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EDEXCEL GCSE BIOLOGY: QUESTIONS BY TOPIC

Genetics (3)

GCSE Biology (Higher) Topic 3

11 questions · 118 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Biology 1BI0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

11 questions · 118 marks · lowest tariff first



7-MARK QUESTIONS

1 question in this booklet



1 Gregor Mendel studied inheritance in pea plants.

Pea plants can produce either yellow pea pods or green pea pods.

Mendel crossed plants that always produce yellow pea pods with plants that always produce green pea pods.

Symbol **A** represents the dominant allele.

Symbol **a** represents the recessive allele.

(a) Which is the genotype of the pea pods produced from this cross?

(1)

☐ **A** **AA**

☐ **B** **aa**

☐ **C** **Aa**

☐ **D** **YG**

(b) (i) Mendel grew many plants from the seeds in these pea pods.

These plants were then crossed with each other.

The seeds from this second cross produced 5 496 plants with yellow pea pods and 1 832 plants with green pea pods.

Give this as a ratio in its simplest form.

(1)

ratio



- (ii) Complete the Punnett square to show the outcome of a cross where both parent pea plants are heterozygous.

Show the percentage probability of homozygous recessive offspring in your answer.

(3)

percentage probability of homozygous recessive offspring %

- (c) (i) Some plants reproduce sexually.

Give **one** advantage of this type of reproduction.

(1)

.....

.....

- (ii) Name the process that forms gametes for sexual reproduction.

(1)

.....

(Total for Question 1 = 7 marks)



9-MARK QUESTIONS

1 question in this booklet



5 Figure 5 shows a great tit on a bird feeder.



© taviphoto/Shutterstock

Figure 5

Scientists have found that great tits living now have longer beaks than great tits living 50 years ago.

Genetic analysis shows changes in the sequence of the bird's DNA.

(a) (i) Give the complementary strand sequence for this DNA template.

(1)

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

(ii) Which statement correctly describes a DNA molecule?

(1)

- ☐ **A** two strands joined together by strong bonds to form a double helix
- ☐ **B** two complementary bases twisted into a double helix by strong bonds
- ☐ **C** a double helix with strands joined by hydrogen bonds between bases
- ☐ **D** four complementary strands joined together with hydrogen bonds

(iii) State the term used to describe a change in the sequence of DNA bases.

(1)

- (b) Scientists think that great tits living now have longer beaks because of the increased use of bird feeders during the last 50 years.

Explain how natural selection could have caused an increase in beak length because of the use of bird feeders.

(4)

- (c) Birds are classified in the domain Eukarya.

- (i) Why are the cells from birds described as eukaryotic?

(1)

- ☐ **A** they have membrane-bound organelles
- ☐ **B** they do not have nuclei
- ☐ **C** they have a rigid cell wall
- ☐ **D** they have a cell membrane

- (ii) Give **one** reason why the three domain classification system was proposed.

(1)

(Total for Question 5 = 9 marks)



10-MARK QUESTIONS

1 question in this booklet



5 (a) Figure 8 shows a diagram of a mouse sperm cell.

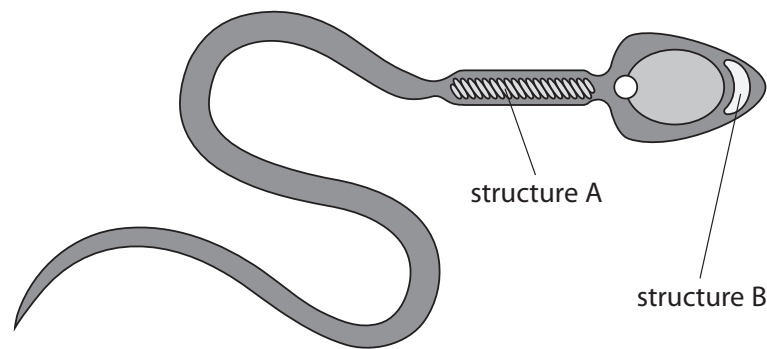


Figure 8

(i) Which row of the table shows the functions of structure A and structure B? (1)

	function of structure A	function of structure B
☐ A	releases energy	contains the genetic material
☐ B	produces glucose	contains digestive enzymes
☐ C	releases energy	contains digestive enzymes
☐ D	produces glucose	contains the genetic material

(ii) The diploid chromosome number for a mouse is 40.
State the number of chromosomes in a mouse sperm cell. (1)

.....

(b) After a mouse egg cell is fertilised, cell division produces a ball of genetically identical stem cells.

(i) Which is the correct order for the stages of one cell division?

(1)

- ☐ **A** metaphase → prophase → anaphase → telophase
- ☐ **B** prophase → metaphase → anaphase → telophase
- ☐ **C** anaphase → prophase → metaphase → telophase
- ☐ **D** prophase → anaphase → metaphase → telophase

(ii) The genetically identical stem cells produce the cells that develop into an embryo.

Describe how stem cells produce the cells of an embryo.

(2)

.....

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.....

.....



- (c) Scientific research has made many discoveries and developments allowing stem cells to be used in medical treatments.

Figure 9 shows a timeline for some of these discoveries and developments.

