

WJEC A-LEVEL BIOLOGY

BIOLOGY



EXAM QUESTION PACK

UNIT BY5 OLD SPECIFICATION PAPERS

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Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01



S16-1075-01

BIOLOGY/HUMAN BIOLOGY – BY5

A.M. THURSDAY, 23 June 2016

1 hour 45 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	10	
2.	10	
3.	16	
4.	21	
5.	13	
6.	10	
Total	80	

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010001

ADDITIONAL MATERIALS

In addition to this examination paper you will need a ruler and a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

Answer all questions.

1. (a) Bananas are grown on large plantations in tropical regions such as South America, using monoculture production methods.

- (i) Define the terms:

I. biodiversity;

[1]

.....

.....

II. monoculture.

[1]

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- (ii) Describe and explain the effects of banana production on biodiversity in South America. [2]

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- (b) Multinational banana companies own plantations, sea transport, ripening facilities and distribution networks in countries where the bananas are consumed. The data below was published by one such company.

	Banana Carbon Footprint (Farm-to-Retail Distribution Centre) /kg	
	USA	Europe
Per box (18kg)	18	24

- (i) Define the term '*carbon footprint*'.

[1]

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- (ii) Explain the difference in the values for USA and the values for Europe.

[2]

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- (c) In an attempt to reduce their carbon footprint for their USA operation, the company switched to transporting the bananas part of the way by rail, instead of taking them the whole way by truck.

(i) Explain why this would reduce the carbon footprint. [2]

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(ii) How would this change benefit the environment? [1]

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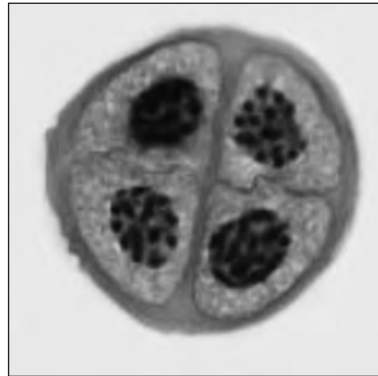
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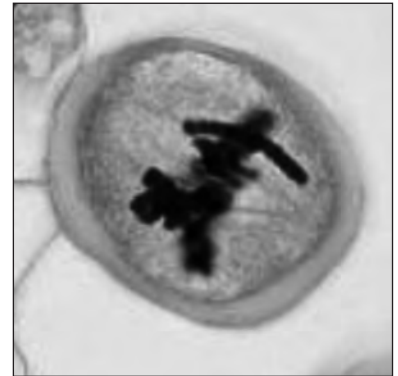
2. The photomicrographs show some stages of cell division in a flower of a lily, *Lilium candidum*.



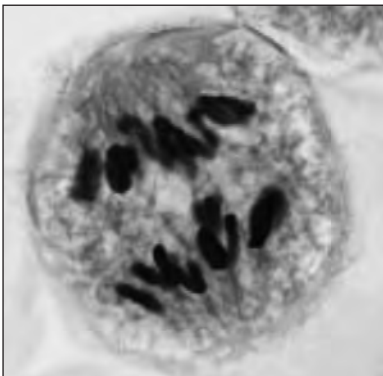
A



B



C



D



E



F

- (a) (i) Identify the type of cell division shown. [1]

.....

- (ii) State a part of the flower that could have been used to produce the photomicrographs. [1]

.....

- (iii) Write the letters in the order the stages would occur (the first one has been done for you). [2]

1 **E** 2 3 4 5 6

- (iv) Use photomicrograph **E** to find the haploid number of *Lilium candidum*. [1]

Haploid number

- (b) (i) Name the stages shown in the following photomicrographs. [1]

A **C**

- (ii) Use your knowledge of cell division to describe **two** differences between the arrangement of chromosomes in stages **A** and **C**. [2]

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- (c) Name **two** processes occurring during this type of cell division which help to ensure genetic variation in the offspring. [2]

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3. In white clover, *Trifolium repens*, one gene determines the production of a cyanide forming substrate. Allele **A** produces the cyanide forming substrate, whilst allele **a** produces no substrate.

A second gene, located on a different chromosome, determines the production of an enzyme which catalyses the release of cyanide from the substrate. Allele **E** produces the enzyme, whilst allele **e** produces no enzyme.

- Clover that has both **A** and **E** alleles gives off cyanide as soon as its leaves are crushed.
- Clover with **A** but not **E** releases cyanide slowly when its leaves are crushed.
- Clover that does not have **A** cannot release cyanide.

- (a) (i) Complete the genetic diagram below to show what proportion of the three types would be produced if clover heterozygous for both genes was self-pollinated. Use the letters for the alleles given above. [3]

Parental genotypes	.....	X	.....
Gametes	.....	X	.....

- (ii) State the ratio of the offspring which would show: [1]

rapid cyanide release : slow cyanide release : no cyanide release

- (b) In an experiment where double heterozygotes were self-pollinated the following numbers of offspring were obtained:

rapid cyanide release – 140
 slow cyanide release – 49
 no cyanide release – 67

- (i) Using the ratio from part (a)(ii) calculate the **expected** number of each phenotype of the offspring, and enter the values in the table below. [1]

Phenotype	Observed number (O)	Expected number (E)	(O – E)	(O – E) ²	$\frac{(O - E)^2}{E}$
Rapid cyanide release	140				
Slow cyanide release	49				
No cyanide release	67				

- (ii) Use the other columns in the table to carry out a Chi square test, testing the Null Hypothesis that *there is no significant difference between the observed and expected results*.

Use the last column in the table and the formula below to calculate χ^2 . [1]

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$\chi^2 =$

- (iii) Using the 5% probability level and the correct number of degrees of freedom **circle** the critical value of χ^2 **in the table below**. [1]

Degrees of freedom	Probability								
	0.9	0.8	0.7	0.5	0.2	0.1	0.05	0.02	0.01
1	0.016	0.064	0.15	0.46	1.64	2.71	3.84	5.41	6.64
2	0.21	0.45	0.71	1.39	3.22	4.60	5.99	7.82	9.21
3	0.58	1.00	1.42	2.37	4.64	6.25	7.82	9.84	11.34
4	1.06	1.65	2.20	3.36	5.99	7.78	9.49	11.67	13.28

- (iv) State whether you would accept or reject the Null Hypothesis for this cross and explain why. [1]

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- (c) (i) What is the term for all the alleles in a population? [1]

.....

- (ii) Cyanide has a taste which discourages cattle from eating clover leaves. How would the proportion of allele **E** in the population of white clover in a field grazed by cattle compare to the proportion of allele **E** in the population of white clover in a hedgerow inaccessible to cattle? [1]

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- (iii) Explain how continued grazing would change the frequency of allele **E** in the population. [4]

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- (iv) Describe how the cattle grazing might lead to the formation of a new species of clover. [2]

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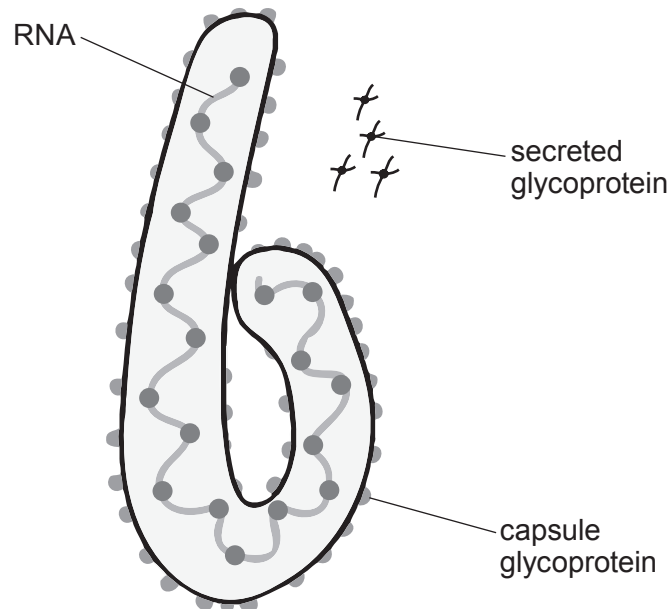
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4. In 2014, parts of West Africa were hit by an epidemic of Ebola Fever. Most people who caught the disease died. The diagram below shows the virus which causes the disease.



- (a) (i) This virus reproduces in the cytoplasm of the host cell. Using information from the diagram, suggest why this virus does not have to enter the nucleus of cells in order to produce proteins. [2]

- (ii) Suggest the organelle in the infected cell which would complete the production of glycoprotein. [1]

- (iii) Describe the process by which the genetic information of the virus would be translated into amino acid sequences in its proteins. [4]

- (b) When Ebola viruses enter human cells one of their genes controls the production of a glycoprotein that is immediately released.

The gene which codes for this glycoprotein is changed after infecting cells. An extra adenine is inserted at position 1016.

The changed gene then controls the production of the second glycoprotein which forms part of the viral capsule.

Diagrams of the changed and original base sequences for the glycoproteins are shown below.

Changed base sequence

Nucleotide position number	1010	1015	1020	1025	
Changed nucleotide sequence	CUU	GUU	AUA	AAA	AAA AUA C
Changed amino acid sequence	Leu	Val			

Original base sequence

Nucleotide position number	1010	1015	1020	1025	
Original nucleotide sequence	CUU	GUU			
Original amino acid sequence	Leu	Val			

- (i) Use the table below to complete the **changed amino acid sequence in the diagram** above. [1]

		Second				
		U	C	A	G	
First	U	Phe	Ser	Tyr	Cys	U
		Phe	Ser	Tyr	Cys	C
		Leu	Ser	STOP	STOP	A
		Leu	Ser	STOP	Trp	G
	C	Leu	Pro	His	Arg	U
		Leu	Pro	His	Arg	C
		Leu	Pro	Gln	Arg	A
		Leu	Pro	Gln	Arg	G
	A	Ile	Thr	Asn	Ser	U
		Ile	Thr	Asn	Ser	C
		Ile	Thr	Lys	Arg	A
		Met	Thr	Lys	Arg	G
	G	Val	Ala	Asp	Gly	U
		Val	Ala	Asp	Gly	C
		Val	Ala	Glu	Gly	A
		Val	Ala	Glu	Gly	G
						Third

- (ii) Complete the **original nucleotide sequence** in the diagram. [1]
- (iii) Use the table again to complete the **original amino acid sequence**. [1]

(iv) Explain why the original glycoprotein is smaller than the changed glycoprotein. [2]

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- (c) On contact with the plasma membrane of human epithelial cells the capsule glycoprotein molecules form transmembrane proteins, which assist the virus in gaining entry to the cells.

Draw a labelled diagram of a typical cell membrane including a transmembrane protein. [2]

- (d) The Ebola virus capsule glycoprotein has been purified and injected into mice which then produce antibodies against the protein. The genes for these antibodies have been cut from mouse DNA and inserted into Tobacco Mosaic Virus (TMV) genes. By allowing these viruses to infect tobacco plants, genetically modified tobacco plants can be grown which produce antibodies against Ebola.

(i) Name the enzyme that would be used to cut the antibody producing gene from the mouse DNA. [1]

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(ii) Name the vector used to transfer the mouse gene. [1]

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(iii) Name the enzyme that would be used to insert the mouse gene into the vector. [1]

.....

(iv) Bacteria could be used instead of tobacco plants to produce the antibodies. What vector would be used in this case? [1]

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(v) Give **one** advantage of using bacteria instead of tobacco plants. [1]

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- (e) The technology described in part (d) was used during the Ebola outbreak of 2014 to develop a drug called ZMapp. The drug was only used to treat two Americans who had been working as medics in Africa. Its use was controversial because the drug had not been tested on humans. At the time there were only a few doses of ZMapp available.

(i) Suggest a reason why the decision to use the drug was taken, even though it had not been tested. [1]

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(ii) Apart from the fact that drug had not been fully tested, give **one** reason why using the drug in the way described could be considered unethical. [1]

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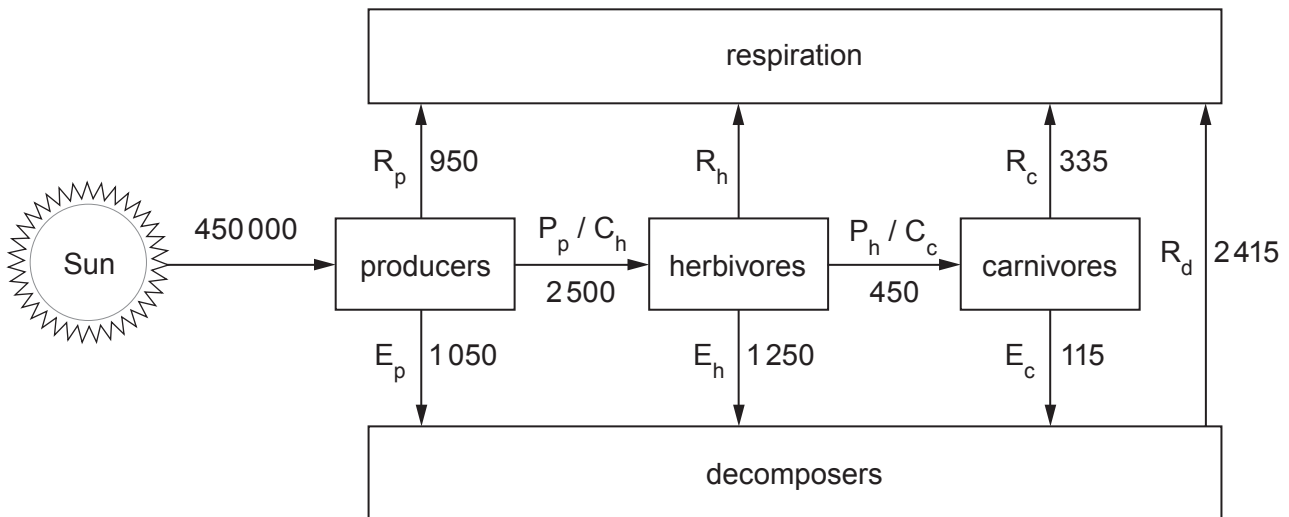
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5. The diagram below shows energy transfer through a model ecosystem, where,

C = consumption, P = production, R = respiration, E = death, faeces or urine;

subscripts indicate the feeding group p = producers, h = herbivores, c = carnivores, d = decomposers,

e.g. C_h = consumption in herbivores.



- (a) (i) Define the term *trophic level*.

[1]

- (ii) Using appropriate letters from the diagram write an equation to represent energy transfer through the herbivores.

[1]

- (b) The numbers in the diagram represent energy transfer over a given area of ecosystem in a given time.

- (i) Suggest suitable units for the values.

[1]

(ii) Calculate the following:

I. the photosynthetic efficiency of the producers.

[2]

photosynthetic efficiency = ...

II. R_h

[2]

R_h = ...

(c) The model assumes that **all** of the biomass produced by one group is transferred to the next group in the food chain. This might not be true in natural ecosystems.

(i) Suggest why this assumption is **not** likely to be true in a woodland ecosystem. [2]

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(ii) State the assumption the model makes about the dead organic material that the decomposers receive. [1]

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(iii) Conditions in peat bogs are acidic. Describe and explain how this will affect the rate of decomposition. [2]

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(iv) Explain whether the assumption the model makes about the dead organic material that the decomposers receive is likely to be true in peat bogs. [1]

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Any diagrams included in your answer must be fully annotated.

Or. (b) Describe the formation of spermatozoa in mammals. Explain how the process of oogenesis differs. [10]

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GCE MARKING SCHEME

SUMMER 2016

**BIOLOGY - BY5
1075/01**

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01



S15-1075-01

BIOLOGY/HUMAN BIOLOGY – BY5

A.M. WEDNESDAY, 17 June 2015

1 hour 45 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	12	
2.	10	
3.	12	
4.	12	
5.	11	
6.	13	
7.	10	
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1075
010001

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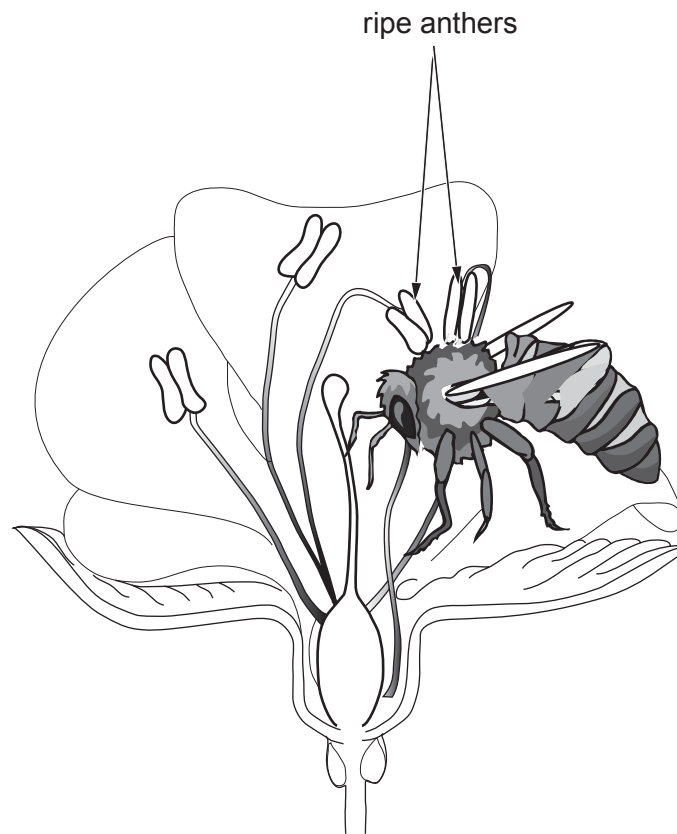
You are reminded of the necessity for good English and orderly presentation in your answers.

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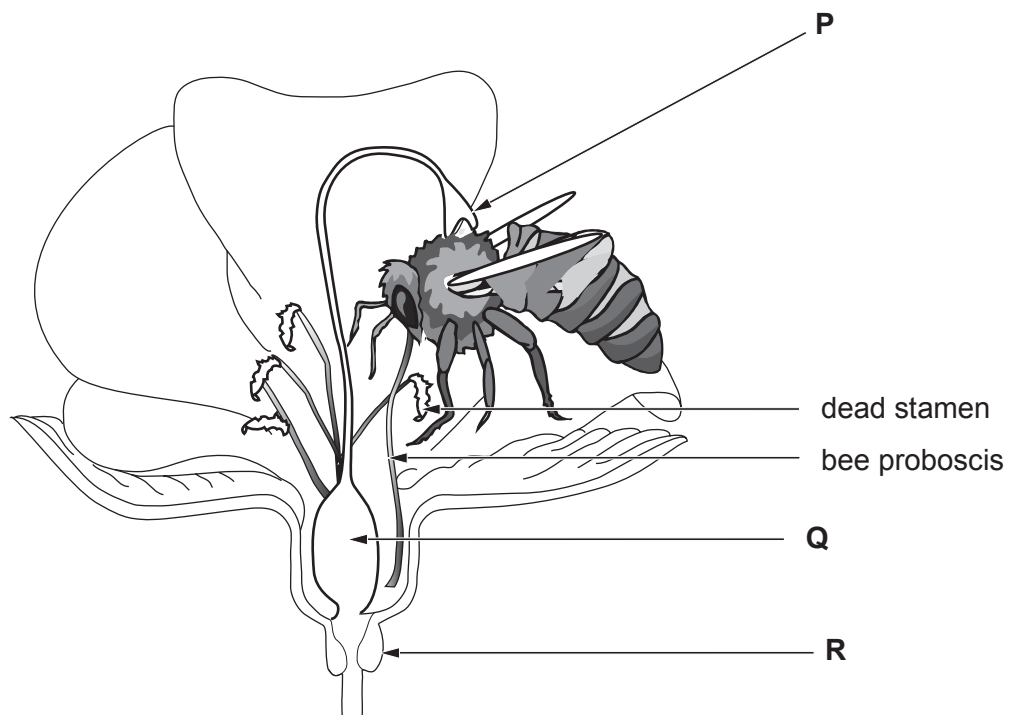
Answer **all** questions.

1. The diagrams below show pollination in an insect-pollinated flower.

I



II



(a) (i) Name parts: [1]

P

Q

(ii) Name the substance produced by structure **R**. [1]

.....

(iii) What is the function of this substance? [1]

.....

.....

(b) Describe what happens to the pollen in diagrams **I** and **II**. [2]

I.

.....

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II.

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(c) Using the diagrams opposite, explain how these flowers are adapted to ensure that;

(i) there is effective pollen transfer between two flowers of the same species, [1]

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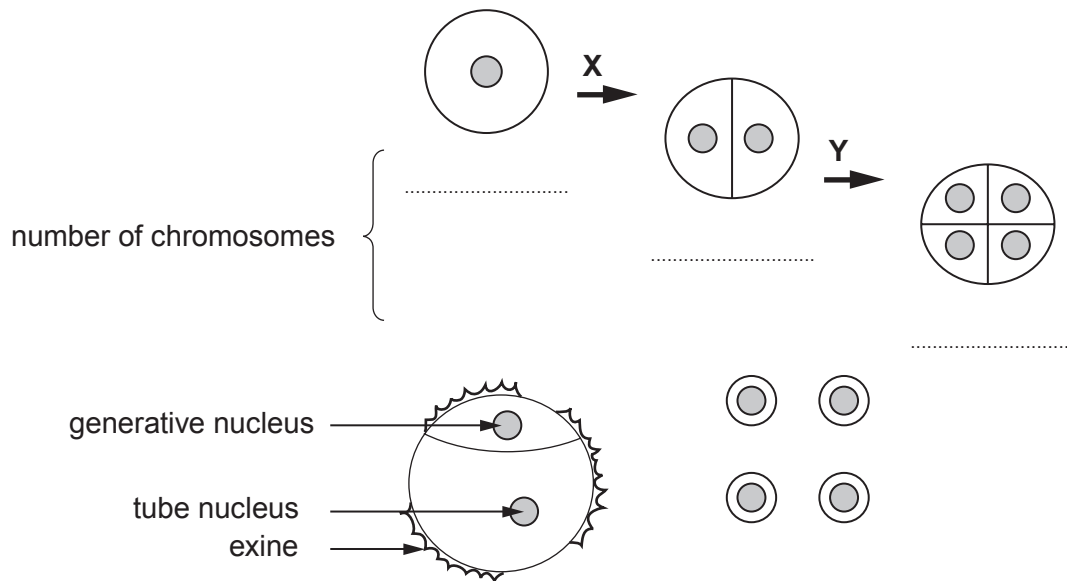
(ii) self-pollination is avoided. [1]

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(d) The diagrams below show the formation of pollen grains.



