AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.6.1.1

Sexual and asexual reproduction

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**7**
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.

4.6.1.1 Sexual and asexual reproduction

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

4.6.1.1 Sexual and asexual reproduction

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

4.6.1.1 Sexual and asexual reproduction

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**	

4.6.1.1 Sexual and asexual reproduction

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

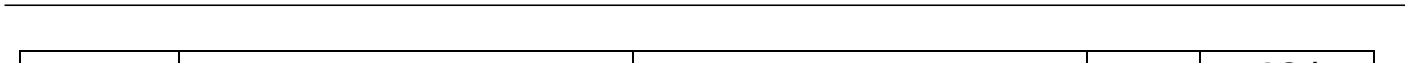
4.6.1.1 Sexual and asexual reproduction

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**	

4.6.1.1 Sexual and asexual reproduction

Answer 02 · Mark scheme

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



4.6.1.1 Sexual and asexual reproduction

Answer 03 · Mark scheme

June 2022 | 8464/B/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	negative feedback (control)	ignore homeostasis	1	AO2 4.5.3.6 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	A = glucagon B = insulin	both required in correct order correct or phonetic spelling only	1	AO2 4.5.3.2

4.6.1.1 Sexual and asexual reproduction

Answer 03 · Mark scheme

June 2022 | 8464/B/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3 indirect marking view with 5.2	(when blood glucose concentration is high after a meal) insulin / B is secreted (by the pancreas) causing glucose to enter cells		1	AO2
	(glucose is) converted to glycogen in the liver / muscle (cells for storage)		1	AO1
	(this causes) blood glucose concentration to return to normal so insulin / B secretion slows / stops / decreases		1	AO2
	when blood glucose concentration is low glucagon / A is secreted (by the pancreas)		1	AO2
	(which causes) breakdown of glycogen in the liver (into glucose)	allow (which causes) breakdown of glycogen in the muscle (cells)	1	AO1
	(this causes) blood glucose concentration to return to normal so glucagon / A secretion slows / stops / decreases		1	AO2 4.5.3.2

4.6.1.1 Sexual and asexual reproduction

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	FSH causes (several) ova / eggs to mature (in the ovary)	allow singular ovum / egg allow follicle for ovary	1	AO2 4.5.3.3 4.5.3.5
	(then) LH causes ovulation **or** LH causes release of the ova / eggs	allow singular ovum / egg	1	
	so more eggs / ova present therefore higher probability / chance of fertilisation **or** so more eggs / ova present therefore higher probability / chance of sperm fusing with an egg		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	collection of (mature) egg(s) from the ovary	allow follicle for ovary	1	AO1 4.5.3.5
	(which are) fertilised (in the laboratory)	do **not** accept if in fallopian tube allow egg and sperm fuse	1	
	develop into embryo(s) (in the laboratory)	allow develop / divide into small balls of cells (in the laboratory) do **not** accept foetus	1	
	embryo(s) inserted into uterus / womb		1	

4.6.1.1 Sexual and asexual reproduction

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **three** from: • meiosis forms sperm **and** mitosis forms liver (cells) • two cell divisions to form sperm **and** one cell division to form liver (cells) • four genetically different sperm cells **and** two genetically identical liver cells • sperm cells have 23 chromosomes **and** liver cells have 46 chromosomes	ignore reproduction max **2** marks if reference to sperm cells dividing allow four genetically different cells formed from meiosis **and** two genetically identical cells formed from mitosis allow sperm cells have 23 chromosomes **and** liver cells have 23 pairs of chromosomes allow haploid (sperm) and diploid (liver cells)	3	AO1 4.6.1.2 4.1.2.2

Total Question 5		**18**

4.6.1.1 Sexual and asexual reproduction

Answer 04 · Mark scheme

June 2023 | 8464/B/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	meiosis	allow phonetic spelling	1	AO1 4.6.1.1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	gametes / eggs / sperm are not (genetically) identical	allow gametes / eggs / sperm are (genetically) different allow cells produced by meiosis are not (genetically) identical	1	AO1 4.6.1.1 4.6.1.2
	(there is) mixing of genetic information / genes / DNA **or** genetic information / genes / DNA from two / both parents	allow genetic information / genes / DNA from each parent ignore gametes fuse unqualified ignore two parents unqualified if no other mark awarded allow **1** mark for mutations	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	heterozygous	ignore dominant / recessive	1	AO2 4.6.1.4

