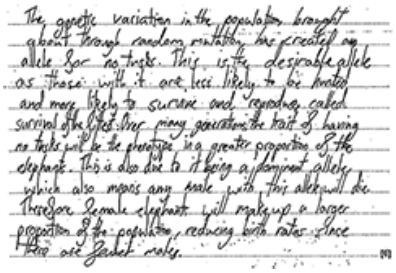
Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			**Level 3 (5–6 marks)** Detailed explanation why the number of tuskless elephants is rapidly increasing in East Africa using ideas of both inheritance and natural selection. **AND** Explains why the spread of this allele may have negative effects on the elephant population *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Explanation why the number of tuskless elephants is rapidly increasing in East Africa using ideas from either inheritance or natural selection. **AND** Explains why the spread of this allele may have negative effects on the elephant population *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Explanation why the number of tuskless elephants is rapidly increasing in East Africa using ideas from either inheritance or natural selection. **OR** Explains why the spread of this allele may have negative effects on the elephant population *There is an attempt at a logical structure with a line of reasoning. The information is in the most part*	6 (2 x AO 1.1) (2 x AO 2.1) (2 x AO 3.2a)	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to explain the significance of the allele being dominant**. **Inheritance:** • Dominant allele is **always** expressed if present • **Only one** tuskless allele needed to give phenotype/for elephant to be tuskless **AO2.1 Applies knowledge and understanding to explain why the proportion of tuskless elephants are increasing**. **Inheritance:** • 50% chance of offspring inheriting this allele (if mother is tuskless) • 50% chance of female elephants born with tusks (if mother is tuskless) • only females born tuskless • 100% of male elephants born with tusks / 0% male elephants born with no tusks (if inherit dominant allele) • Males can only survive as homozygous recessive • Accept correct Punnett square showing heterozygous x homozygous recessive **Natural selection:** • Tuskless elephants are less likely to be hunted ORA • The tuskless elephants are more likely to survive and breed ORA • The allele for tuskless is more likely to be passed on ORA

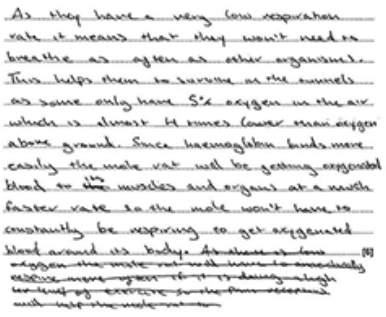
			relevant. **0 mark** *No response or no response worthy of credit.*		• The frequency of the tuskless allele will increase in the population over time • No males born without tusks **AO3.2a Analyses information to explain why the spread of the allele may have negative effects**. • (The allele is lethal to male embryos) so fewer male elephants will be born/male population will fall • This will cause the number of males to females in the population to be unbalanced • Female elephants may find it harder to find a mate • More males hunted with tusks so less males • (Female) elephants will not be able to defend themselves without tusks. • Idea tusks are used to access food **<u>Examiner's Comments</u>** Just under half of candidates were given Level 2 in the Level of Response extended writing question and could access the question where they had to apply their knowledge and analyse information to explain why the number of tuskless elephants is rapidly increasing and why this may have negative effects on the population. Just under half of candidates achieved Level 1 or Level 3 and a small number were not given any marks. The most common given explanation was understanding that if less males are born due to the allele being fatal to them, so females would have less mates available to reproduce. Some candidates got confused that males would still be born but tuskless and unable to defend themselves however that would be the argument that the consequence for the tuskless females.

					Most candidates who correctly explained why the population of tuskless elephants are increasing identified the natural selection idea. Some candidates were able to provide a detailed explanation using their ideas of natural selection and genetic inheritance. Candidates who tried to explain using their knowledge of genetic inheritance got confused that males could pass on the allele so offspring could be homozygous dominant which could not happen. The most common credited response regarding explanations using genetics were candidates appreciating that the dominant allele is always expressed if present. Some candidates stated incorrectly that the dominant allele is always expressed in the offspring if the parent has it which cannot happen as the female cannot be homozygous dominant. Exemplar 1  The candidate explains why the number of tuskless elephants are increasing due to natural selection and explains why the spread of this allele will have negative consequences on the population so was given Level 2. The candidate did not provide a detailed explanation of why the numbers are increasing because they did not explain using ideas about genetic inheritance.
			Total	**6**	
2			**C**	1 (AO 2.2)	
			Total	**1**	