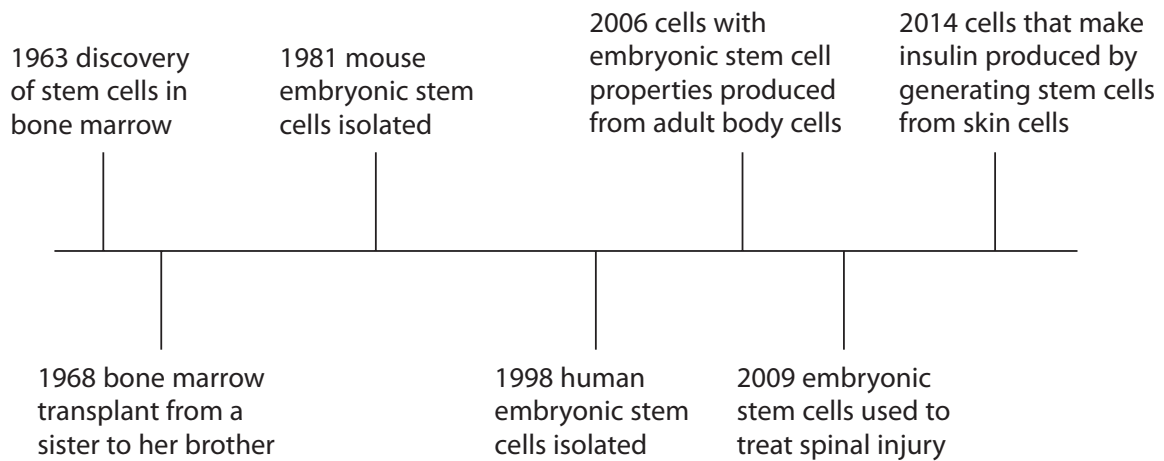


Figure 9

- (i) Give **one** scientific reason why the bone marrow transplant in 1968 was from a sister to her brother.

(1)

.....

.....

- (ii) Give **one** scientific reason why some people are opposed to the isolation of human embryonic stem cells.

(1)

.....

.....

- (iii) Stem cells, with the properties of embryonic stem cells, can be produced from a patient's own skin cells.

Discuss the benefits of using these stem cells to treat the patient.

(3)

(Total for Question 5 = 10 marks)



11-MARK QUESTIONS

5 questions in this booklet



- 4 Gregor Mendel used pea plants in plant breeding experiments. He discovered the basis of genetic inheritance.

(a) He cross-bred tall pea plants with short pea plants.

All the offspring were tall, as shown in Figure 4.

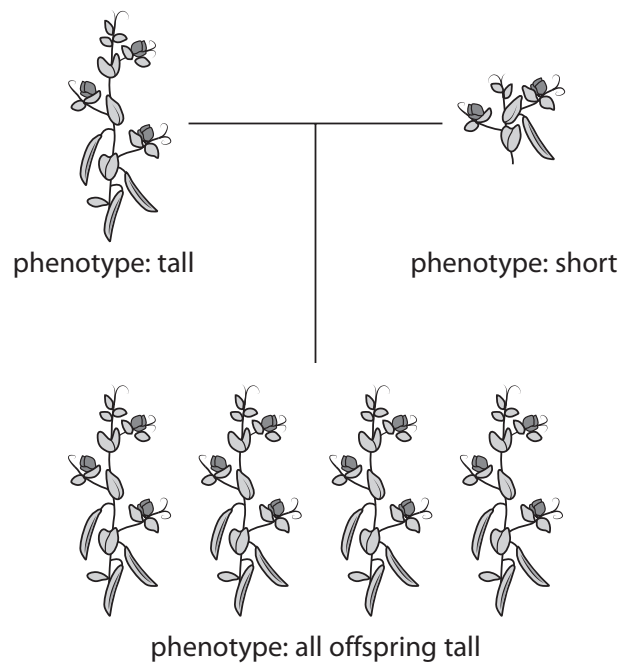


Figure 4

- (i) Explain why the offspring are all tall.

(2)

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- (ii) In this investigation, the parent pea plants were grown in a warm, closed greenhouse.

Give **two** reasons why the parent pea plants were grown in a warm, closed greenhouse.

(2)

1

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2

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(b) Pea plants produce different coloured peas.

The allele for yellow-coloured peas (A) is dominant to the allele for green-coloured peas (a).

Two heterozygous parent plants were used in a genetic cross.

- (i) Predict, using the Punnett square, the percentage probability that this cross will have offspring that produce green-coloured peas.

(3)

percentage probability of green-coloured peas = ...%

- (ii) Explain **one** advantage to pea plants of using sexual reproduction to produce offspring.

(2)

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(c) Peas contain small amounts of fat.

Describe a test to identify fat.

(2)

(Total for Question 4 = 11 marks)



9 (a) Figure 13 shows a sperm cell.

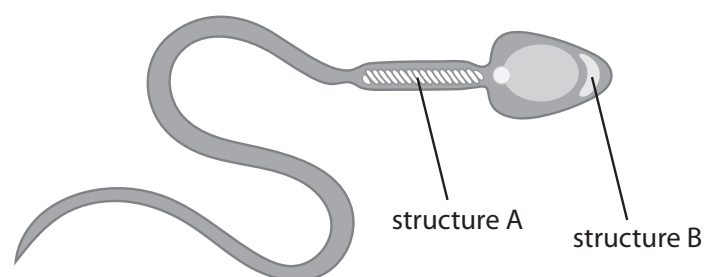


Figure 13

Describe how structure A and structure B enable fertilisation.

(2)

structure A

.....

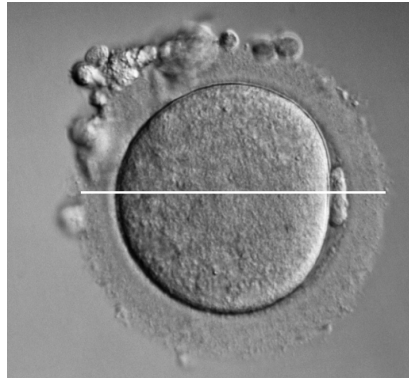
.....

structure B

.....

.....

(b) Figure 14 shows a human egg cell, magnified $\times 700$.



(Source: © Pascal Goetgheluck / Science Photo Library)

Figure 14

Calculate the actual width of the region indicated by the line on Figure 14.

Give your answer in millimetres, in standard form.

