Question		Answers	Notes	Total	Criterion
1	a	***Accept any two human senses other than hearing (2 max)*** • vision/sight/seeing • taste • smell • touch/feel	*Do **not** accept eyes or other organs.* *Do **not** accept listening as this is included in the question.*	**2**	A
	b	receptor		**1**	A
	c	***Any two from the following list in the correct order:*** • receptor ***or*** sense ***or*** a named example of a receptor • sensory nerve cell ***or*** nerves ***or*** peripheral nervous system • central nervous system ***or*** brain ***or*** spinal cord ***or*** relay neuron • motor nerve cell • effector ***or*** muscles ***or*** glands • response ***or*** a descriptor of a response.		**2**	A
	d	cochlea		**1**	A
	e	Mitosis Meiosis ***Any two valid pairs of differences (2 max), for example:*** • 2 vs 4 cells (are produced) • genetically identical vs not genetically identical • same number of chromosomes as mother cells/diploid vs halved number of chromosomes/haploid • somatic cells vs gametes (are produced).	*The differences appear in separate response boxes. The order of response boxes in the candidate response is confusing.* *Award marks for **pairs** of correct differences only.* *Do **not** accept sexual vs asexual reproduction.*	**4**	A
	f	(anaerobic) <u>respiration</u> <u>anaerobic</u>	*Aerobic respiration is a CON, award no marks.*	**2**	A
	g	***Any three points from the following:*** • oxygen is needed for respiration • lack of oxygen leads to cell death ***or*** damage • <u>hair cells</u> are not muscle cells, which can switch to anaerobic respiration • (hair) cells are unable to generate energy/ATP in the absence of oxygen • lack of energy/ATP can lead to damage ***or*** death of (hair) cells • <u>hair cells</u> cannot be repaired ***or*** replaced.	*WTTE* *Accept ciliated cell in place of hair cell.*	**3**	A

2	a	3900 ± 100 (Hz)		**1**	C
	b	***A biological advantage, for example:*** • as the loudness of sounds is increased stronger vibrations are transmitted (to the cochlea) • hair cells are stimulated more intensely • thereby more nerve signals are generated (improving hearing). ***A disadvantage, for example:*** • overstimulation/amplification could lead to further damage of (remaining) hair cells • hearing aids do not help when no functioning hair cells are left • hearing aids are ineffective if vibrations are not transmitted to cochlea.	*WTTE* *Do **not** accept "using the implant allows the person to hear" alone.*	**2**	A
	c	***Either*** • <u>electrical</u> impulses/signals/stimuli • (because) the stimulation/signal enters the cochlea where otherwise hair cells would be generating nerve signals ***or*** • vibration • which would otherwise originate from eardrum or middle ear bones and stimulate hair cells.		**2**	A
	d	***Any reasonable advantage, for example:*** • enables hearing • does not require surgery • low(er) cost (than implant) • readily available. ***Any reasonable disadvantage, for example:*** • expensive • heavy • uncomfortable to wear.	*Advantage and disadvantage should not contradict each other.*	**2**	D
	e	***Any reasonable advantage, for example:*** • enables hearing (even when hair cells do not generate any nerve impulses ***or*** even when sound is not transmitted to the cochlea). ***Any reasonable disadvantage, for example:*** • expensive • requires surgery to fit.	*Advantage and disadvantage should not contradict each other.*	**2**	D

<table>
<tr><td>3</td><td>a</td><td>Recessive/h

because parents do not have condition but child does
or
because if it was dominant the parents would be affected too</td><td></td><td>2</td><td>A</td></tr>
<tr><td></td><td>b</td><td><table><tr><th>Mother</th><th>Father</th><th>Child</th></tr><tr><td>Hh</td><td>Hh</td><td>hh</td></tr></table></td><td>Accept hH</td><td>3</td><td>A</td></tr>
<tr><td></td><td>c</td><td>the AA parent will pass on an A (allele) to every child

the child will always inherit an A or dominant allele
or
the allele inherited from the other parent will have no effect</td><td>WTTE</td><td>2</td><td>A</td></tr>
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4	a	red blood cell / erythrocyte		**1**	A
	b	(Does) the quantity ***or*** amount of <u>oxygen in the blood</u> ***or*** <u>body</u> vary with altitude?	*WTTE* *Accept any question that links IV and DV.*	**1**	B
	c	there are only two data points ***or*** there is only one trial	*Do **not** accept reference to control variable.*	**1**	C
	d	quantity of oxygen in the blood decreases as altitude increases ***or*** there is an inverse relationship	*ORA*	**1**	C
	e	Accept any value in the range 78-82 (units).		**1**	C
	f	***Any four points from the list:*** • a basic, correct reference to homeostasis • if there is less oxygen (in the blood) • (then) the body produces more hemoglobin • to try and increase the quantity of oxygen <u>in the blood</u> • at higher altitude availability of oxygen decreases • if there is less oxygen in the air there will be less oxygen in the blood • the availability of oxygen in the air decreases more than the quantity of oxygen in the blood decreases • hemoglobin concentration increases as altitude increases.	*WTTE, points seen in any order*	**4**	C

