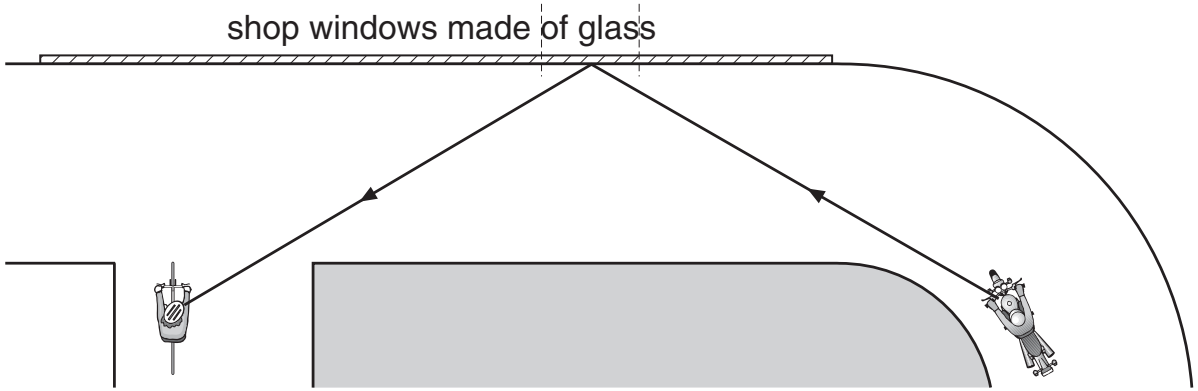
Tier	Q No			Tier	Q No
3–6	10	4/3a	that light travels in a straight line at a finite speed in a uniform medium	3–6	10
5–7	1	4/3c	how light is reflected at plane surfaces	5–7	1
		BS/1a	a range of domestic, industrial and environmental contexts		

Part	Mark	Answer	Accept	Additional guidance
(a)	1	* B ✓		if more than one box is ticked, award no mark
(b) (i)				
	1	* a continuous straight line from Joan's motor bike to the glass, and then from the glass to Nadia's head		the incident ray and the reflected ray must touch the glass at the same point
	1	* angle of incidence must be approximately equal to the angle of reflection		the incident ray must hit the mirror within the tolerance shown
	1	* an arrow pointing away from Joan's motor bike on either section of the ray		
(ii)	1	any **one** from * traffic coming round the bend **or** at the junction will be seen * Nadia **or** Joan **or** you can see round the bend		
Total	**5**			

Tier 3–6 5–7	**Q No 11 2**	4/3k 4/5e	the relationship between the pitch of a sound and the frequency of the vibration causing it ways in which energy can be usefully transferred and stored	**Tier 3–6 5–7**	**Q No 11 2**

Part	**Mark**	**Answer**	**Accept**	**Additional guidance**
(a) (i)	1	* electrical to chemical ✓		if more than one box is ticked, award no mark
(ii)	1	* chemical to electrical to sound ✓		if more than one box is ticked, award no mark
(b)	1 1 1	* Q * R * P		
Total	**5**			

Tier 3–6 5–7	Q No 12 3	4/2c	that unbalanced forces change the speed or direction of movement of objects and that balanced forces produce no change in the movement of an object	Tier 3–6 5–7	Q No 12 3
		4/2d	ways in which frictional forces, including air resistance, affect motion, *for example, streamlining cars, friction between tyre and road*		

Part	Mark	Answer	Accept	Additional guidance
(a) (i)	2	any **two** from * gravity **or** weight * friction * reaction * air resistance	 accept 'upthrust' accept 'drag'	 *do **not** accept* 'centrifugal force' **or** 'centripetal force' **or** 'g-force'
(ii)	1	any **one** from * constant speed * steady speed * it stays the same	 accept 'it is the same' **or** 'it does not change'	
(b)	1	* friction is less		'it is smoother' **or** 'it is slippery' are insufficient
(c)	1 1	* it increases * because there is less air resistance **or** friction	accept 'he goes more quickly' accept 'he is streamlined **or** aerodynamic'	
Total	**6**			