(3)

..... mm

*(c) A student investigated the movement of water.

Hens' eggs were placed in vinegar for two days to dissolve the shell.

This makes the eggs permeable to water.

The eggs were then weighed and placed in different solutions.

After 24 hours the eggs were weighed again.

Figure 15 shows the results.

solution	mass of the egg at the start in grams	mass of the egg after 24 hours in grams
tap water	77	84
5% salt	77	77
10% salt	77	75

Figure 15

Evaluate the results of this investigation.

You should include calculations using the data in Figure 15.

(6)

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(Total for Question 9 = 11 marks)

10 (a) Haemophilia is a sex-linked genetic disorder caused by a recessive allele on the X chromosome.

(i) Describe the phenotype of a male with the genotype X^hY .

(1)

(ii) Complete the Punnett square to show the genotypes of a male who is not affected by haemophilia, a female who is a carrier of the haemophilia allele and their possible offspring.

Use the letters H and h for the alleles.

(3)

		male	
female			

(b) Some genetic disorders occur because the body does not produce enough of a protein.

(i) Describe how a mutation in the non-coding region of a gene can lead to the production of less protein.

(2)

(ii) Which describes the cause of a protein folding incorrectly?

(1)

- ☐ **A** a mutation in the coding region of a gene changes the sequence of the amino acids.
- ☐ **B** a mutation in the non-coding region of the gene changes the sequence of the amino acids.
- ☐ **C** a mutation in the coding region of a gene changes the shape of the tRNA molecule.
- ☐ **D** a mutation in the non-coding region of the gene changes the shape of the tRNA molecule.

(c) Monoclonal antibodies can be used in the diagnosis of genetic disorders and pregnancy testing.

Describe how a pregnancy test uses monoclonal antibodies to show that a woman is pregnant.

(4)

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(Total for Question 10 = 11 marks)

- 4 (a) Mendel crossed pea plants that always produced purple flowers with pea plants that always produced white flowers.

The flowers of the offspring were all purple, as shown in Figure 5.

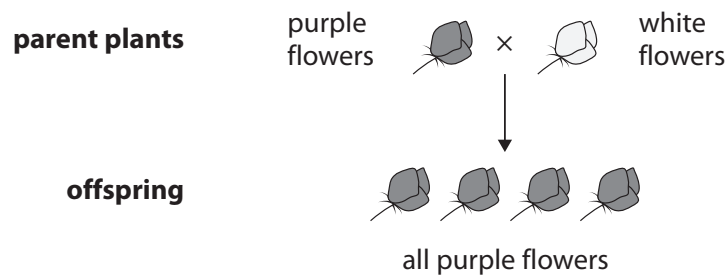


Figure 5

- (i) Which conclusion can be made about the characteristic for purple flowers?

(1)

- ☒ A the characteristic is recessive
- ☒ B the characteristic is dominant
- ☒ C the characteristic is a mutation
- ☒ D the characteristic is environmental

- (ii) Mendel used two of the offspring with purple flowers in another cross.

The pea plants he obtained from this cross produced purple flowers or white flowers in a ratio of 3 : 1.

Calculate the expected number of pea plants with purple flowers, in a sample of 160 pea plants.

(2)

Number of pea plants with purple flowers = ...

(iii) A pea plant producing purple flowers had the genotype Aa.

This pea plant was crossed with a pea plant producing white flowers.

Complete the Punnett square to show the possible genotypes of the offspring.

Show the percentage of pea plants that produce white flowers in your answer.

(3)

		white flowers	
purple flowers	A		
	a		

Percentage of pea plants that produce white flowers = ... %

(b) Asexual reproduction can be used to produce flowering plants.

Give **two** advantages of using asexual reproduction to produce flowering plants.

(2)

1

2



(c) Flower colour is controlled by genes.

(i) Which is a definition of a gene?

(1)

- ☐ **A** a section of a DNA molecule that codes for a protein
- ☐ **B** a section of a chromosome that codes for DNA
- ☐ **C** the entire DNA of an organism
- ☐ **D** a section of a chromosome that coils into a double helix

(ii) The two strands of a DNA molecule are linked by complementary bases.

Describe how the complementary bases are linked in a DNA molecule.

(2)

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(Total for Question 4 = 11 marks)

4 (a) In the 19th century, Gregor Mendel studied genetic inheritance in pea plants.

Mendel made the conclusion that characteristics in organisms were determined by the inheritance of 'units'.

(i) What are these 'units' of inheritance known as today?

(1)

- ☐ A chloroplasts
- ☐ B enzymes
- ☐ C genes
- ☐ D mitochondria

(ii) Figure 5 shows one of Mendel's experiments on the inheritance of pea shape.

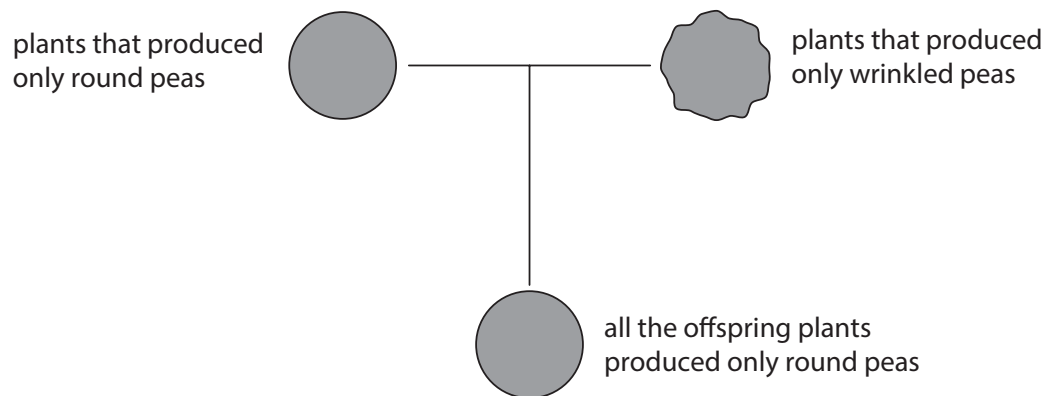


Figure 5

State the conclusion that Mendel was able to make about the wrinkled pea characteristic.