(i) In which floral part does this take place?

[1]

(ii) Name the cell process represented by arrows **X** and **Y**.

[1]

(iii) The diploid number of this species is 10, underneath **each** structure indicated above, write the number of chromosomes in **each** nucleus. [1]

(iv) Give the functions of:

I. the generative (male) nucleus;

[1]

II. the tube nucleus.

[1]

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2. There are three varieties of Labrador dogs; black, chocolate, and yellow. A student noticed that some yellow Labradors have black noses and some have brown noses. She proposed the hypothesis that the overall appearance is determined by fur colour **and** skin colour, as follows:

Variety	Fur colour	Skin colour
black	black	black
chocolate	black	brown
yellow (black nose)	brown	black
yellow (brown nose)	brown	brown

(a) The alleles for black fur (**B**) and black skin (**R**) are both dominant.

- (i) Draw a genetic diagram to illustrate a cross between two heterozygous black Labradors. [4]

Parental phenotypes	black fur, black skin	X	black fur, black skin
Parental genotypes	.....	X	.....
Gametes	.....	X	.....

- (ii) State the proportion of the offspring which would be, [1]
 chocolate
 yellow

- (iii) State the proportion of the yellow offspring which would have brown noses. [1]

- (iv) Suggest what simple observation of the chocolate Labradors could be used to support her hypothesis. [1]

- (b) A dog breeder has a chocolate bitch which she would like to use to produce only chocolate pups.

- (i) State the genotype of bitch the breeder should use to produce only chocolate pups. [1]

- (ii) Describe the cross the breeder should carry out to test whether the bitch has the correct genotype. [1]

- (iii) Which is the only variety of Labrador, if bred with the same variety, will always produce pups with the same phenotype as both parents? [1]

3. (a) Meiosis is a type of cell division.

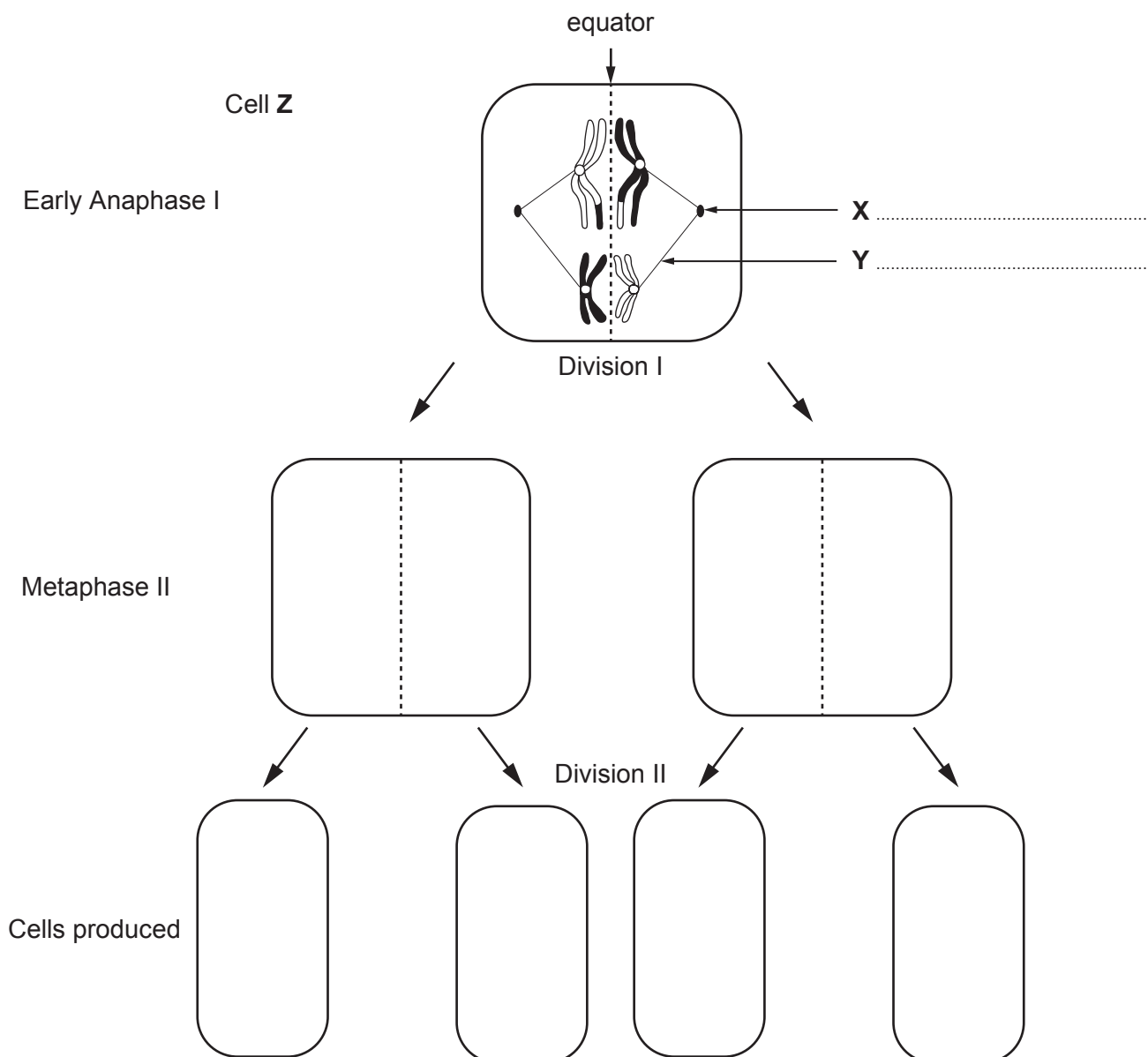
(i) State the purpose of meiosis.

[1]

(ii) Name the organs in animals where meiosis occurs.

[1]

(b) The diagram below represents meiosis in a cell with two pairs of chromosomes.



(i) Label parts X and Y.

[1]

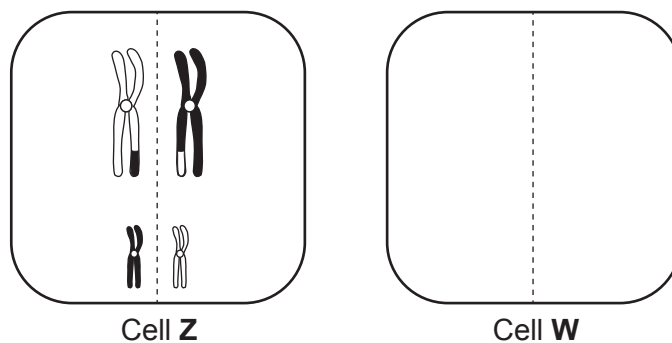
(ii) Draw chromosomes in the cell outlines for:

[4]

I. metaphase II

II. the cells produced

- (c) The drawing of cell **W** below is an outline of another cell from the same individual as cell **Z**. Complete the drawing of cell **W** to show how **independent assortment** could produce an alternative outcome. [1]



- (d) The drawing below shows the two larger chromosomes from cell **Z** at a different stage of meiosis.

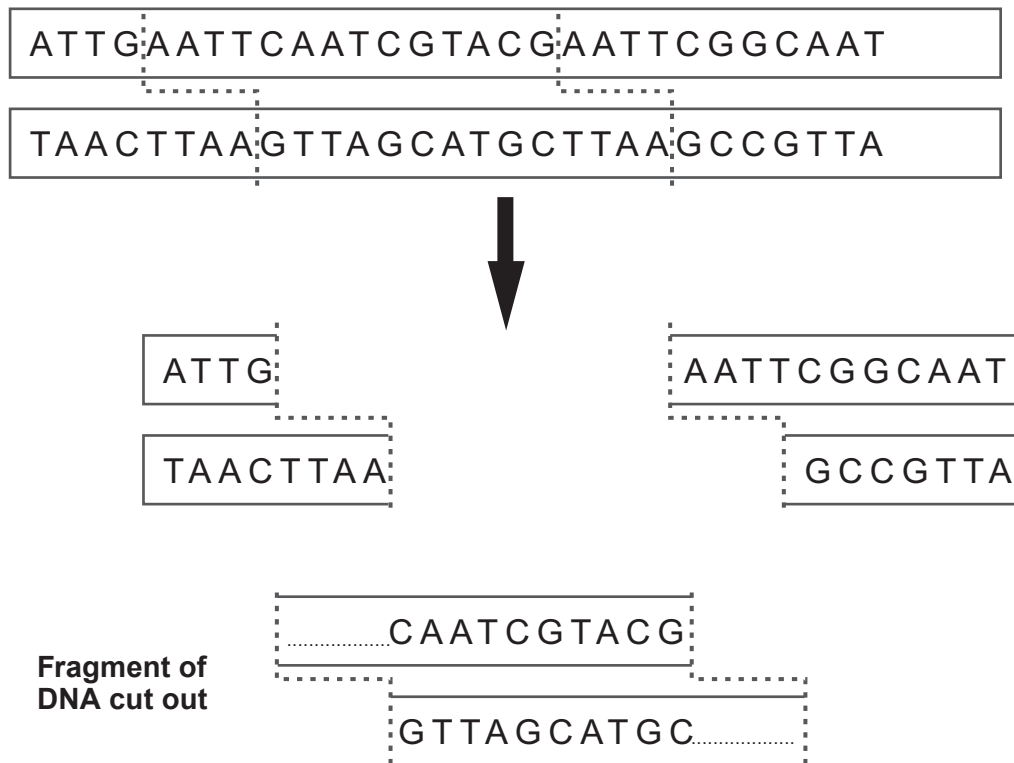


- (i) Name the stage of meiosis. [1]

- (ii) Explain with the aid of diagrams how the larger chromosomes in cell **Z** took on the appearance shown in part (c). [2]

- (iii) Name the process shown in your drawings. [1]

4. (a) Restriction enzymes are essential tools of genetic engineering. A restriction enzyme cuts the double-stranded DNA molecule at its specific **recognition site**. The diagram below shows how one such enzyme would cut out a DNA fragment.



- (i) Draw in the bases which are missing from the ends of the fragment of DNA which has been cut out. [1]
- (ii) Explain why the parts completed in (i) are known as 'sticky ends'. [1]

.....

.....

- (iii) A number of different restriction enzymes are now available, some of which are shown in the table below:

Enzyme	Source	Recognition site
<i>EcoRI</i>	<i>Escherichia coli</i> RY 13	GAATTC
<i>BamHI</i>	<i>Bacillus amyloliquefaciens</i> H	GGATCC
<i>HindIII</i>	<i>Haemophilus influenzae</i> Rd	AAGCTT

Name the enzyme used in the example above.

[1]

.....

- (b) In recombinant DNA technology, the piece of DNA which has been cut out is inserted into a plasmid which has been cut open using the same enzyme.

(i) Define the term 'plasmid'. [1]

.....

.....

(ii) Why is it important to use the same enzyme? [1]

.....

.....

(iii) Name the type of enzyme used to join the cut fragment into the plasmid. [1]

.....

- (c) Restriction enzymes are also used to cut up DNA during DNA fingerprinting/profiling. Labelled DNA probes are then used to identify the positions of the fragments on an electrophoresis gel. The fragments used are sections cut from introns rather than exons.

Explain why introns are more useful for genetic fingerprinting than exons. [2]

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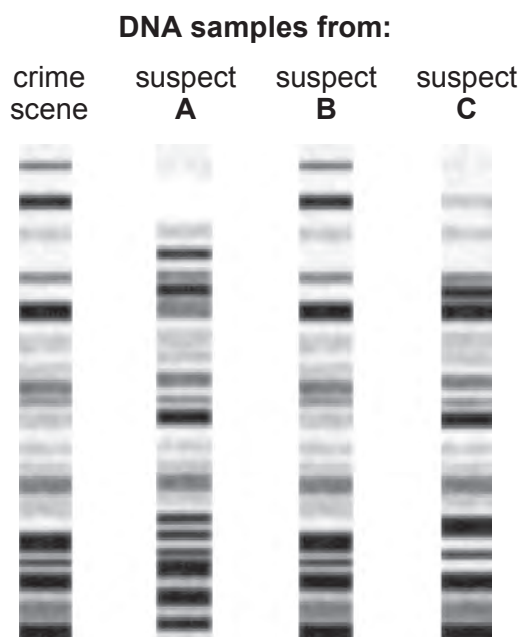
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- (d) DNA profiles of a sample of DNA taken from a crime scene and samples prepared from blood of three suspects are shown below.



Give **two** features of the DNA profiles which would lead to the identification of suspect **B** as being present at the scene of the crime. [1]

- (e) (i) DNA at crime scenes is often found in very small quantities. Polymerase Chain Reaction (PCR) is a technique that enables the analysis of these small samples of DNA. State how PCR makes this possible. [1]

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- (ii) The enzyme used in the technique has an important function during interphase in both mitosis and meiosis.

Name:

[2]

I. the enzyme used;

II. the enzyme's function in interphase.

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5. Finches that inhabit the Galapagos Islands (which include the islands of Genovesa and Champion) have become known as Darwin's Finches. They provide useful evidence to support a gene pool model of speciation.

(a) Define the term 'gene pool'.

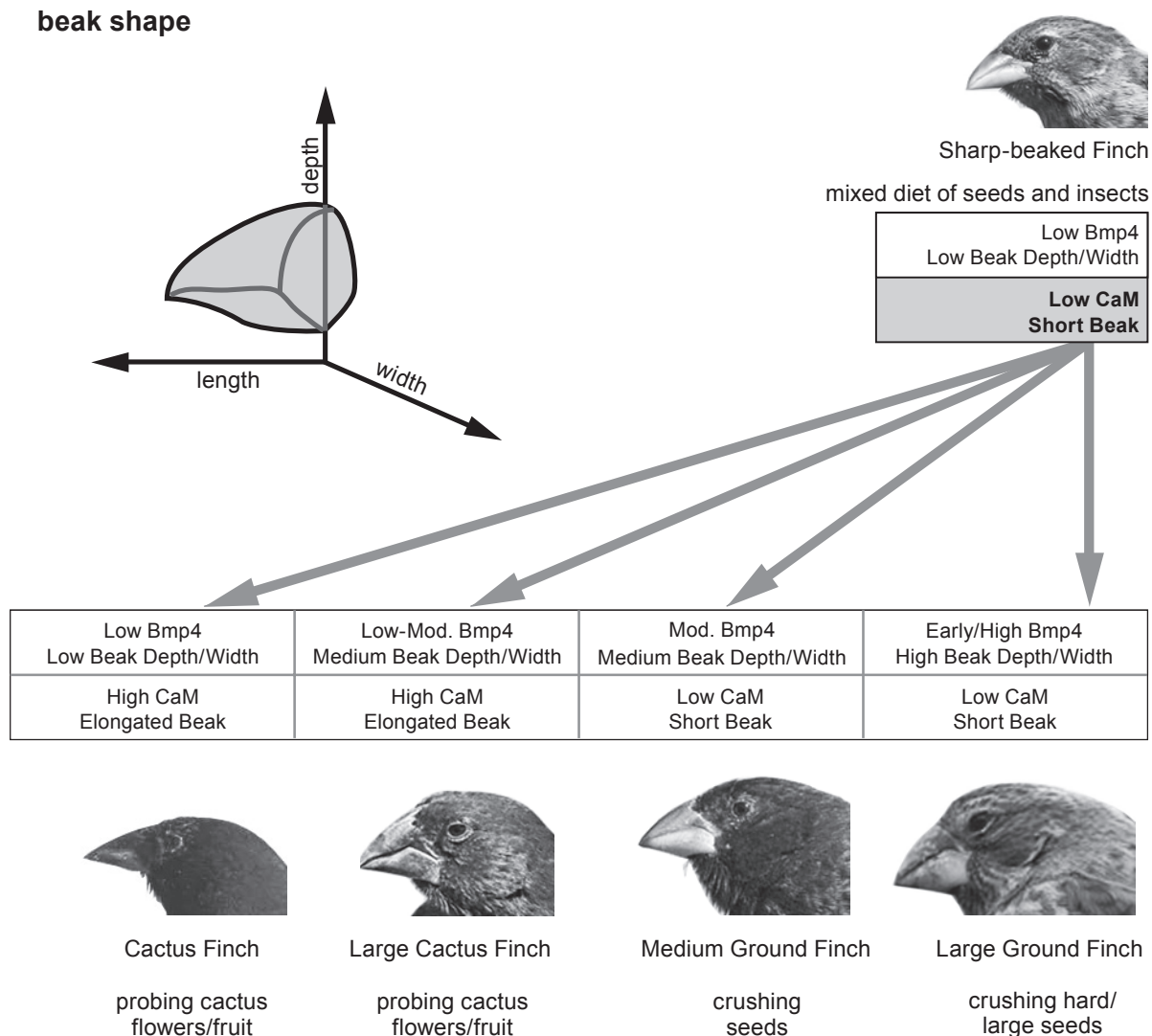
[1]

- (b) There is a strong correlation between the size of finches' beaks and the size of the seeds the beak is able to crack. Recent research has shown that two proteins are involved in controlling beak size:

Bone promoting molecule 4 (Bmp4) and calmodulin (CaM)

The diagrams below show links between the two molecules, beak shape and food source.

beak shape



- [1]

Examiner
only

- [1]

- (c) One theory for the evolution of the different species of Darwin's Finches is that a small population of Sharp-beaked Finch (*Geospiza difficilis*) was blown onto one of the islands from mainland South America. Over many generations they became adapted to feed on the different food sources available.

- [1]

- [4]

- (d) The Large Cactus Finch (*Geospiza conirostris*) from the island Genovesa has a beak that closely resembles that of the Cactus Finch (*Geospiza scandens*) from the island Champion.

(i) State why these two finches are considered to be separate species. [1]

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(ii) Explain why they evolved into separate species. [2]

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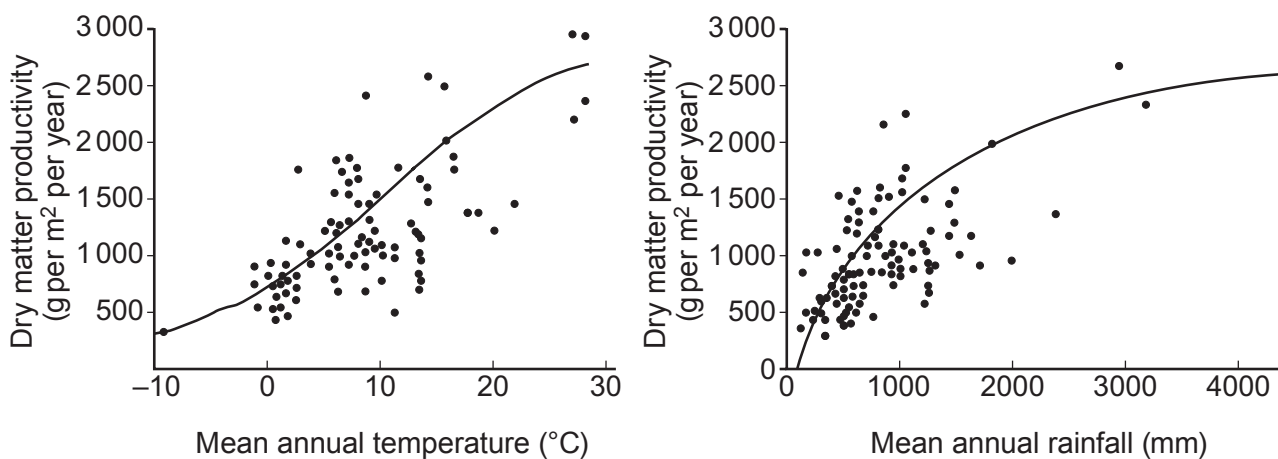
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6. (a) (i) Describe what is meant by the photosynthetic efficiency of a plant. [1]

- (ii) Distinguish between Gross Primary Production (GPP) and Net Primary Production (NPP). [1]

- (b) The rate of Primary Production is called Primary Productivity. The graphs below show the effect of two environmental factors on Primary Productivity.



- (i) Describe the relationship between productivity and the **two** abiotic factors shown. [1]

- (ii) Use this information to suggest why tropical rain forest is one of the most productive ecosystems in the world. [1]

- (c) Estimates of Net Primary Productivity for different types of ecosystem are given in the table below.

Type of Ecosystem	Average NPP (kJ/m ² /yr)
Tropical rain forest	35 280
Temperate forest	24 360
Northern coniferous forest	15 120
Woodland and shrubs	10 920
Lakes and streams	9 240
Agricultural crops	8 820
Desert	840

The average value for the solar energy striking the Earth's atmosphere is estimated at 4.41×10^7 kJ/m²/yr.

The ecological efficiency of tropical rain forest is $(35280 \div 4.41 \times 10^7) \times 100 = 0.08$

- (i) Calculate the ecological efficiency of agricultural crops. [2]

Answer

- (ii) Calculate the loss in Net Production for one year, if an area of tropical rain forest the size of Wales (21 785 km²) was cleared and used to grow sugar cane (an agricultural crop). [2]

Answer

- (iii) Explain why keeping cattle on the cleared land would be less efficient than growing crops. [2]

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- (iv) Suggest a negative impact on the Earth's atmosphere of keeping large numbers of cattle. [2]

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- (v) Suggest why growing sugar cane for producing biofuels could be considered carbon neutral. [1]

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Any diagrams included in your answer must be fully annotated.

