

Mark scheme

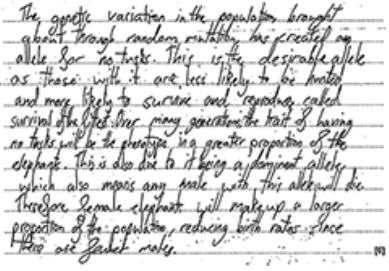
Question			Answer/Indicative content	Marks	Guidance
1	a		First check the answer on the answer line If answer = (-)69 (%) award 3 marks $(900\,000 \div 1\,300\,000) \times 100 \checkmark$ 69.23077(%) $\checkmark$ (-)69 (%) $\checkmark$	3 (2 x AO 2.2) (AO 1.2)	ALLOW $(0.9 \div 1.3) \times 100$ ALLOW any correct calculating method ALLOW any correct rounding of 69.2307692 for 2 marks ALLOW one mark for clear evidence of an incorrect answer correctly rounded to 2 significant figures <u>Examiner's Comments</u> Most candidates were given full marks for correctly calculating percentage decrease to two significant figures. The most common incorrect response was 31% but gained the two significant figures mark. Candidates had completed the calculation in reverse but then did not complete the last processing step.  OCR support The Mathematical Skills Handbook and accompanying check in tasks can be used with candidates to help familiarise them with the calculations and steps required in Science.
	b		Dropping at a decreasing rate $\checkmark$	1 (AO 2.2)	DO NOT ALLOW more than one box ticked <u>Examiner's Comments</u> This was a high scoring question whereby candidates could identify from the date that elephant numbers were dropping at a decreasing rate. The most common incorrect response was identified in Box 3 that numbers were decreasing at an increased rate.

	c	i	Idea to see (threatened) habitats/(endangered) species/ecosystems/nature ✓ To raise money/employment/profit/donation ✓	2 (2 x AO 1.1)	ALLOW in a way that will not damage / conserve the habitat/species/environment/biodiversity ALLOW education <u>Examiner's Comments</u> Most candidates were able to identify that ecotourism enabled people to visit habitats/see species or idea of conservation. Only a small number of candidates gained the second marking point by identifying that this would have monetary benefit.
		ii	Culling: Pain / cruel / unethical ✓ Relocation: Expensive/logistic/difficult/problematic to transport the elephants / elephants might be distressed/split up families ✓ Contraception: May have harmful side effects on the elephants / may not be able to reproduce again / population would be aging / ✓	3 (3 x AO 2.1)	ALLOW controversial ALLOW elephants could be hunted / may try and return to area / spread disease / eat crops in the new location IGNORE not adapted to new location/disrupt food chains/not survive ALLOW reduces number of breeding females /permanent effects on fertility ALLOW numbers drop too low/extinction if the elephants are not reproducing/less offspring. <u>Examiner's Comments</u> This question did challenge the candidates, most did not gain full marks, and some were not given any marks. It required application of knowledge to an unfamiliar context. The most common response scoring marks identified that culling was unethical/cruel and contraception could put the elephants at risk of extinction if they could no longer reproduce. The most common given mark was correctly identifying relocating the elephant was problematic in transportation or distressing to the animal. The most common non-scoring response here were the elephants would not be adapted to survive in the new habitat.

		iii	This method is not swallowed/orally/ingested / the (contraceptive) pill is taken orally/swallowed OR This method does not use hormones / (contraceptive) pill uses hormones OR This method allows egg to mature/release/ovulation / contraceptive pill prevents egg maturing/release/ovulation ✓	1 (AO 2.1)	AW female humans for contraceptive pill ALLOW Pill contains oestrogen/progesterone / pill decreases FSH/LH ALLOW (contraceptive) pill thickens mucus/uterus lining doesn't become as thick IGNORE references to lack of fertilisation IGNORE period/menstruation <u>Examiner's Comments</u> Just under half of candidates gained this mark which provided a challenge to the candidates. The most common non-scoring response were those relating to a lack of fertilisation unqualified. The most common given mark was the appreciation that the contraceptive pill contained hormones. A small number of candidates rewrote the question and stated it was a contraceptive pill and not how it was different from the new method.
	d		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 <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> 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	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)

