AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.6.2.1

Variation

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**5**
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.

4.6.2.1 Variation

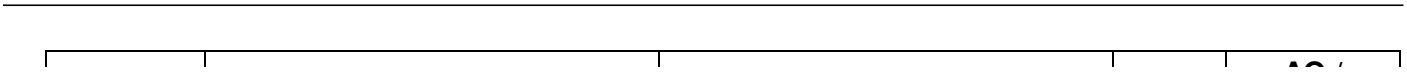
Answer 01 · Mark scheme June 2018 | 8464/B/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	<table><tr><th></th><th>Genes</th><th>Envi</th><th>Both</th></tr><tr><td>Brown...</td><td>✓</td><td></td><td></td></tr><tr><td>Light...</td><td></td><td></td><td>✓</td></tr><tr><td>Short hair</td><td></td><td>✓</td><td></td></tr></table>		1 1 1	AO2 4.6.2.1
05.2	bb		1	AO2 4.6.1.4
05.3	brown	allow light brown **or** dark brown	1	AO2 4.6.1.4
05.4	(using bb for mother's gametes) correct combination in all four boxes, eg <table><tr><td></td><td>*(b)*</td><td>*(b)*</td></tr><tr><td>*(B)*</td><td>Bb</td><td>Bb</td></tr><tr><td>*(b)*</td><td>bb</td><td>bb</td></tr></table>	allow any combination of mother's gametes as mark is for filling in boxes correctly	1	AO2 4.6.1.4
05.5	50%, 0.5, ½	the award of this mark is consequential to the answer in question **05.4** ignore ratios	1	AO2 4.6.1.4
05.6	phenotype		1	AO2 4.6.1.4
05.7	almost certainly have no effect		1	AO1 4.6.2.1
Total			**9**	

4.6.2.1 Variation

Answer 01 · Mark scheme

June 2018 | 8464/B/2F | Original Q5



4.6.2.1 Variation

Answer 02 · Mark scheme

November 2021 | 8464/B/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nut(s) → bird(s) → cat(s)	allow **1** mark for organisms in correct order (left to right) but arrows incorrect or missing allow **2** marks for cat(s) ← bird(s) ← nut(s) do **not** accept cat(s)bird(s) nut(s) do **not** accept cat(s) →bird(s) →nut(s)	2	AO2 4.7.2.1
03.2	answer must be consistent with food chain given in question **03.1**	if no answer to question **03.1** allow bird(s)	1	AO2 4.7.2.1
03.3	food pathogens		1 1	AO1 4.7.1.3
03.4	13.60 (mm)	allow 13.6 (mm)	1	AO2 4.6.2.2
03.5	structural		1	AO2 4.7.1.4
03.6	variation mutation reproduction generation	must be in this order	1 1 1 1	AO2 4.6.2.2

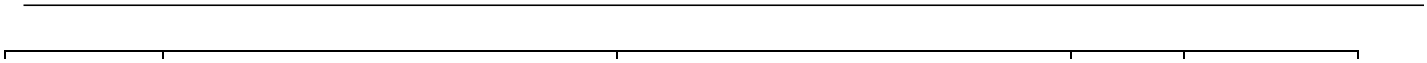
4.6.2.1 Variation

03.7	birds have a shorter life cycle than humans		1	AO3 4.6.3.1 4.6.3.4
03.8	bacteria can become resistant to antibiotics		1	AO1 4.6.3.1 4.6.3.4
Total			**13**	

4.6.2.1 Variation

Answer 02 · Mark scheme

November 2021 | 8464/B/2F | Original Q3



4.6.2.1 Variation

Answer 03 · Mark scheme

June 2023 | 8464/B/2F | Original Q6

Question 6

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	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.
06.3	heterozygous	ignore dominant / recessive	1	AO2 4.6.1.4

4.6.2.1 Variation

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(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

4.6.2.1 Variation

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	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 6	11