4.6.1.1 Sexual and asexual reproduction

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(parents gamete genotypes shown) **D d** and **d d**	allow in either position in Punnett square	1	AO2
	(possible offspring genotypes correctly derived) **Dd Dd dd dd**	allow correct derivation of offspring genotypes from incorrect gametes allow 3 correct offspring genotypes for **1** mark	2	AO2
	correct identification of **Dd** offspring as having polydactyly	if derivation not correct and shows **DD** and **Dd**, both must be identified as having polydactyly	1	AO2
	probability must match derived offspring genotypes	if no derivation shown allow 0.5 **or** 50% **or** 1 in 2 **or** 1:1 **or** ½ do **not** accept 1:2 allow correct probability from incorrectly derived offspring	1	AO3 4.6.1.4 4.6.1.5

4.6.1.1 Sexual and asexual reproduction

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	any **two** from: • can find out if the embryo has an (inherited) disorder • can prepare for baby (with the disorder) • can decide whether to continue with the pregnancy • fewer people with (inherited) disorders over time	allow can find out if the embryo has inherited disease ignore can find out if the embryo has disease(s) allow description of preparation for the baby eg access to early treatment allow choice of (in vitro) embryos (to be implanted)	2	AO3 4.6.1.5

Total Question 1	11

4.6.1.1 Sexual and asexual reproduction

Answer 05 · Mark scheme

June 2023 | 8464/B/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	FSH and LH		1	AO1 4.5.3.5 4.5.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	ovary / ovaries		1	AO1 4.5.3.5 4.5.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any **one** from: • to be able to select / check egg(s) • to select / check sperm sample for live sperm • to see injection / guiding sperm to egg(s) • to see if the egg has been fertilised • to select / check (developing) embryo(s)	allow to count the eggs (collected) allow to grade the embryos ignore egg(s) / embryo(s) / sperm are too small to be seen without a microscope unqualified	1	AO3 4.5.3.5

4.6.1.1 Sexual and asexual reproduction

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(hormones / FSH / LH used in IVF) cause an increase in progesterone **and** oestrogen		1	AO1
	progesterone / oestrogen maintain uterus <u>lining</u>	allow oestrogen / progesterone causes thickening of uterus <u>lining</u>	1	AO1
	(uterus) <u>lining</u> is prepared / ready for embryo to be inserted / implanted	allow the (uterus) <u>lining</u> is prepared / ready for implantation	1	AO2 4.5.3.5 4.5.3.3

4.6.1.1 Sexual and asexual reproduction

Answer 05 · Mark scheme

June 2023 | 8464/B/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$\left(\frac{135}{450}\right) = 0.3$ 3 : 7 alternative method 1: $\frac{135}{45} : \frac{315}{45}$ **or** $\frac{135}{45} : \frac{450 - 135}{45}$ (1) 3 : 7 (1) alternative method 2: evidence of dividing both sides of 135 : 315 by 5 **and** by 9 (1) 3 : 7 (1)	allow $\left(\frac{450 - 135}{450}\right) = 0.7$ if **no** other mark awarded allow **1** mark for 27 : 63 **or** 9 : 21 **or** 15 : 35 **or** 3 : 10	1 1	AO2 4.5.3.5

4.6.1.1 Sexual and asexual reproduction

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **one** from: • age • obesity / fitness / BMI / diet • (the original) reason for infertility • allow the number of eggs collected • the number of embryos implanted	 allow menopause allow body mass **/** weight allow a named reason for infertility / miscarriage eg endometriosis ignore infertility unqualified	1	AO3 4.5.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	any **two** from: • (physical / emotional) stress of operations • success rate is low • multiple births are a risk to mother **/** baby • (ethical concern regarding) embryos are created but not used	 allow physical / emotional stress of named part of IVF process eg infection from surgery ignore side effects unqualified allow (may) take many months / years (to be successful) allow may need several / many attempts allow multiple births more likely ignore unethical unqualified	2	AO3 4.5.3.5