Tier 3–6 5–7	Q No 13 4			Tier 3–6 5–7	Q No 13 4
		1/1a	about the interplay between empirical questions, evidence and scientific explanations using historical and contemporary examples, *for example, Lavoisier's work on burning, the possible causes of global warming*		
		1/1b	that it is important to test explanations by using them to make predictions and by seeing if evidence matches the predictions		
		1/2d	consider key factors that need to be taken into account when collecting evidence, and how evidence may be collected in contexts, *for example, fieldwork, surveys*, in which the variables cannot readily be controlled		
		1/2e	decide the extent and range of data to be collected and the techniques, equipment and materials to use, *for example, appropriate sample size for biological work*		

Part	Mark	Answer	Accept	Additional guidance
(a)	1	* No ✓ **and** any **one** from		if more than one box is ticked, award no mark **both** the answer and the explanation are required for the mark
		* sulphuric acid did not cure scurvy	accept 'some acids did not cure scurvy'	
		* not all the sailors recovered	accept 'only pair 5 totally recovered'	
		* only two pairs recovered		
		* only those that had fruit-related additions recovered		
		* some with acid failed to recover		'only those who received vitamin C recovered' is insufficient
		* a week is not long enough to show the effect	accept 'a week is not long enough'	
(b) (i)	1	any **one** from		
		* addition to their diet		*do **not** accept* 'type of food **or** drink'
		* food **or** drink supplements		*do **not** accept* 'kind of meal'
		* type of acid	accept 'the acid' accept 'amount of acid'	
				*do **not** accept* conclusions such as '4 out of 6 pairs of sailors had scurvy'
(ii)	1	any **one** from		
		* whether they recovered		
		* return to health		
		* recovery from scurvy	accept 'scurvy is cured'	
		* effect after one week		*do **not** accept* 'time to recover'

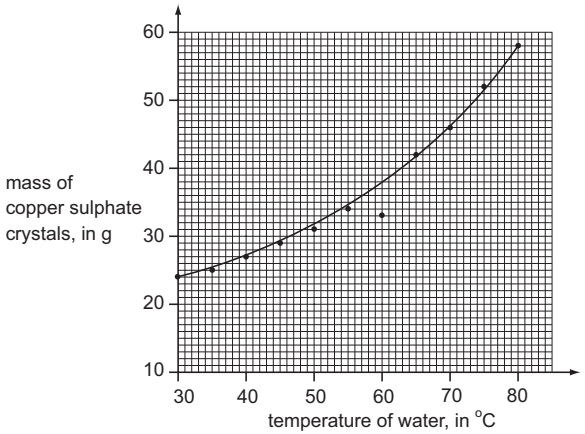
Tier 3–6 5–7	Q No 13 4		Tier 3–6 5–7	Q No 13 4

Part	Mark	Answer	Accept	Additional guidance
(c)	1	any **one** from * there must be a different substance **or** something present in fruits that cures scurvy	accept 'fruits will cure scurvy' accept 'vitamin in the fruit would cure scurvy' accept 'vitamin C will cure scurvy' accept any named vitamin for vitamin C accept 'vitamins would have an effect'	'the acids in oranges and lemons cure scurvy' is insufficient 'oranges and lemons will cure scurvy' is insufficient
(d)	1	any **one** from * effects due to diet may take more than a week to reveal themselves * the body takes time to adjust to the diet * time is needed for the results to reveal themselves * the effects do not take place before a week * the longer the time the more reliable the results	accept 'one week is too short' **or** 'you need to see long term effects' accept 'oranges **or** lemons might be a short term cure'	
Total	**5**			

Tier 3–6 5–7	Q No 14 5	3/1e 3/2d BS/2b	how elements combine through chemical reactions to form compounds, *for example, water, carbon dioxide, magnesium oxide, sodium chloride, most minerals*, with a definite composition how forces generated by expansion, contraction and the freezing of water can lead to the physical weathering of rocks recognise that there are hazards in living things, materials and physical processes, and assess risks and take action to reduce risks to themselves and others	Tier 3–6 5–7	Q No 14 5

