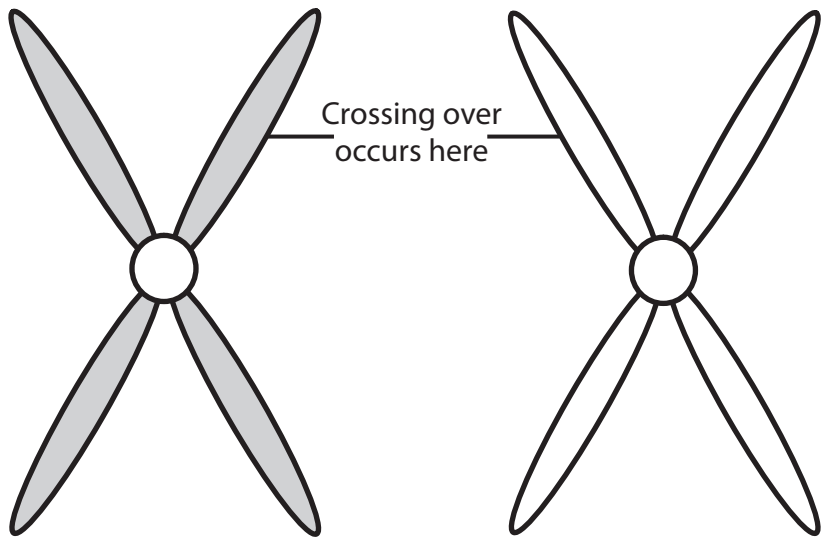
(b) Describe the appearance of a cell in telophase of mitosis as seen in a root tip squash.

(3)

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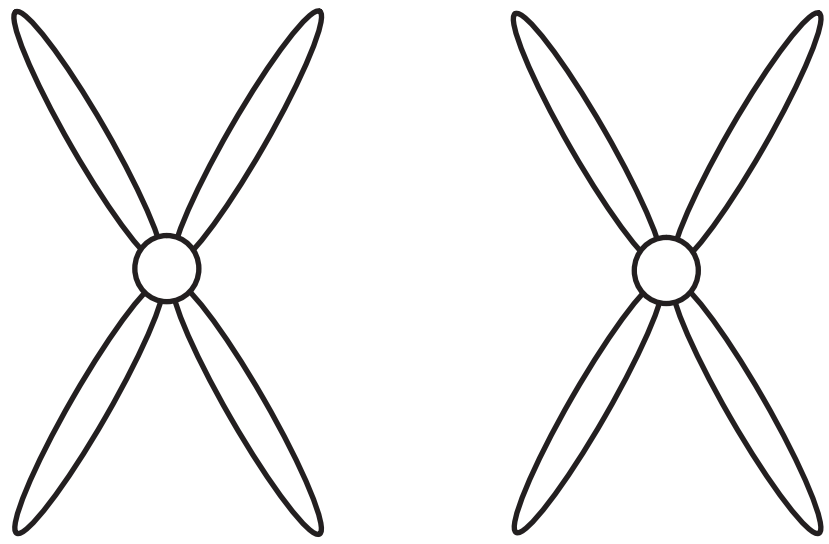
(c) One way in which meiosis increases genetic variation is through crossing over.

(i) The diagram below shows a pair of homologous chromosomes during meiosis. They are positioned next to each other but crossing over has not yet occurred.



Complete the diagram below to show these chromosomes after crossing over has occurred.

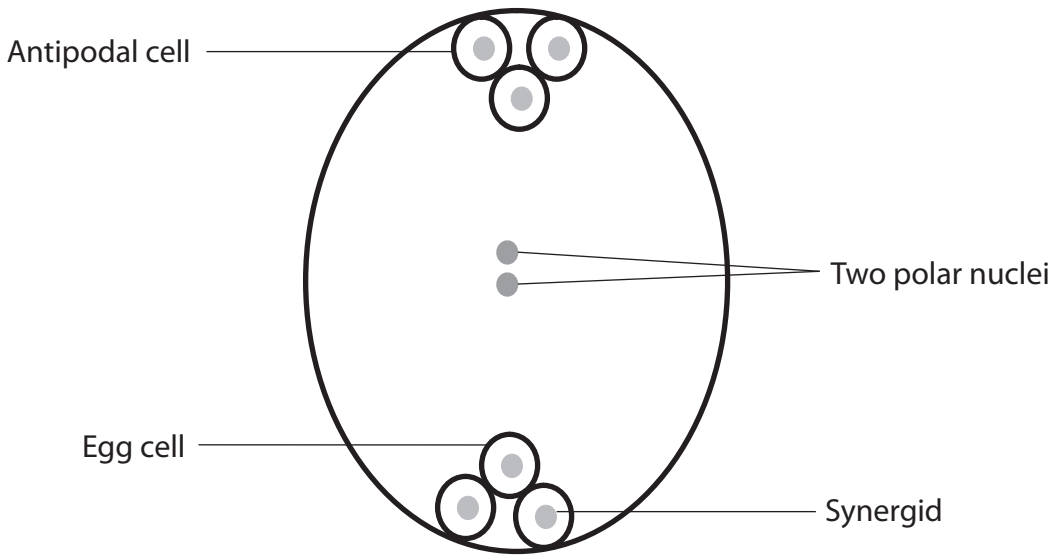
(1)



(ii) Meiosis produces haploid structures in the plant.

The diagram below shows an embryosac.
Draw a circle round each of the labels of **two** haploid structures that are fertilised in the embryosac.

(2)



(iii) Explain what is meant by the term **haploid number** of chromosomes.

(1)

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.....

.....

(Total for Question 4 = 9 marks)

P 3 8 1 7 2 A 0 1 4 2 8

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5 Genetic diversity is important for the long term survival, adaptation and evolution of organisms. Genetic diversity can be considered as the number of different alleles found at each gene locus in a population of organisms.

(a) Explain what is meant by the term **gene locus**.

(2)

.....

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(b) The genetic diversity of two breeds of dog, P and Q, was investigated.
The total number of different alleles found at 31 gene loci was recorded for each breed.

The results are shown in the table below.

Breed of dog	Total number of different alleles at 31 gene loci
P	239
Q	144

(i) The mean number of different alleles per gene locus for both breeds was calculated.
Place a cross ☒ in the box next to the mean for breed P.

(1)

☒ **A** 5.7

☒ **B** 7.2

☒ **C** 7.7

☒ **D** 31.0

P 3 8 1 7 2 A 0 1 6 2 8

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(ii) Breed Q has a mean of 4.6 different alleles per gene locus.
If their environment changed, breed P would be more likely to survive and evolve than breed Q.

Using information on mean number of different alleles per gene locus and your own knowledge, explain why breed P is more likely to survive and evolve than breed Q.

(5)

(c) Two groups of dogs, of breed P, were taken from the same population.
The total number of different alleles at the same 31 gene loci was recorded for each of these two groups.

The results are shown in the table below.

Group	Number of dogs of breed P	Total number of different alleles at 31 gene loci
1	40	239
2	20	215

Suggest why the total number of different alleles in group 1 was greater than in group 2.

(2)

.....

.....

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.....

(d) Adaptation can be behavioural, physiological or anatomical.
Place a cross ☒ in the box that correctly identifies a **behavioural adaptation** in humans.

(1)

☒ **A** Long necks are more common in people living in hot dry conditions

☒ **B** More red blood cells in people living high up a mountain

☒ **C** More white blood cells in people with an infection

☒ **D** Taking a rest in the heat of the day

(Total for Question 5 = 11 marks)

P 3 8 1 7 2 A 0 1 8 2 8

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6 Woese was the scientist who proposed a classification of organisms into three domains called the Archaea, Bacteria and Eukaryota (Eucarya).

(a) The table below shows some of the characteristics of the three domains.