			may have negative effects on the elephant population <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> 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 <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 mark <i>No response or no response worthy of credit.</i>	• 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 • 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
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					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
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					 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	16	
2			B	1 (AO 1.2)	
			Total	1	
3	a		Community is the total number (of butterflies) in an area ✓ Biodiversity takes into account how many different species (of butterflies) are present ✓	2 (2 xAO 1.1)	ALLOW large community means lots of butterflies ALLOW Butterflies may be of the same/few species which means low biodiversity If no worthy answer allow lots of butterflies but few/same species (of butterflies) for one mark <u>Examiner's Comments</u> The candidates were required to know the difference between community and biodiversity. The responses demonstrated that they could not clearly link large community and low biodiversity with their correct definitions. Successful responses gained 1 mark for stating that there are lots of butterflies but only one species.
	b	i	(Larger seeds) will not be spread by the wind ✓	2 (2 xAO 3.1a)	ALLOW (larger seeds) mean less seed dispersal by wind ALLOW (larger seeds) will not be spread by other insects/butterflies IGNORE less seeds

			(New buddleia) less likely/will not spread to other habitats ✓		ALLOW ORA for smaller seeds ALLOW less/no colonisation IGNORE damage to habitats <u>Examiner's Comments</u> This question required candidates to analyse the information and draw conclusions about why larger seeds would reduce damage to habitats, which candidates seemed to find challenging. The most successful responses were able to link larger seeds having less chance of seed dispersal via wind. The majority of unsuccessful responses stated that the larger seeds meant fewer seeds produced which is why there was less damage to habitats.  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%. ExamBuilder can be used to filter for questions that focus on analysis for practice with candidates.
		ii	(Uneven numbers of chromosomes will) prevent gametes being made (by meiosis) ✓ Buddleia will slow down/not be able to produce seeds/reproduce ✓	2 (2 xAO 3.1a)	AW ovule and/or pollen for gametes ALLOW prevent haploid cells being made IGNORE prevents meiosis/replicate ALLOW slow down/stop fertilisation ALLOW number of seeds reduce <u>Examiner's Comments</u> A large number of candidates gained at least 1 mark on this question, mostly given for less reproduction/fewer seeds produced when meiosis is prevented. The most successful responses also correctly identified that fewer gametes would be produced as a result. Some responses that were not given any marks just reworded the question and said stopping meiosis would stop cell

					division and therefore growth of the buddleia bushes. This did not correctly identify that it's stopping gamete production specifically.
			Total	6	
4	a	i	They were adding different volumes of run-off (to each jar) ✓ Keep the total/overall volume the same ✓	2 (2 xAO 2.2)	ALLOW to see effect/change the concentration/ratio of run-off water IGNORE effect of run-off on growth of duckweed IGNORE change concentration of pond water ALLOW so the total volume of run-off and clean pond water remains the same ALLOW to keep contents to 250cm³ IGNORE volume of water/solution kept the same <u>Examiner's Comments</u> Most candidates scored at least 1 mark here for correctly identifying that the total volume of water needed to be kept the same. Most successful responses stated that different volumes of clean pond water were added as there were different volumes of run-off water added. Most unsuccessful responses stated they were keeping the water the same which isn't the case; the volumes of both clean pond water and run-off have been changed. Some responses just reworded the information in the question that they were changing the concentration of pond water which were not given marks.
		ii	Add (excess) sodium/potassium hydrogen carbonate to the water ✓	1 (1 xAO 3.3b)	ALLOW sodium bicarbonate / carbonate solution IGNORE pH probe/CO₂ probe/limewater test/soda lime <u>Examiner's Comments</u> This was the least accessible question on the whole paper. Unsuccessful responses ranged from various devices to test the carbon dioxide concentrations without stating how they could be controlled.