Part	Mark	Answer	Accept	Additional guidance
(a) (i)	1	* water	accept 'H_2O'	
(ii)	1	* carbon dioxide	accept 'CO_2'	
(b) (i)	1	* do not use antifreeze **or** methanol near a naked flame and do not swallow	accept 'it catches fire easily and it is poisonous' accept 'wash hands after use' for do not swallow accept 'it is flammable **or** inflammable and it is poisonous'	**both** answers are required for the mark
(ii)	1	any **one** from * water froze * the mixture froze * the contents froze	accept '10% antifreeze is not enough to stop the water freezing'	'not enough antifreeze used' is insufficient *do **not** accept* 'it froze'
	1	* and expanded		
Total	**5**			

Tier 3–6 5–7	Q No 15 6			Tier 3–6 5–7	Q No 15 6
		1/2j 1/2n	use diagrams, tables, charts and graphs, including lines of best fit, to identify and describe patterns or relationships in data consider anomalies in observations or measurements and try to explain them		

Part	Mark	Answer	Accept	Additional guidance
(a) (i)	1	* the point at (60,33) circled		
(ii)	1	* a smooth curve touching all points except the anomalous point at 60°C  	accept a reasonable smooth curve	the curve must be near to **or** touching all points except the anomalous point *do **not** accept* a dot to dot drawing *do **not** accept* lines which are thicker than the points if the points are not visible the lines are too thick
(iii)	1	* 38	accept answers from 37 to 39	
(b)	1	any **one** from * they measured mass **or** temperature inaccurately * they failed to make sure the solution was saturated * the solution had cooled	accept 'they counted the mass wrong' accept 'not enough time to dissolve' accept 'they did not stir the solution properly' accept 'they did not use enough water'	*do **not** accept* 'carelessness' **or** 'measured it wrong' *do **not** accept* 'it was not a fair test' *do **not** accept* 'they measured in wrong units' *do **not** accept* 'they wrote it down wrong'
Total	**4**			

Tier 3–6 5–7	Q No 16 7	2/1c 2/2i	ways in which some cells, including ciliated epithelial cells, sperm, ova, and root hair cells, are adapted to their functions the role of lung structure in gas exchange, including the effect of smoking	Tier 3–6 5–7	Q No 16 7

Part	Mark	Answer	Accept	Additional guidance
(a)	1	any **one** from * to prevent it collapsing * to keep it open * for support	accept 'protects against collapse' accept 'for strength' accept 'for flexibility'	'for protection' is insufficient
(b) (i)	1	* *A*: oxygen *B*: carbon dioxide	accept 'O_2' accept 'CO_2'	**both** answers are required for the mark
(ii)	1	any **one** from * it is thin * it is one cell thick * it is close to the blood supply	 accept 'there is a diffusion gradient' accept 'it is moist'	
(c) (i)	1	any **one** from * it moves mucus * it sweeps dust from lungs	 accept 'it moves bacteria'	'to clear **or** clean the airways' is insufficient
(ii)	1	any **one** from * it paralyses the cilia * it stops the cilia working * it clogs the cilia	 accept 'it destroys them'	 *do **not** accept* 'it kills cilia'
(iii)	1	* nicotine		
Total	**6**			

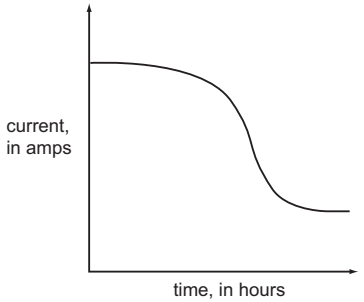
Tier 3–6 5–7	Q No 17 8	2/2g about the human reproductive system, including the menstrual cycle and fertilisation 2/2h how the foetus develops in the uterus, including the role of the placenta	Tier 3–6 5–7	Q No 17 8