Total Question 5	**11**

4.6.1.1 Sexual and asexual reproduction

Answer 06 · 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

4.6.1.1 Sexual and asexual reproduction

Answer 06 · 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		

4.6.1.1 Sexual and asexual reproduction

Answer 06 · Mark scheme

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

4.6.1.1 Sexual and asexual reproduction

Answer 07 · Mark scheme

June 2024 | 8464/B/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	parents of child with AKU / disorder do not have AKU / disorder **or** child(ren) with AKU / disorder have parents who do not	allow **A** and **B** do not have AKU, but child / **D** does (have AKU) allow **F** and **G** do not have AKU, but child / children / **K** / **L** does (have AKU) allow child(ren) with AKU / disorder have parents who are carriers	1	AO3 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	G		1	AO2 4.6.1.4

4.6.1.1 Sexual and asexual reproduction

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(parental gametes) (female) **a and a** (male) **A and a**	allow **1** mark for **a a and A a** parental gametes reversed	1 1	AO2 AO2
	offspring correctly derived **Aa Aa aa aa**	allow correctly derived offspring from incorrect parental gametes	1	AO2
	offspring phenotype correctly derived **Aa** = no AKU **aa** = AKU	allow correctly derived phenotypes from incorrect parental gametes or incorrect offspring genotypes allow inclusion of **AA** = no AKU, if their cross derives this genotype ignore reference to carriers	1	AO2
	(probability =) 0.5	allow 50% **or** ½ **or** 1 in 2 **or** 1:1 **or** 50:50 probability must match offspring genotype do **not** accept 1:2 **or** 50/50	1	AO3 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(mutation causes) incorrect sequence of amino acids		1	AO2 4.6.1.3
	(which) causes the enzyme to be a different shape	allow (which) causes the active site to be a different shape allow which means the enzyme and substrate cannot bind ignore the enzyme is denatured do **not** accept no enzyme produced	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	FSH **and** LH given / injected (into female) to stimulate maturation of egg(s)		1	AO1 4.5.3.3 4.5.3.5
	(collected) egg(s) are fertilised (in laboratory)	allow (collected) egg(s) fused with sperm (in laboratory) allow sperm is injected into egg (in laboratory)	1	
	fertilised egg undergoes mitosis	allow cell(s) undergo mitosis allow fertilised egg divides / develops to form embryo	1	
	(one or two) embryo(s) inserted into uterus / womb **or** (one or two) ball(s) of cells inserted into uterus / womb		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	any **two** from: • risk to embryo	allow risk of miscarriage do **not** accept risk to embryo due to radiation	2	AO3 4.6.1.5
	• risk to female / mother • stressful process • may lead to termination of the pregnancy	allow may lead to destruction of the embryo		
	• (high) cost (of the screening process) • embryo cannot give consent	allow idea of increased prejudice against other people with (inherited) disorders ignore references to religion / ethics		

Total Question 3	15

4.6.1.1 Sexual and asexual reproduction

Answer 01 · Examiner comments

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

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.

4.6.1.1 Sexual and asexual reproduction

Answer 01 · Examiner comments

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

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.

4.6.1.1 Sexual and asexual reproduction

Answer 03 · Examiner comments

June 2022 | 8464/B/2H | Original Q5

Question 5 (standard, standard/high & high demand)

05.1 A quarter of students could identify this type of hormonal control as negative feedback. Common incorrect answers were homeostasis, diabetes and endocrine.

05.2 39% of students could interpret the figure to identify hormone A and hormone B as glucagon and insulin respectively. Both hormones were allowed to be spelt phonetically, however hybrid terms that indicated a possible confusion between glucagon and other terms such as glycogen, glucose and glycerol where not acceptable. Examples such as glycogen were seen.

Common mistakes were to confuse glucagon and insulin, or to name other hormones.

05.3 Explanations usually started with the first marking point but it was equally acceptable to start at the fourth marking point. The most frequently seen mark was for release of glucagon when blood glucose concentration is low.

Confusion was common between the terms glucagon and glycogen, plus glycerol was also regularly seen.

The third and sixth marking points were very challenging. These required an understanding of how negative feedback causes the reduction in the release of each hormone.