(1)

(b) A scientist crossed two pea plants that were heterozygous for pea shape.

- (i) Complete the Punnett square to show the inheritance of the alleles for pea shape and the percentage probability of producing a plant with wrinkled peas.

Use the letter R for the allele for round shape.

Use the letter r for the allele for wrinkled shape.

(3)

		heterozygous	
heterozygous			

percentage probability of producing a plant with wrinkled peas%

- (ii) Plants used to study inheritance are grown in controlled environmental conditions.

Suggest **two** ways of controlling these environmental conditions.

(2)

1

.....

2

.....



(c) Some plants can reproduce asexually and sexually.

- (i) Complete the table by writing **yes** or **no** in **each** box to show the features of asexual and sexual reproduction. (3)

feature	asexual reproduction	sexual reproduction
produce genetically identical offspring		
requires male and female gametes		
rapid reproductive cycle		

- (ii) A zygote with a diploid nucleus is formed by sexual reproduction.
State what is meant by a diploid nucleus. (1)

(Total for Question 4 = 11 marks)

12-MARK QUESTIONS

2 questions in this booklet



10 (a) One gene can have several different alleles.

Explain why these alleles can produce proteins with different structures.

(3)

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(b) Monoclonal antibodies are proteins.

Figure 16 shows the process of monoclonal antibody production.

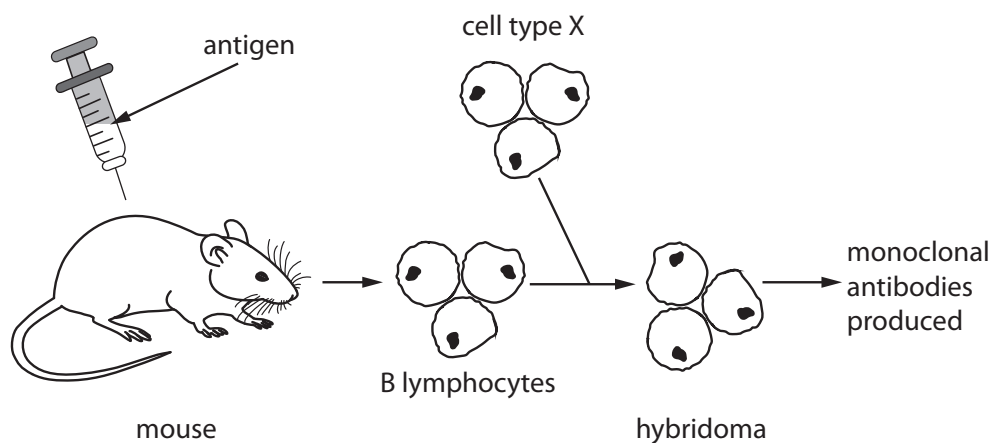


Figure 16

(i) Which type of cell is added to the B lymphocytes to produce the hybridoma?

(1)

- ☐ A phagocytic cell
- ☐ B red blood cell
- ☐ C cancer cell
- ☐ D epithelial cell

- (ii) A person with blood group A has the A antigen on the surface of their red blood cells.

Monoclonal antibodies can be used to detect the A antigen on red blood cells to determine the blood group of a person.

Explain why monoclonal antibodies, used to detect blood group A, would not react with the blood of a person with blood group B.

(3)

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- (c) The allele for blood group A and the allele for blood group B are codominant.

Gregor Mendel investigated the inheritance of alleles using flowering plants.

He showed that the allele for red flowers (I^R) is codominant with the allele for white flowers (I^W).

A heterozygous plant produces pink flowers.

- (i) Give the genotype for a plant producing white flowers.

(1)

.....



(4)



- 9 (a) A person's mass is partially influenced by the alleles they inherit from their parents.

Give **two** other factors that can influence a person's mass.

(2)



(b) Figure 14 shows the data obtained from a patient by a doctor doing a health check.

The guidance used by the doctor is also listed in Figure 14.

measurement	data	guidance
BMI	28	18–25 healthy 26–30 overweight 30+ obese
waist : hip ratio	0.85	<0.9 healthy >0.9 abdominal obesity
alcohol units	3–4 units per day	<14 units per week
number of cigarettes smoked	0	do not smoke or vape

Figure 14

Comment on the data and the health risks to this patient.

(4)

(Total for Question 9 = 12 marks)

13-MARK QUESTIONS

1 question in this booklet



9 Genetic disorders can be caused by mutations in the DNA of genes.

(a) Cystic fibrosis is a recessive genetic disorder.

Figure 13 shows a family pedigree for the inheritance of cystic fibrosis.

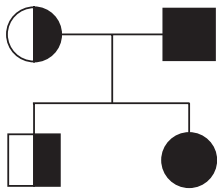


Figure 13

(i) Which row is correct for the mother, father and son?

(1)

	mother	father	son
☒ A	affected	unaffected	carrier
☒ B	carrier	affected	affected
☒ C	carrier	affected	carrier
☒ D	affected	affected	unaffected

(ii) Cystic fibrosis causes the build-up of thick, sticky mucus.

Describe how the build-up of thick, sticky mucus affects the airways of a person.

(2)

(b) Huntington's disease is a condition caused by a dominant allele.

Explain the phenotypes of the offspring of a genetic cross between a person who is heterozygous for the Huntington's allele and a person who is not affected.