4.6.2.1 Variation

Answer 04 · Mark scheme

June 2024 | 8464/B/2F | Original Q1

Question 1

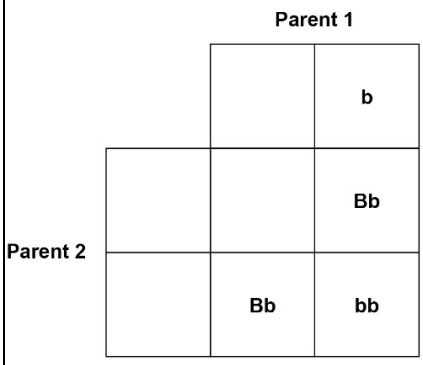
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	cell membrane		1	AO1 4.1.1.2 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	dominant		1	AO2 4.6.1.4 4.6.1.5

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

4.6.2.1 Variation

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4		allow **1** mark for **b** correct allow **2** marks for all 3 offspring genotypes correctly derived from gametes shown / given allow **1** mark for 1 or 2 offspring genotypes correctly derived from gametes shown / given derived genotypes must match parental gamete if given	1 2	AO2 4.6.1.4 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	25%	response must match question **01.4** if no answer in question **01.4** allow 25%	1	AO3 4.6.1.4 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	screening		1	AO1 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	mutation		1	AO1 4.6.2.1

4.6.2.1 Variation

Answer 04 · Mark scheme

June 2024 | 8464/B/2F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	any **one** from: • diet • behaviour • infection • named environmental cause of variation such as sunlight	allow descriptions allow examples such as physical damage, scars, tattoos, (body) piercings, smoking, use of hair / nail colourings / dye allow air pollution ignore climate unqualified	1	AO2 4.6.2.1

Total Question 1	10

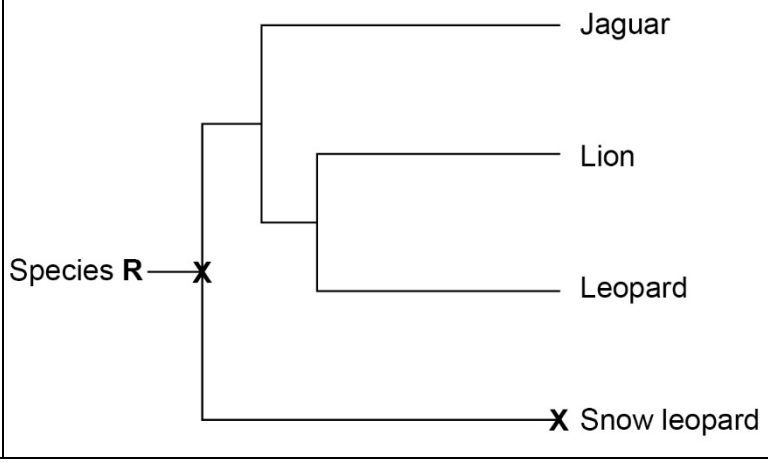
4.6.2.1 Variation

Answer 05 · Mark scheme

June 2024 | 8464/B/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	leopard		1	AO2 4.6.4

Question	Answers	Mark	AO / Spec. Ref.
04.2	a branch / line drawn at any point between 'X' marks, labelled 'tiger(s)'  	1	AO3 4.6.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	a species that the other species evolved from		1	AO3 4.6.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	natural selection		1	AO1 4.6.2.2 4.6.3.1

4.6.2.1 Variation

Answer 05 · Mark scheme

June 2024 | 8464/B/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	any **two** from: • drought • ice age • global warming	if none of these awarded allow **1** mark for climate change ignore weather	2	AO1 4.6.3.3
	• volcanic activity • asteroid collision	if neither of these awarded allow **1** mark for catastrophic event **or** natural disaster		
	• (new) predators	allow named example allow hunters		
	• (new) disease / pathogen	allow named example		
	• competition for food	allow lack of food		
	• competition for mates	allow lack of mates ignore competition unqualified		
	• lack of habitat **or** habitat change	ignore environment change ignore isolation ignore pollution		

4.6.2.1 Variation

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	any **one** from: • if species is extinct • if (fossil) species is unknown • evolution is (usually) slow • (fossils) show (evolutionary) change	ignore fossils are (usually) very old	1	AO1 4.6.4 4.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	**(D) → B → A → E → C**	allow **1** mark for link **B → A** allow **1** mark for link **A → E** allow **1** mark for link **E → C**	3	AO2 4.6.3.1 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	antibiotic resistant bacteria will continue to evolve bacteria reproduce very rapidly		1 1	AO3 4.6.3.1 4.6.3.4