A fifth of students scored either three or four marks.

05.4 40% of students could identify the roles of FSH and LH. Few students gained the third marking point, to fully explain why the probability of pregnancy would be greater following FSH and LH injections.

05.5 Most students knew that IVF involves fertilisation in laboratory conditions. Some inaccuracies of language were seen, such as sperm and egg mix, with no reference to or description of fertilisation, and eggs being inserted into the body, with no reference to uterus or womb.

05.6 Students found this question challenging, with 4% achieving full marks. Confusion between meiosis and mitosis was common. Responses generally lacked the detail required for the points on the mark scheme. Some students only described one process or the other, rather than describing differences.

Responses could not gain full marks if there was an implication that sperm cells go through meiosis.

The third marking point was sometimes attempted, but not expressed clearly, such as four sperm cells are made that are different, but the two liver cells are the same. Reference to *genetically* different or *genetically* identical was required.

4.6.1.1 Sexual and asexual reproduction

Answer 04 · Examiner comments

June 2023 | 8464/B/2H | Original Q1

Question 1 (Standard demand)

01.1 Phonetic spelling was allowed, and variations of many phonetically correct spellings were seen. Hybrid terms between meiosis and mitosis were not credited. The list principle was applied when students stated both meiosis and mitosis. See the 'Information for examiners' on page 4 of the mark scheme for an explanation of how lists within responses are marked.

Whilst mitosis was a common error, there were many students who simply put any word that they could relate to sexual reproduction such as fertilisation, ovum, sperm, hormones.

01.2 Few students could give two reasons why sexual reproduction causes variation in the offspring. Marking point 2 was seen more frequently than marking point 1.

Responses that did not gain credit only referred to the offspring having different characteristics, such as eye colour.

For marking point 1 we were looking for the idea of variation in gametes from one parent or for the variation in gametes more generally, such as 'the genes from the egg and sperm are different'. The word genetically was bracketed, therefore is not required, but could not be contradicted, such as 'the egg and sperm look different'. We cannot put every variation of how students could phrase this in the mark scheme. For example, the mark scheme allowed 'cells produced by meiosis are not identical', so if a student wrote 'cells produced by meiosis are different' that was also worth the mark.

A few students referred to chromosomes crossing over in meiosis. This was a correct response that is beyond the specification and scored marking point 1.

We did not credit vague answers that were open to different interpretations such as:

- egg and sperm contain 50% DNA
- half is from mother, half is from father
- genetics is from mother and father
- one gene from each parent.

Errors were seen in some responses that referred to chromosomes. The response needed to be biologically correct to gain the mark. 'They get chromosomes from each parent' or 'Chromosomes mix' or '2 sets of chromosomes mix' was acceptable. However, '2 chromosomes mix' or 'pairs of chromosomes come from each parent' are incorrect. Likewise, '2 genes mix' was incorrect.

There was a fall back mark for 'mutations'. This mark was awarded only if no other mark was given.

4.6.1.1 Sexual and asexual reproduction

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q1

0 1 . 2 Sexual reproduction produces offspring that are genetically different from each other.

Give **two** reasons why sexual reproduction causes variation in the offspring.

[2 marks]

1 The off spring is a combination of DNA from mother and father

2 The DNA taken from mother and father is not always the same

0 6 . 2 Sexual reproduction produces offspring that are genetically different from each other.

Give **two** reasons why sexual reproduction causes variation in the offspring.

[2 marks]

1 Each sperm and egg cell carry different genes.

2 Mother's and father's ~~are~~ genes are combined differently each time.

The first response (from a Higher tier paper) gave marking point 2 twice, therefore only 1 mark was awarded. The second response (from a Foundation tier paper) gave marking point 1 and marking point 2 for 2 marks.

01.3 This was very well answered. Phonetic spelling was allowed. See page 5 of the mark scheme for information on marking phonetic spelling.

01.4 On the Foundation tier, few students achieved all 5 marks, but partial credit was given frequently, such as correct derivation from incorrect gametes.

On the Higher tier, most students could complete the Punnett square and state the probability of the child having polydactyly. However, few students identified which offspring genotype would result in polydactyly. This could be indicated on any or all offspring, with a circle, line, key or label or any other clear method of identification.

