OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Advanced GCE

BIOLOGY

F215 QP

Unit F215: Control, Genomes and Environment

Specimen Paper

Candidates answer on the question paper.
Additional Materials:

Scientific calculator

Time: 1 hour 45 mins

Candidate Name	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use a scientific calculator.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **100.**

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**23**	
2	**6**	
3	**10**	
4	**17**	
5	**9**	
6	**8**	
7	**11**	
8	**16**	
TOTAL	**100**	

This document consists of **16** printed pages and **2** blank pages.

Answer **all** the questions.

1 (a) (i) A gene controlling coat colour in cats is sex linked. The two alleles of this gene are black and orange. When both are present the coat colour is called tortoiseshell.

Define the following terms:

gene.....

.....

allele .....

.....**[2]**

(ii) Explain why there are no male tortoiseshell cats.

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.....

.....

.....**[2]**

Two pure breeding strains of snapdragon, a garden plant, were obtained. One strain had red flowers and the other had white flowers. The two strains were crossed yielding F_1 plants all with pink flowers. The F_1 were then interbred to produce F_2 plants with the following colours:

red	**62**
pink	**131**
white	**67**

The following hypothesis was proposed:

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

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

C^r = red, C^w = white

Parental phenotypes:	red flowers	x	white flowers
Parental genotypes:	.....		.....
Gametes:	.....		.....

F_1 genotypes: .....

F_1 phenotypes: .....

Gametes: .....

F_2 genotypes: .....

F_2 phenotypes: .....

Expected F_2 phenotypic ratio:.....**[6]**

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

(i) Complete Table 1.1 by calculating the expected numbers.

Table 1.1

F_2 phenotype	observed numbers	expected numbers
red	62	
pink	131	
white	67	
total	260	260

[3]

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

$$\chi^2 = \Sigma \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \qquad \Sigma = \text{“sum of …”}$$

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

χ^2 value = ...**[2]**

[Turn over

(iii) The critical value of χ^2 for this type of investigation with two degrees of freedom is 5.991.

Explain whether your answer to **(b) (ii)** supports the hypothesis.

.....

..... **[1]**

(d) Phenotype is influenced by genetic and environmental factors.

Describe **one** example of how the **environment** influences phenotype.

.....

.....

..... **[2]**

(e) The bacterium *Escherichia coli* (*E. coli*) uses glucose as a respiratory substrate. In the absence of glucose, *E. coli* can use lactose. The use of a different substrate is determined by the interaction between genes and the environment. Describe how the use of a different substrate is determined by the interaction between genes and the environment.

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..... **[5]**

[Total: 23]

2 (a) Cystic fibrosis (CF) in humans is caused by mutations of a gene coding for transmembrane protein (CFTR) which acts as an ion pump. A large number of different mutations of the gene have been found. Explain what is meant by a gene mutation.

.....

.....

.....

..... **[2]**

(b) CFTR regulates the transport of chloride ions (Cl-) across the plasma (cell surface) membrane. Tissues that express the normal CFTR allele secrete alkaline fluids, whereas the secretions of tissues expressing some mutant alleles are acidic.

The transport of Cl^- by epithelial cells expressing the normal CFTR allele was compared with that by epithelial cells expressing one of 10 different mutant CFTR alleles. The results are shown in table 2.1.

In the table, normal digestive functioning of the pancreas associated with a particular allele is indicated with a tick (✓) and the absence of normal functioning by a cross (×).

Table 2.1

CFTR allele	percentage of Cl^- transported in comparison with normal allele	normal digestive functioning in pancreas
normal	100	✓
mutation 1	6	×
mutation 2	4	×
mutation 3	0	×
mutation 4	3	×
mutation 5	1	×
mutation 6	33	✓
mutation 7	41	✓
mutation 8	46	✓
mutation 9	37	✓
mutation 10	44	✓

With reference to the information given in the table, explain why some mutant CFTR alleles allow normal digestive functioning of the pancreas and others do not.