3	a		**Any three from:** (Chemical first produced) by a mutation ✓ (Idea these seeds/plants) less likely/not eaten by birds/people / **ORA** ✓ These seeds are more likely to survive and reproduce / ORA ✓ Pass on allele/gene (for making the chemical) / **ORA** ✓	3 (AO 1.1) (2 xAO 2.1)	If selective breeding described award no marks **ALLOW** these seeds/plants are better adapted (by less being eaten) **ORA** **AW** produce offspring for reproduction **ALLOW** pass on advantageous allele/gene ORA **IGNORE** pass on traits/characteristics **Examiner's Comments** This question assessed the application of knowledge and understanding of natural selection. The question was a good discriminator between candidates at different grades and over half of candidates gained 2 or full marks. Most responses provided evidence that the candidates could identify it was natural selection and they could explain how the sorghum evolved to produce the bitter taste.
	b		**Any two from:** (Select/choose plants/organisms) with less bitter chemical/show desired characteristics ✓ Breed these (plants/organisms together) ✓ Select/choose (offspring) with less bitter chemical/ desired characteristic and repeat the process ✓	2 (2 xAO 1.1)	If genetic engineering/cloning described award no marks **DO NOT ALLOW** (select) seeds/sorghum with no bitter chemical **ALLOW** cross breed/pollinated (together) **Examiner's Comments** Over half of all candidates gained full marks here, demonstrating knowledge and understanding of selective breeding.
	c		In areas where there are many birds there are higher levels of the bitter chemical / **ORA** ✓ (More bitter chemical) less likely to be eaten by the birds / **ORA** ✓	2 (AO 3.1a) (AO 3.1b)	**IGNORE** sorghum evolves to not be eaten If no worthy answer allow birds have evolved to no longer taste the bitter chemical

					Examiner's Comments This question required candidates to analyse information to draw conclusions. This proved challenging and most responses did not gain maximum marks. The most common given marking point was correctly identifying the trend from the graph, however less than half of all responses gained this mark. Many responses did not explain that sorghum that had higher levels of the bitter chemical were grown in areas with higher numbers of birds to prevent it being eaten. **Assessment for learning** Centres could provide more opportunities for candidates to analyse information and draw conclusions. These AO3 skills are accessed in the exam and make up 20%.
			Total	**7**	
4	a	i	Axes- even scales occupying more than half of the grid ✓ Plotting -all points correctly plotted ✓✓	3 (3 xAO 2.2)	0-2 points correctly plotted = 0 marks 3 points correctly plotted = 1 mark **ALLOW** +/− half a square **Examiner's Comments** This was the most accessible question on the paper with most candidates gaining full marks for choosing suitable scales and plotting the data correctly.
		ii	Line of best fit through most points ✓	1 (AO 2.2)	**DO NOT ALLOW** dot to dot line **ALLOW** line of best fit their plotting **IGNORE** any extrapolation of line **Examiner's Comments** The majority of candidates could plot a line of best fit.

	b		Allow idea they live longer than would be predicted by their mass ✓ (A rodent/mole rat) of 60g should live about 1.6 years ✓	2 (2 xAO 3.2b)	**ALLOW** rodents of their mass should not live so long **AW** size for mass **ALLOW** lifespan should be similar to gerbil of 1.5 years **ALLOW** age which matches line of best fit **ALLOW** range 1.5-1.7 years **ALLOW** live 16.5 years longer than they should **<u>Examiner's Comments</u>** This question required candidates to analyse the information regarding correlation between body mass and life expectancy. The vast number of responses were successful in identifying the mole rat for its small body mass lives longer than it should from the pattern from the graph. The more successful responses correctly identified from the graph that the mole rat should live for approximately 1.6 years.
	c		**Level 3 (5–6 marks)** Gives a detailed explanation how each of the features allows the mole rats to survive in the tunnels. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Partially explains how the features allow the mole rats to survive in the tunnels. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Gives a limited explanation of how a feature allows the mole rats to survive in the tunnels. *There is an attempt at a logical structure with a line of reasoning. The*	6 (3 xAO 1.1) (3 x AO 2.1)	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to describe the features.** • oxygen required for aerobic respiration • haemoglobin in red blood cells transports oxygen to tissues • lactic acid produced during anaerobic respiration **AO2.2 Applies knowledge and understanding to explain how the features allow the rats to survive.** • (a low respiration rate) will reduce the need for oxygen • (haemoglobin that binds oxygen more easily) will allow the oxygen to be picked up at the lungs from the low concentration in the air • (haemoglobin that binds oxygen more easily) more oxygen will be carried to the tissues/cells