01.5 Clear responses most frequently knew that embryo screening enables us to find out whether an embryo has an inherited disorder. Some confusion was seen between the term disorder and the terms diseases or disabilities.

Many responses were vague, such as ‘to see if the embryo is healthy’. Some incorrect responses incorrectly implied that embryo screening is ultrasound screening.

Very few students took the marking point 4 approach of the implications to the population over time.

4.6.1.1 Sexual and asexual reproduction

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q1

A general misconception was that embryo screening is the same as genetic counselling, so students referred to finding out the likelihood of the embryo having an inherited disorder. The misconception that embryo screening can change DNA or treat inherited disorders was also seen.

Answer 05 · Examiner comments June 2023 | 8464/B/2H | Original Q5

Question 5 (Standard, Standard/high and High demand)

05.1 Nearly two-thirds of students could identify the hormones that are given to women having IVF treatment.

05.2 Most students could state ovary / ovaries as the target organ of the hormones used in IVF.

05.3 Students found this question challenging. Many simply stated that egg / sperm are too small to see without a microscope, which was insufficient to answer the question.

Students could refer to any relevant stage in the process of IVF, as illustrated by the list of bullet points on the mark scheme.

One common misconception was that microscopes are needed to view hormones.

05.4 Students could write follicle stimulating hormone for FSH and luteinising hormone for LH. Students gave lots of detail on the general roles of FSH and LH that are irrelevant to the question.

Many students did not answer the question in terms of IVF, but could still gain marks.

In marking point 2, 'womb' was taken as equivalent to 'uterus'. 'Building up' (of the uterus lining) is equivalent to 'thickening'. Endometrium was an acceptable alternative to lining (that is beyond the specification). Note that the list rule was applied if additional hormones were referred to here.

For marking point 3, 'the lining is prepared for pregnancy' was common, but insufficient, because this did not add to the information given in the question.

05.5 The correct answer without any working received full marks. If the correct answer was given with working then examiners checked the working to see that it is logical before awarding full marks.

The correct answer did not have to be on the answer line but anything that has been given on the final answer line will always take precedence. Students sometimes displayed the alternative method 2 in a slightly different way, such as dividing both sides of the ratio by 5, then by 3 and then by 3 again.

Answer 05 · Examiner comments June 2023 | 8464/B/2H | Original Q5

There was a fall back mark if students did not complete their simplification of the ratio but got part way through the process. Alternatively, the fall back mark was given for a ratio of 3:10, which indicated students misinterpreted the table but simplified that ratio correctly.

If the ratio was given the incorrect way round, no mark was awarded.

05.6 The most commonly awarded marks were for age (bullet point 1) or for smoking, obesity or alcohol as named reasons for infertility (bullet point 2). There were many insufficient vague references to health or lifestyle which were not creditworthy. Other commonly seen insufficient answers included hormone levels or the levels of named hormones such as FSH as well as statements about the condition or health of the uterus.

Bullet points 4 or 5 were very rarely awarded. When students did attempt these marking points they often referred to the amount of eggs without suggesting it was the number collected that was important or suggesting it was eggs or fertilised eggs that were implanted rather than embryos.

05.7 For bullet point 1 there were many vague statements about stress, it being emotional or harmful without saying how or why it was stressful, emotional or potentially harmful. References to the risks of surgery were seen very rarely.

Bullet point 2 was the most commonly awarded marking point although many students were not awarded this marking point as they made vague references to the idea that it might not work rather than emphasising the low success rate.

There were many references to multiple births or twins, which were not creditworthy as they failed to qualify the reference with the idea of the risks associated with multiple births or that IVF made multiple births more likely.

0 5 . 7 Give **two** arguments against the use of IVF treatment.

Do **not** refer to cost or to religion in your answer.

[2 marks]

1 It ~~tom~~ can be emotionally and physically stressful for the women

2 IVF treatment doesn't always work

This response did not gain any marks. The first reference is too vague to award bullet point 1. The reference to IVF treatment not always working could apply to any conception and therefore needed to be qualified, such as 'low chance of working'. Some students quoted their ratio from question **05.5** to support this response.