Or. (b) Describe the events that take place within a human female from the release of the secondary oocyte to the implantation of the embryo. Details of sexual intercourse are not required. [10]

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10



GCE MARKING SCHEME

**BIOLOGY/HUMAN BIOLOGY
AS/Advanced**

SUMMER 2015

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01

BIOLOGY/HUMAN BIOLOGY – BY5

A.M. FRIDAY, 20 June 2014

1 hour 45 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	6	
3.	8	
4.	11	
5.	12	
6.	12	
7.	13	
8.	10	
Total	80	

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INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

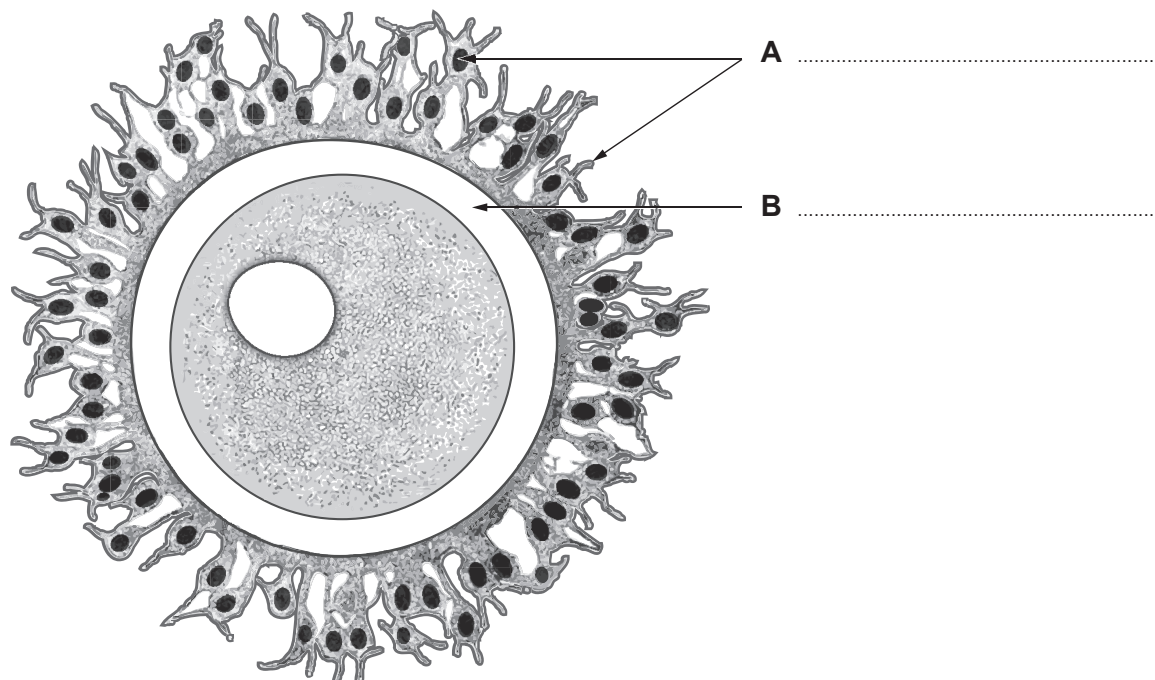
The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

Answer all questions.

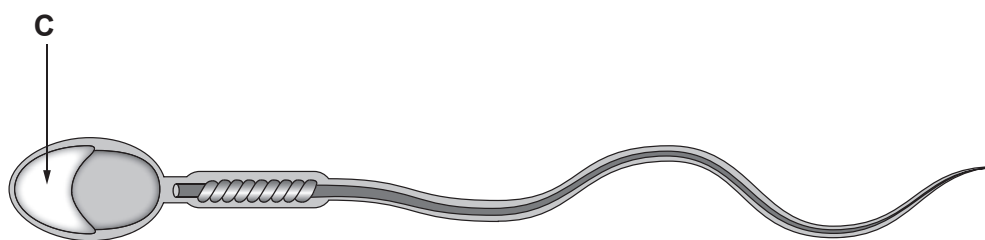
1. The illustration below shows a secondary oocyte.



- (a) Label parts **A** and **B**.

[2]

- (b) The diagram below shows a sperm cell.



- (i) Name the structure labelled **C**.

[1]

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- (ii) Describe the role that structure **C** plays in fertilisation of the ovum.

[2]

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(c) Explain each of the following.

[3]

(i) cell cleavage

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(ii) blastocyst

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(iii) implantation

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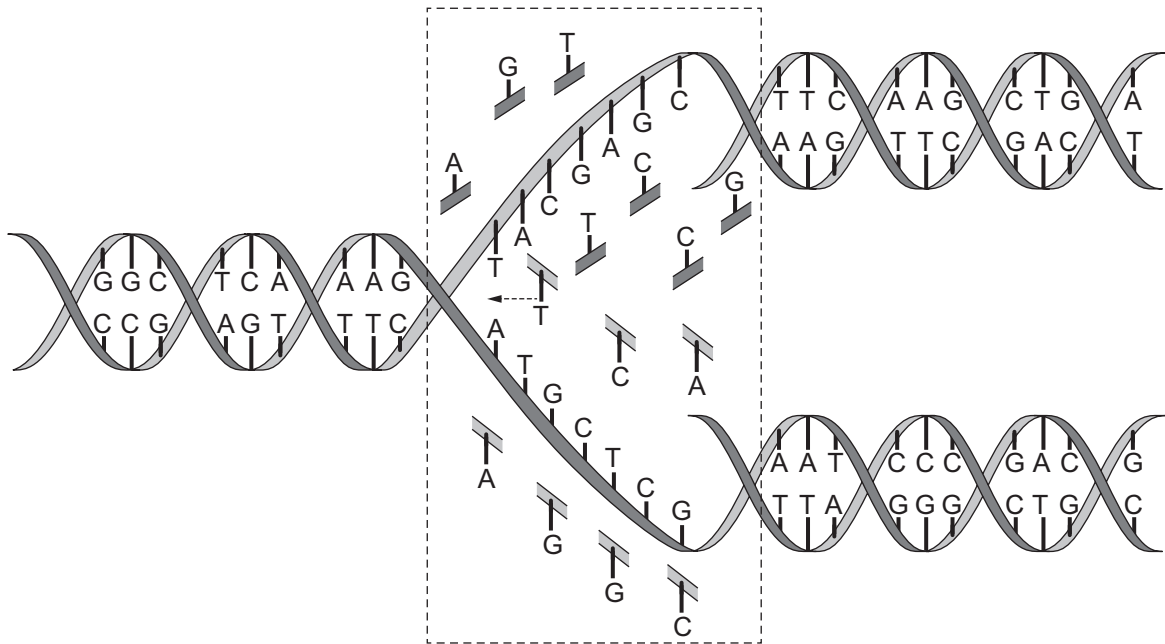
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2. The diagram below illustrates replication of DNA in cells.



- (a) (i) Describe the sequence of events shown within the dotted rectangle in the diagram above. [3]

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- (ii) What is the role of DNA polymerase in the process? [1]

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(b) Explain why the process is referred to as 'semi conservative'.

[2]

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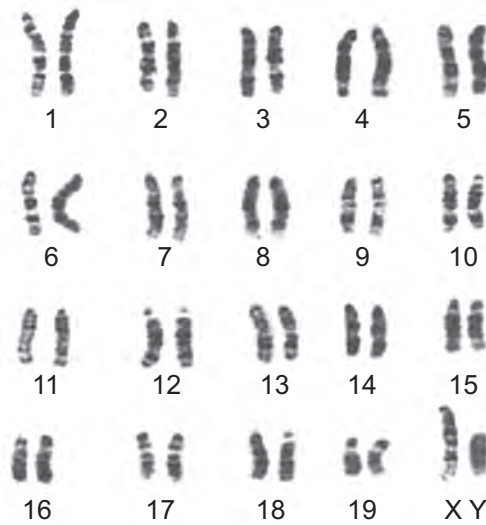
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3. The photograph below shows the pairs of chromosomes found in a body cell of a mouse.

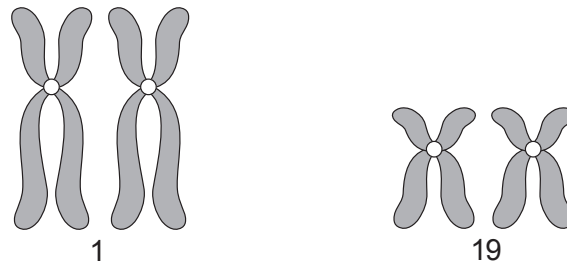


- (a) What is the diploid number of the mouse?

[1]

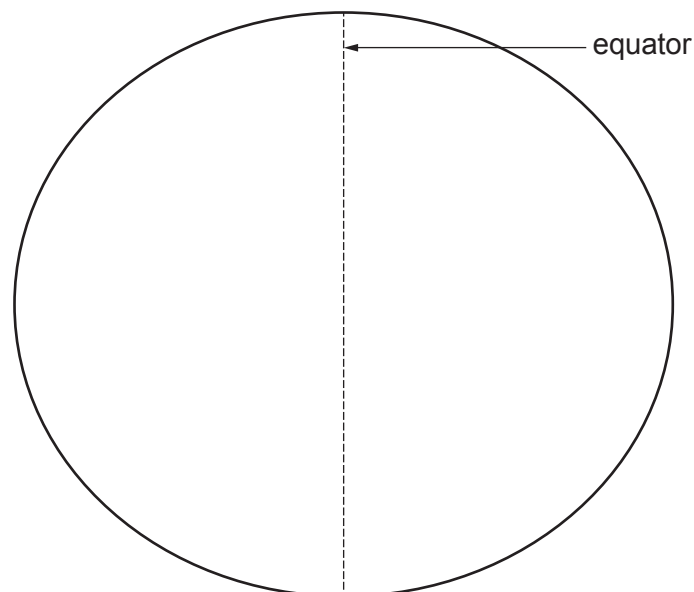
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- (b) The chromosomes in pairs 1 and 19 are commonly represented diagrammatically as:



- (i) Using the cell outline below draw diagrams to show how these pairs of chromosomes are arranged in **metaphase I** of meiosis.

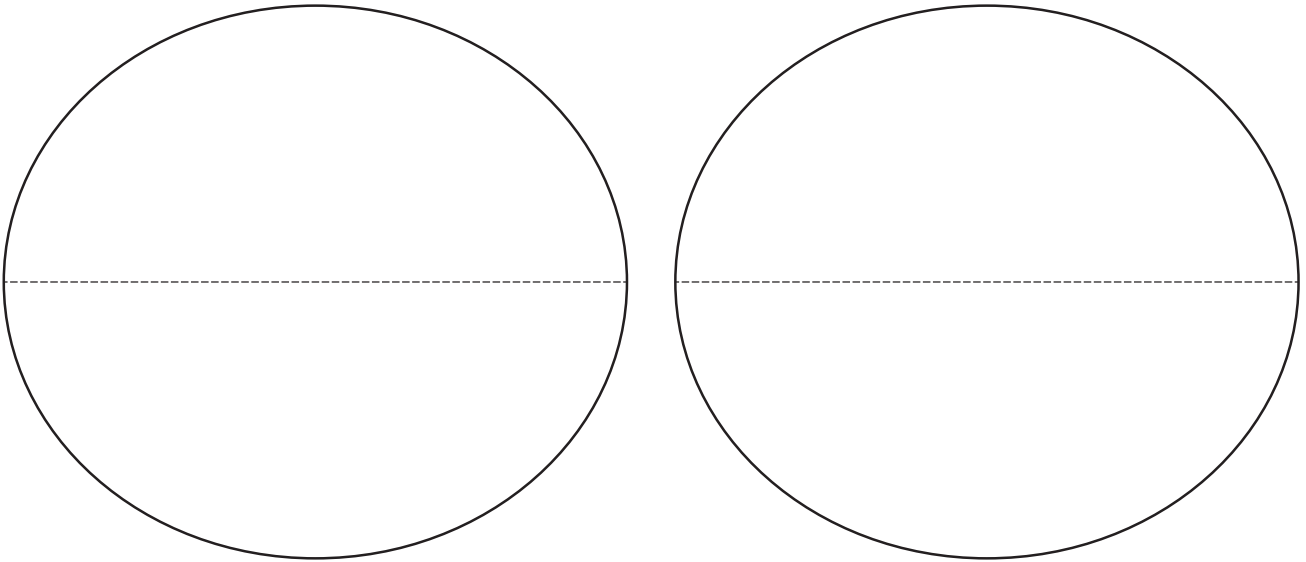
[1]



- (ii) On your drawing label; chromatid, centromere, centriole, spindle fibres.

[2]

- (iii) Using the cell outlines below draw diagrams to show how the chromosomes would subsequently be arranged in **metaphase II** of meiosis. [1]



- (iv) State **three** ways in which meiosis contributes to variation in mouse offspring. [3]

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4. The fruit fly *Drosophila melanogaster* is extensively used to study genetics because it is relatively easy to cause mutations in the flies. Some mutant flies have very small (vestigial) wings:



normal wings



vestigial wings

Other mutants have very dark (ebony) bodies instead of the normal grey body.



grey body



ebony body

In a **dihybrid** cross, when flies with normal wings and grey bodies were crossed with flies with vestigial wings and ebony bodies all the offspring had normal wings and grey bodies.

- (a) The F_1 hybrid flies (heterozygous for both traits) were allowed to interbreed freely. The F_2 flies were sorted and counted. The results are shown below.

Phenotype		Number of flies
Wings	Body	
Normal	Grey	75
Normal	Ebony	23
Vestigial	Grey	21
Vestigial	Ebony	9

- (i) Draw a genetic diagram, in the space provided below, to show the expected F_2 phenotype ratio. [5]

Use the letters given

Allele for normal wings = N

Allele for vestigial wings = n

Allele for grey body = G

Allele for ebony body = g

F_1 phenotypes	Normal wing, grey body	X	Normal wing, grey body
F_1 genotypes	.....	X	.....
Gametes	.....	X	.....

F_2 phenotype **ratio**

- (ii) Using the F_2 phenotype ratio from part (i) calculate the **expected** number of each phenotype in the F_2 generation from a total of 128 offspring, and enter the values in the table below. [1]

Phenotype		Observed number (O)	Expected number (E)	(O – E)	(O – E) ²	$\frac{(O - E)^2}{E}$
Normal wings	Grey body	75				
Normal wings	Ebony body	23				
Vestigial wings	Grey body	21				
Vestigial wings	Ebony body	9				

- (b) Complete the other columns in the table and carry out a Chi square test, testing the Null Hypothesis – that there is no significant difference between the observed and expected results.

- (i) Use the last column in the table to calculate χ^2 . [1]

$$\chi^2 = \sum \frac{(O - E)^2}{E} \qquad \chi^2 = \dots\dots\dots$$

- (ii) Use the 5% probability level and the correct number of degrees of freedom to **circle** the critical value of χ^2 in the table below. [1]

Degrees of freedom	Probability								
	0.9	0.8	0.7	0.5	0.2	0.1	0.05	0.02	0.01
1	0.016	0.064	0.15	0.46	1.64	2.71	3.84	5.41	6.64
2	0.21	0.45	0.71	1.39	3.22	4.60	5.99	7.82	9.21
3	0.58	1.00	1.42	2.37	4.64	6.25	7.82	9.84	11.34
4	1.06	1.65	2.20	3.36	5.99	7.78	9.49	11.67	13.28

- (iii) State whether you would accept or reject the Null Hypothesis, for this cross and explain why. [1]

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- (c) In another cross, flies with ebony bodies and scarlet eyes were crossed with flies homozygous for grey body and red eyes. All the F_1 flies had grey bodies and red eyes. When the F_1 hybrid flies were crossed the following results were obtained:

Phenotype		Number of flies
Eyes	Body	
Red	Grey	91
Red	Ebony	3
Scarlet	Grey	2
Scarlet	Ebony	32

The table shows that some of the offspring were far more common than expected and some phenotypes were very rare. Explain both of these observations. [2]

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5. The techniques of recombinant DNA technology and micro-propagation are used to produce Genetically Modified Crops. The following summary is adapted from an account given on the Food Standards Agency's web site [www.food.gov.uk]

1. A plant with the desired characteristic is identified – e.g. resistance to the herbicide 'Roundup'.
2. The specific gene that produces this characteristic is found in the plant's DNA and cut out.
3. To get the gene into the cells of the plant being modified, the gene needs to be attached to a carrier. A piece of bacterial DNA called a plasmid is joined to the gene to act as the carrier.
4. Once the gene is attached to the plasmid, a marker gene is also added to identify which plant cells take up the new gene.
5. The 'gene package' is put in a bacterium, which multiplies, to create many copies of the 'gene package'.
6. A copy of the 'gene package' is dried onto a gold or tungsten particle – and fired into a piece of tissue from the plant being modified. The particle carries the 'gene package' into the plant's cells.
7. The plant tissue is put into a selective growth medium so that only modified tissue develops into plants.

- (a) Explain how different types of enzymes are used in stages 2 and 3 to produce the 'gene package'. [4]

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- (b) Describe the steps involved in the culture of a large number of genetically identical plants from the plant tissue produced in stage 7. [3]

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- (c) (i) Explain the advantage to farmers of having crops resistant to 'Roundup'. [3]

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- (ii) Explain why environmentalists might have legitimate objections to using GM crops resistant to 'Roundup'. [2]

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6. A species of mouse *Peromyscus polionotus* found in Florida, USA, has a number of different coat colours. Coat colour in mice is controlled by several genes. Dark fur is produced when the hair producing cells secrete a pigment called eumelanin. A high level of eumelanin is produced when a transmembrane protein called MC1R is stimulated by a hormone.

- (a) The diagram below shows part of the amino acid sequence of MC1R, part of the sequence of nucleotides in the gene for MC1R and how it might change to produce light fur:

Original

Amino acid sequence

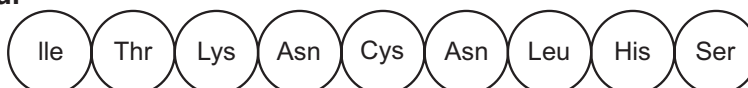


Nucleotide sequence
(allele R)

ATCACCAAAAACCGCAACCTGCACTCG

Changed to produce light fur

Amino acid sequence



Nucleotide sequence
(allele C)

ATCACCAAAAACCTGCAACCTGCACTCG

- (i) Describe the change in the gene and the subsequent change in the MC1R molecule. [2]

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- (ii) Using the information provided, explain how this change results in mice with light fur. [2]

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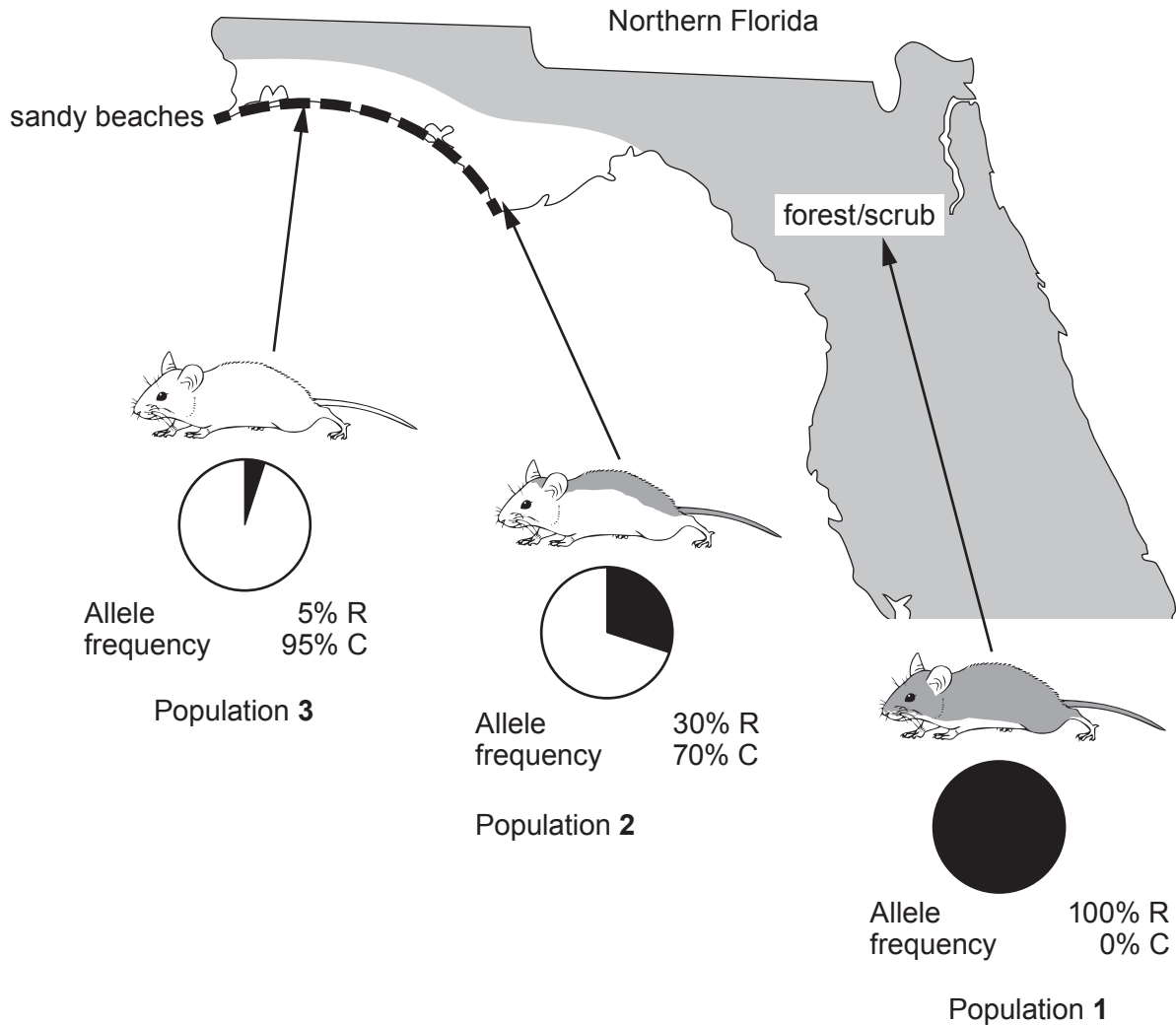
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- (b) This change in the MC1R gene means that there are two alleles, R and C. The map below shows the distribution of the different coloured mice and the relative frequencies of the alleles R and C in each population.



