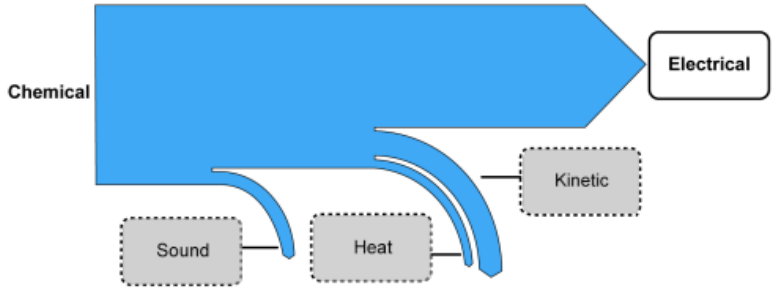
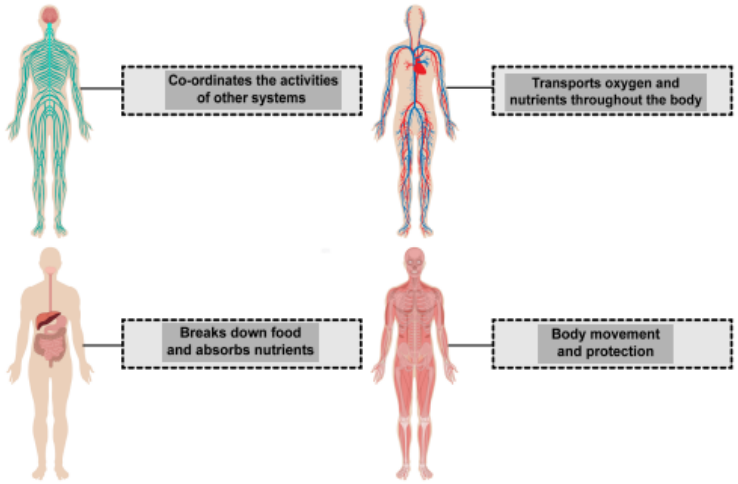
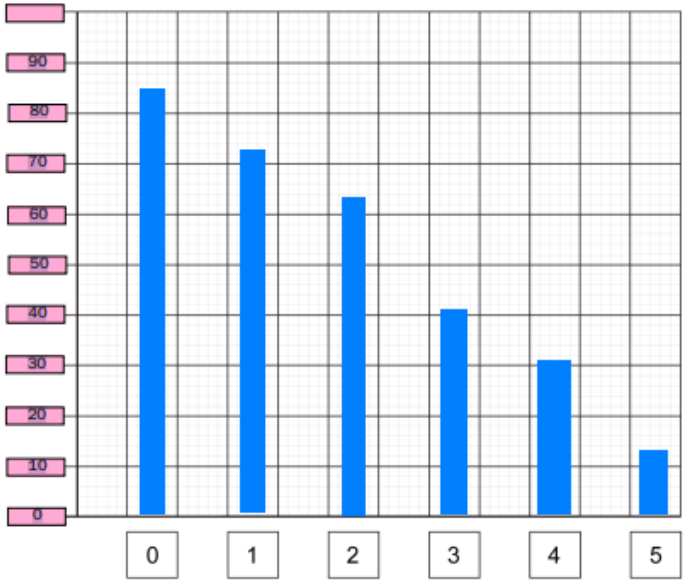
Question		Answers	Notes	Total	Crit
1	a	 Two labels in the correct location All labels in the correct location		2	A
	b	an electrically charged atom ***or*** particle ***or*** group of atoms formed by the loss of one or more electrons ***or*** gain of one or more electrons		2	A
	c	Distance travelled by scooter= 750 (m) Distance travelled by car while accelerating 337.5(m) Distance travelled by car when at constant velocity = 450(m) Total distance travelled by car = 787.5 (m so car has travelled further) m	*Award this unit mark separately. m can be seen anywhere in the calculation for a distance to award this mark*	5	A D

2	**a**	Proton [Positive] Neutron [Neutral] Electron [Negative] All correct		**1**	A
	b	Sodium: 2.8.1 ***or*** $1s^2 2s^2\ 2p^6\ 3s^1$ ***or*** $K^2L^8M^1$ Potassium: 2.8.8.1 ***or*** $1s^2\ 2s^2\ 2p^6 3s^2\ 3p^6\ 4s^1$ ***or*** $K^2L^8M^8N^1$		**2**	A
	c	Group 1 elements/metals lose 1 electron when they react ***or*** Group 1 elements/metals lose 1 electron when they form ions ***or*** Group 1 elements/metals lose 1 electron to achieve full outer shell Going down the group there is more shielding ***or*** lower attraction to the nucleus ***or*** electron is held less strongly ***or*** electron is further away from the nucleus (so) less energy is required or it is easier to lose the electron	*WTTE* *Or reverse argument*	**3**	A
	d	***Accept any two reasonable suggestions, for example [max 2]*** • keep in sealed box • buy from reputable store • do not light in a crowd • move away once the firework is lit • have fire extinguisher or water available • keep away from children and animals		**2**	A