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..... **[3]**

[Total: 5]

3 Fig 3.1 represents the transfer of energy through a woodland ecosystem.

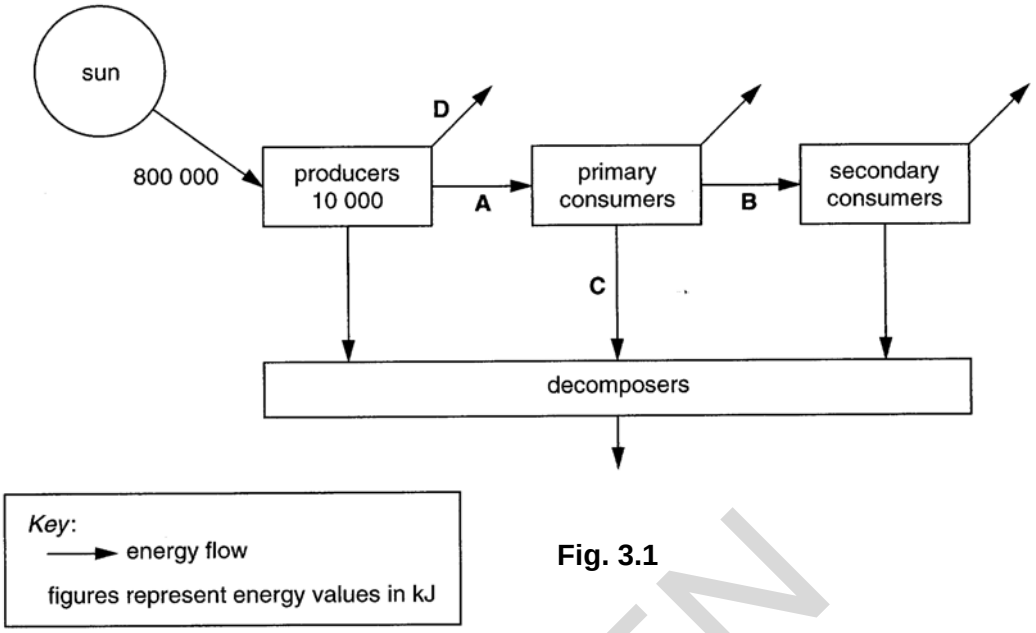

Fig. 3.1

(a) Of the 800 000 kJ of energy which reaches the producers, only 10 000 kJ of energy is converted to growth in the producers.

(i) Calculate the percentage of the energy reaching the producers that is converted to growth in the producers. Show your working.

Answer = ... % **[2]**

(ii) Explain what happens to the energy reaching the producers that is **not** converted to growth.

.....

.....

.....

..... **[2]**

(iii) Name **one** decomposer.

.....**[1]**

(iv) State two ways in which energy is transferred from primary consumers to decomposers at **C**.

1.....

2.....**[2]**

(b) Suggest why the percentage energy transfer between producers and primary consumers at **A** is less than that between the primary consumers and secondary consumers at **B**.

.....

.....

.....

.....

.....

.....**[3]**

[Total: 10]

4 One product manufactured using microorganisms is insulin. The process involves genetically engineering bacteria to synthesise human insulin.

(a) (i) Describe how the isolated human insulin gene is inserted into a bacteria plasmid.

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.....

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..... **[4]**

(ii) Suggest **two** ways in which the bacteria which take up the modified plasmids can be identified.

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..... **[2]**

(b) Suggest **one** reason why it is considered preferable to use genetically engineered sources of human insulin rather than insulin obtained from pigs.

..... **[1]**

(c) Another product manufactured using microorganisms is single cell protein (SCP).

Describe how a protein would be synthesised in the cell of a single celled fungus.

In your answer, you should make clear the sequence of the steps in the process.