There were many references to the process of IVF being unethical or unnatural without saying what made it unethical but on many occasions students went further and explained it was unethical as it might lead to the destruction of a potential life.

Other insufficient answers referred to the embryo or egg not being able to consent or the misconception that IVF allows parents to choose characteristics or will lead to designer babies.

Answer 06 · 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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4.6.1.1 Sexual and asexual reproduction

Answer 06 · Examiner comments June 2024 | 8464/B/2H | Original Q2

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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Answer 07 · Examiner comments

Question 3 (standard, standard/high & high demand)

03.1 There was only 1 mark available here and for this to be awarded it was essential that reference was made to both parents (without the disorder) and their children (who have the disorder). A common misconception was for students to base their descriptions on the (low) frequency of AKU within the family.

Students should be aware that using 'it' will be treated in terms of how the question is phrased, unless the student clarifies what they mean by 'it'. Please see page 4 of the mark scheme for more guidance on the use of 'it'. Here, 'it' unqualified was considered equivalent to 'AKU'.

No evidence could be obtained from C and D as parents. Answers which described this part of the family tree as evidence gained no credit as it is incorrect biology, even if a student went on to make further correct points.

Examples of answers which were too vague to match the mark scheme included:

- 'D has AKU and this means that his parents are heterozygous' ('Heterozygous' does not clearly suggest that a recessive AKU allele is present but the parents do not have AKU)
- 'A and B don't have AKU but future generations do' ('Future generations' is too vague)
- 'AKU skips generations'.

03.2 Fewer than 50% of students could identify which person is definitely heterozygous for AKU. More students selected the incorrect answer of 'D'.

03.3 Most students were able to correctly identify the gametes for both parents, although where one of these marks was not awarded it was often because students presumed that the female with AKU had the genotype AA rather than aa and therefore were struggling to tell the difference between recessive and dominant despite being told AKU was recessive earlier in the question.

Almost all students were able to derive the offspring in the Punnett square and were awarded marking point 3.

For marking point 4, very few students attempted to identify the offspring phenotypes, and when there was an attempt at this, the mark wasn't awarded if only the phenotype 'having AKU' was indicated rather than the phenotype for both having AKU and not having AKU. Many students drew circles around offspring genotypes in the belief that this would be sufficient to suggest a phenotype of 'having AKU', but this was not creditworthy. Another frequent mistake was referring to the phenotype of Aa offspring as being 'heterozygous' or 'a carrier'. Although not incorrect descriptions, these are not actual phenotypes.

Giving the probability of having AKU was, in the majority of cases, done correctly and was usually given as a percentage or a fraction. This was very rarely given as a ratio. When incorrect gametes were given, a common mistake made when working out the probability was that offspring with Aa or AA would have AKU.

Other, more occasional, errors included giving an incorrect probability, such as 1:2 or 50/50 or 50 and using symbols other than those (A and a) directed in the question.

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4.6.1.1 Sexual and asexual reproduction

Answer 07 · Examiner comments June 2024 | 8464/B/2H | Original Q3

It was noted that quite a few students changed their minds when answering this question and made alterations to the gametes and genotypes they originally opted for. If students do this, they must make sure that the changes are unambiguous and, if necessary, rewrite their choices. It was sometimes very difficult for examiners to decide what the student intended to be marked.

0 3 . 3 A female who has AKU and a male who is heterozygous for AKU plan to have a child.

Determine the probability that the child will have AKU.

You should:

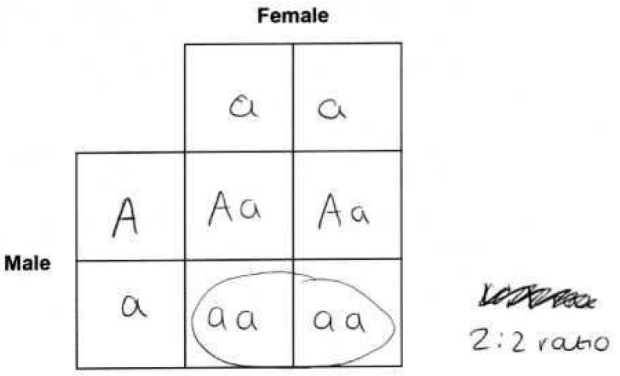
- complete **Figure 4**
- identify the phenotype of each offspring genotype
- use the symbols:

  A = dominant allele

  a = recessive allele.