			information is in the most part relevant. **0 mark** *No response or no response worthy of credit*		• less oxygen so anaerobic respiration is more likely • increased production of lactic acid • (lack of pain receptors) will prevent the lactic acid from causing pain and/or reducing movement **Examiner's Comments** The Level of Response extended writing question proved to be a good discriminator. There was a full range of responses over the 6 marks. The most successful responses were able to explain the benefits of a low respiration rate with the tunnels only having 5% oxygen, haemoglobin binding to oxygen more easily with more oxygen delivered to muscle cells to carry out respiration and few pain receptors would be able to tolerate high levels of lactic acid from anaerobic respiration better. The least successful responses just copied out the information provided in the question or only addressed few pain receptors being able to tolerate lactic acid from anaerobic respiration. The responses that did not achieve Level 3 were not specific about the role of haemoglobin in the delivery of oxygen to tissue/cells. Exemplar 2  Exemplar 2 gained Level 1, 2 marks as the candidate gave a limited explanation of how a feature allows the mole rat to survive in the tunnels. They incorrectly stated that having a

					low respiration rate meant they could breathe less instead of requiring less oxygen for aerobic respiration. They correctly identified oxygen binding with haemoglobin more easily means faster delivery of oxygen to muscles. They crossed out the part addressing pain receptors and acid.
			Total	**12**	
5			**B**	1 (AO 2.1)	
			Total	**1**	
6			A mutation occurs (so some cuckoos have a sticky membrane) ✓ (These cuckoos) can eat caterpillars ✓ (These cuckoos) will pass on the allele (for sticky membranes) ✓ Over many years/eventually all the cuckoos have sticky membranes/the allele ✓	4 (4 × AO 2.1)	**IGNORE** cuckoos get more food **IGNORE** gene **IGNORE** pass on the characteristic **ALLOW** over time, all cuckoos without sticky membranes die out **ALLOW** over time, allele frequency increases so all cuckoos have it **Examiner's Comments** Most candidates were able to score some marks on this AO2.1 question. Candidates did not generalise their description of natural selection and most answers were clearly linked to the cuckoos and the sticky membrane. Some candidates missed the first marking point by not mentioning mutation and/or the second marking point by saying they could survive better, without referring to being able to eat the caterpillars. As in previous years even the higher ability candidates referred to passing on the gene or characteristic for sticky membranes instead of the allele. Many candidates had clearly been taught that this occurred over many generations however some missed the idea that this continued until **all** the cuckoos had the sticky membrane as mentioned in the question.
			Total	**4**	
7			D ✓	1 (AO 1.1)	**Examiner's Comments** This is an AO1.1 question testing

					recall of Darwin and Wallace and the development of the theory of evolution by natural selection. In general candidates chose either A or D, although B and C were also seen. Many candidates incorrectly choosing that Wallace developed Darwin's theory 100 years later. Candidates that performed well chose the correct answer D. **Assessment for learning** Candidates should be encouraged to study the work of Darwin and Wallace in more detail. Many candidates assumed that they had wrote the book or travelled together. Most incorrect answers suggested that they were unaware that Darwin and Wallace were alive during the same time period.
			Total	**1**	
8			B ✓	1 (AO 1.1)	**Examiner's Comments** This is an AO1.1 question testing the recall of the definition of phylogenetics. The most common incorrect answer was for the distractor B.
			Total	**1**	