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.....**[10]**

[Total: 17]

5 Fig. 5.1 is a drawing of the brain that shows the origin of the cranial nerves.

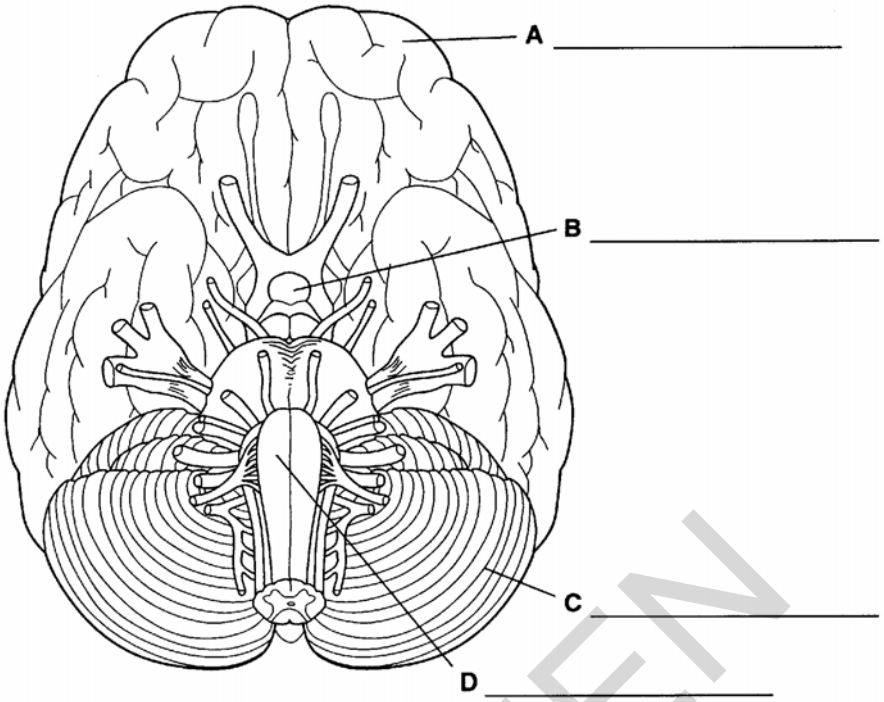

Fig. 5.1 Taken from Human physiology: Foundations and Frontiers, © Moffett, D., Moffett,S., Schauf, Times-Mirror Mosby Publishers ,1990, ISBN 08016435540

(a) State the direction from which the brain has been drawn.

.....**[1]**

(b) **(i)** Name the structures **A**, **B**, **C** and **D** shown on Fig. 5.1.

A .....

B .....

C .....

D .....**[4]**

(ii) State **two** roles of structure **D**.

1. .....

2. .....**[2]**

(c) The hypothalamus constantly monitors and regulates the concentration of hormones in the blood. Outline how the hypothalamus regulates the concentration of hormones in the blood.

.....

.....**[2]**

[Total: 9]

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6 An investigation was carried out into the effects of two plant growth substances, gibberellins and auxins, on apical dominance. The terminal (apical) buds of a number of pea plants were removed and discarded. The tops of each of the remaining shoots were given one of the following treatments:

- Coated with a paste containing gibberellin.
- Coated with a paste containing auxin (IAA).
- Coated with a paste without any plant growth substance.

In addition, a control group of plants did not have their terminal buds removed and were not coated with paste.

The growth of the side shoots was measured at regular time intervals and a mean value calculated. The results are shown in Fig. 6.1.