Characteristic	Domain		
	A	**B**	**C**
Mitochondria	Absent	Absent	Present
Cell wall containing peptidoglycan	Yes	No	No
Amino acid carried on tRNA that starts protein synthesis	Formylmethionine	Methionine	Methionine
Sensitive to antibiotics	Yes	No	No
May contain chlorophyll	Yes	No	Yes

(i) Using the information in the table, suggest which of A, B and C represents the Eukaryota domain. Give a reason for your answer.

(2)

Domain .....

Reason .....

.....

.....

(ii) Many scientists believe that the Eukaryota domain is more closely related to the Archaea domain than to the Bacteria domain.

Using the information in the table, suggest which of A, B and C represents the Archaea domain. Give a reason for your answer.

(2)

Domain .....

Reason .....

.....

.....

(b) Cells of the Eukaryota domain contain rough endoplasmic reticulum and Golgi apparatus.
Both the rough endoplasmic reticulum and the Golgi apparatus are made up of membrane-bound sacs.

(i) Describe how you would recognise the Golgi apparatus as seen using an electron microscope.

(3)

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*(ii) Explain the roles of rough endoplasmic reticulum and the Golgi apparatus in a cell.

(6)

(Total for Question 6 = 13 marks)

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7 Stem cells can differentiate into specialised cells and tissues.

(a) There are about 23 000 genes in a human body cell. The table below shows the number of genes that have not been switched off, in three different cells, A, B and C.

Cell	Number of genes that have not been switched off
A	11 000
B	18 000
C	23 000

Suggest which of these cells is a totipotent stem cell.
Give reasons for your answer.

(3)

Cell .....

Reasons .....

.....

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(b) A fertilised egg can be used as a source of human pluripotent stem cells.

(i) Explain what is meant by the term **pluripotent stem cell**.

(2)

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(ii) Describe how a fertilised egg can be used as a source of human pluripotent stem cells.

(3)

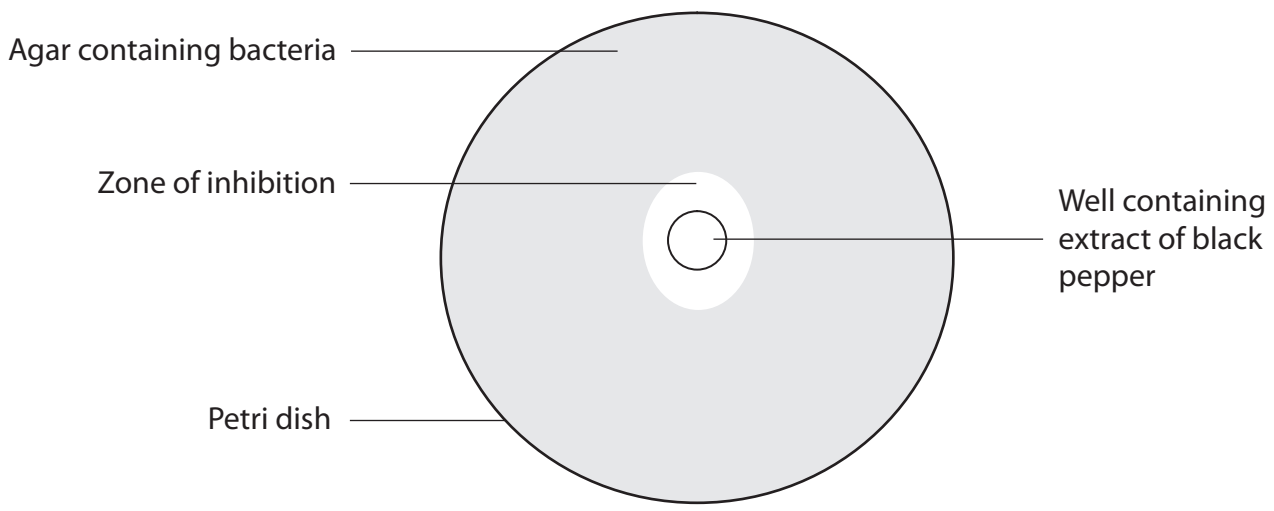
(Total for Question 7 = 8 marks)

8 An investigation was carried out to extract antimicrobial substances from black pepper.

One extraction method used ethanol. The black pepper was crushed and soaked in the ethanol for 24 hours. The crushed pepper was then removed, leaving an ethanol extract.

A Petri dish containing agar and one species of bacterium (B1) had a cylinder of agar removed to produce a well.
The ethanol extract was then placed in the well.

The Petri dish was incubated at 37 °C for 24 hours. After incubation, the diameter of the zone of inhibition around the well was measured. This was repeated using Petri dishes with different species of bacteria (B2, B3, B4 and B5).



The investigation was repeated using an extract prepared with hot water in place of ethanol.

(a) (i) Describe how the bacteria should be added to the Petri dish.

(2)

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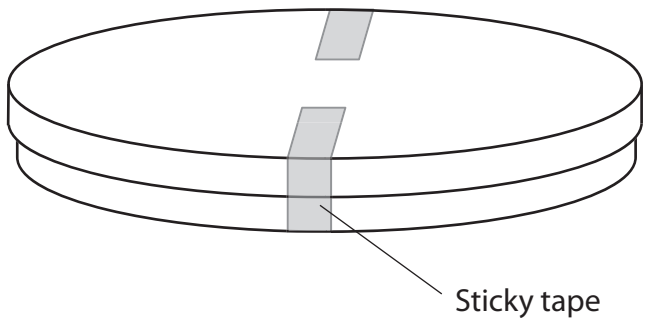
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(ii) Before incubation, the lid was secured to the base of the Petri dish as shown in the diagram below.



Explain why the lid was secured in this way.

(2)

(iii) Suggest why an incubation temperature of 37 °C should not be used in a school or college laboratory.

(1)

(b) The results of this investigation are shown in the table below.

Species of bacterium	Mean diameter of zone of inhibition / mm	
	Ethanol extract	Hot water extract
B1	27.4	18.2
B2	26.2	16.8
B3	15.0	29.6
B4	25.0	16.4
B5	15.0	29.8
Mean	21.7	22.2

(i) One student used the data in the table to form the hypothesis that using ethanol was more effective than hot water at extracting antimicrobial substances from crushed black pepper.

Give evidence from the table that supports this hypothesis.

(1)

.....

.....

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(ii) A second student formed the hypothesis that using hot water to extract the antimicrobial substances was more effective than using ethanol.

Give evidence from the table that supports this hypothesis.

(1)

.....

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(c) Another investigation was carried out using cold water to extract the antimicrobial substances. The same method was used but only bacterium species B1 was tested.
The table below shows the mean diameter of the zones of inhibition and the ranges of the data.

Mean diameter of zone of inhibition / mm	
Hot water extract	**Cold water extract**
18.2 ± 1.4	16.4 ± 0.6

(i) A third student stated that some of the results for the hot water extract overlapped with some of the results for the cold water extract.

Suggest what evidence from the table above the student could have used to support this statement.

(2)

(ii) Using the table above, suggest whether the data for the hot or cold water extract were more reliable. Give a reason for your answer.

