AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.6.1.2

Meiosis

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
Available paper years	**2018–2024**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.6.1.2 Meiosis

Answer 01 · Mark scheme

June 2018 | 8464/B/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	one X and one Y chromosome and 9 pairs of other chromosomes		1	AO2 4.6.1.6
07.2	any **three** from: • (called) meiosis • DNA / chromosomes replicate **or** DNA makes a copy • two divisions to form 4 cells • so only 1 set of chromosomes per cell • (daughter cells / gametes) are all genetically different	correct spelling only allow cells are haploid ignore half the DNA if no other mark awarded allow **1** mark for forms gametes / cells which are all different **or** only happens in testes and (embryonic) ovaries	3	AO1 4.6.1.2
07.3	(meiosis will not work because) number of chromosomes cannot halve	allow chromosomes cannot form pairs allow chromosomes cannot split up evenly	1	AO2 4.6.1.2
07.4	do not use energy in reproduction so more (energy) available to synthesise proteins	allow converse if clearly describing diploid oysters allow other correct molecules or cell components	1 1	AO2 4.6.1.3 4.4.2.1

4.6.1.2 Meiosis

Answer 01 · Mark scheme

June 2018 | 8464/B/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	any **two** from: • global warming may be raising temperature of water and killing oysters • pollutants in the water may be toxic and kill the oysters **or** increased acidity of the oceans is killing oysters • new competitors / triploid oysters are using up the normal food source • new pathogens may be causing diseases • new predators eating oysters	allow correctly named pollutant with reason ignore over harvesting	2	AO2 4.7.3.5 4.7.3.2 4.7.1.2 4.7.1.3

4.6.1.2 Meiosis

Answer 01 · Mark scheme

June 2018 | 8464/B/2H | Original Q7

Question	Answers	Mark	AO / Spec. Ref.
07.6	**Level 3:** A judgement strongly linked and logically supported by a sufficient range of correct reasons is given.	5–6	AO3
	Level 2: Some logically linked reasons are given. There also may be a simple judgement.	3–4	AO3 AO2
	Level 1: Relevant points are made. They are not logically linked.	1–2	AO2
	No relevant content	0	
	Indicative content **for:** • oysters are available to eat all year **so** eating oysters has become very popular • cheaper to produce **so** more food for expanding population • oysters grow faster **so** more oysters for supermarkets / restaurants or more profit for farmers • stocks are replenished each year **so** more sustainable fishing • they can harvest / sell all year **so** more stable and profitable for oyster farmers **against:** • carcinogen put into environment / oysters **so** may enter the food chain or cause cancer in humans • bigger triploid oysters may outcompete the smaller native diploid oysters **so** upset balance of the ecosystem / cause extinction • people may not buy / eat them because they have used a carcinogenic chemical **so** reduced profit for farmers / suppliers / supermarkets / restaurants • farmers have to buy new seed oysters every time **so** more expensive **other content:** • shouldn't be eating the oysters until they are thoroughly tested • should be looking for alternative ways to get triploid oysters • should stop using triploid oysters until the effect on the (marine) environment is known • would replace lost oyster beds **but** could change the ecosystem • oysters available to eat all year **but** probably do not taste the same or have the same flavour		4.7.3.2 4.7.3.6 4.7.2.1 4.7.1.3 4.7.1.1
Total		**15**	

4.6.1.2 Meiosis

Answer 02 · Mark scheme

November 2020 | 8464/B/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	four daughter cells are formed the parent cell divides twice		1 1	AO1 4.6.1.2
04.2	thyroid (gland) adrenal (gland) ovary / ovaries	in this order only	1 1 1	AO1 4.5.3.1
04.3	<table><tr><th>Hormone</th><th>Name of gland which releases hormone</th><th>Target organ of hormone</th></tr><tr><td>Luteinising hormone (LH)</td><td>Pituitary gland</td><td>Ovary</td></tr><tr><td>Adrenaline</td><td>Adrenal gland</td><td>Heart / lungs / liver</td></tr><tr><td>Glucagon</td><td>Pancreas</td><td>Liver / muscle</td></tr></table>		1 1 1	AO2 4.5.3.3 4.5.3.6 4.5.3.2
04.4	only need 1 parent plant will produce (many genetically) identical plants	allow for **1** mark it is a faster process allow for **1** mark will produce a large number of plants at one time ignore clones unqualified	1 1	AO3 4.6.1.1