3	**a**	 All correct		**1**	A
	b	Layers of many cells on top of each other ***or*** accept the epidermis is very thick		**1**	A
	c	Hairs trap a layer of air next to the skin Air is a poor conductor ***or*** good insulator (the trapped air) prevents heat loss to the environment	*WTTE*	**3**	A
	d	***Accept any two responses from the list below [max 2]*** • mitosis produces two (daughter) cells • mitosis produces diploid cell/2n • mitosis produces genetically identical cells ***or*** the chromosome number remains the same		**2**	A
	e	***Accept any two reasonable suggestions, for example [max 2]*** • limiting time under the sun • wearing sunscreen • avoiding tanning beds • wear a hat or protective clothing		**2**	A

4	**a**	***Any two reasonable suggestions, such as: [max 2]*** • isolates the IV to be studied • other variables can be controlled ***or*** for a fair test • safety • no special equipment needed • convenience		**2**	C
	b	D		**1**	C
	c	The prediction is valid until 40 cm^3 (of fertilizer) are added After 40 cm^3 there is no further increase (in rate of growth) Fertilizer is no longer the limiting factor ***or*** Any reference to a different limiting factor ***or*** Something else is stopping the growth eg size of pot, amount of soil, distance between the light and the plant ***or*** A different variable or factor is stopping the increase in rate	*WTTE*	**3**	C
	d	***Any two reasonable improvements. For example: [max 2]*** • three trials • more than 6 volumes of fertilizer tested • reference to another control variable. • same initial mass of plant ***Correctly linked justification. For example: [max 2]*** • increased reliability ***or*** reduce random error • better sense of trend • reduces effect of random errors • plants with the same mass will have similar surface area ***or*** similar number of chloroplasts ***or*** rate of photosynthesis will be similar	*Do **not** reward a different IV*	**4**	C

5	**a**	Algae grew or multiplied	*Accept the number of organisms increased*	**1**	C
	b	Amount of fertilizer correctly linked to percentage of light **or** growth of algae		**1**	B
	c	***Accept any two control variables [max 2]*** • Type of algae **or** algae taken from the same pond • Type of fertilizer • Light source **or** type of light **or** colour of light **or** location should be the same • Volume of water in sample • Size or cross-sectional area of test tube • Time ***Accept any two suggestions correctly linked to the CVs [max 2]*** • Different algae grow different rates, different size clusters, respond to fertilizer differently • Different fertilizers have different amounts of nutrients • Growth rate would be different with different light source or colour • Different amount of algae would be present in the initial sample • Constant distance for light to travel through • Algae would be given different times to grow		**4**	B
	d	Allow comparisons to normal growth without fertilizers ***or*** As a control ***or*** To make it a fair test	*WTTE comparison must be implied to award the mark* *Do **not** accept control variable*	**1**	B
	e	Both values accurately recorded as 33 ***and*** 11 Average for 0 drops correctly stated as 86 (%) Average for 2 drops correctly calculated as 63(%)	*Award this mark independently* *Award one mark only for an average calculation if either average is not rounded correctly*	**3**	C

	f	 ***Scale:*** Scale to cover full range of data and equally spaced increments ***Plotting:*** Bars 1, 3, 4 and 5 plotted to the correct height ***Axis Labels:*** y-axis: (Average) percentage of light (passing through the sample)	*Accept non-zero start of y axis* *Ignore bars 0 and 2*	**3**	C
	g	Increased amount or drops of fertilizer gives increased amount ***or*** concentration of <u>nutrients</u> Nutrients are linked to algae growth ***or*** multiplication Increased growth will mean that more light is blocked	Do ***not*** accept photosynthesis unless linked to growth	**3**	C

	h	Fertilizer enters the pond on day 2. On day 3, the algae multiply and the population [increases.] Initially, oxygen levels [decrease] as oxygen is needed for [cellular respiration.] When the algae population is at its maximum, the oxygen levels [increase] as a result of [photosynthesis.] ***One mark for each correct statement***		**3**	C