(2)

(Total for Question 8 = 11 marks)

TOTAL FOR PAPER = 80 MARKS

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P 3 8 1 7 2 A 0 2 8 2 8

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Mark Scheme (Results)

June 2011

GCE Biology (6BI02) Paper 01 Development, Plants and the Environment

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June 2011
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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)	A ;	**(1)**

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

Question Number	Answer	Mark
1(a)(iii)	1. D ; Any two from: 2. idea that endemic means species restricted to one (geographical) area ; 3. {a species/ flag shape } only present in (Area D/Box 4) ; 4. all other shapes appear in {at least one other box / more than one area} ;	**(3)**

Question Number	Answer	Mark
***1(b)QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) **General points:** 1. to increase numbers/population size ; 2. to {maintain / increase} genetic diversity/ reduce genetic drift / eq ; 3. protect from {predators / poachers / eq} / eq ; **For captive breeding** 4. inter-zoo animal movement / eq ; 5. selection of mates / use of stud books / records kept of breeding programme / eq ; 6. process involved described e.g. IVF / AI / use of surrogates / DNA profiling / eq ; **For reintroduction** 7. preparation for reintroduction described e.g. idea of reinforcing wild behaviour / idea of hacking out / reduce food intake to encourage hunting ; 8. select {habitat / reserves} ; 9. raise {awareness / education} of local population / eq ;	**(5)**

Question Number	**Answer**	Mark
2 (a)(i)	**circle labelled G between one glucose monomer and the next ;**	**(1)**

Question Number	Answer	Mark
2 (a)(ii)	circle labelled H placed on diagonal bonds (dotted lines) between adjacent cellulose molecules ;	**(1)**

Question Number	Answer	Mark
2 (b)(i)	1. B ; 2. {most/highest} magnesium (ions) ;	**(2)**

Question Number	Answer	Mark
2 (b)(ii)	1. B ; 2. {most/highest} calcium (ions) ; 3. (calcium) is a component of {middle lamella / primary cell wall/ calcium pectate / pectin} / eq ;	**(3)**

Question Number	Answer	Mark
2 (c)(i)	2.65 to 2.70 ;	**(1)**

Question Number	Answer	Mark
2 (c)(ii)	Any **one** from**:** 1. {less/reduced} genetic variation/ reduced effect of genotype 2. seeds are the {same age / produced under the same conditions} ;	**(1)**

Question Number	Answer	Mark
2 (c)(iii)	Any **two** from 1. volume of solution ; 2. light / eq ; 3. temperature ; 4. concentration of other mineral ions ; 5. pH ; 6. initial status of seedlings e.g. height ;	**(2)**

Question Number	Answer	Mark
3 (a)	context - as diameter increases, the mass needed to break the rope 1. increases / positive correlation (for both) ; 2. idea that relationship is not linear (for both) e.g. gradient increases for both ; 3. is always higher for nylon / eq ; 4. difference between the two increases as the diameter increases / eq ; 5. credit correct comparative manipulation of the data, e.g. at 5mm the mass taken to break nylon was 350-400 kg more than manila, at 10mm it was 1300-1350kg more ;	**(3)**

Question Number	Answer	Mark
3(b) (i)	**A** = flagellum / flagella ; **B** = (bacterial/ murein / peptidoglycan) cell wall ;	**(2)**

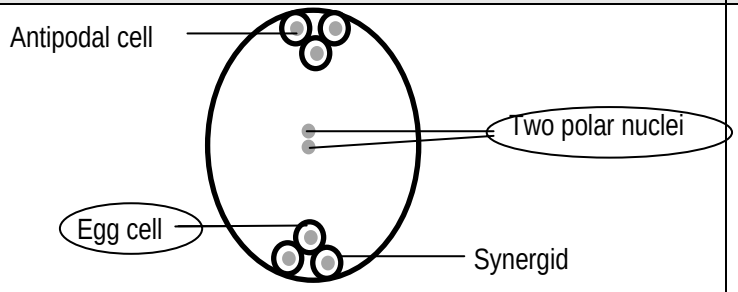
Question Number	Answer	Mark
3 (b) (ii)	Any **two** structures drawn and labelled from the following 1. plasmids ; 2. circular DNA ; 3. ribosomes ; 4. glycogen granule ; 5. lipid droplets ;	**(2)**

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

Question Number	Answer	Mark
4 (a)(ii)	C ;	**(1)**

Question Number	Answer	Mark
4 (b)	1. idea that chromosomes will be in the process of {decondensing /uncoiling/ becoming invisible / eq} ; 2. idea that the {nucleus / nuclear envelope(s)} is visible; 3. idea that a nucleolus may be present ; 4. idea that spindle has {contracted / broken down / absent / eq} ; 5. two {separate nuclei/masses of chromatin} now visible ; 6. idea that there will be evidence of cell plate formation ;	**(3)**

Question Number	Answer	Mark
4 (c)(i)		**(1)**

Question Number	Answer	Mark
4 (c) (ii)		**(2)**

Question Number	Answer	Mark
4 (c) (iii)	Any **one** from 1. half the number (of chromosomes) found in {body cells / somatic cells / named body cell / eq} 2. the number of chromosomes in {gametes/sex cells} 3. the number (of chromosomes) in a cell following meiosis ;	**(1)**

Question Number	Answer	Mark
5 (a)	1. {position / location / eq} of {gene / allele}; 2. on a chromosome / eq ;	**(2)**

Question Number	Answer	Mark
5 (b)(i)	C ;	**(1)**

Question Number	Answer	Mark
5(b)(ii)	1. higher number of alleles (per locus) / 7.7 compared with 4.6 for Q ; 2. (means) higher genetic variation / greater genetic diversity / more allele combinations / eq ; 3. idea that {greater variety of alleles / eq} in gene pool/larger gene pool ; 4. idea that {alleles / genotypes} may give a selective advantage for changes in the environment / eq ; 5. (therefore) more likely to survive and breed / eq ; 6. passing on these favourable allele combinations / eq ; 7. ref to natural selection ; 8. ref to (change in allele frequency) over many generations ;	**(5)**

Question Number	Answer	Mark
5(c)	1. chance / eq ; 2. ref to difference in sample size, e.g. more dogs in Group 1 than in Group 2 ; 3. ref to rare alleles in group 1 ; 4. idea of how representative the samples are of the whole breeding population ;	**(2)**

Question Number	Answer	Mark
5(d)	D ;	**(1)**

Question Number	Answer	Mark
6 (a)(i)	1. C ; 2. mitochondria are present (and only Eukaryota possess mitochondria) ;	**(2)**

Question Number	Answer	Mark
6 (a)(ii)	1. B ; 2. EITHER (because) it has { more / most / three / any two named} characteristics in common (with the eukaryotes/Group C) ; OR the idea that (because) A is sensitive to antibiotics, A must be Bacteria therefore B is Archaea / eq ;	**(2)**

Question Number	Answer	Mark
6 (b) (i)	1. stacks / eq ; 2. cisternae ; 3. smooth membranes / no ribosomes / eq ; 4. (cisternae) curved / flattened ; 5. idea of different sizes (cisternae) ; 6. presence of vesicles ;	**(3)**

Question Number	Answer	Mark
***6 (b) (ii) QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. {*protein* / *polypeptides*} produced by *ribosome* ; 2. *ribosomes* {held on/attached to/eq} rER ; 3. *proteins* {stored / transported / within rER / eq} ; 4. *proteins* {folded/assume 3-D shape/tertiary structure} within (lumen of) rER / eq ; 5. (rER) produce *vesicles* / packages *proteins* /eq ; 6. *vesicles* fuse with *Golgi* (apparatus) / eq ; 7. *Golgi* {modifies/processes} *protein* ; 8. details of modification e.g. *glycoprotein* / *carbohydrate* added, trimming of *carbohydrate* ; 9. water removed (to concentrate) / eq ; 10. *Golgi* produces *{lysosomes* / *secretory vesicles*} ;	**(6)**

Question Number	Answer	Mark
7 (a)	1. C ; Any **two** of the following 2. all genes (potentially) active / as no genes {switched off / deactivated} / {cell A / cell B} has genes switched off / eq ; 3. idea that therefore it can {give rise to/differentiate to become} all cell (types) ; 4. differentiation has occurred in cell {A / B} / eq ;	**(3)**

Question Number	Answer	Mark
7 (b)(i)	1. {undifferentiated / unspecialised} cell ; 2. some genes {deactivated / switched off} ; 3. idea that it can give rise to most specialised cells / eq ; 4. but not totipotent stem cells / extra embryonic cells / eq ;	**(2)**

Question Number	Answer	Mark
7 (b)(ii)	1. fertilised egg allowed to {grow for a few days/ divide several times / eq} ; 2. reference to a {blastocyst/ blastula / hollow ball of cells / eq} ; 3. cells in inner cell mass are {pluripotent / harvested} ; 4. procedure for extraction of cells / eq ; 5. ref to source of fertilised egg e.g. spare embryo after IVF ;	**(3)**