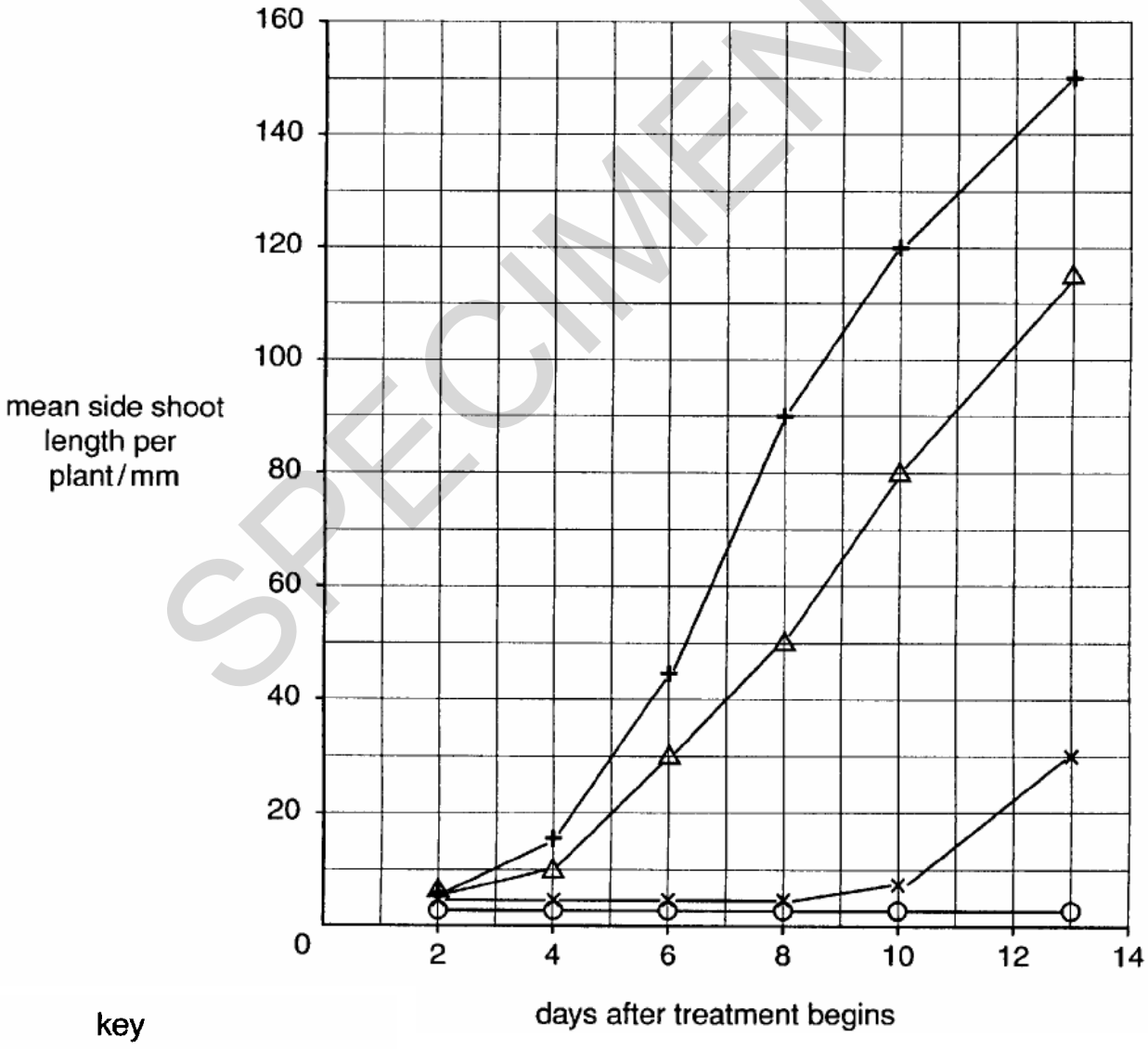

Fig. 6.1

(a) Explain why the side shoots grow when the terminal buds are removed.

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.....**[3]**

(b) Side shoots show greater growth when paste containing gibberellin is applied than when paste without any plant growth substance is applied.

Calculate the percentage increase in growth due to gibberellin in 8 day old seedlings compared to seedlings with paste only. Show your working.

Answer = ...% **[2]**

(c) Using data from Fig. 6.1 describe **and** explain the effect of auxin (IAA) on the growth of side shoots.

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.....**[3]**

[Total: 8]

7 (a) Immobilised enzymes can be used in bioreactors that attach to space suits. The bioreactors recover water from the astronauts' urine. The bioreactors use immobilised urease enzyme which catalyses the hydrolysis of urea, forming carbon dioxide and ammonia. These products react to form ions, which are then removed by the bioreactor.