Part	Mark	Answer	Accept	Additional guidance
(a) (i)	1	* the nucleus of the egg and the nucleus of the sperm join **or** fuse	accept 'the sperm and the egg join' accept 'a sperm fertilises an egg'	'a sperm meets an egg' is insufficient
(ii)	1	* the oviduct **or** fallopian tube		
(iii)	1	* uterus	accept 'womb'	
(b)	1	any **one** from * the egg cannot pass down the oviduct * the sperm and egg cannot meet * sperm cannot get through		*do **not** accept* 'the egg cannot reach the uterus'
(c)	1	any **one** from * muscles contract * contractions		
Total	**5**			

Tier 3–6 5–7	Q No 18 9			Tier 3–6 5–7	Q No 18 9
		3/1g	that mixtures, *for example, air, sea water and most rocks*, are composed of constituents that are not combined		
		3/1h	how to separate mixtures into their constituents using distillation, chromatography and other appropriate methods		
		3/2f	how igneous rocks are formed by the cooling of magma, sedimentary rocks by processes including the deposition of rock fragments or organic material, or as a result of evaporation, and metamorphic rocks by the action of heat and pressure on existing rocks		

Part	Mark	Answer	Accept	Additional guidance
(a)	1	any **one** from * it contains more than one substance which are not chemically combined * they can be separated by physical means **or** by sedimentation **or** filtration * she sees a red and a brown layer	 accept 'substances are not combined' accept 'they can be separated easily' accept 'there are layers' accept 'it splits into sand and clay'	
(b) (i)	1	any **one** from * heat the liquid * evaporate the water	 accept 'leave it until the water had gone' accept 'leave it on a radiator' accept 'distill it'	mark parts (b) (i) and (b) (ii) together 'leave it' is insufficient
(ii)	1	* a deposit left behind	accept 'a deposit' **or** 'a salt' **or** 'a solid' **or** 'crystals'	
(c)	1	* transported deposited compacted		**all three** processes in the correct order are required for the mark
Total	**4**			

Tier 5–7	Q No 10			Tier 5–7	Q No 10
		1/2j	use diagrams, tables, charts and graphs, including lines of best fit, to identify and describe patterns or relationships in data		
		1/2l	decide to what extent these conclusions support a prediction or enable further predictions to be made		
		1/2m	use their scientific knowledge and understanding to explain and interpret observations, measurements or other data, and conclusions		
		1/2n	consider anomalies in observations or measurements and try to explain them		

Part	Mark	Answer	Accept	Additional guidance
(a)	2	any **two** from: * manufacturing differences **or** bulbs are different * reading error * dirty contacts * unreliable **or** inaccurate meter	 accept 'different resistances' accept 'different ages' accept 'bulbs were not screwed in properly' accept 'faulty ammeter' accept 'different wires' **or** 'differences in the wires'	
(b)	1	* 0.75		
(c)				
	1	* *Y axis*: current, in amps **or** A **or** milliamps **or** mA *X axis*: time, in hours **or** minutes **or** seconds	accept 'I, in amps' accept 't, in hours'	**both** axes must be labelled correctly with both the variable and the unit
	1	* a line **or** curve from top left to bottom right		
Total	**5**			

Tier 5–7	Q No 11	4/3f the effect of colour filters on white light and how coloured objects appear in white light and in other colours of light	Tier 5–7	Q No 11

Part	Mark	Answer	Accept	Additional guidance
(a)	1	any **one** from * white light is a mixture of colours * white light contains green light		
	1	* the green light passes through	accept for two marks 'all the other colours are absorbed **or** filtered out' accept for two marks 'only the green light passes through'	
(b) (i)	1	* red because red light passes through the filter		**both** the colour and explanation are required for the mark
(ii)	1	* black	accept 'she cannot see it'	
	1	any **one** from * because red light will **not** pass through * a green filter absorbs red light	accept 'only green light passes through'	
Total	**5**			

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Tier 5–7	Q No 12			Tier 5–7	Q No 12
		1/1a	about the interplay between empirical questions, evidence and scientific explanations using historical and contemporary examples, *for example, Lavoisier's work on burning, the possible causes of global warming*		
		1/2d	consider key factors that need to be taken into account when collecting evidence, and how evidence may be collected in contexts, *for example, fieldwork, surveys*, in which the variables cannot readily be controlled		
		1/2g	make observations and measurements, including the use of ICT for datalogging, *for example, variables changing over time*, to an appropriate degree of precision		