Total Question 4	12

4.6.2.1 Variation

Answer 02 · Examiner comments November 2021 | 8464/B/2F | Original Q3

Question 3 (low demand)

Many students could not give the food chain. Some students obtained one mark out of two for having the organisms in the correct order, but used dashes or commas instead of arrows. More students could give the primary consumer in the food chain. Reading from the graph was generally answered well. Fewer students could complete the sentences about evolution.

4.6.2.1 Variation

Answer 03 · Examiner comments

June 2023 | 8464/B/2F | Original Q6

Question 6 (Standard demand)

06.1 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 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.

06.2 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 and 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. There is no expectation for teachers to teach this idea.

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 fallback mark for 'mutations'. This mark was awarded only if no other mark was given.

4.6.2.1 Variation

Answer 03 · Examiner comments June 2023 | 8464/B/2F | Original Q6

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.

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

06.4 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.

06.5 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.

4.6.2.1 Variation

Answer 03 · Examiner comments June 2023 | 8464/B/2F | Original Q6

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.

4.6.2.1 Variation

Answer 04 · Examiner comments

June 2024 | 8464/B/2F | Original Q1

Question 1 (low demand)

01.1 The vast majority of students could identify that the cell membrane controls the movement of substances into and out of cells.

01.2 More than half of the students could identify that the allele would be dominant.

01.3 More than half of the students correctly selected 'heterozygous' as the term that describes the genotype Bb.

01.4 Most students could interpret the question and use the Punnett square. The Punnet square had been partially completed to reduce the demand of this question. Where students made an error in their choice of gamete for Parent 1, they could still gain the 2 derivation marks using their incorrect gamete. The derivation marks could only be given if the derivation matched the gamete given by the student.

01.5 Students were told that cystic fibrosis is caused by a recessive allele, so the question tested their application of this fact to their Punnett square. The percentage had to match the derivations given in question 01.4. If no derivations were attempted in question 01.4, then an answer of 25% was awarded the mark.

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4.6.2.1 Variation

Answer 04 · Examiner comments June 2024 | 8464/B/2F | Original Q1

0 1 . 4 Two people plan to have a child.

Both people have the genotype **Bb**.

Complete **Figure 1** to show the possible genotypes of the child.

[3 marks]

Figure 1

		Parent 1	
		B	b
Parent 2	B	BB	bb
	b	bb	BB

0 1 . 5 What is the chance that a child of these parents will have cystic fibrosis?

Use **Figure 1**.

[1 mark]

Tick (✓) **one** box.

0% ☐ 25% ☐ 50% ☑ 75% ☐

This student gave the correct Parent 1 gamete, but did not correctly derive any offspring genotypes, therefore 1 mark was awarded for question 01.4.

In question 01.5, the student gave a correct percentage from their Punnett square, therefore the mark was awarded.

01.6 Most students knew that screening was being described.

01.7 Nearly all students knew that mutation is the name of a change in DNA.

01.8 The mark scheme required a cause of environmental variation or the result of the cause. Where a student gave a result of the cause as their response, this was only given credit if it is from an environmental cause. For example, a tattoo would be the result of an environmental cause. However, weight, freckles, skin colour and hair colour are all also affected by genetic causes, so a student needed to qualify these to gain credit. Correct examples commonly seen were 'weight because you eat too much' and 'freckles/skin colour from being out in the sunlight'. Despite the prompt in the question *not* to refer to inheritance or to changes in DNA, these were frequently seen.