Question Number	Answer	Mark
8 (a) (i)	1. ref to aseptic technique (used to prevent contamination of plate), e.g. use of sterile equipment, such as a pipette ; 2. idea of uniform spreading of bacteria e.g. lawn, spread (over agar), mixed in with molten agar, seeded ;	**(2)**

Question Number	Answer	Mark
8 (a) (ii)	1. reduces contamination (of culture) / eq ; 2. allows { aerobic conditions / entry of air / entry of oxygen} / prevents anaerobic conditions ; 3. reduces {growth / eq} of {harmful / anaerobic} bacteria being {cultured / eq} ;	**(2)**

Question Number	Answer	Mark
8 (a) (iii)	encourages growth of bacteria that are {harmful / pathogenic / eq} (to humans) ;	**(1)**

Question Number	Answer	Mark
8 (b)(i)	{3 species of bacteria / B1, B2 and B4 / most} {killed more effectively / had a larger zone of inhibition} (when using ethanol) / eq ;	**(1)**

Question Number	Answer	Mark
8 (b)(ii)	Idea of mean zone of inhibition larger when using hot water e.g. mean diameter 0.5mm larger for hot water extract ;	**(1)**

Question Number	Answer	Mark
8 (c) (i)	1. the ranges overlap / largest diameter for cold water method is { bigger / eq } than the smallest for hot water / eq ; 2. use of calculated figures to support this e.g. hot water is 16.8 mm **AND** cold water is 17.0 mm **OR** reference to 0.2 mm overlap;	**(2)**

Question Number	Answer	Mark
8 (c) (ii)	1. cold water ; 2. {smaller / eq} range / spread of data is less / eq ;	**(2)**

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Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary

Unit 2: Development, Plants and the Environment

Tuesday 8 June 2010 – Morning
Time: 1 hour 30 minutes

Paper Reference
6BI02/01

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 80.
- 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 on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*
- 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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1/1/1/1/

N 3 5 8 5 5 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 The phenotype of an individual is dependent on a variety of factors.

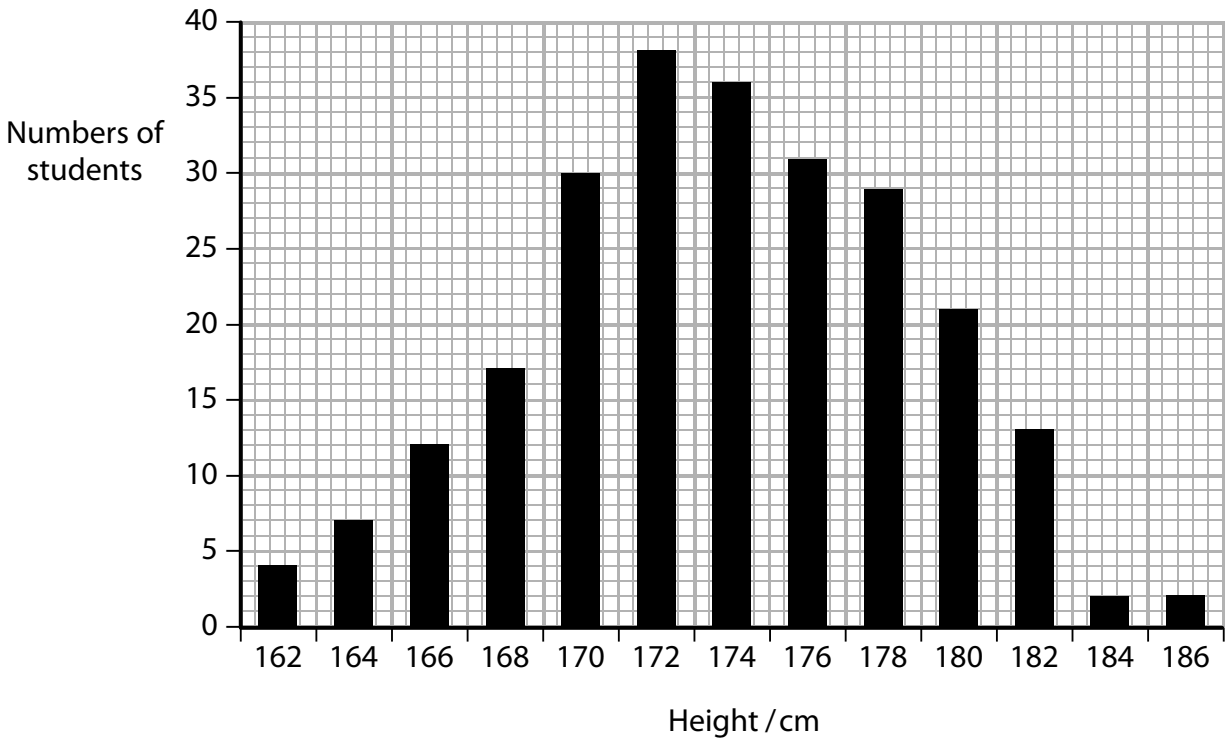
(a) (i) Complete the following sentence by writing the most appropriate word or words on the dotted lines.

(2)

In polygenic inheritance, the phenotypes are affected by forms of genes called ..... found at many ..... on chromosomes.

(ii) The graph below shows some data on the numbers of students of different heights.

Height is an example of polygenic inheritance.



State the heights that represents the median and the mode for this group of students.

(2)

Median height ..... cm

Mode height ..... cm

N 3 5 8 5 5 A 0 2 2 4

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(b) (i) Complete the following short passage by writing the most appropriate word or words on the dotted lines.

(2)

Animal fur colour is an example of a phenotype. The phenotype of

an animal can be the result of an interaction between the

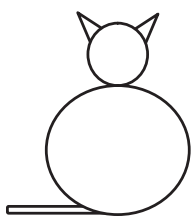
..... and the ..... .

(ii) The enzyme tyrosinase is involved in producing dark coloured fur in cats. Tyrosinase is active at the cat's body temperature.

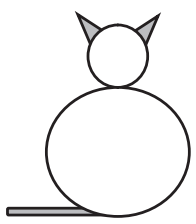
Some cats have a defective form of tyrosinase. The defective tyrosinase is inactive at normal body temperature, but becomes active in the cooler extremities of cats living in a cold environment.

The diagrams below show four cats with different fur colour distributions. Shaded areas represent dark coloured fur and non-shaded areas represent light coloured fur.

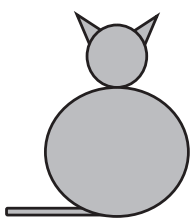
Cat A



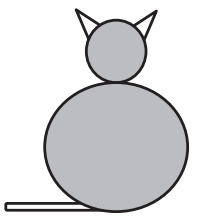
Cat B



Cat C



Cat D



Place a cross ☒ in the most appropriate box to select the diagram which represents:

(3)

a cat with normal tyrosinase	☒ A	☒ B	☒ C	☒ D
a cat with defective tyrosinase, in a hot country	☒ A	☒ B	☒ C	☒ D
a cat in a cold country with defective tyrosinase	☒ A	☒ B	☒ C	☒ D

(Total for Question 1 = 9 marks)

2 Stem cells are considered to be a potential treatment for many conditions. However, research on stem cells needs to be regulated.

*(a) Explain the meaning of the term **stem cell**.

(2)

.....

.....

.....

.....

(b) State **three** potential sources of human stem cells.

(3)

1 .....

2 .....

3 .....

(c) (i) Suggest **two** reasons why there are regulating authorities for human embryo research.

(2)

1 .....

.....

2 .....

.....

(ii) Suggest why these regulating authorities should include people involved in human embryo research and people not involved in embryo research.

(2)

People involved in embryo research .....

.....

.....

People not involved in embryo research .....

.....

.....

(Total for Question 2 = 9 marks)

N 3 5 8 5 5 A 0 4 2 4

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3 In the 1990s, a scientist called Woese suggested a new way of grouping organisms into domains.

(a) The table below shows Woese's three domains and gives some of the characteristics of each domain.