- (i) Use the diagram to suggest how fur colour is related to environmental conditions. [2]

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- (ii) Under what circumstance could the difference between the allele frequencies in populations 2 and 3 be explained by **genetic drift**, despite both living on beaches? [1]

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- (iii) Explain how **Natural Selection** could have caused the relative allele frequency shown in population 3. [4]

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- (iv) Under what circumstances would the mouse population become a separate species? [1]

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7. The following is a quotation from an ecological investigation.

“Lowland heaths are high-profile ecosystems for conservation action in England, but they are under threat from invasion by *Betula spp.*, *Pinus sylvestris*, and *Ulex europaeus*.”

[R.J. Mitchel et al. *Journal of Applied Ecology*, 1997, 37, 1426-1444]

- (a) Distinguish between primary succession and secondary succession. [2]

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The authors studied a number of heathland sites in Dorset including Arne, Blackhill, and Higher Hyde, where succession to one or another of the three species had taken place. The data below are based on the paper but have been simplified and modified for illustrative purposes.

The successional stages in the study were named according to the dominant invasive species; **plus B**, where *Betula spp.* was the invader, **plus PS**, where *Pinus sylvestris* was the invader and **plus U**, where *Ulex europaeus*, was the invader.

- (b) The group examined changes in soil chemistry from the original heath stage. Some of their results are summarised in the table below:

soil chemical property	value by succession stage			
	original heath	plus B	plus PS	plus U
pH				
Arne	3.63	4.01	3.60	3.63
Blackhill	3.52	3.66	3.48	3.54
Higher Hyde	3.53	5.06	3.51	3.47
mean	3.56	4.24	3.53	3.55
phosphorus μgPg^{-1}				
Arne	2.41	3.85	2.69	3.16
Blackhill	4.15	4.91	3.79	4.55
Higher Hyde	5.08	5.35	3.55	4.76
mean	3.88	4.70	3.34	4.16
nitrate/nitrite μgNg^{-1}				
Arne	0.51	0.65	0.59	1.16
Blackhill	0.84	0.88	0.97	2.31
Higher Hyde	0.69	0.98	1.17	3.64
mean	0.68	0.84	0.91	2.37

- (i) What do the pH values tell us about the soil in all stages in all sites? [1]

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- (ii) Use **mean** values from the table above to compare **three** changes to soil chemistry following invasion by *Betula spp.* with the changes following invasion by *Ulex europaeus*. [3]

pH

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phosphorus

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nitrate/nitrite

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- (c) The table below shows changes to the vegetation in the successional stages:

Species (by successional stage)	% cover of species (by site)		
	Arne	Blackhill	Higher Hyde
original heath			
<i>Calluna vulgaris</i>	62.0	66.1	88.2
<i>Erica cinerea</i>	22.4	25.7	2.6
<i>Erica tetralix</i>	9.9	2.6	9.9
<i>Cladonia portentosa</i>	8.5	0	0.5
plus B			
<i>Betula spp.</i>	18.9	11.7	16.5
<i>Agrostis curtisii</i>	0.0	53.6	0.0
<i>Pteridium aquilinum</i>	25.2	7.5	1.6
<i>Calluna vulgaris</i>	0.0	0.0	0.4
plus PS			
<i>Pinus sylvestris</i>	36.2	38.2	
<i>Pteridium aquilinum</i>	0.3	24.7	
<i>Erica cinerea</i>	0.0	0.0	
<i>Calluna vulgaris</i>	0.0	0.0	
plus U			
<i>Ulex europaeus</i>	87.0	75.3	79.0
<i>Calluna vulgaris</i>	14.7	5.8	7.2
<i>Erica cinerea</i>	1.5	11.3	4.3
<i>Erica tetralix</i>	0.1	0.3	0.3

- (i) Which invading species has least impact on the vegetation on the original heathland? [1]

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- (ii) With reference to the data for **plus B** in both tables suggest a mechanism by which changes to vegetation occur during succession. [2]

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(d) Sixteen years later some of these successions have reached their natural conclusions.

- (i) What name is given to the group of organisms that inhabit the ecosystem at the end of successional change? [1]

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- (ii) What usually happens to species diversity as succession proceeds? [1]

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- (iii) Using **named** species from the table in part (c) explain why conservationists in Dorset are taking steps to prevent **plus B** and **plus PS** succession in heathland, but are less worried about type **plus U** succession. [2]

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Either, (a) Describe how the structure of a typical flower is adapted for insect pollination and subsequent fertilisation. [10]

Or (b) Describe energy transfer in an ecosystem. Briefly explain the agricultural practice of keeping animals in heated sheds with little room to move about. [10]

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GCE BIOLOGY - BY5

MARK SCHEME - SUMMER 2014

Question	Marking details	Marks Available
1 (a)	A – Corona radiata / follicle (cells)/ cumulus cells/ granulosa cells; B- Zona pellucida;	2
(b) (i)	Acrosome;	1
(b) (ii)	{Releases/ contains} {enzymes/proteases/carbohydase}; To {digest/ break down/ penetrate/ soften} {corona radiata/ zona pellucida};	2
(c) (i)	{Splitting/dividing} of { <u>zygote/early embryo</u> } cells to form new cells;	1
(c) (ii)	Hollow ball of cells/ ball of {undifferentiated/ partly differentiated} cells;	1
(c) (iii)	The {burying/ embedding/ implanting} of the {blastocyst/ embryo} into the {uterine lining/endometrium};	1
Question 1 Total		[8]

Question	Marking details	Marks Available
2 (a) (i)	DNA molecule unwinds; Unzips/ breaks hydrogen bonds/ strands separate; (free) { <u>nucleotides</u> } {join/align} with {complementary bases/ A to T/ C to G};	3
(ii)	{To join the nucleotides together/ catalyses the addition of nucleotides} to form a {new strand/ backbone/ phosphodiester bonds};	1
(b)	Each new DNA <u>molecule</u> has one {original/ template} strand; And one new strand which has been { <u>made/ synthesised/ replicated</u> };	2
		Question 2 Total
		[6]

Question	Marking details	Marks Available
3 (a)	40;	1
(b)	(i) Correct diagram; two chromosome pairs vertically orientated one of each pair on each side of the equator one pair of chromosomes bigger than the other	1
	(ii) Correct labelling of chromatid, <u>centromere</u> , <u>centriole</u> , spindle fibres 2 marks for 4 correct labels 1 mark for 2 or 3 correct labels	2
	(iii) Correct diagrams; Two chromosomes in each cell (one large and one small) Centromeres on dotted line	1
	(iv) {Random/ independent} assortment of {chromosomes/ chromatids}/ description of {random/ independent assortment}; crossing over/ chiasmata; produces haploid cells;	3
		Question 3 Total [8]

Question	Marking details	Marks Available
4	(a) (i) NnGg for both; NG Ng nG ng for both; correct completion of punnet square; correct ratio 9:3:3:1; correct phenotypes matched to ratio; (ii) Correct expected number column 72 : 24 : 24 : 8; (b) (i) 0.667/ 0.67/ $\frac{2}{3}$; (ii) 7.82 circled; (iii) Accept because χ^2 value is to left of {critical value/ 7.82}/ Accept because χ^2 value has probability higher than {0.05/5%}/ Accept because χ^2 value falls between {0.9/90%} and {0.8/80%} probability/ Accept because the probability lies between 80-90% that it is due to chance alone; <i>If not circled any answer for (ii) must refer to 7.82 in (iii)</i> ECF from chi squared table (c) {Common phenotypes/red grey and scarlet ebony} are due to linkage/ description of linkage; {Rare phenotypes/ red ebony and scarlet grey} due to {crossing over/ recombinants};	5 1 1 1 2
Question 4 Total		[11]

Question	Marking details	Marks Available
5 (a)	Restriction {endonuclease/ enzymes} used to cut (out the desired gene); The <u>same</u> {endonuclease/ enzyme} is used to open the plasmids; Producing {complementary/ corresponding} 'sticky ends'; Ligase is used to {join/ splice/ attach/ adhere/ anneal} gene into plasmid;	4
(b)	Placed in sterile, (aerated) {medium/agar}; NOT soil (Allow) cells to form {callus/ mass of {undifferentiated/ totipotent cells}}; Callus is subdivided; Apply hormones to callus to differentiate into plantlets/ Plantlets {transplanted/put} into sterile soil;	Max 3
(c) (i)	'Roundup' will not kill crop but it will kill {other plants / weeds}; Reducing competition in the field; Allowing increased yield;	3
(ii)	There will be increased use of herbicide; a reduction in biodiversity/ may lead to {herbicide resistant weeds/ superweeds} bioaccumulation in food chain; OR <u>Dispersal of pollen</u> from crops engineered for herbicide resistance to {wild relatives/ weeds}; may lead to {herbicide resistant weeds/ superweeds}; OR <u>Dispersal of pollen</u> from crops engineered for herbicide resistance to other crops; May contaminate organic crops; OR (GM crop) produces a new protein; Unknown effects of <u>eating</u> new protein;	Max 2
Question 5 Total		[12]

Question	Marking details	Marks Available
6 (a) (i)	CGC is replaced by TGC/ C is replaced by T; Amino acid cys has replaced arg;	2
(ii)	Change in {protein/ tertiary} structure/ different protein is made; MC1R will not be stimulated (by the hormone); {Less/no} eumelanin will be produced;	Max 2
(b) (i)	Mice with light fur found in an environment providing {light backgrounds/sandy beaches} AND mice with dark fur in {forest /dark backgrounds}/ Dark fur is found in the darker <u>er</u> background/ light fur is found in the lighter <u>er</u> background; For camouflage/ OWTTE;	2
(ii)	Small populations (of mice);	1
(iii)	Mice with light fur {are less easily seen/caught by predators/ correct reference to camouflage/ have a selective advantage}; Light fur mice (survive to) reproduce and <u>pass {allele C/ advantageous allele/ light fur allele}</u> to next generation; Increasing the frequency of the allele; 95% of population (have allele C);	4
(iv)	{Genetic/behavioural/geographic/allopatric/reproductive/ sympatric/ seasonal/ temporal} isolation;	1
Question 6 Total		[12]

Question	Marking details	Marks Available												
7 (a)	Primary: environment not previously colonised/ from bare rock; Secondary: environment has soil/previous inhabited;	2												
(b) (i)	Acid/acidic; NOT low	1												
(ii)	<table border="1"> <thead> <tr> <th>feature</th><th>Betula</th><th>Ulex</th></tr> </thead> <tbody> <tr> <td>pH</td><td>(from 3.56 to 4.24, difference of 0.68) Increases pH/makes more alkali/ makes less acidic/</td><td>(from 3.56 to 3.55 difference of 0.01) Not much/ no change/ no effect/ slight decrease;</td></tr> <tr> <td>Phosphorus</td><td>(from 3.88 to 4.7 difference of 0.82) Increases a lot</td><td>(from 3.88 to 4.16 difference of 0.28) Small increase;</td></tr> <tr> <td>Nitrate</td><td>(from 0.68 to 0.84 difference of 0.14) Increases</td><td>(from 0.68 to 2.37 difference of 1.69) Very large increase;</td></tr> </tbody> </table> 1 mark for valid COMPARISON of each feature	feature	Betula	Ulex	pH	(from 3.56 to 4.24, difference of 0.68) Increases pH/makes more alkali/ makes less acidic/	(from 3.56 to 3.55 difference of 0.01) Not much/ no change/ no effect/ slight decrease;	Phosphorus	(from 3.88 to 4.7 difference of 0.82) Increases a lot	(from 3.88 to 4.16 difference of 0.28) Small increase;	Nitrate	(from 0.68 to 0.84 difference of 0.14) Increases	(from 0.68 to 2.37 difference of 1.69) Very large increase;	3
feature	Betula	Ulex												
pH	(from 3.56 to 4.24, difference of 0.68) Increases pH/makes more alkali/ makes less acidic/	(from 3.56 to 3.55 difference of 0.01) Not much/ no change/ no effect/ slight decrease;												
Phosphorus	(from 3.88 to 4.7 difference of 0.82) Increases a lot	(from 3.88 to 4.16 difference of 0.28) Small increase;												
Nitrate	(from 0.68 to 0.84 difference of 0.14) Increases	(from 0.68 to 2.37 difference of 1.69) Very large increase;												
(c) (i)	<i>Ulex europaeus</i> ;	1												
(ii)	The {invading /dominant/ new/ named species} {change the soil chemistry/ named change}; Giving them a competitive advantage/ competition for named resource/ existing species are at a disadvantage/ so are better suited to the environment;	2												
(d) (i)	Climax community;	1												
(ii)	Increases;	1												
(iii)	<u>{C. vulgaris /E. cinerea /E. tetralix}</u> are disappearing from plus B and plus PS; These are surviving in plus U; Names must be included to access any marking points	2												

Question 7 Total [13]

Question	Marking details	Marks Available
8 (a)	A* Sepal/calyx –tough leaf-like- to protect more delicate parts {in bud/ when immature}/ can be coloured to attract insects/ green for photosynthesis; B* Petals/corolla - large/brightly coloured/scented - to attract insects ; C {Nectaries/nectar /sugar} to attract insects; D* Filament – thin/stalk-like/short/hooks – to hold anthers where they will come in contact with insect/ contains vascular tissue to provide anther with nutrients; E Anther— to {produce/ contain} {haploid gametes/male gametes/pollen /microspore}; F* Anther – is hollow/ has a line of weakness- description of splitting and rolling to put pollen on outside/ correct reference to dehiscence/ getting pollen onto insect; G* Pollen (grain) - sculptured exine/ has hooks – to attach to insects body; H* Stigma – {is sticky – to catch/trap pollen (grains)}/{ - secretes chemicals/sugar} – to stimulate pollen tube growth}; I Style to hold stigma where it will come in contact with insects/ pollen tube {gains nutrients from the style/ digests its path though the style}; J Correct reference to relative positions of anthers and stigmas to {prevent self /encourage cross} pollination; K* Ovary – {walls - to {protect/contain} developing ovule/embryo sac}/ { -secretes chemicals – pollen tube growth}; L* Ovule- integuments – to protect developing embryo; M (Ovule) – tiny hole/micropyle – to allow entry of pollen tube; N Good drawing correctly labelled with at least 4 of above; O Appropriate means of ensuring cross pollination, e.g. dimorphism (single sex plants)/ protogyny (ovules mature first)/ protandry (pollen matures first)/genetic incompatibility/ chemical inhibition on the stigma; To award * there must be a name, a description and a function	
Question 8 Total		[10]

Question	Marking details	Marks Available
8 (b)	A Sun is source of energy/ energy enters as light energy; B Photosynthesis converts light energy to chemical energy (in organic molecules); C {Not all light/ only some light} striking plants is used for photosynthesis; D Some {is reflected/ passes between {cells/chloroplasts}/ wrong wavelength/ is transmitted/ passes through}; E Correct definition of GPP/ total (bio)mass of (organic) produce/ rate at which products are formed/ $\text{kJm}^{-2}\text{yr}^{-1}$; F Correct definition for NPP/ Mass available to primary consumers; Accept correct equation to credit E and F (GPP- Respiration=NPP) G {<u>Biomass/ plant matter/ chemical energy</u>} is transferred from producer to {herbivores/primary consumers} when it is eaten; H Not all plant is {eaten e.g. roots/ digested e.g. cellulose}; I (Respiration) energy is lost as heat energy/ used for {movement/ metabolism/ active transport}; J {<u>Biomass/ chemical energy</u>} is passed to {carnivores/secondary consumers}; K Energy in {faeces /urine/ dead bodies} is <u>passed to decomposers</u>; NOT excretion L Carnivores are more efficient + protein is more easily digestible/ herbivores are less efficient + cellulose is less easily digestible; <i>Keeping animals in heated sheds with little room to move about</i> M Less heat energy will be lost {if the difference between body temperature and shed temperature is small/ maintaining body temperature}; N Less energy will be lost in movement if the animals are prevented from moving; O More of the energy is used for making meat / eggs / milk / increasing {biomass/ size}yield;	
Question 8 Total		[10]

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01

BIOLOGY/HUMAN BIOLOGY – BY5

P.M. MONDAY, 17 June 2013

1 ¾ hours

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	16	
3.	12	
4.	15	
5.	11	
6.	8	
7.	10	
Total	80	

1075
010001

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

1. Distinguish between the following pairs of biological terms.

(a) seminiferous tubule and seminal vesicle;

[2]

.....

.....

.....

(b) DNA ligase and DNA polymerase;

[2]

.....

.....

.....

(c) gene and allele;

[2]

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.....

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(d) primary succession and secondary succession.

[2]

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2. The Grand Banks is an area of sea off the coast of Newfoundland in Canada. It was once one of the most productive fishing grounds in the world for Atlantic cod.

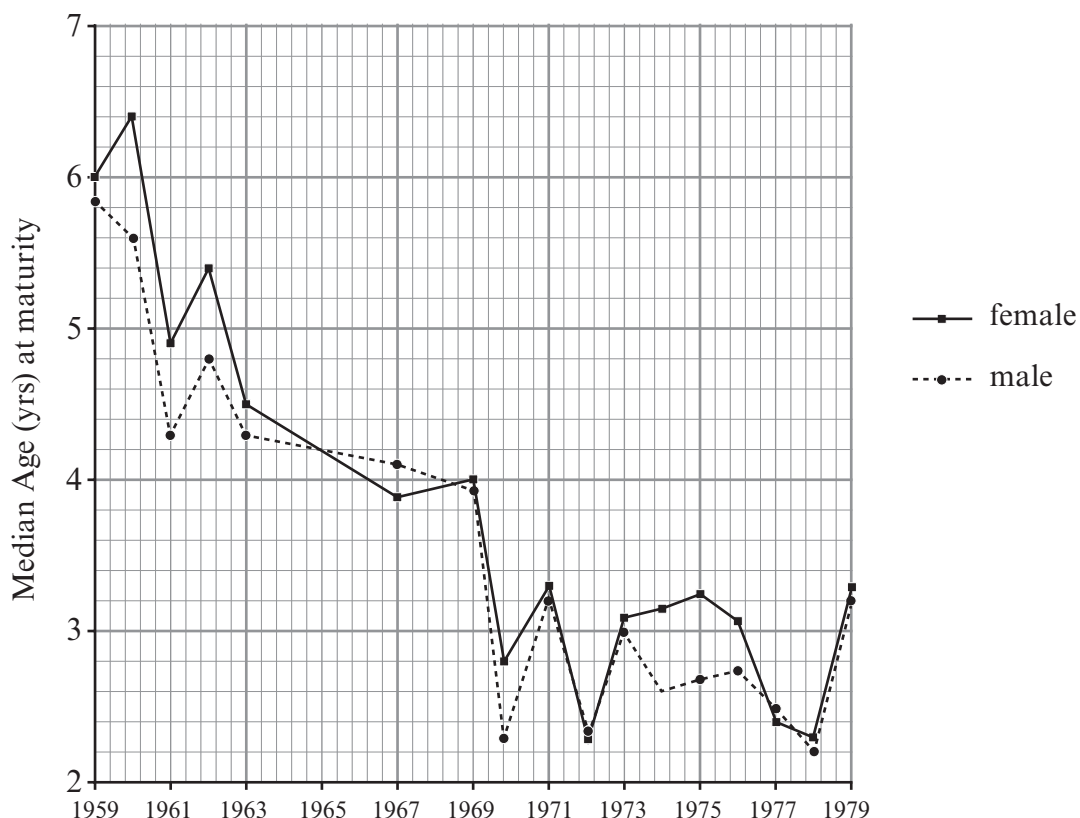
The cod was fished heavily for about 50 years.

About 60% of the total cod population of reproductive age was harvested annually.

Cod fishing in the Grand Banks was closed in 1992 but by then the population was less than 1% of what it had been.

Cod grow evenly throughout their life.

The cod that remained when fishing was finally closed were much smaller and grew more slowly than the cod that lived in the Grand Banks several decades previously.



Graph to show the median age of cod at sexual maturity in the same location during the time of heaviest fishing.

- (a) (i) Use the information provided opposite and your own knowledge of natural selection to describe and explain how the phenotype of the cod has changed since 1960. [5]

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- (ii) The cod fisheries have been closed for nearly 20 years but there has been little change in the phenotype and no population recovery. Suggest why there has been little change in the phenotype and no population recovery. [3]

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- (b) Other than restricting the mesh size of nets, give **two** other methods which are used to prevent overfishing. [2]

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- (c) (i) One solution to overfishing is aquaculture or fish farming.
Give **two** problems associated with producing fish in this way. [2]

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- (ii) Wild trout are diploid (**2n**). Some trout used in fish farming are triploid (**3n**).
Suggest why triploid trout are infertile. [4]

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3. Haemophilia is caused by a sex linked gene.

- (a) (i) What is meant by the term '*sex linkage*'? [1]

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- (ii) Complete the following genetic diagram to show how parents who did not suffer from haemophilia, could have a son with haemophilia but also other children who did not suffer from haemophilia. Use the symbols X^H for the normal allele and X^h for the allele which causes haemophilia. [4]

Phenotype of parents	Normal male	Normal female
Genotype of parents	.....	.....
Genotype of gametes	.....	.....

Genotype of offspring

Phenotype of offspring

- (iii) What is the probability of the couple having a daughter with haemophilia? [1]

.....

- (iv) What is the probability of the couple having another son with haemophilia? [1]

.....

- (b) An organism has two genes A and B which are found on the same chromosome.

Complete the following genetic diagram for a cross between two individuals with genotype Aa Bb but where no crossing over occurs (complete linkage). [3]

Genotype	AaBb	AaBb
Genotype of gametes	.....	.....