(i) State the meaning of the term immobilised enzyme *and describe how immobilisation can be achieve*d.

.....

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.....

..... **[3]**

(ii) Suggest three practical advantages of using an immobilised urease bioreactor in a spaceship.

1. .....

2. .....

3. ..... **[3]**

(b) An investigation was carried out to compare lipase in soluble and immobilised forms. Palm oil was hydrolysed to produce fatty acids and glycerol.

- The two forms of lipase showed optimal activity at the same pH and temperature (pH 7.5 and 35^{o}C).
- At that pH and temperature, 100% of the oil was hydrolysed in two minutes.
- If the temperature was increased to 45^{o}C, the immobilised enzyme hydrolysed 100% of the oil but the soluble enzyme hydrolysed only 80% of the oil in two minutes.

(i) Define the term *hydrolysis*.

.....

..... **[1]**

(ii) Explain, **using the information in the passage**, the advantages of using an immobilised enzyme to hydrolyse palm oil.

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..... **[4]**

[Total: 11]

8 (a) Explain the meaning of the term *primary succession*.

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..... **[2]**

Fig. 8.1 shows a primary succession in a temperate climate.

X represents an example of deflected succession.

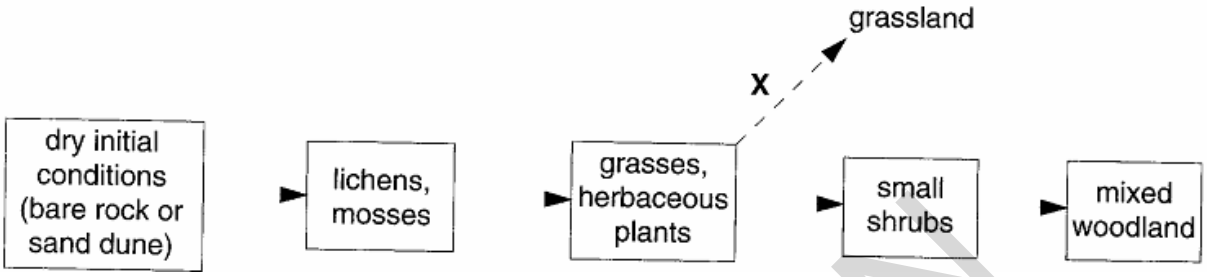

Fig. 8.1

(b) Explain the role of pioneer plants in succession on a bare rock or sand dune.

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..... **[3]**

(c) Suggest **two** ways in which deflected succession at **X** could be caused.

1.....

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2.....

..... **[2]**

(d) Explain how biomass changes during a **primary** succession.

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..... **[2]**

[Turn over

(e) Using timber production in a temperate country as an example, explain how ecosystems can be managed in a sustainable way.

✎ *In your answer, you should make clear how the management is sustainable.*

....**[7]**

[Total: 16]

Paper Total [100]

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OCR RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY F215 MS

Unit F215: Control, Genomes and Environment

Specimen Mark Scheme

The maximum mark for this paper is 100.

This document consists of **11** printed pages and **1** blank page

Question Number	Answer	Max Mark
1(a)(i)	*gene* length of DNA; codes for a (specific), polypeptide / protein / RNA; *max 1* *allele* alternative form of a gene; found at a, locus / particular position on, a chromosome; *max 1*	[2]
(a)(ii)	*assume allele refers to coat colour allele* (coat colour) gene / alleles, only on X chromosome; **A** *no (coat colour), gene / allele, on Y chromosome* male cats, XY / only have one X chromosome; males have only one (coat colour) allele / cannot have two (coat colour) alleles; need black and orange alleles for tortoiseshell colour;	[2]
(b)	parental genotypes $C^{r}C^{r}$ x $C^{w}C^{w}$; gametes C^{r} , C^{w} ; *F_1 genotypes and phenotypes 1 mark:* F_1 genotypes (all) $C^{r}C^{w}$ F_1 phenotypes (all) pink; *F_2 genotypes and phenotypes 1 mark:* gametes C^{r} , C^{w} C^{r} , C^{w} ; F_2 genotypes $C^{r}C^{r}$ $C^{r}C^{w}$ $C^{r}C^{w}$ $C^{w}C^{w}$ F_2 phenotypes red pink (pink) white; F_2 ratio 1:2:1; *accept other symbols if key given.* *accept r and w as symbols without key.*	[6]
(c) (i)	65; 130; 65;	[3]