Domain	Some characteristics of each domain
P	True nucleus absent Small (70S) ribosomes present Smooth endoplasmic reticulum absent RNA polymerase made up of 14 subunits
Q	True nucleus present Large (80S) ribosomes present Smooth endoplasmic reticulum present RNA polymerase made up of 14 subunits
R	True nucleus absent Small (70S) ribosomes present Smooth endoplasmic reticulum absent RNA polymerase made up of 4 subunits

(i) Place a cross ☒ in the box which shows the two domains which are most **distantly related**.

(1)

☒ **A** P and Q

☒ **B** P and R

☒ **C** Q and R

(ii) Place a cross ☒ in the box which shows the domain that represents eukaryotic organisms.

(1)

☒ **A** P

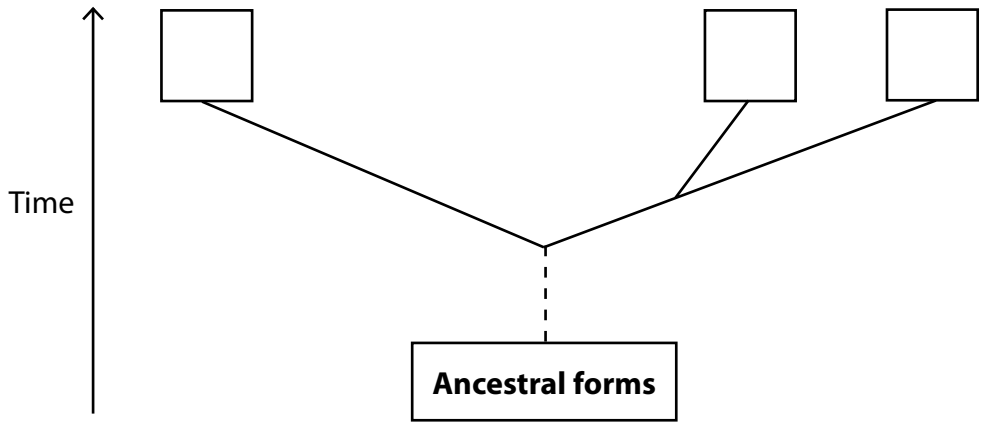
☒ **B** Q

☒ **C** R

(iii) The diagram below represents the phylogenetic tree for the three domains.

Place a cross (×) in the box on the diagram that correctly identifies the eukaryotic domain.

(1)



(iv) Give the name of **one** of the other two domains.

(1)

.....

(b) One domain includes the plants and these have cells with a cell wall.

*(i) Describe the structure of a plant cell wall.

(4)

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N 3 5 8 5 5 A 0 6 2 4

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(ii) A student studied the cell wall arrangement between two adjacent plant cells. He noticed several features which he could not name. Two of these are described in the table below.

Complete the table by writing in the name of each feature described.

(2)

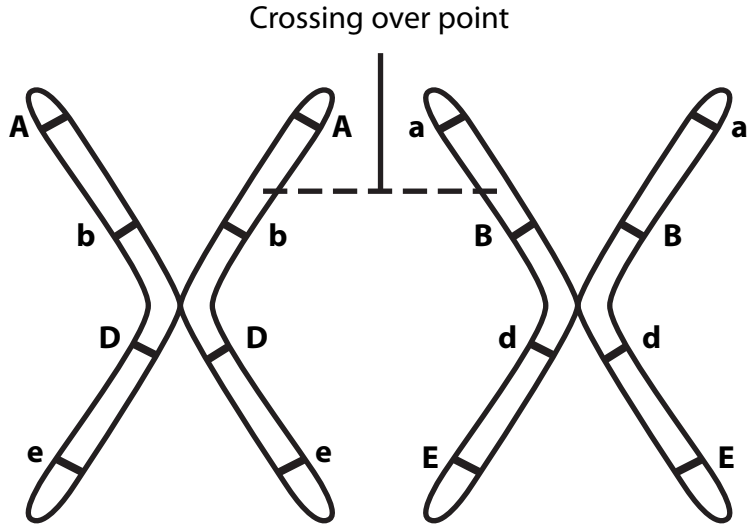
Feature described	Name of feature
Site where there was no cell wall and the cytoplasm linked the two adjacent cells	
Dark line that is the boundary between one cell and the next cell	

(Total for Question 3 = 10 marks)

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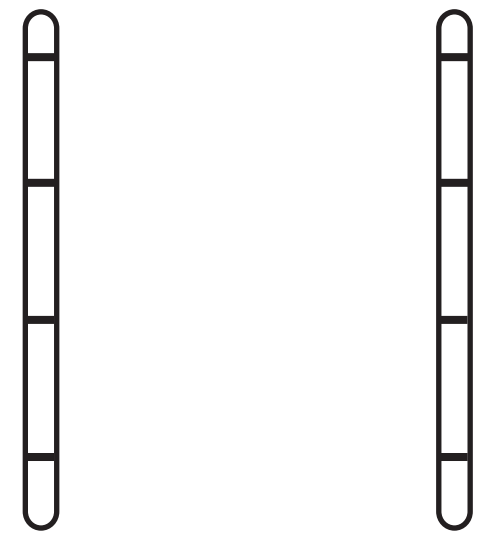
4 Meiosis leads to the production of gametes and is important in allowing genetic variation to occur.

(a) The diagram below shows one homologous pair of chromosomes during early meiosis.
Four genes (A, B, D and E) and the crossing over point have been labelled.



At the end of meiosis, four gametes will have been produced, each with a different combination of alleles.
Complete the diagram below to show the combination of alleles for the two recombinant chromosomes.

(1)



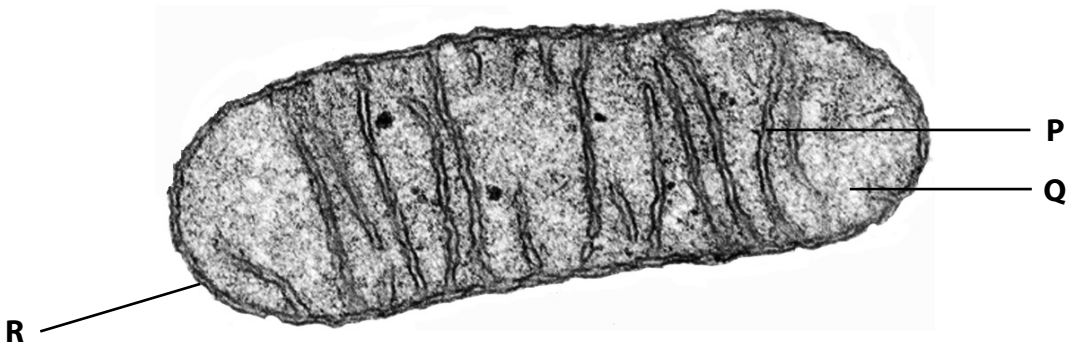
N 3 5 8 5 5 A 0 8 2 4

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(b) Sperm cells are gametes. They contain mitochondria in their mid region.

(i) The photograph below shows a mitochondrion as seen using an electron microscope.

(3)



CNRI / Science Photo Library
Magnification x 90 000

Name the labelled structures shown in the photograph above.

P .....

Q .....

R .....

(ii) Explain the function of mitochondria in sperm cells.

(3)

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N 3 5 8 5 5 A 0 9 2 4

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(c) In some species of mammal, at fertilisation most of the sperm cell enters the egg cell. The fertilised cell then divides by mitosis.

(i) A sperm cell containing 65 mitochondria fertilises an egg cell containing 100 000 mitochondria.
Calculate the percentage of the total mitochondria in this fertilised cell that come from the sperm cell. Show your working.

(2)

Answer ..... %

(ii) State how many cells there would be after the fertilised egg has divided, by mitosis, **four** times.

(1)

.....

(Total for Question 4 = 10 marks)

N 3 5 8 5 5 A 0 1 0 2 4

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5 The rice plant is a type of grass and reproduces by producing grains.



Tom Myers / Agstockusa / Science Photo Library

(a) The rice grains are full of starch.

(i) Starch is a polymer of one monosaccharide.
Name this monosaccharide.