Genotype of offspring

Ratio of Phenotype

- (c) In another cross between two individuals with the genotype DdEe, where the genes D and E are on the same chromosome, the offspring showed four different types of phenotype. The phenotype of some of the offspring were far more common than expected and some phenotypes were very rare. Explain these observations. [2]

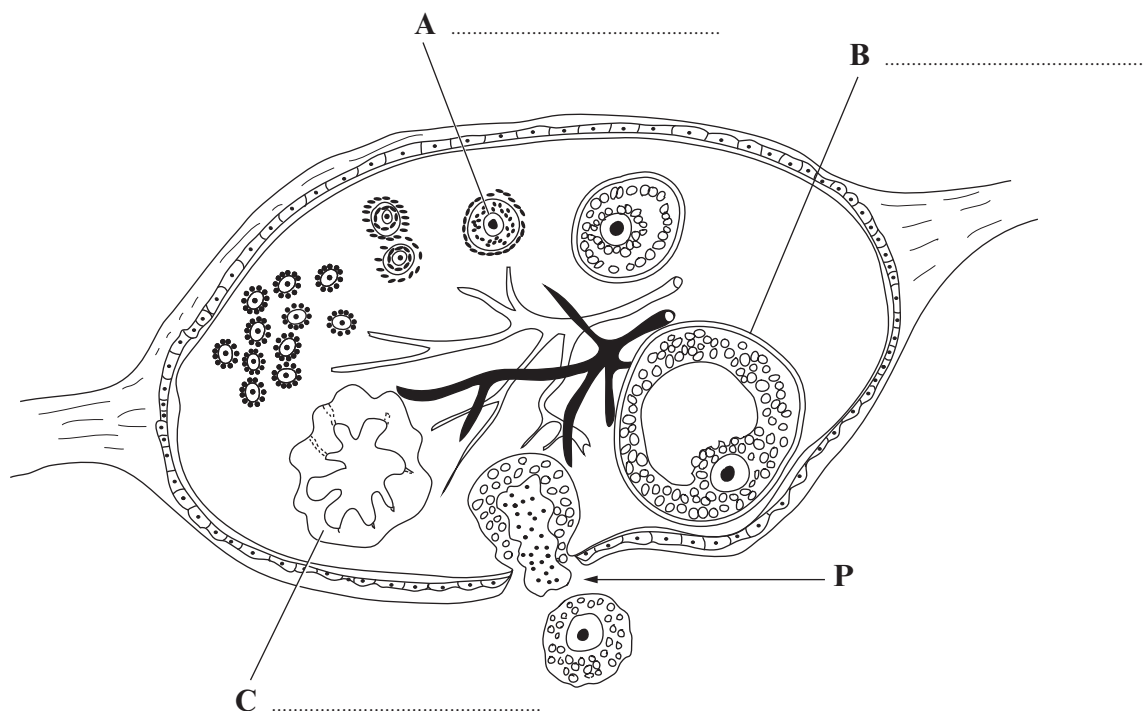
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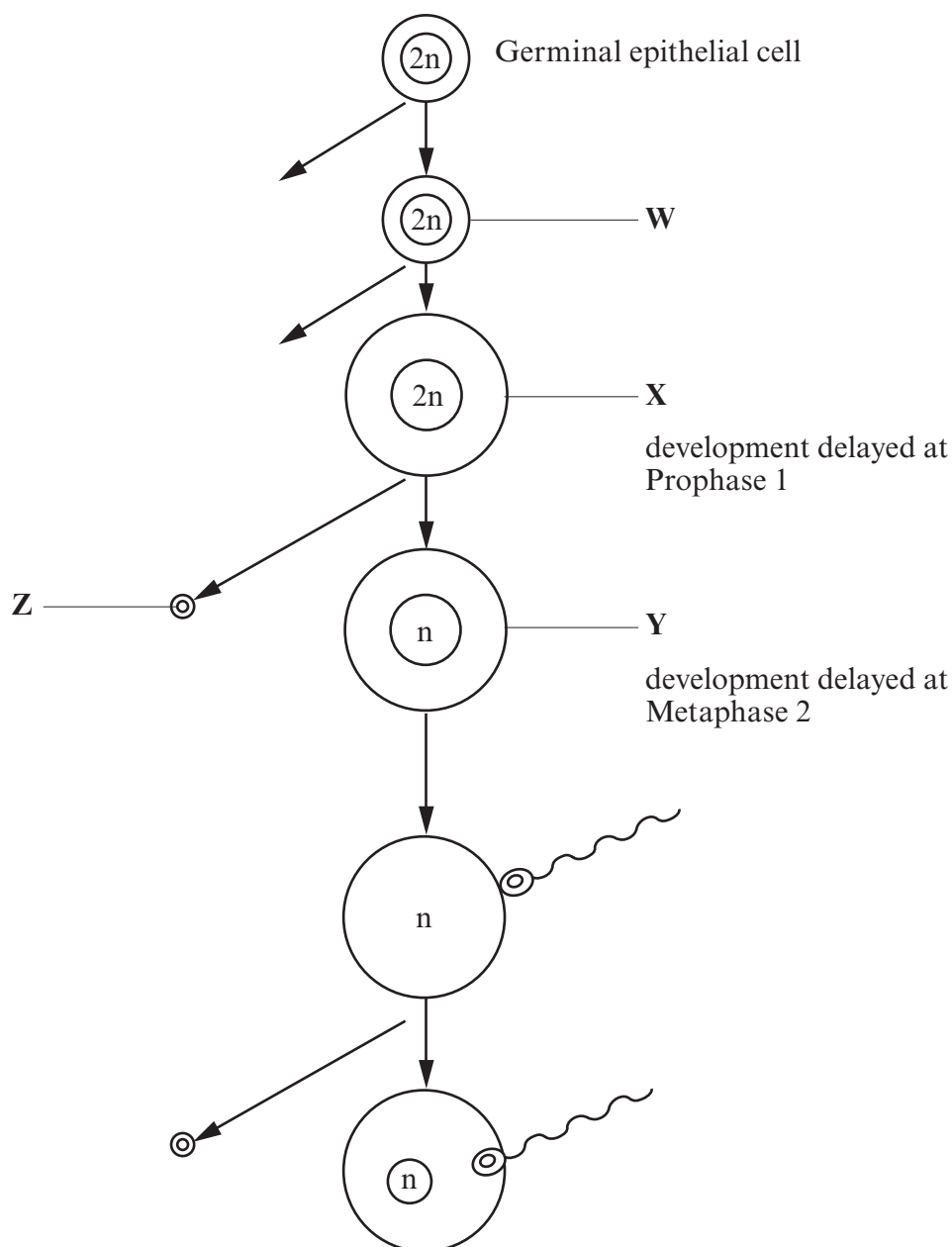
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4. The diagram below represents a section through a human ovary showing the developmental stages which lead to ovulation.



- (a) (i) Label the structures **A** – **C** shown on the diagram above. [3]
- (ii) What process is taking place at **P**? [1]
-
- (iii) Name the hormone produced by the developing embryo which prevents the breakdown of structure **C**. [1]
-

(b) The diagram below represents the stages of oogenesis and fertilisation.



(i) Name cells **W**, **X**, **Y** and **Z** shown on the diagram above.

[4]

W

X

Y

Z

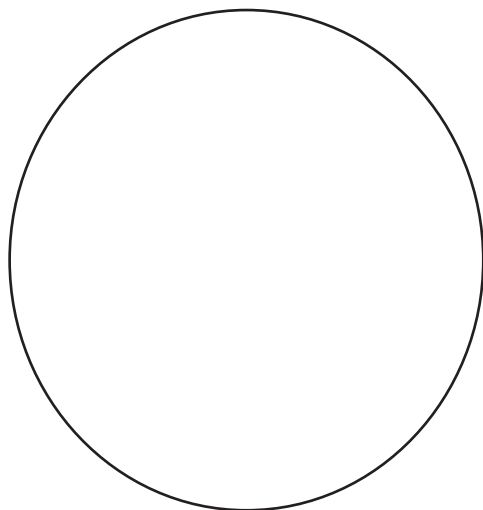
(ii) What process is involved in the production of cell **W**?

[1]

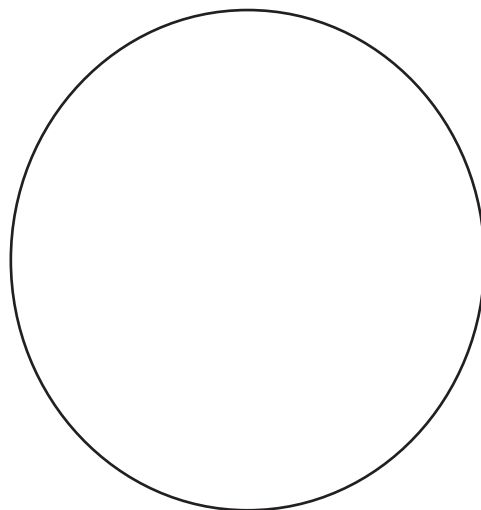
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- (iii) In the circles below draw diagrams showing **two pairs** of homologous chromosomes as they would appear in cell **X** on the diagram opposite (Prophase 1) and the appearance of the chromosomes following cell division to form cell **Y** on the diagram opposite (Metaphase 2). [3]

Cell X



Cell Y



- (c) Suggest why only one functional female gamete is produced as a result of meiosis. [2]

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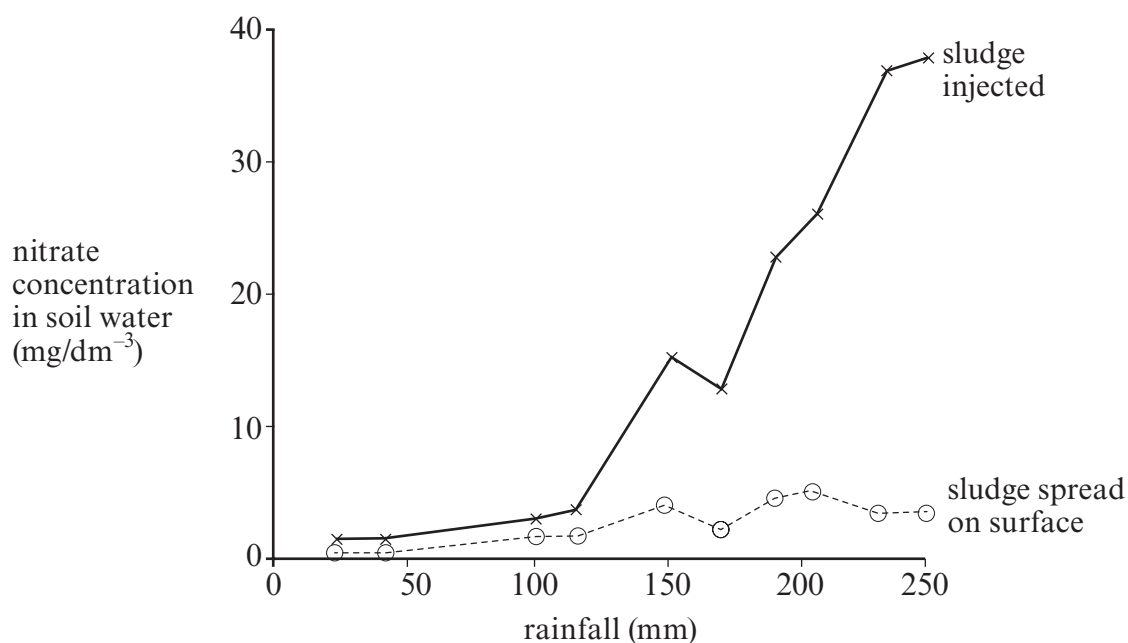
.....

5. The treatment of sewage produces sludge as a product. This sludge contains high concentrations of nitrogen compounds such as nitrates and ammonia.

Experiments have been carried out into the leaching of nitrate from grassland to which sludge has been applied. The sludge was applied to two areas of grassland. On one area it was spread onto the surface whilst in the other it was injected at various points across the area.

The rate of leaching was measured by taking samples from the water flowing through the soil and measuring the concentration of nitrate in them after different volumes of rainfall had fallen.

The graph below shows the results obtained.



- (a) (i) State **two** precautions that should be taken to ensure that the results are reliable. [2]

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- (ii) Using the information in the graph describe fully the relationship between the leaching of nitrate and rainfall. [2]

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- (iii) Using the data from the graph opposite, what advice would you give to a farmer as to the best time to apply sludge to the farmer's field for maximum benefit? [1]

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- (b) The presence of high nitrate levels in rivers can lead to eutrophication. Briefly describe why eutrophication can result in the death of fish and many invertebrates in a river. [3]

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- (c) Describe and explain what type of crops a farmer could grow to increase the nitrate level in the soil without using fertilisers, such as sludge. [3]

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6. (a) Explain what is meant by the term *gross primary productivity*. [1]

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- (b) It has been found that an increase in temperature has a greater effect on the rate of respiration in a plant than on the rate of photosynthesis. Using this information, explain what effect an increase in temperature has on the net primary productivity. [2]

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- (c) (i) Give **two** ways by which energy is lost as it passes from one trophic level to the next. [2]

.....

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- (ii) Consumption efficiency is defined as the percentage of net production at one trophic level that is consumed by the next. Suggest why the consumption efficiency of herbivores is much lower than that of carnivores. [2]

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- (d) Tropical marine or tropical lake ecosystems generally have one or two more trophic levels than terrestrial ecosystems. Suggest **one** reason why this is the case. [1]

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Any diagrams included in your answers must be fully annotated.

Or (b) Describe the principles and techniques involved in the cloning of plants. Give the advantages and disadvantages of this process.

[10]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no text or other markings on the paper.

Examiner
only

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(1075-01)

GCE BIOLOGY BY5

SUMMER 2013

Question			Marking details	Marks Available
1.	(a)		Seminiferous tubule - (meiosis) sperm production/ spermatogenesis; <i>Accept spermatids</i> Seminal vesicles - produce nutrient (solution) for sperms; <i>Accept aids sperm motility/ mobility</i> <i>Reject Neutralise acidic urine</i>	2
	(b)		Ligase - {splices / joins} two {sections of DNA/ groups of nucleotides/ sugar phosphates} together; <i>Accept joins (donor) DNA into a {plasmid/ vector}</i> <i>Reject joins strands of DNA</i> Polymerase - joins single nucleotides to end of a DNA chain; <i>Accept addition of {free/single} nucleotides to {exposed (DNA) bases/ template};</i>	2
	(c)		Gene - {section of DNA / chromosome} which codes for a {single polypeptide / protein/ sequence of amino acids}; Allele - {different/ specific} {forms/ versions} of {a/same} gene; <i>Accept different types of the <u>same</u> gene</i>	2
	(d)		Primary succession {Colonisation of/ introduction of species to} an area where no living organisms have lived before; Secondary succession colonisation of area where living organisms had previously lived/ recolonisation / reintroduction of species. Question 1 total	2 [8]

Question			Marking details	Marks Available
2.	(a)	(i)	A. <u>Variation</u> in age at which sexual maturity is reached; B. Caused by mutation; C. Reach sexual maturity earlier/ Small fish {have a selective advantage/ pass through net}/ ora; D. Breed/ reproduce; <i>reject mate</i> E. Pass on alleles to offspring; <i>reject genes</i> F. Allele frequency for earlier maturity / hence small size at maturity increases; G. Figs quoted from graph (in context);	Max 5
		(ii)	Very few large cod survived/ ORA; <i>reject none</i> reduced gene pool; {No/ little} mutation (to increase size) / insufficient time for genetic drift (to increase size) / No gene flow from another gene pool; Small fish produce less gametes/ difficulty in breeding/ few fish remain to reproduce/ reproductive isolation; Not enough food/ increased competition for food/ increased predation/ disease; Change in {temperature/ pH}/ pollution;	Max 3
	(b)		Restricted fishing times/ hours; Quotas/ licenses; Exclusion zones/ OWTTE; Limiting numbers of fishing vessels/ international agreements limiting catches; Limiting season; Restriction of <u>area</u> of nets; Closing spawning and/ or nursery areas; <i>REJECT any reference to mesh size</i>	2

Question			Marking details	Marks Available
	(c)	(i)	Eutrophication/ pollution; {Disease/ parasites} more likely (to spread) in {cultivated fish/ overcrowded conditions}/ disease may spread to wild fish; {Antibiotics/ pesticides} qualified e.g. can harm other marine organisms/ bioaccumulation of pesticides/ enters food chain/ high cost; Problems associated with flow of alleles into wild population; Higher level of dioxins/ PCBs in farmed fish;	2
		(ii)	Three of each type of chromosome / {odd/uneven} number of chromosomes/ unpaired chromosomes; No pairing of <u>homologous</u> chromosomes/ no bivalent formed; Prophase 1 meiosis; Meiosis does not take place; No gametes produced; Question 2 total	Max 4 [16]

Question			Marking details				Marks Available																				
3.	(a)	(i)	(Genes) on the {X/ Y} chromosomes; Reject sex chromosomes Accept (genes) on sex chromosomes not on the autosomes				1																				
		(ii)	<table border="1"> <tr> <td>Parents</td> <td colspan="2">$X^H Y$</td> <td colspan="2">$X^H X^h$;</td> </tr> <tr> <td>Gametes</td> <td>X^H</td> <td>Y</td> <td>X^H</td> <td>X^h ;</td> </tr> <tr> <td>Offspring</td> <td>$X^H X^H$</td> <td>$X^H X^h$</td> <td>$X^H Y$</td> <td>$X^h Y$;</td> </tr> <tr> <td></td> <td>Normal female</td> <td>Normal/ Carrier female</td> <td>Normal male</td> <td>Haemophiliac/ sufferer/ affected} male;</td> </tr> </table> <i>Suitable symbols with key eg. $X^N X^n$ max 3</i> <i>Suitable symbols with no key max 2</i> <i>Reject crosses not involving X and Y chromosomes</i> <i>If wrong genotypes ecf apart from phenotype of offspring which must correctly identify a haemophiliac son</i>				Parents	$X^H Y$		$X^H X^h$;		Gametes	X^H	Y	X^H	X^h ;	Offspring	$X^H X^H$	$X^H X^h$	$X^H Y$	$X^h Y$;		Normal female	Normal/ Carrier female	Normal male	Haemophiliac/ sufferer/ affected} male;	4
		Parents	$X^H Y$		$X^H X^h$;																						
		Gametes	X^H	Y	X^H	X^h ;																					
		Offspring	$X^H X^H$	$X^H X^h$	$X^H Y$	$X^h Y$;																					
	Normal female	Normal/ Carrier female	Normal male	Haemophiliac/ sufferer/ affected} male;																							
(iii)	None;				1																						
(iv)	0.25 / 25%; Accept 1 in 4/ $\frac{1}{4}$ Reject 1:3				1																						
(b)	<table> <tr> <td>AB</td> <td>ab</td> <td>AB</td> <td>ab ;</td> </tr> <tr> <td>AABB</td> <td>AaBb</td> <td>AaBb</td> <td>aabb ;</td> </tr> </table> 3:1 ; <i>Genotypes must show some correct indication of linkage between a and b for ecf</i> <i>Award 0 if dihybrid cross is completed</i>				AB	ab	AB	ab ;	AABB	AaBb	AaBb	aabb ;	3														
AB	ab	AB	ab ;																								
AABB	AaBb	AaBb	aabb ;																								

Question			Marking details	Marks Available
	(c)		Incomplete linkage; Genes {further/ far} apart on same chromosome; {Crossing over/ chiasmata} can occur; Four types of gametes produced(but not in equal numbers); Small numbers of recombinants / large numbers parental types; Recombinants equal in numbers / parental equal in numbers; Question 3 Total	Max 2 [12]

Question			Marking details	Marks Available
4.	(a)	(i)	A = Primary oocyte/ Primary follicle; B = Graafian follicle; <i>Accept secondary follicle/ theca</i> C= Corpus luteum; <i>reject yellow body</i>	3
		(ii)	Ovulation;	1
		(iii)	HCG/ human chorionic gonadotrop(h)in;	1
	(b)	(i)	W = Oogonium/ oogonia; X = primary oocyte; Y = Secondary oocyte; Z = (first) Polar body; <i>reject nucleus accept polar cell</i>	4
		(ii)	Mitosis;	1
		(iii)	Correct number of chromosomes in each; X = 4 Y =2 Cell X Prophase 1 drawn correctly; chromosomes inside nuclear membrane, not on equator Cell Y Metaphase 2 drawn correctly; must be clearly on equator	3
	(c)		Polar bodies produced/ reduction in genetic material at each stage of meiosis; ecf from bi – accept polar nucleus if used in bi Functional gamete retains (most of) the cytoplasm; (Cytoplasm) acts as a food store for zygote/ provide mitochondria for zygote; needed until implantation takes place/ obtained from placenta;	2
Question 4 Total				[15]

Question			Marking details	Marks Available
5.	(a)	(i)	repeat experiments; Same area of grassland used for each test/ Same grass covering/ sludge injected to same depth/ Same {volume / mass/ concentration} of sludge/ same sludge applied/ Same soil {type/ gradient/ aspect/ exposure}/ same soil nitrate concentration/ same time of year; NOT temperature/ pH	2
		(ii)	increase in rainfall increases {leaching/ nitrate concentration in soil water}; greater effect on injected sludge with increased rainfall/ ORA; only a small effect at low rainfall;	2 max
		(iii)	apply (to surface) when {dry / little rainfall/ rainfall is less than [any figure less than 120]};	1
	(b)		Algal growth/ algal bloom/ overgrowth of plant; Less <u>light</u> , so {algae/ plants} <u>die</u> ; { <u>Bacteria/ saprobionts/ saprotrophs/ fungi</u> } <u>decompose</u> { <u>plants/ organic material</u> } (and increase in number); (Reject decomposers) Using up <u>oxygen</u> in <u>respiration</u> ;	3 max
	(c)		Leguminous plants/ any named leguminous plant; Rhizobium/ nitrogen fixing bacteria (in root nodules); <i>Reject nitrate fixing Azotobacter</i> Convert nitrogen (gas) into ammonium/ ammonia/ amino acids; Plants {left to decay/ ploughed in}; Question 5 Total	3 [11]

Question			Marking details	Marks Available
6.	(a)		Rate of Conversion of light energy into chemical energy (by producers /by photosynthesis); <i>Accept rate at which {products/ organic materials} are formed/ produced</i>	1
	(b)		(net primary production) decreases; More {carbohydrate/ glucose} is {broken down/ used by} respiration (than is produced by photosynthesis);	2
	(c)	(i)	(heat lost in) respiration; Excretion; egestion/not all parts of the material are digestible; not all parts eaten;	Max 2
		(ii)	Herbivores: {difficult to digest/ less efficient at digesting} cellulose/ have more {indigestible/ fibrous} material (in diet)/ ; <i>Reject cannot digest cellulose</i> Carnivores:{easily digest/ more efficient at digesting } {protein/ fat}; More { <u>egested</u> material/ faeces} (lost) by herbivores/ less { <u>egested</u> material/ faeces} lost by carnivores;	Max 2
	(d)		Productivity of producers higher/ primary productivity higher; Secondary productivity higher/ more energy stored in consumers; {Less energy {used/wasted} /respiratory rate is lower} + qualification eg.in cold blooded animals/ buoyancy; Higher {temperature/ light} higher rate of photosynthesis;	Max 1
Question 6 Total				[8]

Question			Marking details	Marks Available
7.	(a)		A. {nucleotide/ base} sequence of DNA contains code for {primary structure of polypeptide/ amino acid sequence}; B. Triplet base hypothesis/ 3 bases = 1 amino acid/ triplet code; C. transcription; D. RNA polymerase links to DNA; E. DNA unwinds / unzips; F. (One of) DNA strands acts as {coding/ template/ sense} strand; G. {mRNA } synthesised; H. complementary base pairing + detail of A-U C-G; I. mRNA leaves nucleus through a <u>nuclear pore</u>; J. translation; K. mRNA {held by/ attaches to} a ribosome/ ribosome moves along mRNA molecule; L. Two tRNA binding sites on each ribosome; M. each tRNA has its own specific amino acid; N. tRNA molecules bind to codon on mRNA via an anticodon; O. peptide bond formed between amino acids on adjacent tRNA; P. Reference to ATP use {in Amino acid activation/ formation of peptide bonds};	

Question		Marking details	Marks Available
	(b)	A. Asexually produced and genetically identical; B. Artificial, cuttings ; C. micropropagation; D. meristem removed; E. meristem is {able to differentiate/ give rise to different cell types/ totipotent} F. cut into <u>small</u> pieces/ explants; G. Culture under sterile conditions; H. On a nutrient {medium/ agar jelly}; I. (Cells divide to form a) Callus ; J. Callus divided and {allowed to differentiate into a plantlet/ treated with plant growth substances to promote root and/or shoot growth}; Max 8 Advantages, K. speed of production; L. Production of large numbers; M. {Identical/ desired} line/ crop uniform/ disease free; Disadvantages N. Must maintain sterile conditons to avoid introduction of pathogens; O. Genetic instability/ increased mutation rate; P. loss of <u>genetic</u> variation/ reduction gene pool/ all susceptible to same diseases; <i>Candidates must attempt an advantage and a disadvantage in order to be awarded full marks.</i> Question 8 Total	[10]

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01

BIOLOGY/HUMAN BIOLOGY - BY5

A.M. FRIDAY, 22 June 2012

1¾ hours

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	5	
2.	8	
3.	7	
4.	6	
5.	17	
6.	11	
7.	8	
8.	8	
9.	10	
Total	80	

1075
010001

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the continuation pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.