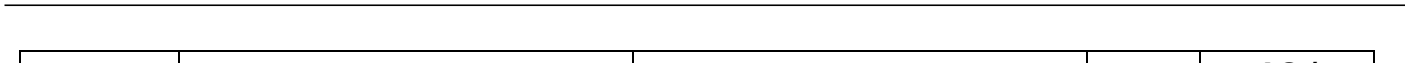
4.6.1.2 Meiosis

04.5	any **two** from: • genetically identical so will all be susceptible to same diseases / pathogens • no genetic variety for new colours / characteristics to offer customers • no genetic variety leads to weaker / unhealthy plants (due to lack of evolution)		2	AO3 4.6.1.1 4.6.2.2
Total			**12**	

4.6.1.2 Meiosis

Answer 02 · Mark scheme

November 2020 | 8464/B/2H | Original Q4



4.6.1.2 Meiosis

Answer 03 · Mark scheme

June 2022 | 8464/B/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	gene chromosome nucleus cell	must be in this order	1	AO1 4.1.1.1 4.1.1.2 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	differentiation	ignore specialisation	1	AO1 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	4	allow 15	1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	46	allow 23 pairs (of chromosomes)	1	AO2 4.1.2.1 4.1.2.2

4.6.1.2 Meiosis

Answer 03 · Mark scheme

June 2022 | 8464/B/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	**Stage 1** any **one** from: • (cell) growth • increase in number of sub-cellular structures • DNA replicates • chromosomes double / duplicate / replicate	allow increase in number of organelles / ribosomes / mitochondria allow genetic material for DNA allow DNA doubles / duplicates	1	AO1 4.1.2.2
	Stage 2 any **one** from: • (one set of) chromosomes pulled to each end of cell • two nuclei form	ignore mitosis occurs allow chromosomes line up across the centre of the cell allow chromosomes move to opposite ends of the cell allow nucleus divides / splits (into two)	1	
	Stage 3 any **one** from: • cytoplasm / membrane divides • two identical cells formed	allow cytokinesis	1	

Question	Answers	Mark	AO / Spec. Ref.
02.6	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	4–6	AO3
	Level 1: Relevant features are identified and differences noted.	1–3	AO2
	No relevant content	0	

	Indicative content General comparisons: • boys height at birth (slightly) greater than girls height • boys are (slightly) taller than girls up to age 11 • correct height comparisons eg boys are approximately 4 / 5 cm taller than girls up to age 11 • girls and boys are the same height at age 11 • girls are taller than boys between age 11 and age 14 • girls and boys are the same height at age 14 • boys are taller than girls above age 14 • correct height comparisons eg boys are 5 to 18 cm taller than girls above age 14 • boys (eventually) grow taller than girls • boys carry on growing for a longer time than girls • girls stop growing age 13 / 14 / 15 **and** boys stop growing age 17 / 18 Rate comparisons: • rate of growth similar up to age 10 / 11 • girls grow faster than boys between 10 / 11 and 14 allow girls have a greater increase in height between 11 and 14 • growth spurt occurs at a younger age in girls • growth spurt starts age 10 / 11 in girls **and** age 13 / 14 in boys • increased rate of growth in girls aged 10 to 13 /14 **and** in boys aged 13 to 17 / 18 Key points for Level 2 are correct reference to 0-11 year period, 11-14 period and after age 14, with at least one correct reference to rate of growth or use of correct values of height and age to illustrate rate.		4.1.2.2

4.6.1.2 Meiosis

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	repair of tissues **or** replacement of cells	ignore growth allow repair of organs ignore repair of cells allow replacement of tissues ignore replacement of organs	1	AO1 4.1.1.4

Total Question 2		**14**

4.6.1.2 Meiosis

Answer 04 · Mark scheme

June 2024 | 8464/B/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	domain		1	AO1 4.6.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	offspring are genetically identical		1	AO1 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	a gamete contains half of the number of chromosomes		1	AO1 4.6.1.1 4.6.1.2