(1)

.....

*(ii) Describe **two** ways in which the structure of starch is related to its function.

(4)

Structure .....

.....

Function .....

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Structure .....

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Function .....

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N 3 5 8 5 5 A 0 1 1 2 4

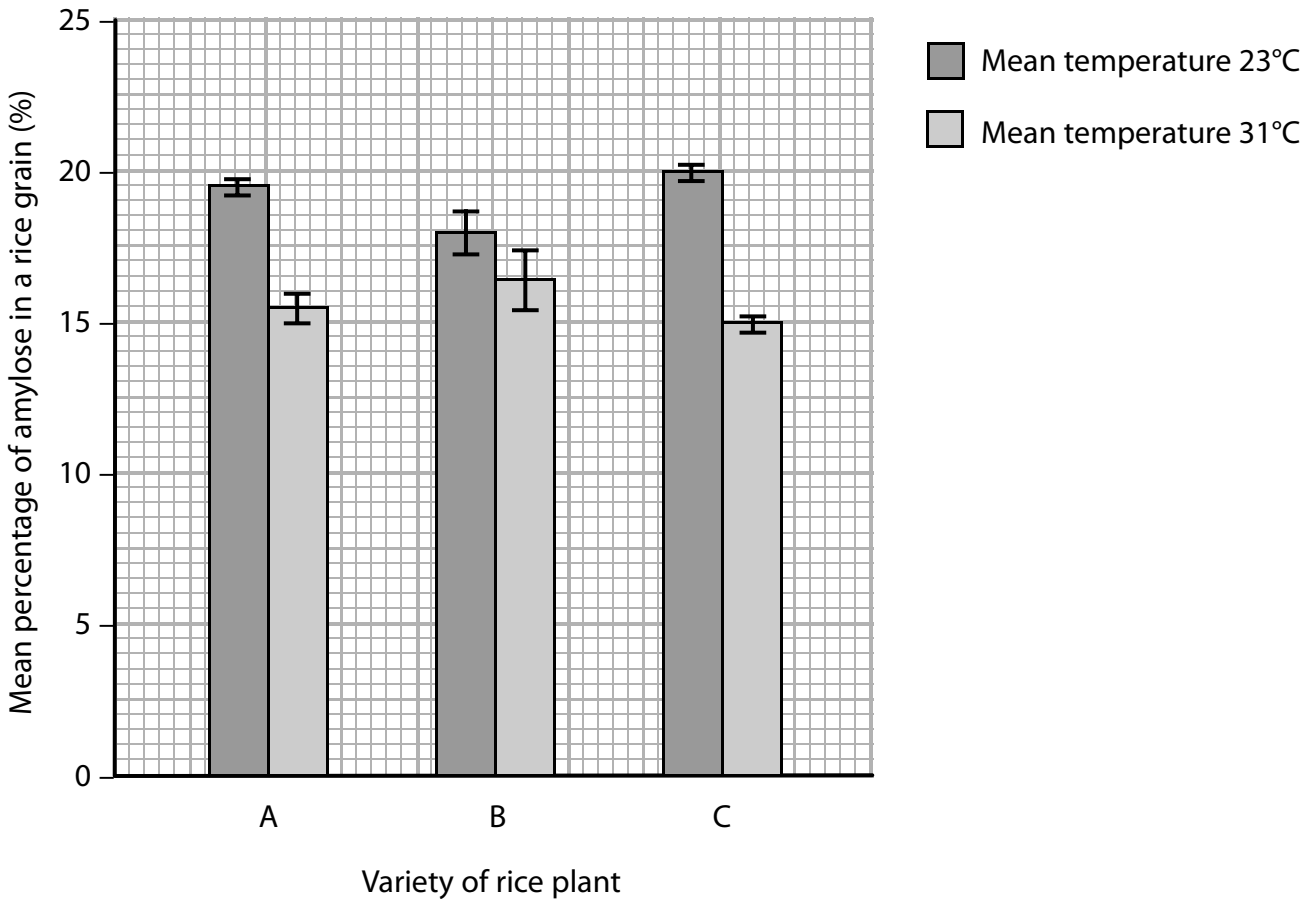
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(b) Starch is made up of amylose and amylopectin. An investigation was undertaken to study the effect of temperature on amylose production in rice grains. Three different varieties of rice plant, A, B and C, were grown at a mean temperature of 23°C until they had produced mature rice grains. All other variables were kept constant.

Fifty rice grains were then collected from each variety and the mean percentage of amylose in a rice grain was determined.

This investigation was repeated at a mean temperature of 31°C.

The results are shown in the graph below.



N 3 5 8 5 5 A 0 1 2 2 4

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(i) Describe the effect of temperature on the mean percentage of amylose in the rice grains of all three varieties of rice plant.

(2)

(ii) Using the information in the graph, suggest which set of data is least supportive of the statement that 'temperature has an effect on the percentage of amylose present in rice grains'. Explain your answer.

(3)

(Total for Question 5 = 10 marks)

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6 Biodiversity, including both species richness and genetic diversity, is an important concept to be considered when organising captive breeding programmes.

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

(3)

Niche .....

.....

.....

Species richness .....

.....

.....

.....

N 3 5 8 5 5 A 0 1 4 2 4

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(b) One way to measure genetic diversity is to find the percentage of genes that have different alleles.

The table below shows the percentage of genes that have different alleles in four types of cat.

Type of cat	Percentage of genes with different alleles (%)
Cheetah	4
Domestic cat	23
Lion	12
Ocelot	21

*(i) Using the information in the table above and your own knowledge, suggest why the cheetah is the cat at most risk if the environment changes.

(3)

(ii) Cheetahs are unusual amongst the big cats.



Cheetah and cub

Dr P. Marazzi / Science Photo Library

A female cheetah often mates with several different males and gives birth to two or three cubs at a time, each having a different father.

Suggest why this may be advantageous to cheetahs.

(2)

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.....

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.....

N 3 5 8 5 5 A 0 1 6 2 4

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(c) Rafa was a male cheetah involved in breeding programmes in several zoos.
The table below shows some data from Rafa's studbook.

Name of zoo housing Rafa	Event	Date of event
WINSTON	Birth of Rafa	24 Dec 1974
SD-WAP	Transfer	26 Nov 1980
LAGUNA HI	Transfer	9 Apr 1982
SD-WAP	Transfer	5 Dec 1984
BATON ROUGE	Transfer	11 Feb 1986

Suggest what effect transferring Rafa from one zoo to another had on genetic diversity in this species.

(2)

.....

.....

.....

.....

.....

.....

(d) Place a cross ☒ in the box to the right of the statement that correctly describes an endemic animal.

(1)

Statement	
Ducks that migrate from one continent to another	☒
House fly that is found in all continents except Antarctica	☒
Cheetahs that are exclusive to one continent	☒

(Total for Question 6 = 11 marks)

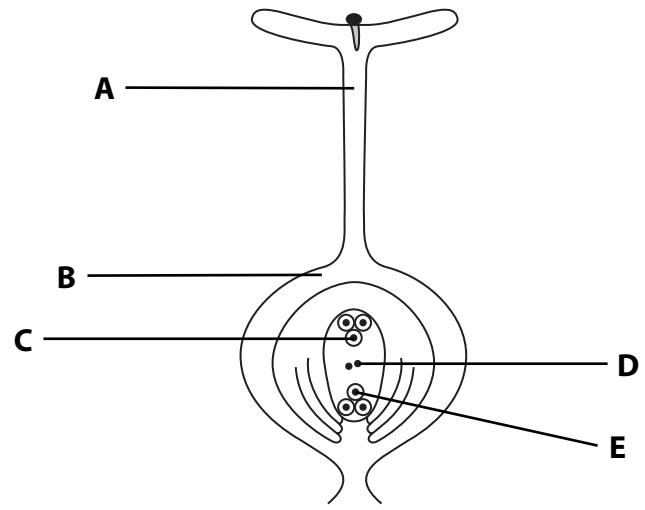
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N 3 5 8 5 5 A 0 1 8 2 4

7 Pollen germination and pollen tube growth are important stages in plant sexual reproduction.

(a) The diagram below shows a pollen grain on the stigma of a flower.