Question Number	Answer	Max Mark
(c) (ii)	0.138 + 0.007 + 0.061; *(or other suitable working)* 0.206 – 0.208; *2 marks for correct value if no working shown* *ecf for both marks but calculated value must be to three decimal places*	[2]
(c)(iii)	support, figure lower than 5.991 / figure lower than critical value; ***R** 'support' on its own.* *ecf applies if value in (ii) is incorrect*	[1]
(d)	named characteristic; named environmental factor; *(mark first answer only)*	[2]
(e)	1 ref to operon; 2 normally repressor substance bound to operator; 3 prevents RNA polymerase binding (at promoter) / prevents transcription; 4 lactose binds to repressor; 5 changes shape of protein molecule; 6 unable to bind (to operator); 7 RNA polymerase binds (at promoter) / transcription occurs / genes switched on; 8 AVP; e.g. production of lactose permease / production of beta-galactosidase;	max[5]
	Total:	[23]
2(a)	a change in the genetic material; unpredictable / AW; extra detail; e.g. addition / substitution / deletion / frame shift / small part of chromosome / may code for different protein / may code for no protein	[2]

Question Number	Answer	Max Mark
(b)	*1 mark max for general effect of mutations:* mutation may give different, amino acid / primary structure**;** **A** *ref stop codon* some mutations alter, molecular shape / tertiary structure / binding**;** *max 3 for explaining data in Table:* so unable to, accept / transport, HCO_3^-**;** unable to bind ATP**;** so increase in acidity / decrease in pH**;** effect on mucus**;** effect on enzyme(s) /ref pH optimum of enzyme(s)**;** poor digestion of, protein / lipid / starch**;** AVP**;** e.g. some mutations, give some transport / have less effect. >33% (of norm) allows normal digestive function / < 6% [**A** *very low*] does not.	**max[4]**
	Total:	**[6]**
3(a)(i)	*award both marks for correct answer* 10 000 / 800 000 (x 100)**;** 1.25 / 1.3 / 1(%)**;**	**[2]**
(ii)	**R** *any reference to energy / light missing the plant* reflected (off plant) / only certain wavelengths of light can be, absorbed / used**;** ora absorbed by / hits, non-photosynthetic parts**;** e.g. bark passes through leaf / misses chlorophyll / misses chloroplasts**;** some is heat that is used in evaporation / respiration**;**	**max[2]**
(iii)	bacteria / named bacterium decomposer**;** (*Nitrobacter* , *Nitrosomonas*)	**[1]**

Question Number	Answer	Max Mark
(iv)	*take the first 2 answers:* death / dead remains**;** excretion**;** **R** *waste products* egestion**;** other suitable method**;** e.g. insects moulting hatched eggs moulting (fur / feathers) **R** *leaves*	**[2]**
(b)	*Primary consumers are eating and…* producers have, cell walls / cellulose**;** ora difficult to digest / much material, wasted / egested**;** energy used by gut microorganisms**;** ora much material cannot be eaten (by primary consumer)**;** ora	**[3]**
	Total:	**[10]**
4(a)(i)	plasmid cut by restriction enzyme**;** at specific sequence**;** same enzyme as used to cut (insulin) gene**;** sticky ends / described**;** ref. complementary sticky ends**;** ligase seals (sugar-phosphate) backbone / AW**;**	**max[4]**
(ii)	*credit any two from the following:* 1 antibiotic resistance (gene) introduced and survivors have plasmid**;** 2 fluorescent marker (gene) introduced and glowing bacteria have plasmid**;** 3 identify bacteria producing insulin using antibodies**;**	**[2]**