4.6.1.2 Meiosis

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • similar / same structure / characteristics / phenotype (as potatoes)	allow named similar structure / characteristics such as same shape / leaves / flowers / taste allow studied with microscopes ignore 'look the same / similar' unqualified	1	AO1 4.6.4
	• similar DNA / genes	allow DNA analysis allow analysis of genetic material allow similar genetic material ignore genetic information do **not** accept same DNA / genes		
	• similar / same biochemistry			
	• same first part of binomial (name)	allow same first part of Latin / scientific name		

Question	Answers	Mark	AO / Spec. Ref.
02.5	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content allow reference to named crop throughout **effects of climate change** • climate change will change weather patterns / trends • climate change causes flooding **or** drought **or** temperature change • farming land decreased by sea level rise / flooding / desertification • current crops cannot grow / survive (in changing conditions) **benefits of GM** ○ GM may allow crops to grow in wider range of conditions ○ GM may allow crops to be resistant to wider range of pests / diseases ○ GM may allow crops to be stored for longer ○ GM may increase crop yield **or** increase growth rate ○ to feed the increasing human population ○ useful if less area available for farming ○ larger human population needs more land for housing **other relevant content** ▪ variation amongst current crops reduced by asexual reproduction **or** selective breeding ▪ rate of evolution (by natural selection) may be slower than rate of climate change For **Level 3**, answers must explain effect(s) of climate change **and** benefit(s) of GM with logical link.		4.6.2.4 4.7.3.2 4.7.3.5 4.7.3.6

Total Question 2	**10**

4.6.1.2 Meiosis

Answer 01 · Examiner comments

Question 7 (standard, standard / high & high demand)

As expected with this question being higher demand, students generally achieved lower marks. Some excellent answers were seen where students were able to access knowledge from different parts of the specification as well as use information from the question stem and their own wider reading to express complex concepts.

07.1 This was not a straightforward knowledge question as students needed to use logical thinking as well as knowledge of chromosomes to work out the correct alternative. 50% of students arrived at the correct response. Many realised that there would be one X and one Y chromosome but their maths let them down when they computed that only eight more pairs would be needed.

07.2 A large number of students understood meiosis was the type of cell division and many students could not spell it correctly. Being able to understand the differences in mitosis and meiosis is crucial as is being able to correctly spell all keywords. 28% of students achieved two or three marks.

07.3 Students seemed to struggle with the idea that meiosis created four daughter cells from the two divisions, although they did tend to identify that the cells would be haploid. Many just stated the cells would be not identical rather than being genetically different.

The majority of students found it difficult to transfer their knowledge of humans and their 23 pairs of chromosomes to oysters with ten pairs and so their answers were confused. 19% of students achieved the mark here.

07.4 While students were able to note that triploid oysters didn't spend time reproducing, very few related this to energy. Many went down the route of not needing time to look for a mate. The few that did identify energy and reproduction (6% of students) rarely linked the energy available to synthesising proteins, and instead going with vague references to 'growth' which is insufficient at this level.

07.5 Students had the idea that global warming, pollutants, competition or predators could be involved, but rarely gained credit as they did not express this with the necessary high demand biological detail required to explain how it would lead to a reduction in population.

Key points were generally missing such as toxic pollutants and new predators or pathogens. Some students mentioned disease but did not relate it to pathogens. 3% of students achieved full marks.

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Answer 01 · Examiner comments

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07.6 This 'extended response' question was targeted at grades 6–9. Many students were able to access level 1 (43%) and level 2 (27%). It served its purpose of allowing the higher-attaining students to perform well, while not discouraging lower-attaining students from answering, and very few students made no attempt.

It was felt that students engaged with the opportunity to have an opinion about ideas on whether supermarkets and restaurants should be allowed to stock a product which may have a link to a carcinogen.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.6.1.2 Meiosis

Answer 03 · Examiner comments

June 2022 | 8464/B/1H | Original Q2

Question 2 (standard demand)

02.1 54% of the students put gene, chromosome, nucleus and cell in order of increasing size.

02.2 Half of the students gave the correct answer, differentiation. Some said specialisation, whilst most students thought the process to produce specialised cells was mitosis, cell division or therapeutic cloning.

02.3 44% of the students correctly calculated the number of cell divisions to form a 16-cell embryo.

02.4 65% of students knew that the cells of a human embryo have 46 chromosomes.

02.5 A quarter of students scored full marks, with 69% scoring at least one mark. Many students scored a mark for Stage 1 by saying that the cell grows or that there is an increase in the number of sub-cellular structures. Some students thought Stage 1 was fertilisation, and they went on to describe the development of an embryo.