5	a	***Independent variable*:** altitude ***First control variable, from:*** age of runners, resting heart rate of runners, time of runners acclimatizing, mass of food etc ***Dependent variable:*** quantity of oxygen in the blood ***or*** (percentage) blood saturation ***or*** heart rate ***Second, different control variable, from list above***	*Accept any reasonable control variable that can be measured.*	**4**	B
	b	blood oxygen saturation decreases with altitude heart rate increases with altitude ***Any additional point (1 max)*** • to move blood through the body more quickly • to supply oxygen to meet oxygen demand • (because) as the altitude increases the availability of oxygen in the air decreases	*WTTE*	**3**	C
	c	***Any two reasonable improvements, for example (2 max):*** • more than three altitudes • more than five people • another reasonable control variable. ***Correctly linked justifications, for example (2 max)*** • better idea of trend • data would be more reliable	*Do **not** accept "use better equipment".* *Review 5(a) before awarding a mark for an additional measurable control variable.*	**4**	C
	d	***Any reasonable extension, for example (1 max):*** • study various ages • study other physiological factors. ***Correctly linked justification***		**2**	C

6	a	***Any two reasonable control variables, for example (2 max):*** • age of pika • sex of pika • time of year. ***Correctly linked justification (2 max)***	*Do **not** award the justification mark if the control variable is not correct.*	**4**	B
	b	at least three individuals		**1**	B
	c	***Correct headings:*** altitude mean or average (body) mass ***Both units correct:*** m ***and*** g at least five values recorded	*Can be seen in headings or with data – allow one omission if with data.*	**4**	C
	d	correct calculation of the difference in mass: 16.6 (g) correct final percentage: 11.874106 ***or*** 11.87411 ***or*** 12 etc (%) any final value to three significant figures	*Award **3** if only 11.9 is seen.* *Award **(2 max)** if 10.6 is seen.* *If working is shown and these values are not seen, use the highest and lowest values given in part (c) to calculate the % increase, do not accept the % decrease using values from (c).*	**3**	C D D
	e	justification refers to trends in the data answer is supported by numerical data		**2**	C

	f	***One strength, for example:*** • separate groups were identified • measurements were taken at several altitudes • trait was reliably measured. ***One limitation, for example:*** • did not check if the groups were isolated • only looked at one mountain • did not check whether the food was the same • change in mass does not necessarily mean natural selection has taken place. ***Two further points from either list (2 max)*** ***A concluding appraisal that the method was inappropriate***		**5**	C

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<tr><td>• states the problem to be studied
• some variables are referred to, that are connected to the problem, but these may not be explicitly identified</td><td>1-2</td></tr>
<tr><td>• describes the problem to be studied but this is incomplete
• formulates a hypothesis connected to the variables but not explicitly linked to the variables with no explanation
• independent or dependent variable and one control variable are identified
• incomplete description of how the variables will be manipulated</td><td>3-6</td></tr>
<tr><td>• describes the problem to be studied
• formulates a testable hypothesis correctly linked to the variables (with no explanation) or formulates a (non-testable) hypothesis with correct scientific explanation
• independent variable and dependent variable and one control variable are identified
• detailed description of how the variables will be manipulated
• some equipment is stated
• method is likely to give sufficient data relevant to the problem
• any relevant comment relating to monitoring the health of the participant or an ethical concern eg keeping the test within the normal limits of the human body, informed consent</td><td>7-13</td></tr>
<tr><td>• describes, with reasons, the problem to be studied
• formulates a testable hypothesis correctly linked to the variables and with correct scientific explanation
• independent, dependent and at least two control variables are identified
• detailed description of how the variables will be manipulated
• relevant equipment is stated
• method is likely to give sufficient data relevant to the problem
• any relevant comment relating to monitoring the health of the participant
• an ethical concern eg keeping the test within the normal limits of the human body, informed consent</td><td>14-21</td></tr>
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<td>21</td>
<td>B</td>
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8	a	fungus		**1**	A
	b	introduction of <u>Japanese</u> / <u>foreign</u> / <u>non-native</u> / <u>exotic</u> trees that were carrying the blight disease/fungus/infection	*Not "tree" alone*	**2**	D
	c	***Correct use of a term from the list:*** xylem, phloem, transpiration, translocation ***Two points from the list below (2 max):*** • xylem ***or*** phloem ***or*** <u>transport</u> tissue is damaged • transport ***or*** transpiration ***or*** translocation will be affected • water / mineral nutrients are not transported (by damaged xylem) • sugars / assimilates are not transported (by damaged phloem).	*WTTE*	**3**	D A
	d	***Similarity, for example:*** • both can add new traits/characteristics/features to an organism • both can create a new combination of genes. ***Difference, for example:*** • genetic engineering produces faster results • genetic engineering can add traits from one species to a new species.		**2**	D
	e	(extract the) resistance / target ***or*** desired gene / DNA / genetic information… …(oxo gene) from <u>wheat</u> ***or*** …<u>oxo</u> gene (from wheat) insert the gene into the American chestnut (using enzymes) resistance /target ***or*** desired gene /DNA/genetic information is transferred to the offspring	*WTTE*	**4**	D

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<tr><td>• a statement of an advantage or a disadvantage
• a statement of an environmental or an economic impact</td><td>1-2</td></tr>
<tr><td>• a statement of an advantage and a disadvantage
• a statement of an environmental and an economic impact
• the environmental or economic impact is linked to the advantage or disadvantage
• a suggestion of how the wider ecosystem could be affected</td><td>3-6</td></tr>
<tr><td>• a description of an advantage and a disadvantage
• a description of an environmental and an economic impact
• the environmental or economic impact is correctly linked to the advantage or disadvantage
• a correct statement of how the new genetic variant would impact the wider ecosystem linking different factors</td><td>7-10</td></tr>
<tr><td>• a detailed discussion of an advantage and a disadvantage
• the environmental and the economic impacts are correctly linked to the advantage
• the environmental and the economic impacts is correctly linked to the disadvantage
• a detailed discussion of how the new genetic variant would impact the wider ecosystem linking different factors
• a concluding appraisal of all factors discussed</td><td>11-15</td></tr>
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<td>15</td>
<td>D</td>
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