JUN1210750101

1. The following list of terms concerns ecology and related topics.

[5]

A	secondary productivity
B	biomass
C	eutrophication
D	trophic efficiency
E	pyramid of energy
F	coppicing
G	monoculture
H	algal bloom
I	carbon footprint

Below are five statements. Select from the above list the **letter** for an appropriate term to match each statement.

- (a) The rate at which consumers accumulate energy in the form of cells or tissue.
- (b) The total level of carbon dioxide due to the actions of an individual, mainly through their energy use, over a period of one year.
- (c) A natural process which results from the build up of nitrates in lakes and rivers.
- (d) A technique whereby trees are cut down close to the ground and then left for several years to re-grow shoots.
- (e) The simultaneous growth of a large number of crop plants of similar age and type within a defined area.

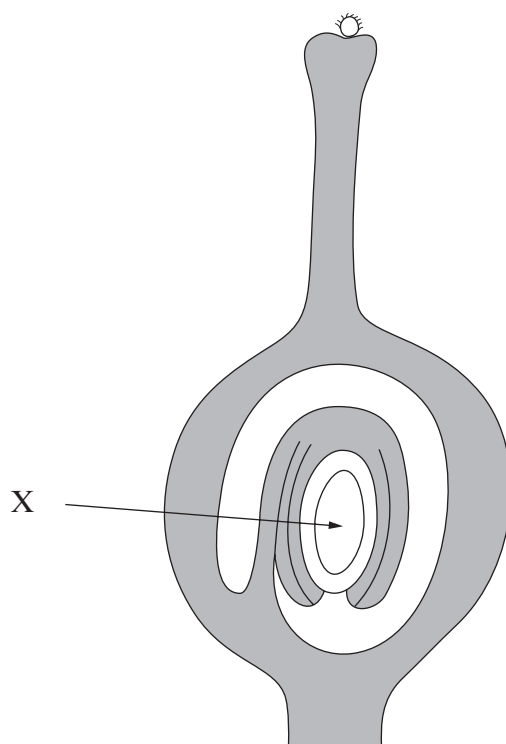
(Total 5 marks)



2. (a) Most flowering plants are adapted for pollination by wind or insects.
Define the term pollination.

[1]

- (b) After pollination a pollen tube grows through the carpel of a flower.
The diagram shows a longitudinal section through a carpel with a pollen grain on the stigma.



- (i) Name the structure **X** shown in the diagram.

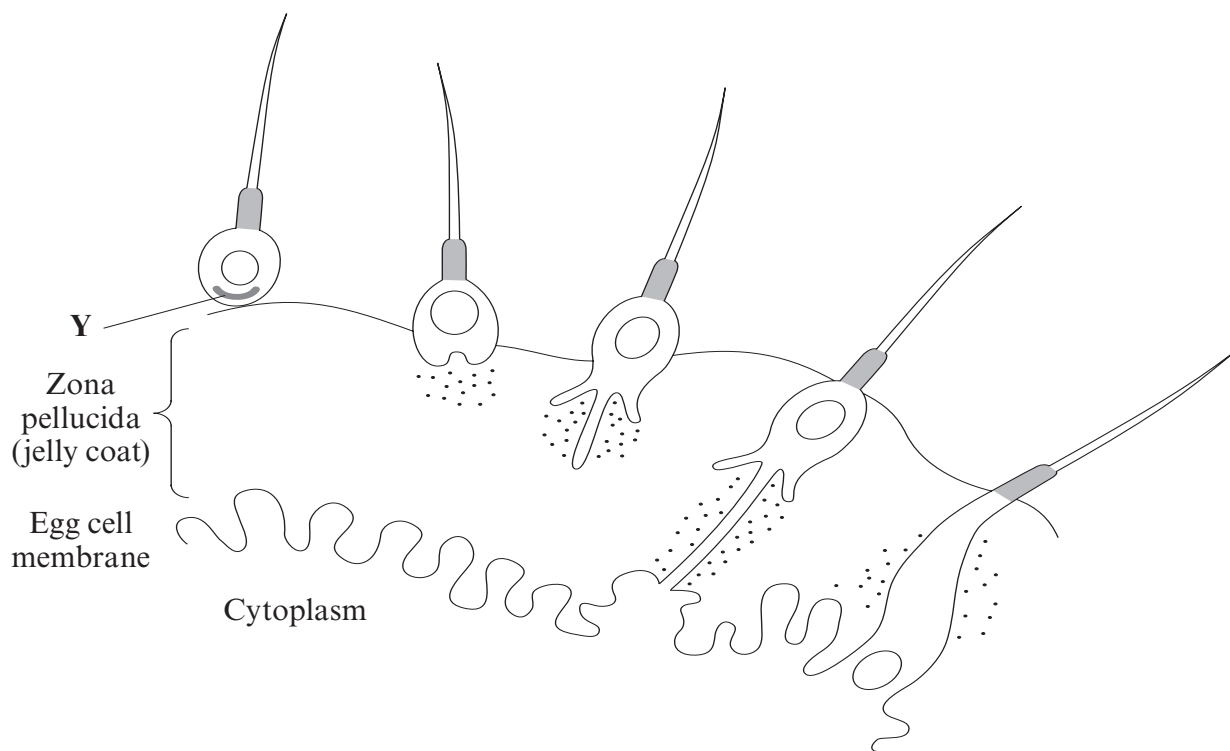
[1]

- (ii) Draw a line **on the diagram** to indicate the route of growth of a pollen tube through the carpel to structure **X**.

[1]



- (c) The diagram below shows the sequence of events which take place when the nucleus of an animal sperm enters the cytoplasm of the egg.



- (i) Name the part of the reproductive tract in which these events take place. [1]
-
- (ii) Use the information in the diagram to explain the role of Y in the process. [2]
-
-
-
- (d) State **two** similarities between the process visible in the diagram in part (c) and the process by which the male nucleus enters a plant ovule. [2]
1.
-
2.
-

(Total 8 marks)



3. A maize plant homozygous for smooth, coloured grain was cross-pollinated with a plant homozygous for wrinkled, colourless grain. The F1 plants all produced smooth, coloured grain. On cross-pollinating the F1 plants, it was found that most of the F2 generation resembled the original plants, 73% producing smooth, coloured grain and 22% producing wrinkled, colourless grain.

(a) Which of the characteristics described above are

(i) dominant

(ii) recessive [2]

(b) What conclusion can be drawn about these genes? [1]

.....

(c) (i) State the probable phenotypes of the remaining 5% F2 plants **not** described above. [1]

.....

(ii) Suggest how these phenotypes arose. [1]

.....

(d) Using appropriate symbols to represent the alleles, give the genotype of an

(i) F1 plant

(ii) F2 plant you described in (c) [2]

(Total 7 marks)

**USE THE SPACE BELOW FOR YOUR ROUGH WORKING.
IT WILL NOT BE MARKED.**



4. The evolution of a new species over a long period of time begins when some sort of **isolating mechanism** (1) separates a population into two or more subgroups. Natural selection acting on the subgroups ensures that the individual most suited to the conditions survive or breed more successfully, that is, **survival of the fittest** (2). If the conditions facing the two subgroups are different they will gradually show **divergence** (3) from the ancestral form and from each other. Evidence for the evolutionary relationship of organisms can be derived directly from their **fossil record** (4) and from their **classification** (5).

The following statements could be used to illustrate **one or more** of the numbered terms. After each statement, write in the appropriate **number** or **numbers**.

- (a) The pentadactyl limb is a characteristic of extinct and present day mammals. [1]

.....

- (b) A wide range of bacteria are now resistant to penicillin. [1]

.....

- (c) Over 500 species of plants have been recorded on the Galapagos islands and 180 of these are not found anywhere else in the world. [1]

.....

- (d) Two species of pine trees are found in Monterey Bay, California. *Pinus radiata* produces pollen in February and *P. attenuata* produces pollen in April. [1]

.....

- (e) A particular plant-feeding bug, arrives on a suitable host and lives there for several weeks and produces a large number of offspring. [1]

.....

- (f) The cichlid fish are a family recognised by their curious jaw formation. In Lake Victoria there are about 450 different species. [1]

.....

(Total 6 marks)



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5. (a) (i) What is meant by the term 'gene therapy'?

[1]

.....

.....

(ii) The following statements describe the two different types of gene therapy, somatic cell therapy and germ line therapy.

1. Targets cells in affected tissues
2. Introduces genes into the egg
3. Inherited
4. Not inherited.

Under the two headings below write the appropriate **numbers** of the statements that describe the two forms of gene therapy. [2]

Somatic cell therapy	Germ line therapy

(b) (i) Cystic fibrosis is caused by a mutation of the gene producing the protein CFTR. Explain how the presence of this altered protein results in the production of thick, sticky mucus and how this accounts for the respiratory symptoms of the disease. [4]

.....

.....

.....

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.....

(ii) Describe **one** technique that could be used to introduce functional CFTR genes into someone with cystic fibrosis. [3]

.....

.....

.....

.....

.....



- (c) (i) Explain why the replication of DNA is described as semi-conservative. [1]

.....

.....

- (ii) The polymerase chain reaction (PCR) is used to make many copies of a section of DNA. Each stage of the reaction takes place at different temperatures. [3]
Explain why during each stage

I. the DNA is first heated to 95°C

.....

.....

.....

II. the temperature is then reduced to 55°C

.....

.....

.....

III. the temperature is then increased to 70°C

.....

.....

.....

- (iii) About twenty percent of the DNA produced by the polymerase chain reaction (PCR) is copied inaccurately. Suggest and explain why it is not safe to use the PCR to clone the CFTR gene for use in treating cystic fibrosis. [3]

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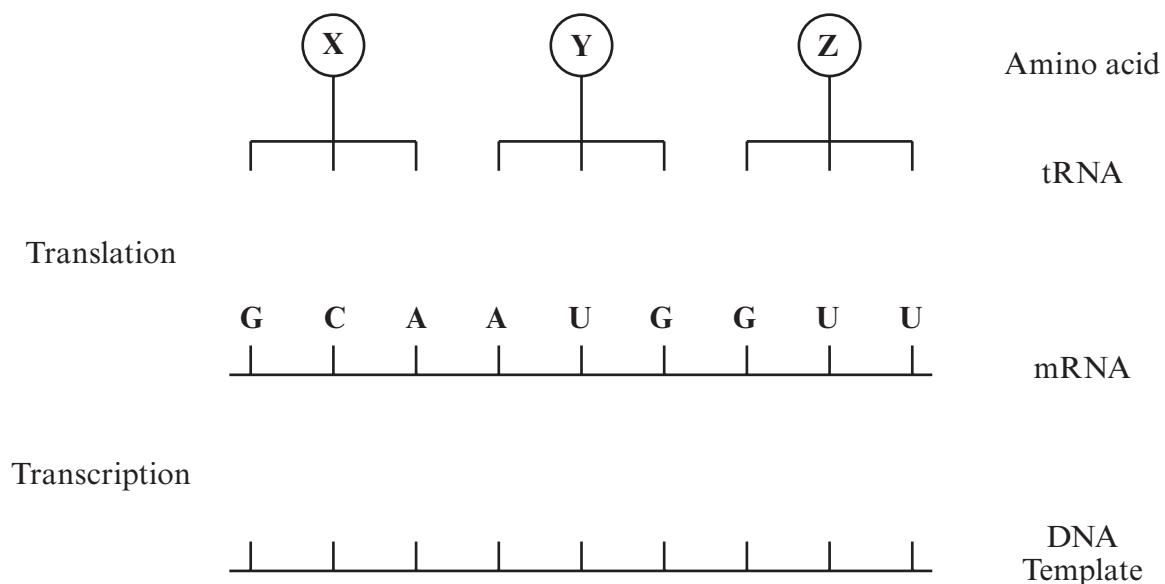
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(Total 17 marks)



6. (a) Name the enzyme involved in the transcription stage of protein synthesis. [1]

(b) The diagram shows some molecules involved in protein synthesis.



Complete the diagram to show

- (i) the bases on the template DNA strand from which the mRNA was transcribed; [1]
- (ii) the bases forming the anticodons of the tRNA molecules. [1]



- (c) The diagram below shows the effects of two different mutations of the DNA on the base sequence of the mRNA.
The table shows the mRNA codons for three amino acids.

Original mRNA	G C A A U G G U U		
	| | | | | | | |	Amino acid	mRNA codon
		methionine	AUG
Mutation 1	G C U A U G G U U		
	| | | | | | | |	valine	GUC GUU
Mutation 2	G C A A U G G C U		
	| | | | | | | |	alanine	GCA GCC GCU

Use the information in the table to

- (i) Identify amino acid **X** in the diagram in part (b). [1]

- (ii) Explain how each mutation may affect the polypeptide for which this section of DNA is part of the code.

Mutation 1 [2]

.....

.....

.....

Mutation 2 [2]

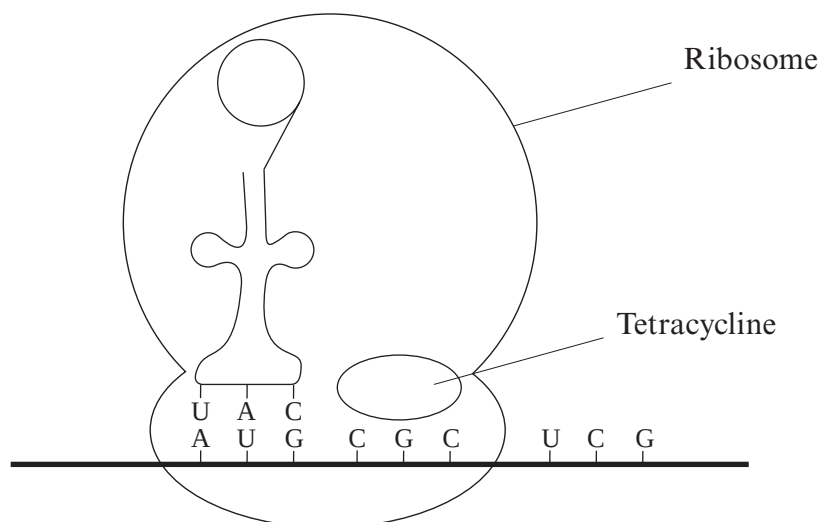
.....

.....

.....



- (d) Tetracycline is an antibiotic. The diagram below shows how tetracycline binds to bacterial ribosomes.



Explain how the tetracycline stops protein synthesis in bacteria.

[3]

.....

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.....

(Total 11 marks)



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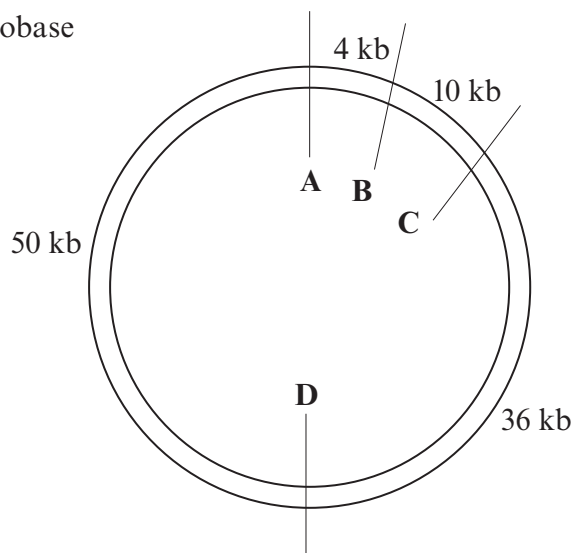


7. (a) In the formation of recombinant DNA many different restriction endonuclease enzymes are used. Each enzyme cuts the DNA of a plasmid at a specific base sequence called a restriction site.

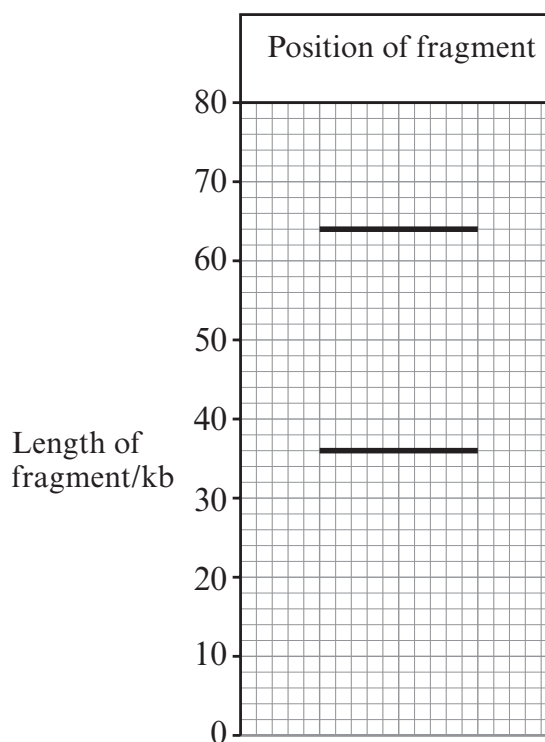
The diagram shows the position of restriction sites, A, B, C and D, for each of four different enzymes on a plasmid.

The distance between these sites is measured in kilobases of DNA.

1 kb = 1 kilobase



The plasmid was cut using only **two** of the restriction enzymes. The resulting fragments were separated by gel electrophoresis. The positions of the fragments are shown in the chart.



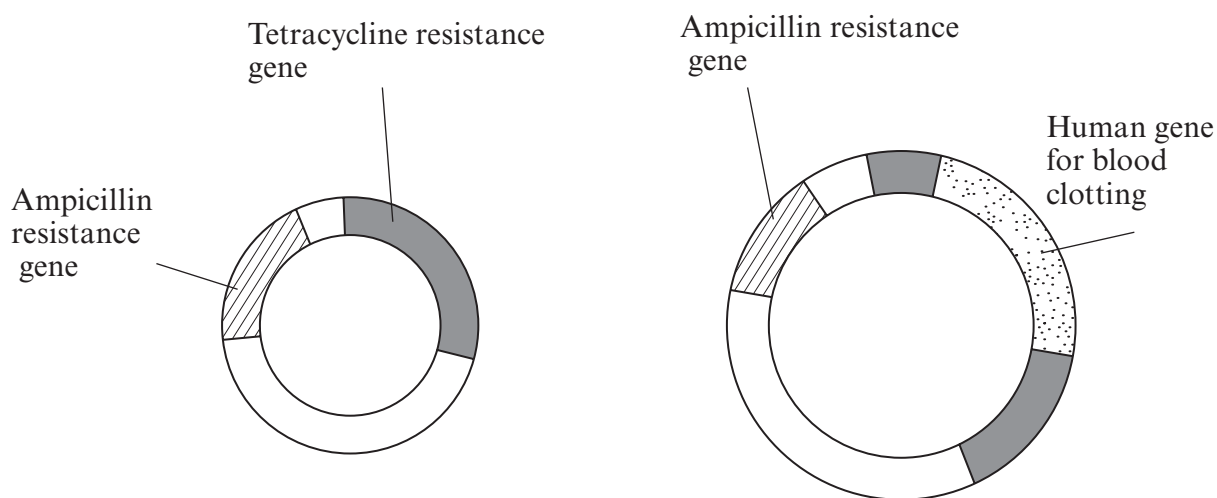
(i) Which of the restriction sites were cut?

[1]

(ii) Explain your answer.