Use the Punnett square as part of your answer.

(4)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Mark
1(a)	C Aa The only correct answer is C <i>A is incorrect because there has to be a dominant and a recessive allele</i> <i>B is incorrect because there has to be a dominant and a recessive allele</i> <i>D is incorrect because the alleles are not co-dominant</i>	(1) AO2 1

Question number	Answer	Additional guidance	Mark
1(b)(i)	3:1 / 3	accept three : one accept three	(1) AO1 1

Question number	Answer	Additional guidance	Mark									
1(b)(ii)	correctly completed Punnett square: correct gametes (1) correct offspring (1) correct percentage 25(%) (1) <table border="1"><tr><td></td><td>A</td><td>a</td></tr><tr><td>A</td><td>AA</td><td>Aa</td></tr><tr><td>a</td><td>Aa</td><td>aa</td></tr></table>		A	a	A	AA	Aa	a	Aa	aa	accept correct offspring from incorrect gametes for 1 mark ecf from incorrect Punnett square accept aA accept the use of other letters	(3) AO3 1ab
	A	a										
A	AA	Aa										
a	Aa	aa										

Question number	Answer	Additional guidance	Mark
1(c)(i)	(genetic) variation in the offspring / offspring have different alleles / genetically diverse (1)	accept allows evolution / natural selection / species to adapt / survive a selection pressure	(1) AO1 1

Question number	Answer	Additional guidance	Mark
1(c)(ii)	meiosis	accept meiotic division	(1) AO1 1

Total marks for question 1 = 7 marks

Question number	Answer	Additional guidance	Mark																																				
5(a)(i)	<table border="1"><tr><td>A</td><td>T</td><td>G</td><td>T</td><td>T</td><td>A</td><td>C</td><td>G</td><td>T</td></tr><tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr><tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr><tr><td>T</td><td>A</td><td>C</td><td>A</td><td>A</td><td>T</td><td>G</td><td>C</td><td>A</td></tr></table> accept lower case letters	A	T	G	T	T	A	C	G	T	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	T	A	C	A	A	T	G	C	A		(1)
A	T	G	T	T	A	C	G	T																															
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T	A	C	A	A	T	G	C	A																															

Question number	Answer	Mark
5(a)(ii)	C a double helix with strands joined by hydrogen bonds between bases The only correct answer is C <i>A is not correct because DNA strands are not held together with strong bonds</i> <i>B is not correct because complementary bases do not form the helix</i> <i>D is not correct because there are two complementary strands</i>	(1)

Question number	Answer	Additional guidance	Mark
5(a)(iii)	Mutation	accept genetic modification / genetic engineering / insertion / deletion / substitution	(1)

Question number	Answer	Additional guidance	Mark
5(b)	An explanation linking four of the following: - the population of great tits shows variation (1) - bird feeders provide a selection pressure (1) - birds with longer beaks {can feed from bird feeders/get more food} (1) - these birds are more likely to {survive/ reproduce} / survival of the fittest (1) - pass the {allele/gene /characteristic} for long beaks to their offspring (1) - over many generations the beak length of the bird population increases (1)	accept there is a mutation that leads to some birds having longer beaks accept there is competition for food / birds with longer beaks outcompete accept birds with shorter beaks can't get food accept birds with shorter beaks die out accept offspring have long beaks accept the process continues/repeats itself	(4)

Question number	Answer	Mark
5(c)(i)	A they have membrane-bound organelles The only correct answer is A B is not correct because they have a nucleus C is not correct because they do not have a cell wall D is not correct because this is not a specific feature of eukaryotic cells	(1)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	genetic analysis / based on {DNA/genetics} / DNA of Archaea more similar to eukaryotes (1)	accept more knowledge because of better microscopes	(1)

(Total for question 5 = 9 marks)



Question number	Answer	Mark
5(a)(i)	C releases energy contains digestive enzymes The only correct answer is C <i>A is not correct because structure B does not contain the genetic material</i> <i>B is not correct because structure A does not produce glucose</i> <i>D is not correct because structure A does not produce glucose and structure B does not contain the genetic material</i>	(1)

Question number	Answer	Mark
5(a)(ii)	20 / twenty	(1)

Question number	Answer	Mark
5(b)(i)	B prophase → metaphase → anaphase → telophase The only correct answer is B <i>A is not correct because metaphase is not the first stage</i> <i>C is not correct because anaphase is not the first stage</i> <i>D is not correct because metaphase is before anaphase</i>	(1)

Question number	Answer	Additional guidance	Mark
5(b)(ii)	An answer including: (stem cells divide) by <u>mitosis</u> (1) - cells differentiate / to become specialised cells (1)	reject meiosis accept produce cells with a specific function	(2)

Question number	Answer	Additional guidance	Mark
5(c)(i)	so the tissues matched / to reduce the chance of rejection	accept because they are genetically similar / have similar DNA	(1)

Question number	Answer	Additional guidance	Mark
5(c)(ii)	they have the potential to develop into a {foetus / baby / person / life} so embryos are not {harmed / destroyed}	accept people have ethical concerns / think it is unethical / the {embryo / foetus} is alive	(1)

Question number	Answer	Additional guidance	Mark
5(c)(iii)	An answer including three from: - means that embryos do not need to be used / a donor is not needed (1) - they can {develop / differentiate / specialise} into any cell (1) - replace damaged {cells / tissue} (1) - they will match the tissue type of the patient / less chance of rejection (1)	accept they are easier to obtain / unlimited supply accept can develop into a named cell (type) accept specific examples of use e.g. Parkinson's ignore repair cells accept repair tissues accept no need to take immune-suppression medication (1)	(3)

(Total for question 5 = 10 marks)