[5 marks]

Figure 4



Probability that the child will have AKU = 50%

In a typical response, as shown above, students gave the correct parental gametes, and derived offspring genotypes correctly. The student has not indicated the phenotype of each offspring genotype, therefore marking point 4 was not awarded. However, the probability is acceptable, so 4 marks could be awarded.

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4.6.1.1 Sexual and asexual reproduction

Answer 07 · Examiner comments June 2024 | 8464/B/2H | Original Q3

03.4 Students found this question difficult with very few gaining both marks. They struggled to make appropriate connections between the mutation and the non-functioning enzyme.

Answers were often too general and repetitive of information given in the question to be adding any value, such as 'a mutation could change the cell's DNA to stop producing functioning enzymes' or 'if the gene has changed it will mean that the enzyme has changed'.

In other cases, students clung to the familiarity of terms in the question but created their own, inappropriate, narratives around them. So, 'mutation' triggered reference to 'random changes', incidence in the family tree, links to cancer and 'uncontrollable cell division'; 'protein' prompted discussions of ribosomes, protein digestion by protease, proteins being needed for growth and repair; 'enzyme' opened the way to details of denaturation.

Misconceptions were quite frequently seen, such as:

- 'DNA is made of amino acids'
- 'DNA a protein'
- 'genes make amino acids that code for a protein'
- 'the enzyme is 'mutated'
- 'the enzyme changes shape and can then no longer fit the active site'.

Overall, marking point 2 was seen far more frequently than marking point 1. Students clearly felt more comfortable discussing why enzymes might not be functioning rather than the reason behind this (the immediate consequence of the mutation).

03.5 This question was set at high demand. It closely reflects the specification content for the use of hormones in the treatment of infertility. Answers were often confused and poorly sequenced. Appreciation of the distinctions between 'egg', 'fertilised egg' and 'embryo' and between 'ovary' and 'uterus' was often lacking.

For the first mark, students had to refer only to FSH and LH being given to the female to stimulate maturation of eggs. Incorrect answers included ideas of the hormones 'increasing the chances of fertilisation', 'making the eggs more fertile', 'strengthening the eggs'. Students occasionally suggested that FSH and LH production was stimulated through treatment rather than the hormones being given directly. No credit was given for this.

The second marking point was the most commonly awarded mark. Credit was not given, however, for vague references such as the eggs and sperm were 'combined' or 'joined together'. The term 'fertilisation'/'fusion' was required or a suitable description of sperm being injected into eggs (ICSI). No mark was given when the student described fertilisation 'in the woman'.

Very few students achieved marking point 3. Words that were too vague such as 'growing'/'forming'/'turning into' were used instead. Mention of 'mitosis' was exceptionally rare. No credit was given if it was implied that embryo development only happened at a later stage within the uterus.

For the fourth mark, many students did not state that the embryo was inserted into the uterus. Answers which said that the embryo was 'put back into the woman' were insufficient. Reference to anything other than the 'embryo' or the 'ball of cells' at this stage, such as 'fertilised egg'/'baby', was incorrect. Some students wrongly suggested that the embryos were inserted into ovaries.

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4.6.1.1 Sexual and asexual reproduction

Answer 07 · Examiner comments June 2024 | 8464/B/2H | Original Q3

03.6 This was generally well answered. The most commonly awarded marks were for bullet point 4 and bullet point 5, as students clearly understood the high cost of the process and that it might lead to parents choosing to terminate their pregnancy. Some students attempted bullet point 1 but did not understand the process and wrote about the embryo being harmed due to the radiation used in the process, which was incorrect.

Some students simply wrote 'ethics' without giving details on why some people might think this and there were often references to 'designer babies', which was incorrect. Some students appeared to be talking about IVF, such as 'not always successful', with some confusion about what embryo screening involves.

Some students described ideas of prejudice against people with inherited disorders. This was described in a variety of ways and was creditworthy.