<table>
<tr><td>6</td><td>a</td><td colspan="5">irritant</td><td>1</td><td>B</td></tr>
<tr><td></td><td>b</td><td colspan="5">
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>1. RQ

(Research question)</td><td>RQ is suggested</td><td>RQ links IV and DV</td><td></td><td></td></tr>
<tr><td>2.V

(Variables)</td><td>IV or DV stated</td><td>IV identified as storage temperature and DV explicitly identified as volume of juice</td><td>IV identified as storage temperature and DV explicitly identified as volume of juice and at least 1 correct CV explicitly identified</td><td>IV identified as storage temperature and DV explicitly identified as volume of juice and at least 2 correct CV explicitly identified</td></tr>
<tr><td>3.E

(Equipment used in method)</td><td>Thermometer
or
Measuring cylinder</td><td>Thermometer (IV) used in method
or
Measuring cylinder to measure volume of juice (DV) used in the method</td><td>Thermometer (IV) used in method
and
Measuring cylinder to measure volume of juice (DV) used in the method
and
Equip linked to one CV that has been identified the method</td><td>Thermometer (IV) used in method
and
Measuring cylinder to measure volume of juice (DV) used in the method
and
Equip explicitly linked to measuring the enzyme volume
and
one additional CV identified in the method</td></tr>
<tr><td>4.M

(Details of Method)</td><td>Attempt at a method but detail is insufficient to follow</td><td>Partial method which includes measuring the volume of juice (DV) and two other points from following list
• Temperature (IV)
• Use of enzyme to release juice
• Collecting juice</td><td>Complete method with a logical sequence includes all of the following
• measuring the volume of juice (DV)
• Temperature (IV)
• Use of enzyme to release juice
• Collecting juice</td><td></td></tr>
<tr><td>5.D

(Data)</td><td>Method implies a range of values</td><td>Method includes 5 values of IV with 3 trials</td><td>Method includes 5 values of IV with 3 trials and plans to calculate average</td><td></td></tr>
<tr><td>6.S

(Safety issues)</td><td>One relevant safety precaution linked to the method is considered</td><td>One safety precaution correctly linked to the irritant nature of the enzyme</td><td></td><td></td></tr>
</table>
</td><td>18</td><td>Biv</td></tr>
</table>

<table>
<tr><td rowspan="4">7</td><td>a</td><td>Accept any two reasonable suggestions, for example [max 2]
• existence of health and safety laws
• accessibility of the land
• expensive initial layout for machinery so easier to employ more people
• large number of unskilled workers</td><td></td><td>2</td><td>D</td></tr>
<tr><td>b</td><td>Accept any reasonable suggestion, for example [max 1]
• lack of recycling facilities nearby
• fears regarding data/identity security</td><td></td><td>1</td><td>D</td></tr>
<tr><td>c</td><td>Accept any two, linked reasonable points, for example [max 2]
• Breathing in toxic gas
• Released from burning of components
or
• Drinking polluted ground water
• from metals leeching into the ground
or
• Physical injury – scratch, burns
• From sharp objects from breaking up phones</td><td></td><td>2</td><td>D</td></tr>
<tr><td>d</td><td colspan="3"><table><tr><th></th><th>1</th><th>2</th><th>3</th></tr><tr><td>Advantages</td><td>A statement of an advantage</td><td>A statement of two or more advantages</td><td>A statement of two or more advantages with at least one explained</td></tr><tr><td>Disadvantages</td><td>A statement of a disadvantage</td><td>A statement of two or more disadvantages</td><td>A statement of two or more disadvantages with at least one explained</td></tr></table></td><td>6</td><td>D</td></tr>
</table>

8

	1	2	3	4
Raw materials	A statement of an issue related to raw materials	A statement of two issues related to raw materials linked to science (carbon footprint, waste from ore)	A statement of two issues related to raw materials and linked to science (carbon footprint, waste from ore)	
Impact on individual and society	A statement of an impact on an individual ***or*** wider society	A statement of an impact on an individual ***and*** wider society	A statement of an impact on an individual ***and*** wider society ***and*** with further detail for one impact	A statement of an impact on an individual ***and*** wider society ***and*** with further detail for both an individual and wider society
Effects on environment	A statement of an impact on the environment	Statement of more than one effect on the environment	Statement of more than one effect on the environment ***and*** Further detail for at least one	
Implementation	A statement of one issue with implementing	Statements of two issues with implementing	Statements of two issues with implementing with further detail for at least one	
Alternate proposal	A conclusion is suggested	A conclusion is suggested ***and*** justified		

15 D