Question number	Answer	Additional guidance	Mark
4(a)(i)	An answer that links the following - tall is dominant (1) - they are heterozygous / have one tall allele (1)	accept short is recessive accept one of each allele ignore genes accept they have inherited one tall dominant allele for 2 marks	(2)

Question number	Answer	Additional Guidance	Mark
4(a)(ii)	Any two from: - provide {optimal/identical /best/ideal/controlled} growth conditions (1) - reduce chances of disease/ pests/pathogens (1)	accept all grown under the same conditions accept examples of optimal conditions. accept prevent unwanted pollination	(2)

Question number	Answer	Additional guidance	Mark									
4(b)(i)	One mark for gametes	accept aA	(3)									
	One mark for the offspring											
	<table><tr><td></td><td>A</td><td>a</td></tr><tr><td>A</td><td>AA</td><td>Aa</td></tr><tr><td>a</td><td>Aa</td><td>aa</td></tr></table>				A	a	A	AA	Aa	a	Aa	aa
				A	a							
	A			AA	Aa							
a	Aa	aa										
25 (%) (1)												
		accept ecf from the Punnett square										

Question number	Answer	Additional guidance	Mark
4(b)(ii)	An answer linking the following: - genetic variation increase / (offspring) show variation (1) - more likely to survive {a disease / environmental change / selection pressure} / allows evolution/survival of the fittest (1)	accept different combination of alleles accept allows dispersal of offspring through seeds accept other examples of a survival reason e.g natural disaster	(2)

Question number	Answer	additional guidance	Mark
4(c)	An answer linking: - mix the food in ethanol and pour into water (1) - white emulsion forms (1)	accept add water and ethanol and mix accept white precipitate / goes cloudy / emulsion test accept rub pea / food on filter paper (1) and look for a translucent mark (1)	(2)

(Total for question 4 = 11 marks)

Question number	Answer	Mark
-----------------	--------	------

Question Number	Answer	Additional Guidance	Mark
9(a)	Structure A - the mitochondria {release energy / for respiration} (1) Structure B {acrosome / contains enzymes} to digest the egg cell membrane (1)	reject produces / creates energy	(2) AO1 1

Question Number	Answer	Additional Guidance	Mark
9(b)	measurement 45 (mm) / 4.5 cm (1) calculation (45 ÷ 700) = 0.0643 (1) conversion into standard form and millimetres 6.43×10^{-2} / 6.4×10^{-2}	award full marks for the correct answer with no workings allow 44-46 (mm) allow ecf for incorrect measurement allow ecf for incorrect substitution accept answer to any number of decimal places	(3) AO1 1

Question Number	Indicative content	Mark
9 *(c)	AO2 3 marks/AO3 3 marks Analysis of data - the egg in the water has gained mass / water - the egg in the 5% salt has no mass change - the egg in the 10% salt has lost mass / water - mass increase is 7 g for the egg in water - mass increase is 0 g for 5% salt - the mass decrease is 2g for 10% salt % mass change +9% / 0% / -3% Water movement - osmosis is the movement of water - across a partially permeable membrane - from a high concentration of water molecules to a low concentration of water molecules 5% salt is an isotonic solution	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	- Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. - Presents an explanation with some structure and coherence.
Level 2	3–4	- Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. - Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5–6	- Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. - Presents an explanation that has a well-developed structure which is clear, coherent and logical.



Additional Guidance

Level 1	1–2	• a brief analysis of the experimental data. • with reference to the movement of water.
Level 2	3–4	• an evaluation of the data including a calculation of mass gain or loss. • with reference to the direction of movement of the water for tap water or 10% salt.
Level 3	5–6	• a detailed evaluation of the data including a % mass change calculation. • with reference to the direction of movement of water by osmosis for tap water and 10% salt.

(Total for question 9 = 11 marks)

Question number	Answer	Additional guidance	Mark
10(a)(i)	the male is affected / has haemophilia	accept has the disorder	(1)

Question number	Answer	Mark									
10(a)(ii)	<table border="1" data-bbox="443 622 1058 898"> <tr> <td></td><td>X^H</td><td>Y</td></tr> <tr> <td>X^H</td><td>$X^H X^H$</td><td>$X^H Y$</td></tr> <tr> <td>x^h</td><td>$X^H x^h$</td><td>$x^h Y$</td></tr> </table> correct female parent genotype (1) correct male parent genotype (1) correct offspring (1) (ecf from incorrect parental genotype)		X^H	Y	X^H	$X^H X^H$	$X^H Y$	x^h	$X^H x^h$	$x^h Y$	(3)
	X^H	Y									
X^H	$X^H X^H$	$X^H Y$									
x^h	$X^H x^h$	$x^h Y$									

Question number	Answer	Additional guidance	Mark
10(b)(i)	An answer including: - RNA polymerase {binds less well / cannot bind} (1) - less mRNA (is produced) (1)	accept alternative words for bind e.g. attach ignore affects the binding accept no mRNA (produced) / less transcription	(2)

Question number	Answer	Mark
10(b)(ii)	A a mutation in the coding region of a gene changes the sequence of the amino acids. The only correct answer is A <i>B is not correct because the mutation is not in the non-coding region</i> <i>C is not correct because it does not change the shape of the tRNA</i> <i>D is not correct because the mutation is not in the non-coding region and does not change the shape of the tRNA</i>	(1)

Question number	Answer	Additional guidance	Mark
10(c)	An answer including four from: (pregnancy test detects) a hormone in urine (1) (hormone/antigen) binds to the antibody (on the test) (1) - which have a coloured (bead) attached to them (1) (a line appears because) there are immobile antibodies (in the test window) (1)	accept hCG for hormone accept antibodies are complementary (to the hormone) accept a named colour /idea that a colour, dye or tag is attached accept there are antibodies fixed down accept the antibodies move up the strip and colour appears	(4)

(Total for question 10 = 11 marks)