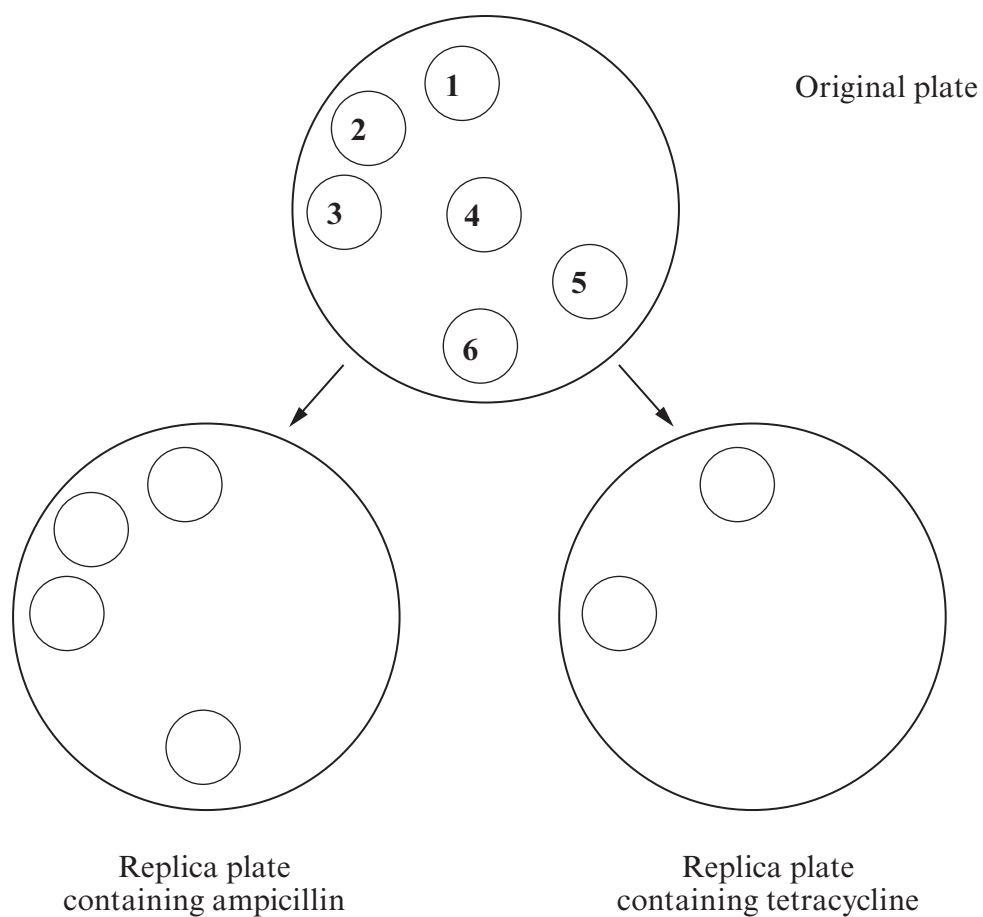
[1]

- (b) In genetic engineering, genes for antibiotic resistance in bacterial plasmids can be used as genetic markers. Scientists used a plasmid containing genes for resistance to two antibiotics, ampicillin and tetracycline. A human gene for blood clotting was inserted in the plasmid in the position shown in diagram below.



Plasmids were then inserted into bacteria, although some of the plasmids had not taken up the human gene. Plates were replicated to identify the bacteria with the human gene. The diagram overleaf shows the bacterial colonies that grew on the two replica plates.





- (i) **Complete the above diagram** by writing the correct **numbers** for the bacterial colonies that grew on the replica plates. [1]
- (ii) Explain the results of the replica plate containing ampicillin. [2]
-
-
-
-
- (iii) Explain the results of the replica plate containing tetracycline. [3]
-
-
-
-

(Total 8 marks)



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8. (a) Explain what is meant by the following terms:

(i) Succession

[2]

.....

.....

.....

(ii) A climax community.

[1]

.....

.....

(b) Heather plants are small shrubs and are the dominant species in the climax community of some moorlands. The structure and shape of the heather plant changes as it ages. This results in changes in the species composition of the community. A large area of moorland was burnt leaving bare ground. The table shows four stages of succession in this area.

Time after burning/ years	Appearance of heather plant	Mean percentage cover of heather	Other plant species present
4		10	Many
12		90	Few
19		75	Several
24		30	Many



Explain why the number of other plant species decreases between 4 and 12 years after burning. [2]

.....

.....

.....

.....

- (c) The rate at which a heather plant produced new biomass was measured in g per kg of heather per year. As the plant aged the ratio of leaves to woody parts decreased. Use the information in the table to explain why. [3]

.....

.....

.....

.....

.....

.....

(Total 8 marks)



Any diagrams included in your answer must be fully annotated.

[10]

[8]

[2]





Examiner
only

(Total 10 marks)



[illegible]

[illegible]

GCE BIOLOGY BY5

Question	Marking details	Marks Available
1. (a)	A	1
(b)	I	1
(c)	H/C	1
(d)	F	1
(e)	G	1
Question total		5

Question	Marking details	Marks Available
2. (a)	The transfer of pollen from the anther to the stigma.	1
(b) (i)	Embryo sac.	1
(ii)	Through stigma, style, ovary wall, micropyle. (Must travel through ovary wall to bottom before going into micropyle)	1
(c) (i)	Oviduct / fallopian tube;	
(ii)	(Acrosome / Y) <u>contains enzymes</u>; Not Y is an enzyme - which <u>{hydrolyse / dissolve / breakdown / digest / softens}</u> the <u>{zona pellucida / jellycoat}</u>;	2
(d)	<u>Formation / growth</u> of <u>tube</u>; <u>nucleus</u> travels along a <u>{tube / channel / pathway}</u> (into the egg / ovule); <u>enzymes are produced</u> which <u>{allow a tube to grow / which digests a path}</u>; - both are chemotropic; - membranes burst to release male gametes;	2
Question total		8

Question	Marking details	Marks Available
3. (a)	1. Smooth, coloured; 2. Wrinkled, colourless; Accept non- coloured;	2
(b)	Linked / on same chromosome / (genes) are inherited together; NOT sex linked;	1
(c) (i)	Smooth, colourless AND wrinkled, coloured;	1
(ii)	Crossing over / exchange of alleles; Not independent assortment / recombinants / chiasmata alone.	1
(d)	F1 SsCc	1
	F2 Sscc or SScc or ssCc or ssCC	1
Question total		7

Question	Marking details	Marks Available				
5. (a) (i)	Inserting a {normal / correct} {gene / DNA sequence} / <u>Replacing</u> {defective / faulty} genes with {copies of a new DNA sequence / normal allele / normal gene} / (owtte);	1				
(ii)	<table border="1"><tr><td>Somatic cell therapy</td><td>Germ line therapy</td></tr><tr><td>1 and 4</td><td>2 and 3</td></tr></table> (Must have both for 1 mark)	Somatic cell therapy	Germ line therapy	1 and 4	2 and 3	2
Somatic cell therapy	Germ line therapy					
1 and 4	2 and 3					
(b) (i)	• CFTR is a {Channel protein / carrier protein / ion pump}; Not active transport alone • Blocks {transport / movement} of chloride ions out of cells (into mucus) / ORA; • Water retained in cell / water prevented from leaving / no osmosis; • Unable to remove mucus in lungs; • {Infection/ more susceptible to disease} / coughing {more likely / increased}; • <u>{Narrowing / blocking}</u> of air passages (so reduced air flow); • <u>{Increased diffusion distance / reduced surface area}</u> for <u>gas exchange</u> / insufficient oxygen received / not enough oxygen absorbed;	4				
(ii)	• (Modified / normal / correct) genes are inserted; • into liposomes / virus (as vector); • Liposomes fuse with cell membrane / virus infects cell / ref to endocytosis; • (Modified) gene passes through membranes / into cell; • Applied by aerosol / spray / inhaler; (Any 3 points)	3				

Max 2 for
symptoms

only

Question	Marking details	Marks Available
(c) (i)	Each new DNA molecule consists of one {original / parent / old / template} strand and one new strand of DNA;	1
(ii) I	To (break bonds between DNA strands or bases to) <u>separate</u> original DNA into two single strands;	1
II	Triggers / Allows {primers / short pieces of RNA / single-strand DNA / free nucleotides} to {bind / attach / join} (to single stranded DNA);	1
III	TAQ / DNA polymerase {makes nucleotides join / makes a strand of DNA / catalyses the synthesis of a complementary strand};	1
(iii)	• (Percentage) risk is too high (for <i>human</i> application) / Incorrect base sequence; • Incorrect mRNA; • Different tRNA / brings incorrect amino acid; • Structure of protein synthesised unknown / folding of protein is different / sequence of amino acid altered; • Protein {non-functional / function altered} / chloride ions not transported / thick mucus still produced / gene therapy not effective;	3
(Any 3 points)		
Question total		17

Question	Marking details	Marks Available
6. (a)	RNA polymerase;	1
(b) (i)	CGT TAC CAA;	1
(ii)	CGU UAC CAA;	1
(c) (i)	Alanine;	1
(ii)	• Mutation 1 – no change to sequence of amino acids; • Codon for alanine / degenerate codon / same amino acid coded for; Neutral mutation;	2
	• Mutation 2 – valine replaced by alanine / codon for alanine; • (Tertiary) {structure / shape of protein} may change / position of bonds may change / sequence of amino acids changing / structure of protein changing / protein non functional;	2
(d)	• Translation prevented; • Tetracycline {binds to / blocks / inhibits} {mRNA triplet / codon / CGC / second attachment site}; • {Anticodon / tRNA triplet} cannot pair with {mRNA triplet / codon} / cannot form codon-anticodon complex; • Amino acid not added to polypeptide chain / peptide bonds not formed;	3
	(Any 3 points)	
Question total		11

Question	Marking details	Marks Available
7. (a) (i)	C and D;	1
	(ii) Fragments 64 and 36 (kb);	1
(b) (i)	1, 2, 3 & 6 AND 1 and 3;	1
	(ii) - Colonies {1, 2, 3 & 6 / shown / present} have taken up {plasmid / ampicillin resistant gene}; - Reject taken up human gene; - Ignore recombinant plasmid; - Because they are resistant to ampicillin / able to grow on ampicillin; 4 and 5 have not taken up the {plasmid / ampicillin resistant gene}; - And so are not resistant to ampicillin;	2
	(iii) - Colonies 1 and 3 do not have the gene / recombinant plasmid; - As they (remain) resistant to tetracycline / gene for tetracycline resistance has not been {disrupted / destroyed}; - Colonies 2 and 6 do have the gene / recombinant plasmid; - Tetracycline resistance destroyed / prevents gene from being expressed;	3
Question total		8

Question	Marking details	Marks Available
8. (a) (i)	• Change in structure in a <u>community</u> over time; • Change in {composition of species / species present} (in a community) over time; • Either due to change in environmental / (named) abiotic factors;	2
(ii)	A stable community which {undergoes no further change / reached equilibrium} / no further succession;	1
(b)	• (Increased) interspecific competition / other plant species compete with heather / heather outcompetes other plant species; • For light / nutrients / minerals / named nutrient / water (linked to competition); Reject resources unqualified.	2
(c)	• More energy used in respiration; • Higher respiration relative to {photosynthesis / GPP} / NPP decreases; • {Fewer leaves / less surface area} for photosynthesis; • Less energy / glucose to {produce new biomass / for growth / synthesis of protein or named compound}; • (Heather increases in size / ages / more competition from other species) soil fertility decreases / less minerals or nutrients available / greater competition for named resources; • Growth rate decreases / fewer leaves produced; • (As heather increases in size) less light penetrates the centre of the plant; • Loss of central leaves, (therefore woody parts increase); (Any 3 points)	3
Question total		8

Question	Marking details	Marks
		Available
9 (a)	A Extinction is the loss of species;	1
	B Conservation is the <u>planned</u> preservation of wildlife / the {enhancement / maintenance} of biodiversity;	1
	C To ensure the survival of the species;	1
	D Conservation of existing <u>gene pools</u> ;	1
	E To conserve potentially useful {genes / genetic sources} (for future generations);	1
	F Qualification / Example of E – resistance to disease or other;	1
	G Use of plants / animals as a gene bank to cross with highly cultivated varieties;	1
	H Conservation of <u>plants</u> with medicinal properties;	1
	I (Planned) preservation of habitat, with example – wetlands, coral reef, sand dune;	1
	J Seed / sperm banks;	1
	K Re-introduction programmes, e.g. Red Kite;	1
	L Protection / breeding of endangered species in specialised zoos / captive breeding programmes / rare breeds;	1
	M Trade restrictions on endangered species / reference to CITES / ivory / whaling;	1
	N Relevant reference to NGOs {e.g. WWFN / government agency / CCW / SSSI / National Parks / nature reserves} / ecotourism / education;	1
	O Correct reference to relevant <u>legislation</u> e.g. to prevent over-grazing / over-fishing / hunting / poaching in context / collecting birds eggs / picking wild flowers / collecting plants;	1
Question total		10



Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01

BIOLOGY/HUMAN BIOLOGY - BY5

A.M. WEDNESDAY, 22 June 2011

1¾ hours

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	12	
3.	14	
4.	10	
5.	10	
6.	12	
7.	6	
8.	10	
Total	80	

INSTRUCTIONS TO CANDIDATES

- Use black ink or black ball-point pen.
- Write your name, centre number and candidate number in the spaces at the top of this page.
- Answer **all** questions.
- Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets at the end of each question or part-question.
- You are reminded of the necessity for good English and orderly presentation in your answers.
- The quality of written communication will affect the awarding of marks.

1075
010001

BIOLOGY - BY5

No.	Answer	Mark
1.	<u>Secondary</u> succession; Pioneer; Climax community; Seres; Gross primary productivity/GPP; Pyramid of energy/energy flow diagram;	6
2. (a)	Large petals, small insignificant petals/no petals; Brightly coloured, dull/brown/green; (not: not coloured) Scented, not scented; Nectar, no nectar; Small amount of pollen, large amount of pollen; Pollen sticky/sculpted, pollen smooth/not sticky/air sacs; Pollen large/heavy, pollen small/light; Anthers/stigma outside flower, enclosed within petals; (Large) feathery stigmas, small/round stigmas; Any 4. One comparison from each pair matched boxes.	4
(b)	lack of/less genetic variation/inbreeding/increased risk of <u>genetic</u> faults/ ref. homozygous recessive. (not: no variation)	1
(c)	pollen tube delivers male gametes to egg/ovule/do not need motile (gametes)/ no water needed/pollen grains transferred by wind or insects;	1
	stops risk of dehydration of gametes;	1
	Tough exine/outer wall;	1
(d)	<i>Fruit from fertilised ovary</i> ; (not: ref. ovary wall/pericarp)	1
	<i>Embryo plant from zygote</i> ; (not: fertilized egg cell)	1
	<i>Testa from integuments</i> ;	1
	<i>Seed from ovule</i> ; (not: ovum)	1

3. (a) (i)

Gametes	HW	HR	hW	hR
HW	HW HW	HR HW	hW HW	hR HW
HR	HW HR	HR HR	hW HR	hR HR
hW	HW hW	HR hW	hW hW	hR hW
hR	HW hR	HR hR	hW hR	hR hR

1 mark per column; if wrong- gametes-1, letters -1;

4

(ii) Phenotypes

Horn less roan 6

Horn less red 3

Horn less white 3

Horned roan 2

Horned red 1

Horned white 1

3 marks all phenotypes + 3 for all correct matching ratio

-1 per error, no ecf from (i)

6

(b)

mutation;

Variation in population;

(Light coats and dark skins) advantage/better adapted;

Greater chance of survival/selective advantage(in context);

Passed on alleles to offspring; (not: genes)

Repeated over many generations/frequency of alleles increased.

Max 4

4. (a) Wolf, dingo, coyote, golden jackal;
Interbreed producing fertile offspring; 2
- (b) share same gene pool;
Similar physiology;
Similar behaviour;
Similar genetic makeup/ref DNA;
Similar proteins;
Similar morphology
Similar genetic profile (not: same/same number of chromosomes) Max 2
- (c) (i) Black backed and side striped jackal
(not: jackals/golden jackal) 1
- (ii) reproductive cycles different;
Difference in reproductive/courtship behaviour
/pheromones;
Changes in chromosome numbers/ploidy;
Different activity times;
Mechanical isolation;
Any sensible suggestion e.g. gamete attack by immune system. Max 1
- (d) Chromosomes not homologous; (not: ref. number)
Cannot pair/form bivalents;
During prophase 1 (of meiosis);
Meiosis does not take place;
no gametes produced; Max 4

5. (a) Each strand of DNA used as a template to make a new DNA strand;
New DNA (mols) made of an old/original strand linked to a new strand; (not: if ref. to new DNA strand) **2**
- (b) (i) nitrogenous bases/organic bases/purines and pyrimidine bases/ all four named
(not: bases/letters only/nucleotide) **1**
- (ii) spin (at same) speed;
(Same) time;
(Same) density/concentration of gel;
(Same) temperature
(not: pH/ref. volume or mass) **Max 2**
- (c) (i) Tube A all heavy/ N^{15} ;
Tube B DNA mixture of heavy and light (so intermediate position)/ $N^{15} + N^{14}$;
DNA in B must be made from one strand of heavy and one light;
If conservative would get two bands in light and heavy position. **Max 3**
- (ii) C intermediate and light equal amounts;
(touching dotted lines)
D intermediate and light more light than intermediate
e.g. shown as thicker or wider line;

- 6. (a) (i)** X transcription;
Y translation; **2**
- (ii)** 8 marks on diagram **8**
S- to line between anticodon/codon; T – to solid line not dotted line; R not if just labelled to black circle
- (b)** CCT ACA GCA CGT
All correct 2 marks
2/3 correct 1 mark
- 7. (a) (i)** A Spermatogonia
B Primary spermatocytes
C Secondary spermatocytes
D Spermatids
2 correct for 1 mark
- (ii)** Sertoli cell. (not: nurse cell) **1**
- (iii)** nutrition of sperm cells/supplies oxygen/removes waste products; not protection unqualified. **1**
- (b) (i)** Mitosis (correct spelling only) **1**
- (ii)** 4 cells produced (from each/B) during meiosis

8. (a)
- A. Less carbon dioxide removed from air;
 - B. Ref global warming; (not: greenhouse effect)
 - C. ref one consequence of global warming e.g. melting ice caps/flooding/climate change/greenhouse effect qual.;
 - D. destruction/loss of (natural) habitats;
 - E. leads to reduction in biodiversity;
 - F. Extinction of some species (not: ref. destroys).
 - G. Some plants may have clinical/medicinal properties, lost before investigated;
 - H. some species may have alleles which could be introduced into gene pool of related species;
 - I. Soil erosion or desertification/localised flooding;
 - J. ref less protection of soil from drying/wind helps to increase desertification;
(I+J in context of removal of roots)
 - K. effect climate, ref transpiration/water cycle/rainfall patterns;
 - L. replanting;
 - M. allow (natural) regeneration;
 - N. coppicing/selective cutting;
 - O. ref to efficient forestry, planting trees of correct/endemic/local species/correct distance apart;
 - P. control pests and diseases;

Max 7 for A-K

- (b)
- A. Cells from Islets of Langerhans;
 - B. gene for insulin located;
 - C. gene/DNA probe;
 - D. (cut gene) restriction endonuclease /enzyme;
 - E. mRNA for insulin;
 - F. reverse transcriptase qual.; (e.g. make DNA from RNA)
 - G. DNA polymerase qual.;(e.g. make DNA double stranded)
 - H. sticky ends on gene;
 - I. bacterium/*E.coli* (is source of);
 - J. plasmids;
 - K. same restriction endonuclease;
 - L. sticky ends with complementary bases;
 - M. DNA ligase;
 - N. ref marker/tracer genes/antibiotic resistance;
 - O. recombinant DNA.
 - P. introduced back into bacterium/ *E. coli*;

Candidate Name	Centre Number	Candidate Number
		2



GCE A level

1075/01

BIOLOGY/HUMAN BIOLOGY - BY5

P.M. FRIDAY, 25 June 2010

1³/₄ hours

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	12	
2	12	
3	14	
4	12	
5	10	
6	10	
7	10	
Total	80	

1075 01 01

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

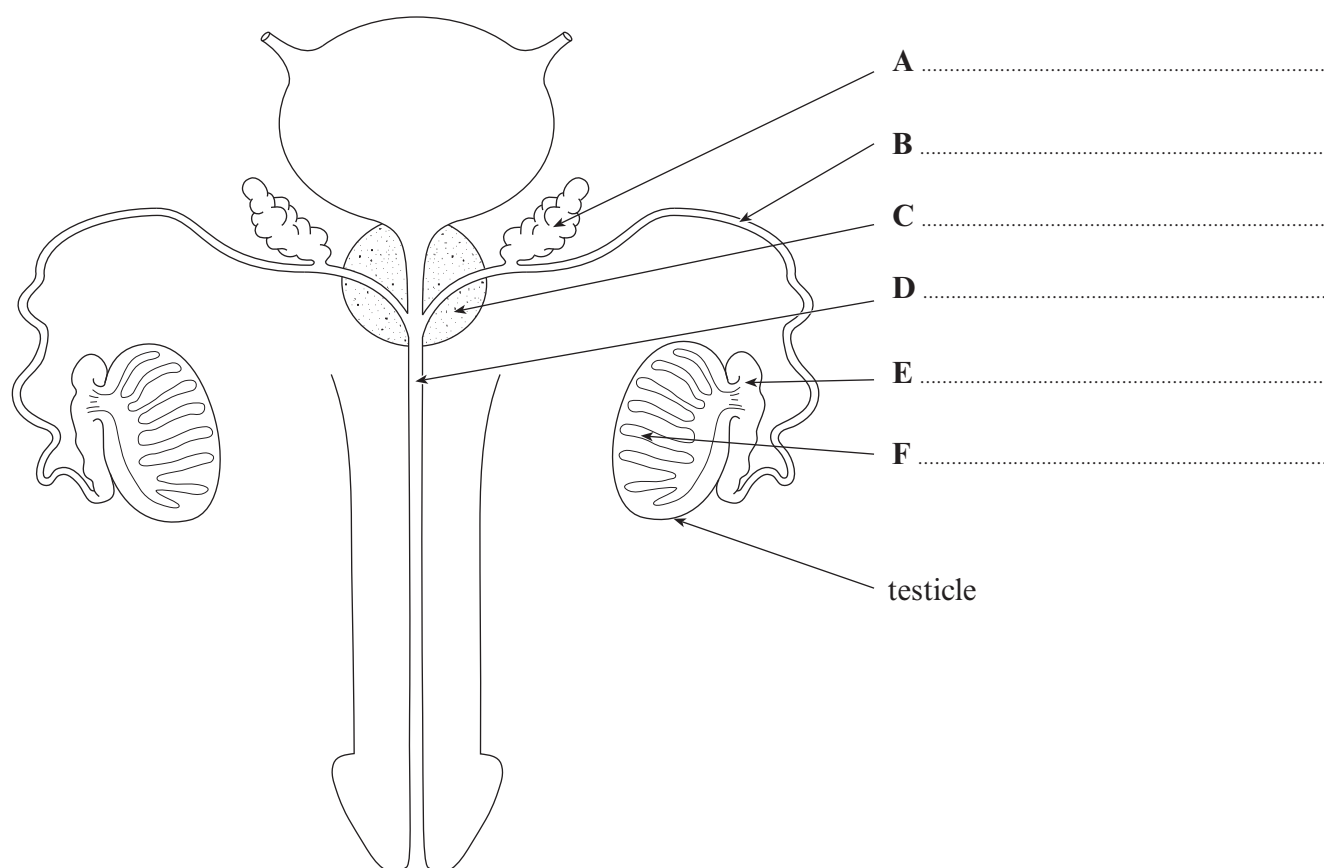
INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

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The quality of written communication will affect the awarding of marks.