					 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%. Responses suggested candidates did not know how carbon dioxide concentrations could be controlled.
	b		Run-off water contains minerals ✓ Increases the growth of the duckweed ✓ (They do not agree) because duckweed is not a submerged plant/floats on the surface so cloudiness/light would not affect photosynthesis ✓	3 (3 xAO 3.2a)	ALLOW named mineral/nitrogen compounds IGNORE nutrients IGNORE more/higher yield/biomass of duckweed IGNORE affects growth of duckweed <u>Examiner's Comments</u> The question required candidates to analyse information and draw conclusions. This was challenging for the candidates and just under half of all responses were not given any marks. The most common response seen that gained a marking point was for increased growth. Most responses did not link run-off water containing minerals. Some responses did not link eutrophication not affecting the duckweed as it floats on the surface and its ability to photosynthesise is not affected by the cloudy water.  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%. Most unsuccessful responses did not link minerals with run-off water and eutrophication to the answer.
	c		Any one from: Measure the change in mass (during	1 (AO 3.3a)	ALLOW length/height (of plant) <u>Examiner's Comments</u>

			the experiment) Length of stem/root of the plant (during the experiment) ✓		Just under half of all candidates were given this mark. Most unsuccessful responses stated they could measure the growth by collecting the volume of oxygen produced and counting the number of plants.
			Total	7	
5			Any three from: (Capture butterflies using) nets ✓ Capture some butterflies, mark, and release them ✓ Capture some again and count how many are marked ✓ Use formula/equation to (estimate the number) ✓	3 (3 xAO 1.2)	ALLOW credit for reference to a formula used Last three marking points can be awarded for a correct written formula Award 'capture – recapture' one mark if none of the last three MP are scored <u>Examiner's Comments</u> This discriminated well between candidates at different grades, with a full range of responses for marks given. This question required candidates to be able to identify the capture-recapture method for estimating the population of butterflies. The most common marking point given was use of a net to capture the butterflies. A large number of responses described the method of capture-recapture but some missed the stage of releasing the butterflies once captured and marked. A small number of responses stated you would use quadrats and random sampling as an incorrect sampling method.  Misconception In estimating the population of butterflies you would use a net and carry out the capture-recapture method.

					A number of incorrect responses chose the incorrect method of random sampling with grid co-ordinates and a random number generator with quadrats. Centres should make sure that candidates are aware of what sampling method you would choose for estimating the population of a range of species.
			Total	3	
6			B	1 (AO 1.1)	
			Total	1	
7			B	1 (AO 2.2)	<u>Examiner's Comments</u> This was one of the more challenging multiple choice questions and less than half of candidates were able to identify that B a 'key and quadrat' would be used to find the abundance of lichen on trees. The most common incorrect responses ranged equally from all A, C and D options.
			Total	1	
8	a	i	Biological ✓	1 (AO 1.1)	<u>Examiner's Comments</u> On this AO1.1 recall question only the higher ability candidates scored. A whole range of incorrect answers were given included pesticides, fungicides, spore control, pest control and artificial. It was also the most frequently omitted question as candidates either knew the term 'biological' or did not.
		ii	2 ✓	1 (AO 1.2)	<u>Examiner's Comments</u> A good number of candidates could calculate 2 orders of magnitude higher from 1×10^6 and 1×10^8. The most common incorrect answers were 10^2 and 100.
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 69.23 award 2 marks $9/13 \times 100 \checkmark$	2 (AO 1.2) (AO 2.2)	ALLOW 69.2307692308 or any correct rounding e.g. 69/69.2 <u>Examiner's Comments</u>