Part	Mark	Answer	Accept	Additional guidance
(a)	1	any **one** from * plants subjected to **or** not subjected to acid * pH of the acid * strength of solution * volume of acid	 accept 'concentration of acid' accept 'amount of acid'	 accept any appropriate independent variable
(b) (i)	1	any **one** from * plants live **or** die * plants healthy **or** not healthy * plants **or** leaves change colour * how many seeds grow		mark parts (b) (i) and (b) (ii) together the dependent variable must relate to the independent variable mentioned in part (a)
(ii)	1	any **one** from * number of plants dying **or** ailing * number of leaves falling **or** ailing * mass of plant matter * area of plant leaf growth * height of plant	 accept 'count them' accept a reference to appropriate measuring equipment	
(c)	1	any **one** from * soil nutrients * temperature * humidity * light * acidity of soil at the beginning	accept any suitable control relevant to the factors specified in parts (a) and (b)(i)	
Total	**4**			

Tier 5–7	Q No 13	3/1f 3/3a 3/3c	to represent compounds by formulae and to summarise reactions by word equations how metals react with oxygen, water, acids and oxides of other metals, and what the products of these reactions are how a reactivity series of metals can be determined by considering these reactions, and used to make predictions about other reactions	Tier 5–7	Q No 13

Part	Mark	Answer	Accept	Additional guidance
(a) (i)	1 1	* *magnesium* + hydrochloric acid → *magnesium chloride* + * hydrogen		*do* ***not*** *accept* 'hydrogen chloride' *do* ***not*** *accept* formulae
(ii)	1	* magnesium is more reactive than hydrogen **and** copper is less reactive than hydrogen	accept 'magnesium is more reactive than copper' accept 'copper is less reactive than magnesium' accept 'magnesium is higher than copper in the reactivity series' accept 'copper is lower in the reactivity series'	
(b)	1	* sulphuric		
(c)	1 1			

	formula	name
*	$CuSO_4$	copper sulphate
*	$MgCl_2$	magnesium chloride

Total	6			

Tier 5–7	Q No 14			Tier 5–7	Q No 14
		2/2a	about the need for a balanced diet containing carbohydrates, proteins, fats, minerals, vitamins, fibre and water, and about foods that are sources of these		
		2/3a	that plants need carbon dioxide, water and light for photosynthesis, and produce biomass and oxygen		
		2/5a	about ways in which living things and the environment can be protected, and the importance of sustainable development		

Part	Mark	Answer	Accept	Additional guidance
(a)	3	any **three** from * by photosynthesis * carbon dioxide and water used * oxygen produced * chlorophyll **or** chloroplasts absorb solar energy **or** sunlight	accept for two marks the second and third marking points in a word **or** symbol equation, for example 'carbon dioxide + water → *glucose* + oxygen' accept 'solar energy transferred to chemical energy'	
(b)	1	* carbohydrates		
(c) (i)	1	any **one** from * loss of habitat * use of herbicides **or** weedkillers * climate change * competition with other plants	accept 'more buildings' accept 'global warming'	*do **not** accept* 'growing populations' as this answer is too vague
(ii)	1	* it increases because there is more light **or** there is more photosynthesis		**both** the answer and the explanation are required for the mark
Total	**6**			

Tier 5–7	Q No 15			Tier 5–7	Q No 15
		1/2d	consider key factors that need to be taken into account when collecting evidence, and how evidence may be collected in contexts, *for example, fieldwork, surveys*, in which the variables cannot readily be controlled		
		1/2o	consider whether the evidence is sufficient to support any conclusions or interpretations made		

Part	Mark	Answer	Accept	Additional guidance
(a)	1	any **one** from * only a small sample **or** insufficient evidence * a bigger sample may have boys with green eyes	accept 'they only tested boys in their class'	
(b)	1	any **two** from * armspan * handspan * height * mass		**both** answers are required for the mark
(c)	2	* false * true * true * cannot tell		award two marks if all four answers are correct award one mark for three **or** two correct answers
Total	**4**			