Question number	Answer	Mark
4(a)(i)	B the characteristic is dominant The only correct answer is B <i>A is not correct because the characteristic is not recessive</i> <i>C is not correct because the characteristic is not a mutation</i> <i>D is not correct because the characteristic is not environmental</i>	(1) A03 1a

Question number	Answer	Additional guidance	Mark
4(a)(ii)	One from: • 40 (1) • 480 (1) • $160 \div 4 \times 3$ (1) • $160 \times 3 \div 4$ (1) • 160×0.75 (1) • $160 \times \frac{3}{4}$ (1) AND Evaluation 120	award full marks for the correct answer with no workings accept 120:40 for two marks accept 40:120 for one mark	(2) A02 2

Question number	Answer	Additional guidance	Mark
4(b)	Any two from: genetically identical offspring (1) - they will have the {same / desired} characteristics (1)	accept clones produced / same (advantageous) alleles ignore no variation / same genes accept same features accept named characteristics e.g. flower colour	(2) AO2 1

Question number	Answer	Mark
4(c)(i)	A a section of a DNA molecule that codes for a protein The only correct answer is A <i>B is not correct because a chromosome does not code for DNA so it is not a gene</i> <i>C is not correct because the the entire DNA of an organism is not a gene</i> <i>D is not correct because a section of a chromosome which coils into a double helix is not a gene</i>	(1) AO1 1

Question number	Answer	additional guidance	Mark
4(c)(ii)	An answer including two from: - A with T / C with G (1) - weak (1)	accept names of bases	(2) AO1 1
	hydrogen bonds (1)	accept H bonds	

(Total for question 4 = 11 marks)



Question number	Answer	Mark
4(a)(i)	C genes The only correct answer is C A, B and D are not correct because they are units of inheritance.	(1) AO1 1

Question number	Answer	Mark
4 (a)(ii)	wrinkled characteristic is recessive / wrinkled characteristic is not passed on	(1) AO2 1

Question number	Answer			Additional guidance	Mark
4(b)(i)		R	r	accept rR	(3) AO3 1a and 1b
	R	RR	Rr	accept other letters	
	r	Rr	rr		
	correct parental gametes (1)				
	correct offspring genotypes (1)			ecf from incorrect parental genotypes	
	percentage probability = 25% (1)			ecf from incorrect Punnett square	

Question number	Answer	Additional guidance	Mark
4(b)(ii)	Any two from: - grow in a greenhouse (1) (same) soil (conditions) (1) (same) temperature / use a heater (1) (same) light / use a lamp (1) (same) watering / rain (1) - eliminate (micro) organisms / insects (1)	accept enclosed area / (same) carbon dioxide (concentration) accept named soil condition e.g. pH accept optimum temperature accept same humidity accept pathogens / named pathogens accept use pesticides accept control {abiotic / biotic} factors (1)	(2) AO2 2

Question number	Answer			Additional guidance	Mark	
4(c)(i)		feature	asexual reproduction	sexual reproduction	accept Y / ✓ / true for Yes accept N / X / false for No	(3) AO1 1
		produce genetically identical offspring	yes	no		
		requires male and female gametes	no	yes		
		rapid reproductive cycle	yes	no		
	one mark for each correct row of the table					

Question number	Answer	Additional Guidance	Mark
4 (c)(ii)	{two copies / pairs} of each chromosome / full set of chromosomes	accept 46 chromosomes / a chromosome from the male and a chromosome from the female ignore double the number of chromosomes / all of the chromosomes / all the genetic material	(1) AO1 1

Total for Question 4 = 11 marks



Question Number	Answer	Additional Guidance	Mark
10(a)	An explanation linking three from: - alleles have different DNA {sequences / mutations} (1) - mRNA strand has a different sequence / triplets have different sequences (1) - codes for a different amino acid / order of amino acids is different (1) - protein folds with a different structure (1)	accept the order of the amino acids determines the structure	(3) AO1 1

Question Number	Answer	Mark
10(b)(i)	C cancer cell The only correct answer is C <i>A is not correct because a phagocytic cell is a white blood cell</i> <i>B is not correct because a red blood cell does not divide</i> <i>D is not correct because an epithelial cell does not divide rapidly</i>	(1) AO1 1



Question Number	Answer	Additional Guidance	Mark
10(b)(ii)	An explanation linking: - the shape of the antibody is complementary to the A antigen / antibodies only react with specific antigens - the B antigen has a different {shape / structure} (1) (therefore) it will only bind to the A antigen / it will not bind to the B antigen (1)	accept antigen A has a specific structure accept blood group B does not have the A antigen	(3) AO2 1

Question Number	Answer	Additional Guidance	Mark
10(c)(i)	$I^W I^W$ / homozygous I^W	accept WW ignore homozygous dominant	(1) AO2 1

Question Number	Answer	Additional Guidance	Mark									
10(c)(ii)	An explanation linking the following: • correct gametes / parental genotype (1) • correct completion of the Punnett square (1) <table><tr><td></td><td>I^W</td><td>I^R</td></tr><tr><td>I^W</td><td>$I^W I^W$</td><td>$I^W I^R$</td></tr><tr><td>I^R</td><td>$I^R I^W$</td><td>$I^R I^R$</td></tr></table> • 50% offspring will produce pink flowers (1) • 25% will produce white flowers and 25% will produce red flowers (1)		I^W	I^R	I^W	$I^W I^W$	$I^W I^R$	I^R	$I^R I^W$	$I^R I^R$		(4) AO3
	I^W	I^R										
I^W	$I^W I^W$	$I^W I^R$										
I^R	$I^R I^W$	$I^R I^R$										

(Total for Question 10 = 12 marks)