Question Number	Answer	Max Mark
(b)	*referring to pig insulin:* ethical / religious, reasons**;** incompatibility / lack of tolerance / immune response**;** ora not exactly the same as / less effective than, human insulin**;** ora *referring to human insulin from bacteria:* engineered insulin is cheaper**;** ora greater supply of engineered insulin**;** ora	**[1]**
4(c)	*allow max 5 for following:* <u>transcription</u>**;** DNA unzips / H bonds break**;** exposing required, gene / sequence of bases**;** RNA nucleotides align with DNA**;** U with A, A with T, C with G, **and** G with C**;** RNA polymerase**;** mRNA formed (using DNA strand as template)**;** leaves nucleus through pore**;** *allow max 5 for following:* <u>translation</u>**;** mRNA attaches to ribosome**;** tRNA brings amino acid (to, ribosome / mRNA)**;** each tRNA attached to specific amino acid**;** tRNA binds to mRNA using complementary, base triplet / anticodon**;** peptide bond formed between amino acids**;** DNA / mRNA, (nucleotide / base) sequence determines sequence of amino acids**;** AVP**;** e.g. 2, base triplets / codons, in ribosome **AVP; e**.g. ref. to : start / stop, codons polysomes large and small subunit in ribosome Mg^{2+}	**[10]**
	Total	**[17]**
5(a)	from below / ventral / AW**;** **A** *idea of brain being seen from below* **R** *upside down, looking upwards*	**[1]**

Question Number	Answer	Max Mark
(b)(i)	*reject choice of answers, accept any reasonable spelling* **A** cerebrum / cerebral hemisphere / cerebral cortex / frontal lobe**;** ignore refs to right or left **R** *incorrect lobe* **B** pituitary (gland)**;** **R** *hypothalamus* **C** cerebellum**;** **D** medulla (oblongata)	**[4]**
(b)(ii)	control of breathing**;** control of heart rate**;** control of circulation**;** control of swallowing / salivation / vomiting reflex**;**	**[2]**
(c)	*If blood hormone concentration rises* inhibits output of trophic hormones by pituitary gland**;** which inhibits output of hormones by endocrine glands**;** blood hormone concentration falls to normal levels**;** ref. negative feedback**;** *ORA*	**max[2]**
	Total:	**[9]**
6(a)	(apical / terminal) bud is source of auxin**;** auxin inhibits growth of side shoot / ora**;** remove bud and auxin concentration drops**;** (this allows) cell division / elongation to take place**;** *ecf – marking points 2 and 3 if growth regulator or hormone used instead of auxin*	**max[3]**
(b)	*award two marks if correct answer (80%) is given* *award one mark for calculation if answer is not correct* (90 – 50 = 40) 40 / 50 x 100**;** 80%**;;**	**[2]**
(c)	no growth until day, 8 / 10**;** auxin moves out of paste / AW**;** inhibits growth**;** growth occurs after, 8 / 10, days**;** because auxin, levels fall / 'used up'**;**	**[3]**
	Total:	**[8]**

Question Number	Answer	Max Mark
7(a)(i)	*max 1 for meaning of term* attached to an insoluble material / AW**;** *max 2 for description* (micro)encapsulation / (trapped) in alginate beads**;** adsorption / stuck onto, collagen / clays / resin / (porous) glass**;** cross linkage / covalent / chemical, bonding to, cellulose / collagen fibres**;** gel entrapment / trapped inside gel e.g. silica (lattice / matrix)**;** partially permeable membrane (polymer) microspheres**;**	**[3]**
(ii)	*any three from the following:* urine can be processed / no problem of removing urine / AW**;** pure / drinkable / useable, water produced**;** **A** water recycled space saving / less water needs to be taken into space**;** payload limit / weight reduction / AW**;** no problem in separating enzyme from products / product not contaminated**;** ref. to longer shelf-life of enzyme**;** no need to take more enzymes into space / enzymes reusable **;** **A** enzymes recoverable AVP**;** e.g. larger surface area of enzyme exposed, more stable at extremes, ref. to ease of use (of bioreactor)	**[3]**
(b)(i)	adding / using, water to break, bond / ester bond, (in molecule)**;** **A** breakdown into smaller molecules	**[1]**
(ii)	matrix, protects / stabilises, enzyme / lipase**;** functions, at optimal rate / more efficiently, at higher temperature / 45 ^{o}C**;** **A** *greater activity / AW* ref. to soluble lipase begins to denature (reducing activity)**;** ora functions, at optimal rate / more efficiently, at lower pH**;** ref. to presence of fatty acids changing pH**;** ref. to ionic bonds breaking (in soluble lipase) **;** ora AVP **;** e.g. ref to industrial uses ref to effect on R groups	**max[4]**
	Total:	**[11]**