(i) On the diagram above, draw a line to show the route taken by the pollen tube, from the pollen grain to the micropyle.

(2)

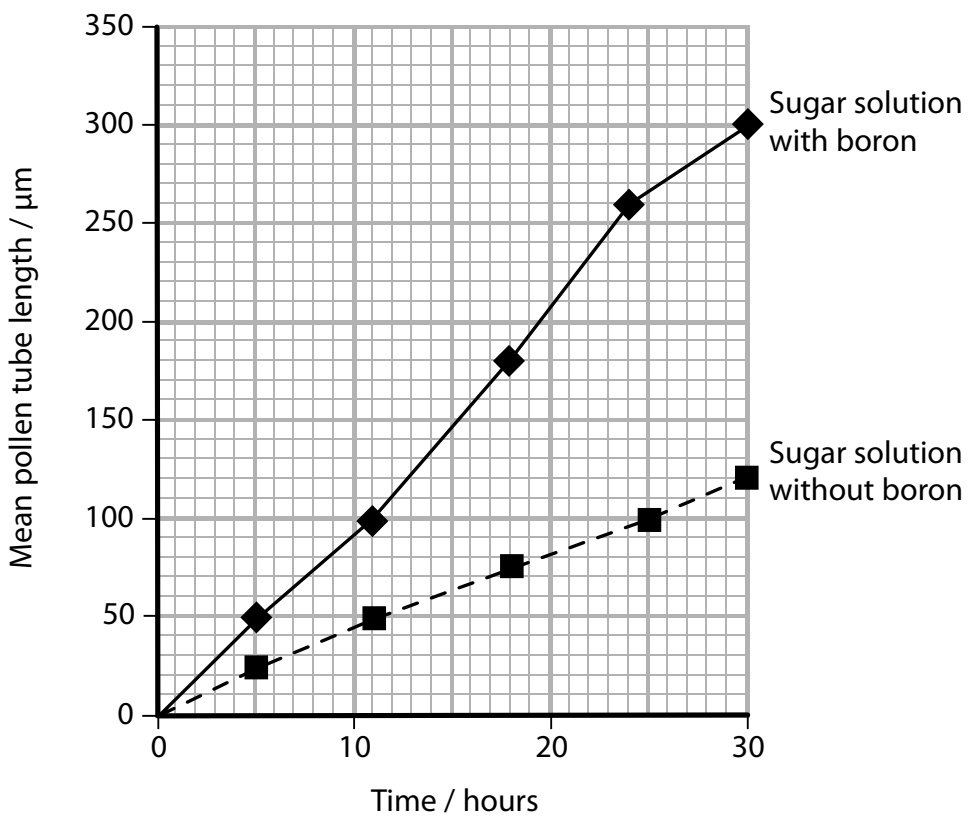
(ii) The table below shows the structures labelled on the diagram. Place a tick (✓) in the box next to each one in which the chromosome number increases at fertilisation.

(2)

Labelled structure	Tick (✓) if chromosome number increases at fertilisation
A	
B	
C	
D	
E	

(b) An investigation was undertaken to study the effect of the element boron on the growth of pollen tubes.
A large number of pollen grains was placed in a dilute sugar solution. Every six hours, for 30 hours, 500 pollen grains were removed and the length of the pollen tube of each was measured. The mean length of the pollen tubes was then calculated.
This was repeated with boron added to the dilute sugar solution.

The results are shown in the graph below.



(i) Using the information in the graph, compare the mean pollen tube length in these two sugar solutions, over this 30-hour period.

(3)

N 3 5 8 5 5 A 0 2 0 2 4

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(ii) Using the result of this investigation, a student concluded that boron was necessary for pollen tube growth.
Suggest why another student disagreed with this conclusion.

(1)

(iii) Using the information in the graph, suggest an appropriate conclusion for the effect of boron on the rate of growth of pollen tubes.

(1)

(iv) Suggest the advantages to flowering plants of increased pollen tube growth.

(2)

(Total for Question 7 = 11 marks)

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8 Plants usually take up nitrogen as nitrate ions for use in growth.

(a) An investigation was undertaken to study the effect of nitrate ion concentration on mitosis in the root tip of wheat seedlings.

Wheat seedlings were grown in a mineral solution containing a nitrate ion concentration of 3.3 mmol dm^{-3}. Root tip samples were taken and the number of cells undergoing mitosis per 500 cells was counted.
This was repeated using a nitrate ion concentration of 6.6 mmol dm^{-3}.
The results are shown in the table below.

Nitrate ion concentration / mmol dm^{-3}	**Number of cells undergoing mitosis per 500 cells**
3.3	25
6.6	19

(i) Using the information in the table, describe the effect of nitrate ion concentration on mitosis in root tips.

(2)

(ii) Suggest why a prediction of the number of cells undergoing mitosis, if the nitrate ion concentration used were 9.9 mmol dm^{-3}, would be unreliable.

(2)

N 3 5 8 5 5 A 0 2 2 2 4

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(iii) To count the number of cells undergoing mitosis, a root tip squash was carried out.

Give **two** potential safety risks associated with the root tip squash technique. For one of the risks you have given, suggest a precaution to reduce the risk.

(3)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(b) Describe an experiment to find the optimum nitrate ion concentration for the growth of wheat seedling roots.

(3)

.....

.....

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.....

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.....

(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 80 MARKS

N 3 5 8 5 5 A 0 2 4 2 4

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Mark Scheme (Results)
June 2010

GCE

GCE Biology (6BI02/01)

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Summer 2010

Publications Code US023556

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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)	1. alleles ; 2. loci / locations / positions / eq ;	**(2)**

Question Number	Answer	Mark
1 (a) (ii)	1. 174 (cm) ; 2. 172 (cm) ;	**(2)**

Question Number	Answer	Mark
1 (b) (i)	1. {genotype / eq} ; 2. {environment / eq} ;	**(2)**

Question Number	Answer	Mark
1 (b) (ii)	C ; A ; B ;	**(3)**

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Question Number	Answer	Mark
***2(a) QWC**	(QWC – Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. *undifferentiated* cell / eq ; 2. that can give rise to other {types of cell / eq }; 3. idea that no limit to division ; 4. correct reference to {*totipotent* / *pluripotent* /eq} ;	**max (2)**

Question Number	Answer	Mark
2(b)	1. cord blood /umbilical cord / placenta ; 2. {fertilised egg / zygote / eq} / blastocyst / (early) embryo ; 3. detail of site within blastocyst 4. bone marrow / eq ; 5. {brain / connective / skin / liver} cells / eq ; 6. addition of adult nucleus to enucleated egg cell ;	**max (3)**

Question Number	Answer	Mark
2(c)(i)	1. decide on max age of embryo allowed for research / eq ; 2. idea of setting or considering {ethical / legal} aspects / judging what is acceptable / follow a code of practice ; 3. example of what {is / is not} acceptable ; 4. checking that source of stem cells is acceptable / eq ; 5. stopping of cloning (of humans) / eq ; 6. appropriate reference to unnecessary repeating of research / eq ;	**max (2)**

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Question Number	Answer	Mark
2 (c)(ii)	**people involved in embryo research:** 1. idea of being able to (fully) understand the science / recognise what is possible {benefits / risks / eq} / judge in an informed manner ; **people not involved in embryo research:** 2. idea of giving a {balanced /alternative / wider / named} view ;	**(2)**

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

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

Question Number	Answer	Mark
3 (a)(iii)	far right-hand box ;	**(1)**

Question Number	Answer	Mark
3 (a)(iv)	Bacteria / Eubacteria / Archaebacteria / Archaea ;	**(1)**