1. The diagram below shows the human male reproductive system.



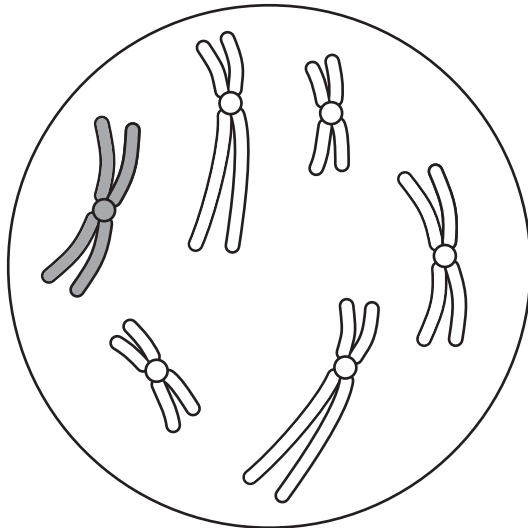
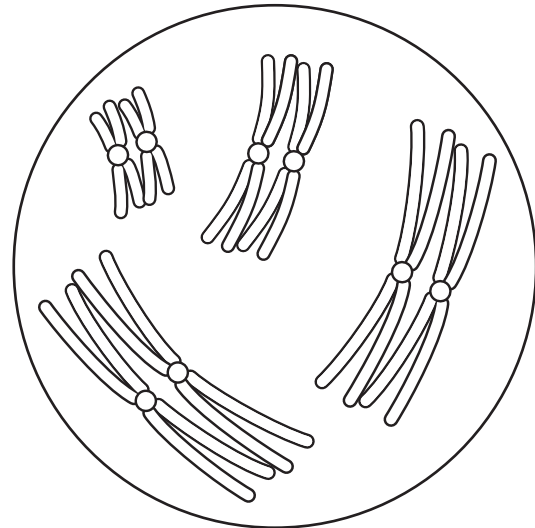
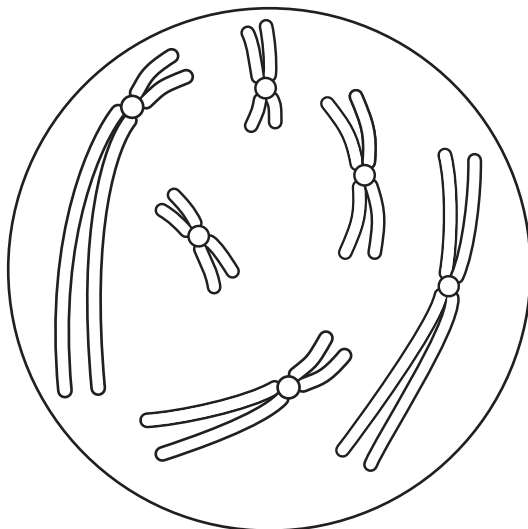
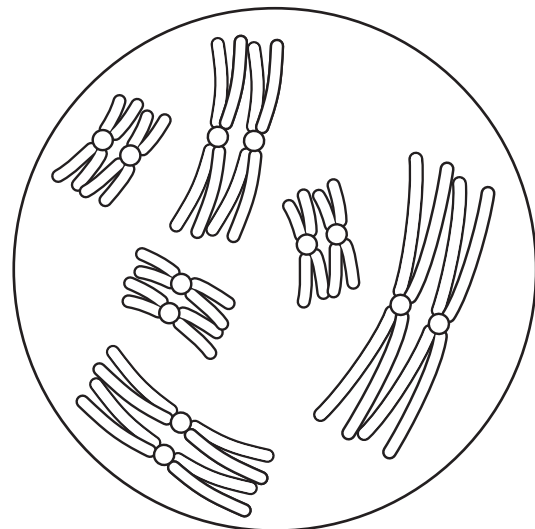
- (a) Label the structures A – F. [6]
 (b) Complete the following using appropriate biological terms. [6]

Spermatozoa are produced in the of the testes by a process called Spermatogonia divide many times to produce These undergo meiosis and the products of the first meiotic division are haploid These undergo the second half of the meiotic division producing which differentiate and mature into spermatozoa. The spermatozoa are protected and nourished by cells.

(Total 12 marks)

BLANK PAGE

2. The following diagrams, **A** to **D** are of nuclei undergoing mitosis or meiosis.

**A****B****C****D**

(a) On diagram **A** one chromosome has been shaded. Shade the homologous chromosome. [1]

(b) Which of the diagrams **A-D** show cells undergoing prophase 1 of meiosis. [1]

.....

- (c) The diploid number of chromosomes in a mosquito (*Culex sp.*) is 6 ($2n = 6$) and in a kangaroo (*Macropus sp.*) 12 ($2n = 12$).
State which of the diagrams, A, B, C or D represents the following: [2]

Haploid cell from a kangaroo

Diploid cell from a mosquito

- (d) (i) A species of ant (*Myrmecia pilosula*) has a diploid number 2. Why is it not possible to have an organism with a diploid number lower than this? [1]

.....

- (ii) In this species of ant the male is haploid, suggest the type of cell division this organism would use to produce sperm cells. [1]

.....

- (e) The following gives the names of some stages of cell division.

Anaphase 1	Metaphase 2	Anaphase 2	Prophase 1	Telophase 2	Metaphase 1
M	N	P	Q	R	S

- (i) Using only the letters, give the correct sequence of the stages. [1]

.....

- (ii) State the **letter** of the stage when each of the following processes occur. [5]

Pairing of chromosomes

Centromeres divide

Crossing over

Bivalents align on equator

Nuclear membrane reforms

(Total 12 marks)

3. Snapdragons are a type of garden plant. A pure breeding strain of a white flowering variety was obtained and crossed with a pure breeding red flowered strain. The two strains were crossed producing F_1 plants all with pink flowers. The F_1 plants were then interbred to produce F_2 plants with the following flower colours:

red	62
pink	131
white	67

The following hypothesis was proposed:

Flower colour in snapdragons is controlled by a single gene with two codominant alleles.

- (a) Complete the genetic diagram to explain this cross. Use the following symbols to represent the alleles:

R = red flowers

W = white flowers

Parental phenotypes:	Red flowers	x	White flowers	
Parental genotypes	.....		.....	[1]
Gametes	.....		.....	[1]

F_1 genotypes [1]

F_1 phenotypes [1]

Gametes [1]

F_2 genotypes [1]

F_2 phenotypes [1]

Expected F_2 phenotype ratio [1]

(b) A chi-squared (χ^2) test is carried out on the data to determine whether the hypothesis is supported or rejected.

(i) The χ^2 statistic is calculated in the following way:

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \quad \Sigma = \text{sum of}$$

Complete the following table.

[2]

F ₂ phenotype	Observed numbers [O]	Expected numbers [E]	O-E	(O-E) ²
red	62			
pink	131			
white	67			
total	260	260		

(ii) Calculate the χ^2 value for the above data. Show your working.

[1]

χ^2 value = ...

- (c) A suitable Null hypothesis would be that there is no significant difference between the observed and expected numbers.
 Biologists consider that if the probability is greater than 5% the deviation is statistically non significant.

Degrees of freedom	Probability													
	0.99	0.98	0.95	0.90	0.80	0.70	0.50	0.30	0.20	0.10	0.05	0.02	0.01	0.001
1	0.00016	0.00063	0.0039	0.016	0.064	0.15	0.46	1.07	1.64	2.71	3.84	5.41	6.64	10.83
2	0.02	0.04	0.10	0.21	0.45	0.71	1.39	2.41	3.22	4.60	5.99	7.82	9.21	13.82
3	0.12	0.18	0.35	0.58	1.00	1.42	2.37	3.66	4.64	6.25	7.82	9.84	11.34	16.27
4	0.30	0.43	0.71	1.06	1.65	2.20	3.36	4.88	5.99	7.78	9.49	11.67	13.28	18.46

- (i) Using the figures from the χ^2 table for 2 degrees of freedom, explain whether you would accept or reject the Null hypothesis. [2]

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.....

- (ii) What does this suggest about the inheritance of flower colour in snapdragons? [1]

.....

.....

(Total 14 marks)

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4. (a) Part of a particular sequence of bases on a DNA molecule is as follows:

T T A T C T T T C G G G A T G

- (i) Give the sequence of nitrogenous bases on the mRNA which is obtained by using this DNA molecule as a template. [1]

.....

.....

<i>mRNA codons</i>	<i>Amino acid</i>
AAG	Lysine (lys)
AAU ACA AGA AUA	Asparagine (asn) Threonine (thr) Arginine (arg) Isoleucine (ile)
CAU CGG CGU	Histidine (his) Arginine (arg) Arginine (arg)
CCC CCG	Proline (pro) Proline (pro)
CUU	Leucine (leu)
GAU GAA GAG GCA	Aspartic acid (asp) Glutamic acid (glu) Glutamic acid Alanine (ala)

<i>mRNA codons</i>	<i>Amino acid</i>
GGA	Glycine (gly)
UAU	Tyrosine (tyr)
UGC	Cysteine (cys)
UCG	Serine (ser)
UUG	Leucine (leu)
UCU	Serine (ser)
UGG	Tryptophan (trp)
UUA	Leucine (leu)
UAC	Tyrosine (tyr)

- (ii) A sequence of nitrogenous bases on another section of mRNA is shown below.

UACAGAGCAUCGUUA

Using the table, determine the order the amino acids would be incorporated into the polypeptide constructed from this mRNA sequence (the abbreviations of the amino acids in brackets can be used). You may assume that the sequence is read from the left hand end. [1]

.....

.....

- (iii) Suggest how the cell ensures that the code is read in the correct direction. [1]

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- (iv) Proflavin, is a chemical which alters the base sequence of DNA. What is the name given to such a change ? [1]

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- (v) If proflavin caused the deletion of the first adenine, (A), in the DNA sequence which codes for the above mRNA, what consequences would this have on the subsequent translation of the sequence? [1]

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.....

- (b) Haemoglobin is a protein found in red blood cells.
 Haemoglobin is a quaternary protein.
 There are three different types of haemoglobin found in adult humans, HbA, HbA₂ and HbF as shown in the table.

<i>Haemoglobin type</i>	<i>% found in adult</i>	<i>Types of polypeptide</i>
HbA	97	2 alpha chains 2 beta chains
HbA ₂	2	2 alpha chains 2 delta chains
HbF	1	2 alpha chains 2 gamma chains

- (i) From **this data** suggest how many genes are involved in the production of the haemoglobins found in the adult human. [1]

- (ii) Beta thalassaemia is a condition in humans caused by a change in the nucleotide sequence which codes for the primary structure of the beta polypeptide chain. Scientists have now discovered a drug which can switch on the gene for the production of HbF (HbF is the type of haemoglobin found in the fetus). Explain, using your knowledge of protein synthesis, how this drug results in the production of HbF. [4]

- (iii) Give **one** disadvantage in an adult human of not producing beta chains of haemoglobin. [1]

- (iv) Give **one** possible disadvantage if an adult has fetal haemoglobin. [1]

(Total 12 marks)

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5. Scientists have successfully cloned five puppies from Trackr, a German Shepherd dog who searched for survivors in the rubble of the World Trade Centre after the 9/11 explosions. Trackr died in 2009 but before his death the five puppies shown in the photograph were cloned. The puppies range in age from 2 to 6 months old.



- (a) Suggest and describe a method which could have been used to clone these dogs. [4]

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- (b) The coat colour in the puppies is not the same. Suggest **two** reasons to explain the difference. [2]

1.

2.

- (c) The phenotype of dogs such as Trackr have been produced by artificial selection. Suggest how natural selection has brought about evolution of coat colour in other species. [4]

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(Total 10 marks)

6. (a) State how each of the following are used in the formation of recombinant DNA. [5]

Restriction endonuclease

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DNA ligase

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Reverse transcriptase

.....

.....

Marker gene

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.....

PCR (polymerase chain reaction)

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- (b) (i) What was the aim of the human genome project? [2]

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- (ii) Give **two** potential uses of the information gained from it. [2]

1.

.....

2.

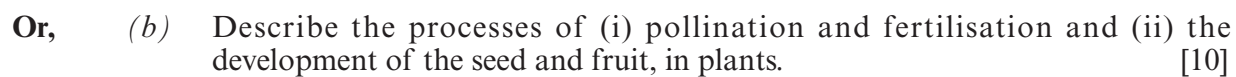
.....

- (iii) State **one** way in which the information gained from it could be misused. [1]

.....

.....

- Either,** (a) Using the diagram below explain what is meant by the flow of energy through an ecosystem. Describe how energy is lost at each stage and comment on the efficiency of the transfer. Suggest reasons for any differences in efficiency which you may observe. [10]

[illegible]

Handwriting practice area with 25 horizontal dotted lines.

[illegible]

Biology BY5

Question		Mark Scheme
1	(a)	
	A = Seminal vesicle	1
	B = Vas deferens (not: sperm duct)	1
	C = Prostate (gland) (not: Prostrate)	1
	D = Urethra (correct spelling required)	1
	E = Epididymis	1
	F = Seminiferous tubule	1
	(b)	
	Seminiferous tubules (A. Germinal epithelium)	1
	Spermatogenesis; (not: spermiogenesis)	1
	<u>Primary</u> spermatocytes;	1
	<u>Secondary</u> Spermatocytes;	1
	Spermatids;	1
	Sertoli. (not: nurse)	1

12 MARKS

Question			Mark Scheme
2	(a)	Shaded on diagram	1
	(b)	B + D (both needed)	1
	(c)	Haploid kangaroo C (not: if more than 1 letter)	1
		Diploid mosquito A	1
	(d)	(i) Diploid means <u>a pair</u> (of each) chromosome (not: 2 chromosomes present) because meiosis could not take place/ because haploid can't be less than 1 or equiv.	1
		(ii) Mitosis. (correct spelling required)	1
	(e)	(i) Q S M N P R	1
		(ii) Q	1
		P	1
		Q	1
		S	1
		R	1
		(If words used minus 1 mark)	

12 MARKS

Question		Mark Scheme
3	(a)	
	RR	WW (allow: C ^r C ^w /key) 1
	R	W 1
		RW 1
		Pink 1
	R	W 1
	RR RW RW WW	(allow genotype in Punnett square) 1
	lines to correspond	
	Red Pink White	1
	1 2 1	1
(b)	(i) E Column:	1
	(1 mark) $\left\{ \begin{array}{l} 65 \\ 130 \\ 65 \end{array} \right.$	
	O-E ² column 9 1 4 (1 mark)	1
	O.21 (A. O.207 O.208.) (not: 0.05)	1
(c)	(i) Accept null hypothesis Less than critical value / 0.90 probability / 90% probability/ deviation from expected due to chance/< 95%/> 5% ref. chance or significance needed If calc ⁿ wrong e.g. 5.99 or above then reverse above i.e. ecf ∴ reject null hypothesis etc	1
	(ii) Snapdragon flower colour is controlled by a single gene with <u>two</u> <u>codominant</u> alleles (not: genes)	1

14 MARKS

Question				Mark Scheme
4	(a)	(i)	A A U A G A A A G C C C U A C	1
		(ii)	tyr, arg, ala, ser, leu. (abbreviation or full name)	1
		(iii)	Start codon / AUG (allow: ref. 5-3 direction) (not: punctuated/stop codon)	1
		(iv)	Mutation (not: chromosome mutation).	1
		(v)	Amino acid sequence different/one less/ thr, glu, his, arg/alters primary structure/different polypeptide chain. (not: sequence is wrong/different protein/ref. reading frame)	1
	(b)	(i)	4	1
		(ii)	Switches on gene which codes for gamma chain; (not: fetal haemoglobin/HbF) mRNA made; Transcription or description; mRNA translated or description; Ribosomes; Ref <u>role</u> tRNA; Ref formation of <u>peptide</u> bonds.	
			Max 4	4
		(iii)	Reduced oxygen supplied to tissues/haemoglobin doesn't carry as much oxygen (not: no oxygen/ref. affinity)	1
		(iv)	Foetus would not be provided with sufficient oxygen/ Oxygen would not be supplied to tissues until pp of oxygen low/affinity for oxygen too high. (not: higher)	1

12 MARKS

Question**Mark
Scheme**

- 5 (a) Egg taken;
- Nucleus/DNA removed;
- Nucleus/DNA (from adult dog Trakr) taken from a body cell (skin)
- placed into enucleate egg/2 cells fused.
- Stimulated to divide;
- Placed/implanted into uterus of surrogate/bitch (allow:dog);
- (Who is at) correct stage of reproductive cycle.

Somatic cell nuclear transplant/transfer (not: embryo cloning)

Max 4

- (b) (Somatic) mutation;

Environmental influence or description;

Different ages. (not: cloned at different times)

Max 2

- (c) a. More offspring produced than can survive, overproduction;
- b. Numbers in a species remain constant;
- c. Large number die;
- d. Struggle for survival/competition;
- e. Variation or description of coat colour;
- f. Selection pressures favour one phenotype
- g. Those with beneficial alleles better chance of survival/selective advantage;
- h. Reproduce/breed;
- i. Pass on beneficial alleles to offspring.

Max 4

10 MARKS

Question		Mark Scheme
6	(a)	<i>Restriction endonuclease</i>, cuts DNA into smaller segments/at specific base sequences. (not: cuts genes/removes gene from DNA) 1 <i>DNA ligase</i>, joins sections of DNA together/splices genes. (not: joins sticky ends) 1 <i>Reverse transcriptase</i>, enzyme which uses RNA as a template for making a DNA mol. (not: converts RNA into DNA). 1 <i>Marker gene</i>, a gene which enables the detection of a bacterium which has taken up a genetically modified plasmid/with the gene. 1 <i>PCR</i>, (in vitro) replication of <u>DNA</u> molecule, to give multiple <u>copies</u> (amplify DNA) 1
	(b)	(i) Determine sequence of bases throughout all human DNA; Identify genes formed by bases; Find location of genes; Produce database of genes. 2 Max 2 (ii) Identification of carriers/allow genetic counselling; Checking embryo before implantation; Pre/post natal testing; Checking to see if there is a risk of a condition developing; Extra screening/regular health checks/life style advice; Drug targeting; Possibly gene therapy/forensic/identity. 2 Max 2 (iii) Cause anxiety; Should a line be drawn between medical treatment and enhancement; Ref problems if information gets into wrong hands, insurance, employment/discrimination, etc. (not: designer babies) 1 Max 1

10 MARKS

Question	Mark Scheme
7 (a) A = Energy (in form of organic mols) passing from one trophic level to another. (not: through food chain/between consumers) B = Photosynthesis/light energy to chemical energy. C + D = Energy loss, not all wavelengths of light absorbed/some reflected/transmitted; Latent heat of evaporation; Loss as heat/ by radiation/convection. (Any 2 marks from 3 for C + D energy loss from plant) E = Loss of energy from plant by respiration. F = Ref NPP <u>and</u> GPP. G = Calc of efficiency = 1% or 0.8% H = some parts of plant not eaten / enter decomposition pathway. I = Respiratory loss by consumers/heterotrophs. J + K = Examples of what energy produced by respiration used for. 2 Examples from movement/anabolic / catabolic reactions/ maintaining temp/active transport. L = Consumers lose energy by egestion/ref. cellulose not digested. M = Consumers lose energy by excretion. O = Secondary and tertiary consumers more efficient than primary consumer/ Calc primary to secondary or secondary to tertiary (comparison 10% to 20%). P = reason for difference in efficiency – more egested waste in primary consumers	10 MARKS

Question

Mark Scheme

- (b) A = Pollination transfer of pollen from anther to stigma.
- B = 2 examples of pollinating mechanisms from wind, insect, self, bird, water, bat, mammal. (not: specific example e.g. bee/ cross pollination unless qualified)
- C – (*After landing on stigma*) pollen grain absorbs water/ref. sucrose.
- D = Pollen tube.
- E = Tube nucleus controls growth.
- F = Enzymes/pectinase released/secreted.
- G = Digest route along ovary wall/through style/carpel.
- H = Passes through micropyle.
- I = Male gamete fuses with egg cell.
- J = Forms zygote which develops into embryo plant.
- K = Embryo plant consists of plumule and radicle,
- L = Radicle is embryo root/plumule is embryo shoot .
- M = Cotyledon, embryo/seed leaf, food store.
- O - Product of (fertilised) ovule is seed.
- P = Product of (fertilised) ovary is fruit.

10 MARKS