Question number	Answer	Additional guidance	Mark
9(a)	An answer including two from: • environmental factors (1) • diet / food intake (1) • exercise / activity (1) • if the person is affected by a disease (1)	accept lifestyle accept calories consumed / named food groups accept calories used / metabolism accept named diseases e.g. hyperthyroidism / diabetes ignore age / sex / smoking / height	(2)

Question number	Answer	Additional guidance	Mark
9(b)	An answer including: • BMI is in the overweight range (1) • waist:hip is in the healthy range (1) • suggesting that the fat is not around the vital organs / the patient may have a high percentage of muscle (1) • patient is consuming too much alcohol which {affects the liver / causes liver damage} (1) • not smoking reduces the risk of {cardiovascular disease / lung disease / stroke} (1)	disease risks must be linked to measurements / data from the table accept idea that BMI does not take account of muscle / fat is evenly distributed / fat is not around their middle accept numerical comparisons accept named liver diseases e.g. cirrhosis, liver cancer or fatty liver accept other smoking related diseases e.g. cancer	(4)

Question number	Indicative content	Mark
9*(c)	AO1 6 marks Structure - stimulus detected by a receptor - receptor transfers the signal to the sensory neurone - sensory neurone transfers the signal to the CNS / brain / spinal cord / relay neurone - signal is transferred to a motor neurone - myelin sheath speeds up the transmission of the electrical impulse - the motor neurone transmits the signal to the effector - the effector produces the response Function - rapid response - to protect the body / response to danger - involuntary automatic response	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. - Presents an explanation with some structure and coherence.
Level 2	3-4	- Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and /or developed. - Presents an explanation that has a structure which is mostly clear, coherent and logical.
Level 3	5-6	- Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. - Presents an explanation that has a well-developed structure which is clear, coherent and logical.

Additional Guidance

Level 1	1-2	- The answers refers to at least one structural aspect of a reflex arc - The response includes reference to the function of a reflex arc
Level 2	3-4	- The explanation links some structural components of a reflex arc - The response includes links to the function of a reflex arc as a rapid or protective response
Level 3	5-6	- The explanation links the structural components in a complete reflex arc - The response links this to the function of a reflex arc as a rapid and protective response

(Total for question 9 = 12 marks)



Question number	Answer	Mark
9(a)(i)	C carrier affected carrier The only correct answer is C <i>A is not correct because the father should be affected</i> <i>B is not correct because the son should be a carrier</i> <i>D is not correct because the mother should be a carrier</i>	(1) AO2 1

Question number	Answer	Additional guidance	Mark
9(a)(ii)	An answer including two from: • (cilia) can't move the mucus (1) • {bacteria / pathogens / dust} are trapped (1) • (increased chance of) infection (1) • reduced diameter of the airway / cough / breathing difficulties (1)	accept cannot move the pathogens / named pathogens accept blocks the airway accept less gas exchange	(2) AO2 1

Question number	Answer	Additional guidance	Mark																		
9(b)	An answering including: <table><tr><td></td><td>a</td><td>a</td></tr><tr><td>A</td><td>Aa</td><td>Aa</td></tr><tr><td>a</td><td>aa</td><td>aa</td></tr></table> correct parental genotypes (1) correct offspring (1) 50% (chance) of the offspring being unaffected / 50% (chance) of the offspring being affected (1) (Hh) is affected because they have one dominant allele / (hh) is unaffected because they have {two recessive alleles / no dominant alleles} (1)		a	a	A	Aa	Aa	a	aa	aa	accept any letter with gametes in either orientation <table><tr><td></td><td>H</td><td>h</td></tr><tr><td>h</td><td>Hh</td><td>hh</td></tr><tr><td>h</td><td>Hh</td><td>hh</td></tr></table> award from the Punnett square award from the Punnett square ecf from incorrect parental gametes accept 2/4, 1/2, 1 in 2, 1:1 for 50% reject 50% are carriers accept heterozygous are affected and homozygous recessive are unaffected		H	h	h	Hh	hh	h	Hh	hh	(4) AO2 2
	a	a																			
A	Aa	Aa																			
a	aa	aa																			
	H	h																			
h	Hh	hh																			
h	Hh	hh																			

Question number	Indicative content	Mark
*9 (c)	A01 6 marks Extraction • strawberry is crushed • to increase the surface area • detergent is added • to break down membranes / cells • protease added • to break down proteins • heat in a water bath • to speed up reaction • salt added • to clump DNA • filtering • insoluble material is removed • ice cold ethanol is added • to precipitate the DNA / makes the DNA visible Structure • double helix • polymer of nucleotides • made of two strands • backbone consists of a sugar and phosphate • bases connect the two strands • four bases A pairs with T and C pairs with G • joined together by weak hydrogen bonds	(6) A01 2

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. - Presents a description which is not logically ordered or with significant gaps.
Level 2	3-4	- Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific, enquiry, techniques and procedures is not fully detailed and/or developed. - Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing.
Level 3	5-6	- Demonstrates accurate and relevant biological understanding throughout. Understanding of scientific, enquiry, techniques and procedures is detailed and fully developed. - Presents a description that has a well-developed structure which is clear, coherent and logical.

Additional Guidance

Level 1	1-2	- A brief description of the structure of DNA OR how it can be extracted from fruit cells - The response links to a reason for the extraction stage OR two extraction stages OR two ideas on the structure of DNA
Level 2	3-4	- A brief description of the structure of DNA AND how it can be extracted from fruit cells OR a detailed description of the structure of DNA OR a detailed description of how it can be extracted from fruit cells - Response gives reasons for at least two extraction stages
Level 3	5-6	- A detailed description of DNA molecule AND a detailed description of how it can be extracted from fruit cells - Response gives reasons for at least three stages of the extraction process AND the complementary base pairs linked by hydrogen bonds for a DNA molecule.

Total for Question 9 = 13 marks