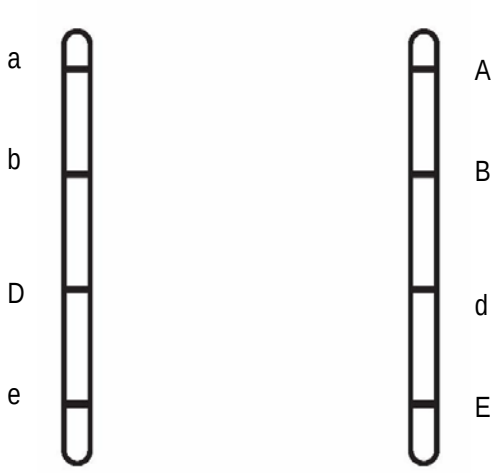
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Question Number	Answer	Mark
***3(b)(i) QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. cellulose ; 2. as microfibrils ; 3. (cellulose molecules) held together by hydrogen bonds / eq 4. detail of microfibril (e.g. {bundle /correct stated number of}) cellulose molecules) ;; 5. correct reference to arrangement of microfibrils (in primary cell wall) ; 6. reference to {matrix / hemicelluloses / pectins / eq} ; 7. reference to primary and secondary cell walls ; 8. detail of different laying down arrangement (in secondary cell wall) /reference to lignin ;	**max (4)**

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<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>3 (b)(ii)</td><td>
<table>
<tr><th>Feature described</th><th>Name of feature</th></tr>
<tr><td>site where there was no cell wall and the cytoplasm linked the two adjacent cells</td><td>plasmodesmata / plasmodesma ;</td></tr>
<tr><td>dark line that is the boundary between one cell and the next cell</td><td>middle lamella ;</td></tr>
</table>
</td><td>(2)</td></tr>
</table>

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Question Number	Answer	Mark
4 (a)		**(1)**

Question Number	Answer	Mark
4 (b) (i)	P = crista ; Q = matrix ; R = outer (mitochondrial) membrane / envelope / double membrane ;	**(3)**

Question Number	Answer	Mark
4 (b)(ii)	1. (they carry out) (aerobic) respiration ; 2. provide {ATP / energy / eq} ; 3. to {move / drive the / eq} {flagellum / tail} ; 4. allows sperm to swim / eq ; 5. towards the {egg / eq} / {towards /along} the oviduct / eq ;	**max (3)**

Question Number	Answer	Mark
4 (c)(i)	0.065 (%) ;;	**(2)**

Question Number	Answer	Mark
4 (c)(ii)	16 ;	**(1)**

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Question Number	Answer	Mark
5 (a)(i)	{α/ alpha} glucose ;	**(1)**

Question Number	Answer	Mark
***5(a)(ii)QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. made up of {<u>many / eq</u>} glucose (monomers) ; 2. reference to {energy / eq } storage / glucose is the respiratory substrate / synthesis of organic molecules / eq ; 3. idea that it is {large / eq} ; 4. so is un-reactive / insoluble /no osmotic effect ; 5. molecule coiling / compact / reference to amylose /eq ; 6. more can be stored (in available space) / eq ; 7. reference to branches / reference to (glycosidic) 1-6 bonds / amylopectin ; 8. {rapid / increased / eq } mobilisation of glucose units / eq ;	**max (4)**

Question Number	Answer	Mark
5 (b)(i)	**Allow converse** 1. increase in temperature {decreases / eq } (the mean percentage of amylose present)/ negative correlation ; 2. but by differing percentages in all 3 varieties / C, then A & then B ; 3. credit correct manipulation of the data for 1 variety (e.g. by 4.0 % in variety A / 1.5% in variety B / 5% in variety C) eq ;	**max (2)**

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Question Number	Answer	Mark
5 (b)(ii)	1. (variety) B ; 2. idea of smallest difference between (means / amylose content) in B for the two different temp regimes ; 3. idea of {biggest error bars / widest spread} ; 4. idea that error bars for the 2 different temp regimes overlap ; 5. explanation of overlap e.g. some of the data for the lower temp falls within that of the higher temp ;	**max (3)**

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Question Number	Answer	Mark
6(a)	**Niche:** 1. the {role / function / eq} (of a species / organism) ; 2. {within the community / ecosystem /habitat / environment / eq } ; **Species richness:** 3. number of (different) species ; 4. in a {habitat / eq } / at any one time ;	**max (3)**

Question Number	Answer	Mark
***6 (b)(i)QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. (cheetah has) {lowest genetic diversity / least genetic variation } (of the listed cats) ; 2. correct reference to lack of adaptation / example / no selective advantage (when environment changes) ; 3. (therefore) less likely to survive / eq ; 4. (therefore) more at risk of {extinction / eq} ;	**max (3)**

Question Number	Answer	Mark
6 (b)(ii)	1. {greater / eq} genetic diversity (amongst the litter) / eq ; 2. greater chance that will {survive / eq} ; 3. increased chance of fertilisation / pregnancy / eq ; 4. increase in population size / eq ;	**max (2)**

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Question Number	Answer	Mark
6 (c)	1. increases genetic diversity /eq ; 2. (because it) allows {outbreeding / mating / eq} with (genetically) different individuals / eq ; 3. stop/reduces {inbreeding / mating with parents / siblings} ; 4. (which) reduces genetic diversity / eq ;	**max (2)**

Question Number	Answer	Mark
6 (d)	cheetahs that are exclusive to one continent ;	**(1)**

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Question Number	Answer	Mark
7 (a)(i)	1. line drawn correctly e.g. from pollen grain, down style to start of ovary ; 2. to micropyle (around the edge) ;	**(2)**

Question Number	Answer	Mark
7 (a) (ii)	<table><tr><th>Labelled structure</th><th>Tick (✓) if chromosome number increases at fertilisation</th></tr><tr><td>A</td><td></td></tr><tr><td>B</td><td></td></tr><tr><td>C</td><td></td></tr><tr><td>D</td><td>✓</td></tr><tr><td>E</td><td>✓</td></tr></table> Comments given if more than 2 ticks and if use cross or crosses and ticks	**(2)**

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Question Number	Answer	Mark
7 (b)(i)	1. both {increase / positive correlation / eq} ; 2. (pollen tube) length (always) {greater/ eq} when boron present / eq ; 3. idea of rate of growth greater with boron ; 4. linear without boron (for 25 / 30 hours) and not linear with boron / eq ; 5. correct comparative manipulation of the data ;	**max (3)**

Question Number	Answer	Mark
7 (b)(ii)	idea that pollen tube does grow even in the absence of boron ;	**(1)**

Question Number	Answer	Mark
7 (b)(iii)	boron {increases / speeds up / eq} rate ;	**(1)**

Question Number	Answer	Mark
7 (b)(iv)	1. more likely to reach the ovule /eq ; 2. fertilisation more likely to occur /eq ; 3. idea of fertilisation in shorter time period ;	**max (2)**

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Question Number	Answer	Mark
8 (a)(i)	1. (increasing or doubling nitrate ion concentration) decreased mitosis / negative correlation / eq ; 2. manipulation of the data (e.g. by 6 cells (per 500 cells) / reduces by 24%) ;	**(2)**

Question Number	Answer	Mark
8 (a)(ii)	1. only two concentrations were used / additional nitrate ion concentrations should be used ; 2. no {trend / eq} (as only 2 data sets) ; 3. If one of the two sets of data was {anomalous / eq} ; 4. reference to one with no nitrate ions present ;	**max (2)**

Question Number	Answer	Mark
8 (a)(iii)	Two appropriate safety risks given ; ; One appropriate precaution, linked to one of the risks above ;	**(3)**

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Question Number	Answer	Mark
8 (b)	1. 3 + / sensible range of nitrate ion concentrations ; 2. reference to repeats (at each concentration) ; 3. reference to uniformity of seedlings (e.g. all from same parent plant, same age, same original root length) ; 4. idea that solution used should contain other mineral ions / named mineral ions ; 5. mention one other variable maintained / kept constant (e.g. temp, all run for same length of time, light intensity, volume of mineral solution) ; 6. reference to mechanism of judging root {growth /eq} (to measure optimum nitrate concentration) ;	**max (3)**

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