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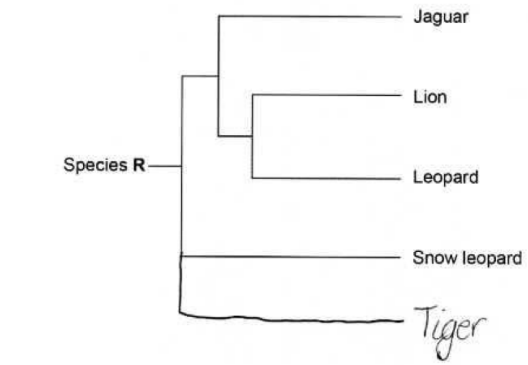
4.6.2.1 Variation

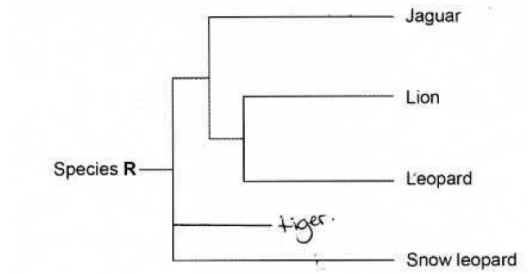
Answer 05 · Examiner comments

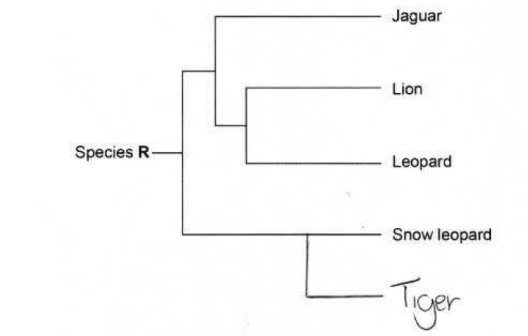
Question 4 (low & standard demand)

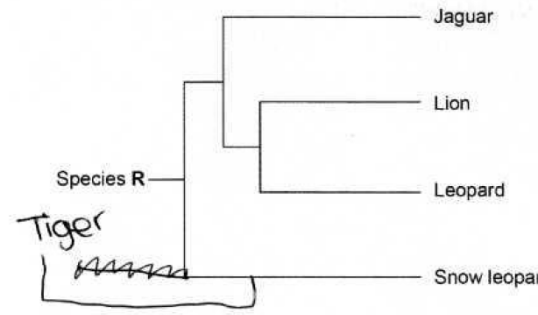
04.1 Most students could interpret the evolutionary tree correctly.

04.2 Most students could add the line and label to the Figure. Students who did not score the mark did not label their line or labelled it incorrectly, 'lion' being frequently used. Other incorrect responses linked their line with other lines on the diagram.







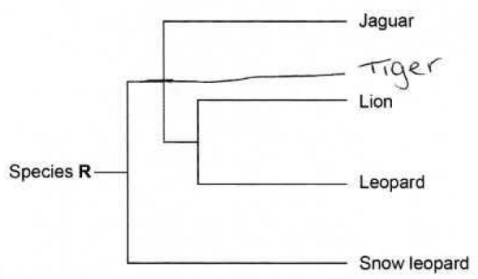


The above examples were correct, even the fourth example despite reading right to left.

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4.6.2.1 Variation

Answer 05 · Examiner comments June 2024 | 8464/B/2F | Original Q4



This response is incorrect.

04.3 The majority of students could identify what 'species R' represented.

04.4 Most students knew that evolution occurs by the process of natural selection.

04.5 Many students could give two possible causes of extinction. The most common correct responses described predators or lack of food or loss of habitat.

04.6 Most students expressed their answers in line with marking point 1 or marking point 4, with the majority saying to compare old species with those of today or seeing what they used to look like. Alternatively, for the first marking point students responded 'to see what animals there used to be before they became extinct'.

There was confusion evident in answers, with many students referring to what fossils are or references to history, what life was like in the past or how big/old the fossils were. Some students referred to fossils showing the skeletal structure but didn't compare it to the structure of the species today or discuss any change that could be seen between different fossils.

There were also many responses that referred to fossils being hundreds or thousands of years old or giving us knowledge of species that existed thousands of years ago, which is a misconception regarding geological time.

04.7 Rarely did students score 3 marks for this question, indicating that the process of evolution was not clearly understood. Students frequently linked:

- A to E or E to C
- B to A was less frequently linked.

Some students also included D in their responses even though D had already been given as the first stage.

04.8 More than 50% of students gained both marks here. A significant number of students only ticked one box, or ticked more than two boxes.

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