			69.23 (%) ✓		Higher ability candidates scored full marks on this calculation question. A common error was to put the 9 over 22 instead of 13, giving a percentage change of 40.9. Some candidates misread the question and used the data for ginger or rosemary instead and not the control treatment as asked for in the question.
		ii	Any one from: Predators ✓ Parasites/other pathogens/diseases ✓ Weather conditions/change in temperature ✓ Lack of food ✓ More competition ✓	1 (AO 2.1)	IGNORE the oil from the pine trees <u>Examiner's Comments</u> This AO2.1 was generally well answered by most candidates. The larvae having predators on the pine trees was the most common correct answer. When candidates did not score it was usually because their answer was too vague, for example a less controlled environment, or unsuitable conditions on the pine tree.
		iii	Any two from: Ginger is more effective than rosemary (at killing larvae) / ORA ✓ Ginger/rosemary is more effective on the pine trees than in the lab / ORA ✓ Both are more effective than the control treatment ✓ AND Data used to back up argument ✓	3 (3 × AO 3.1b)	ALLOW AW throughout for more effective e.g. better Data mark can only be given if at least one correct evaluation mark awarded Data must involve some manipulation e.g. ginger kills 1586 and rosemary kills 1061 in total/ginger kills 525 more overall than rosemary e.g. ginger kills 412/41.2% more in the lab than rosemary e.g. ginger kills 113/11.3% more on the pine trees than rosemary e.g. ginger kills 16.2% more on the pine trees than in the lab <u>Examiner's Comments</u> The majority of candidates gained some marks on this AO3.1b question, with a minority gaining maximum marks. Most candidates were able to analyse the information and recognise that the ginger oil was the most effective at killing the larvae. Fewer commented on the ginger or rosemary oil being more effective on the pine tree and fewer still used data from the table and just quoted it instead. Some

					candidates only referred to one oil instead of evaluating the two oils as asked for in the question.  Assessment for learning Candidates should be prepared to evaluate by processing information from the table provided, before attempting to answer the question. This will help them to construct a response that will cover the marks available in the question and make sure that the data is used to support their evaluation.												
			Total	8													
9	a		<table><tr><td></td><td>Theory 1</td><td>Theory 2</td><td></td></tr><tr><td>Changes the phenotype of the tulip plant</td><td>✓</td><td>✓</td><td>✓</td></tr><tr><td>Changes the genotype of the tulip plant.</td><td>✓</td><td>✗</td><td>✓</td></tr></table>		Theory 1	Theory 2		Changes the phenotype of the tulip plant	✓	✓	✓	Changes the genotype of the tulip plant.	✓	✗	✓	2 (2 × AO 2.1)	1 mark for each correct row <u>Examiner's Comments</u> Candidates scored well on this AO2.2 question if they followed the instructions and put ticks or crosses in the table. Those that scored 1 mark got the first row correct with 2 ticks but omitted the cross in the second row.  Assessment for learning Candidates should practice a variety of questions asking for just ticks or ticks and crosses. This would encourage candidates to read the question carefully and to follow the directions in the question.
	Theory 1	Theory 2															
Changes the phenotype of the tulip plant	✓	✓	✓														
Changes the genotype of the tulip plant.	✓	✗	✓														
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2112.68 award 2 marks $\frac{2 \times 10^9}{14200} \times \frac{1.5}{100}$ ✓ 2112.68 ✓	2 (AO 1.2) (AO 2.2)	ALLOW any correct rounding of 2112.676056 ALLOW 2112/2113 for total number of infected tulips for 2 marks ALLOW correct answer in standard form <u>Examiner's Comments</u> Most candidates carried out this calculation well and scored full marks.												