A mark for Stage 2 was less often awarded. Many students said mitosis happens, but as this was written on the cell cycle diagram it did not gain credit.

For Stage 3 all the changes listed on the mark scheme were seen, but many students only referred to two daughter cells forming, when reference to two identical cells was required. Reference to specialised cells being formed was seen quite a lot, and was ignored.

4.6.1.2 Meiosis

Answer 03 · Examiner comments

02.6 The question asked students to compare the growth of boys with the growth of girls, using data from growth curves.

There are three main sections in the graph:

- a section from birth to age 10 or 11, where the height and growth rate of boys and girls is very similar
- a section from age 10 or 11 up to age 14, where girls grow faster than boys
- the section from 14 to 18 years, where boys continue to grow rapidly whilst girls have stopped growing.

Within each section there were several comparisons that could be made.

To score the highest marks reference to all three sections of the graph was required, in addition to at least one comparison of the rate of growth. 30% of students scored four or more marks. More than two thirds of students scored three or more marks.

As the command word was 'Compare' it was important that comparative statements about boys and girls were made. All the statements given in the indicative content are comparisons.

Many responses gave descriptions of what they had learnt about puberty and growth spurts, but if they did not match the data given in the graph they were not credited. Any data given had to be correct.

Common errors in interpreting the graph included:

- boys grow faster than girls up to age 11
- boys grow shorter, or stop growing, at age 11
- girls stop growing at age 18.

02.7 The question asked for one way that mitosis is important in fully grown animals, so saying 'to grow' was not credited. Many students said for growth and repair, which was insufficient. Repair of tissues, organs or wounds all gained credit. Many students said to repair damaged cells, which is incorrect. Replacement of cells or tissues was another acceptable response. Many said mitosis was important for reproduction, which was ignored.

Answer 04 · Examiner comments

Question 2 (standard demand)

02.1 More than 50% of students could select that the classification group 'Eukaryota' is a domain.

02.2 Almost all students knew that asexual reproduction produces genetically identical offspring.

02.3 More than 80% of students knew that a gamete contains half the number of chromosomes compared to the other cells in a potato plant.

02.4 Most students could describe how a new plant species could be identified as being in the same genus as potatoes. DNA analysis or similar characteristics were the most common correct answers.

Misconceptions were seen, such as the idea that the species would have identical DNA.

02.5 Most students followed the direction of the question, stating that GM crops can be made to grow even if the climate changes.

Some students were aware of food insecurity as a result of climate change, and this could be given credit for the idea that current crops will not be able to grow/survive.

Lists of possible benefits of GM were limited to Level 1 if there was no link to climate change. Most students made very good attempts at this question and many recognised some of the effects of climate change and were able to link these to the idea that current crops would struggle to grow in these conditions. This was an attempt at a logical link and achieved a Level 2 mark.

Some students further developed this idea, and clearly had a grasp of the question being asked, as they then went on to describe how GM would enable crops (or potatoes) to survive the conditions that climate change brings. They could further strengthen their account with suggestions that more crops could be grown or crops could be grown faster. These responses were detailed and logically linked accounts and were therefore Level 3 responses.

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Some students gave explanations of causes of climate change, but this did not answer the question.

Some students responded in terms of 'how' GM crops can be produced, mentioning enzymes and vectors. This was not answering the question and therefore could not be given credit. These responses often gained marks from the rest of their explanation.

0 2 . 5 Scientists have collected and stored seeds from species in the same genus as potatoes.

In the future, these seeds may be used for genetic modification of potato plants.

Genetically modified potato plants could help supply food to the human population as the climate changes.

Explain why genetic modification of crop plants may be important for the human population to survive climate change.

[6 marks]

As climate changes occurs the global temperature could get warmer. This means that agriculture will become harder and it will become harder for crops to be grown under hot conditions. This means that genetically modified crops could be modified to withstand greater heat and be produced in bigger yields. These crops could be produced with more nutrients and be bigger so that humans could get more energy in the future where there will be limited resources.

The student has described two effects of climate change (global temperature getting warmer and that it will be harder for crops to be grown). They then give two relevant benefits of GM linked to these ideas. This meets and exceeds the description for entry into Level 3, for both logical linking and detail, therefore 6 marks were awarded.

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