Question Number	Answer	Max Mark
8(a)	starts with previously uncolonised area / bare ground / bare rock / AW; ref to pioneer species / named pioneer; series of recognisable, seres / stages; progresses to, climax / final equilibrium stage;	**max[2]**
(b)	stabilise environment; soil development / increase humus / organic material; change soil pH; hold more water; release more minerals or nutrients / increase N content or fix N / hold ions; form microhabitat / reduce exposure / provide shelter / reduce erosion;	**max[3]**
(c)	*any two from following:* grazing; burning; mowing / application of fertilizer / application of selective herbicide; exposure to wind; grass able to continue to grow (linked to a statement above);	**[2]**
(d)	increases; plants at later stages are large / plants in early stages are small; trees / shrubs. are woody, appear later in succession;	**[2]**

Question Number	Answer	Max Mark
(e)	*max 1 mark from following:* **1** economic definition of sustainable**;** e.g. similar quantities of timber can be harvested year on year **2** grants for planting forests / management schemes **;** **3** planting to ensure sustainable harvest rate**;** *max 3 marks for planting strategy:* **4** trees not planted too closely together**;** **5** support young trees to prevent damage e.g. from grazing animals**;** **6** species planted that are suitable for prevailing conditions / native spp**;** **7** softwood sp. / conifers / named conifer / fast growing sp. planted**;** **8** deciduous broadleaved species around edges for aesthetic reasons**;** **9** creates different habitats / named habitat / protected habitats/ some fallen trees left to rot**;** *max 3 marks for felling/cropping strategy:* **10** ref. to clear felling having negative effects e.g. soil erosion**;** **11** only mature trees removed / selective felling / individual trees**;** **12** some clearings / rides / glades in woodland / strip felling**;** **13** control of, pests / diseases / fire prevention**;** **14** ref to coppicing / pollarding**;** **15** (deciduous trees) regrow from base/ idea of rotation/ cycle**;** **16** standards / large trees not coppiced, as encourages biodiversity**;**	**[7]**
	Total:	**[16]**
	Paper Total	**[100]**

Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1(a)(i)	2			2
1(a)(ii)		2		2
1(b)		6		6
1(c)(i)		3		3
1(c)(ii)		2		2
1c(iii)		1		1
1(d)	2			2
1(e)		5		5
2(a)	2			2
2(b)		4		4
3(a)(i)		2		2
3(a)(ii)		2		2
3(a)(iii)	1			1
3(a)(iv)	2			2
3(b)		3		3
4(a)(i)	4			4
4(a)(ii)			2	2
4(b)		1		1
4(c)	10			10
5(a)		1		1
5(b)(i)	2	2		4
5(b)(ii)	2			2
5(c)	2			2
6(a)		3		3
6(b)		2		2
6(c)		3		3
7(a)(i)	1		2	3
7(a)(ii)		3		3
7(b)(i)	1			1
7(b)(ii)		2	2	4
8(a)	2			2
8(b)	2	1		3
8(c)		2		2
8(d)		2		2
8(e)	4	3		7
Totals	**39**	**55**	**6**	**100**
Targets	**36**	**54**	**10**	**100**

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