					Those that did not score often missed out the division by 14 200 hectares to convert their answer to the number of infected tulips in one hectare of land.
		ii	Level 3 (5-6 marks) Discusses the advantage of early detection and appreciates its consequences AND Discusses the usefulness of the machine including judgements based on the data <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3-4 marks) States an advantage of early detection AND Discusses the usefulness of the machine <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1-2 marks) State an advantage of early detection OR Discusses the usefulness of the machine <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit</i>	6 (2 × AO 2.1) (2 × AO 1.1) (2 × AO 3.2a)	AO1.1 Demonstrates knowledge and understanding to state the advantages of early detection - less insecticide/spray is needed - less chance that the virus is spread to other tulips (by the insects) AO2.1 Apply knowledge and understanding to appreciate the consequences of early detection. - less insecticide sprayed means less chance of pollution/less damage to the environment - less insecticide sprayed means less cost to grower - less insecticide sprayed means less risk to other insects AO3.2a Analyse information to make judgements on the usefulness of the machine. - machine can reduce the time needed to inspect tulips/the machine is faster - fairly accurate diagnosis/all/15 infected tulips are identified - only 14 diagnosed incorrectly 14 diagnosed incorrectly can lead to more area being sprayed/loss of biodiversity - idea that although some non-infected are diagnosed, no infected tulips are missed <u>Examiner's Comments</u> * There were a lot of well-constructed answers to this Level of Response question covering the AO1.1 and AO3.2a components. Most candidates could state that early detection of the virus would stop the spread of infection and that the machine helped the farmer

				to quickly identify the infected tulips. Many candidates discussed the diagnosis rates of the machine and although it did identify some non-infected tulips as infected, they recognised that it did not miss out any infected tulips. The most common score was Level 2, 4 marks. The discussion of the advantage for AO2.1 was rarely seen to score at Level 3, as many candidates mentioned that there would be a disadvantage to using the machine if it detected noninfected tulips as infected. Exemplar 2 <i>In early detection of infected tulips, this allows growers to prevent other tulips from becoming infected and also allows them to only have to use a small amount of insecticide on the tulips effected which prevents harm and harm to other insects. The machine is able when in making detection possible, since it identified all 15 infected tulips. However, it also indicated if non-infected tulips as infected, which would result in growers having to use unnecessary insecticide. Although, it did only identify the majority of not infected tulips as not infected, which benefits the grower.</i> This response represents an excellent example of how to gain maximum marks. The candidate has clearly stated the advantage of early detection by ‘preventing other tulips from being infected’ for AO1.1. They also discuss the advantage of the early detection as ‘the use of a small amount of insecticide on the tulips effected, preventing waste and harm to other insects’ for AO2.1. The candidate then discusses how useful the machine is, ‘since it identified all 15 infected tulips’ for AO3.2a. The communication is clear, concise and all aspects of the question have been covered so it scores Level 3, 6 marks.  OCR support This ‘how to answer 6 mark Level of Response questions’ set of activities will be useful to share with candidates https://www.ocr.org.uk/Images/561672-how-to-answer-6-mark-lor-activities.zip. It will allow them to practice identifying key parts of questions, as well as
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					familiarise themselves with different levels of answer.
			Total	10	
10			C ✓	1 (AO 2.2)	<u>Examiner's Comments</u> In this AO2.2 question candidates had to apply their knowledge and understanding of practical techniques. Many candidates incorrectly chose D as the scales smallest divisions are 2cm³. The question tells the candidate that the uncertainty of the scale is half of the smallest divisions on the scale, suggesting that some candidates had not read the full stem of the question.  Assessment for learning Candidates should be encouraged to read and highlight or underline key parts of the question which provide relevant information, and to not be tempted to rush and answer the question until all the stem of the question has been read.
			Total	1	
11			A ✓	1 (AO 2.2)	<u>Examiner's Comments</u> This AO2.2 question required applying knowledge of the capture-recapture technique and how the markings that would make the animals less camouflaged would affect the population estimate. Half of the candidates correctly chose A showing an understanding that the number of marked animals in the second sample would be less due to predation, causing a high estimate. Some candidates incorrectly thought the estimate would be too low and chose B, and some candidates did not commit either way choosing C.
			Total	1	
12			A ✓	1 (AO 1.2)	

			Total	1	
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