

GCSE



WJEC GCSE in
**APPLIED SCIENCE
(DOUBLE AWARD)**
APPROVED BY QUALIFICATIONS WALES

**SAMPLE ASSESSMENT
MATERIALS**

Teaching from 2016

This Qualifications Wales regulated qualification is not available to centres in England.





For teaching from 2016
For award from 2018

GCSE in APPLIED SCIENCE
(Double Award)

SAMPLE ASSESSMENT
MATERIALS

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Candidate Name	Centre Number				Candidate Number			
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**GCSE****APPLIED SCIENCE (Double Award)****UNIT 1: (Double Award) ENERGY, RESOURCES AND THE ENVIRONMENT****FOUNDATION TIER****SAMPLE ASSESSMENT MATERIALS****(1 hour 30 minutes)**

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	7	
2.	14	
3.	11	
4.	10	
5.	8	
6.	12	
7.	13	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
Question 2(b) is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** questions

1. Copper sulfate solution can be made by reacting copper carbonate with an acid.

(i) Tick (✓) the boxes next to the correct statements about this reaction. [3]

Sulfuric acid is used in this reaction

Other products are water and oxygen

The solution changes to a blue colour

The temperature of the solution decreases during the reaction

The reaction stops when fizzing stops

The fizzing is caused because oxygen is produced.

(ii) Copper sulfate crystals can be prepared from the solution produced in part (i). Complete the sentences below about this process. [2]

Impurities can be removed from the solution by

Crystals are formed when the water

(iii) A different salt can be made by reacting copper oxide with dilute hydrochloric acid. Complete the word equation below for the reaction that takes place. [2]

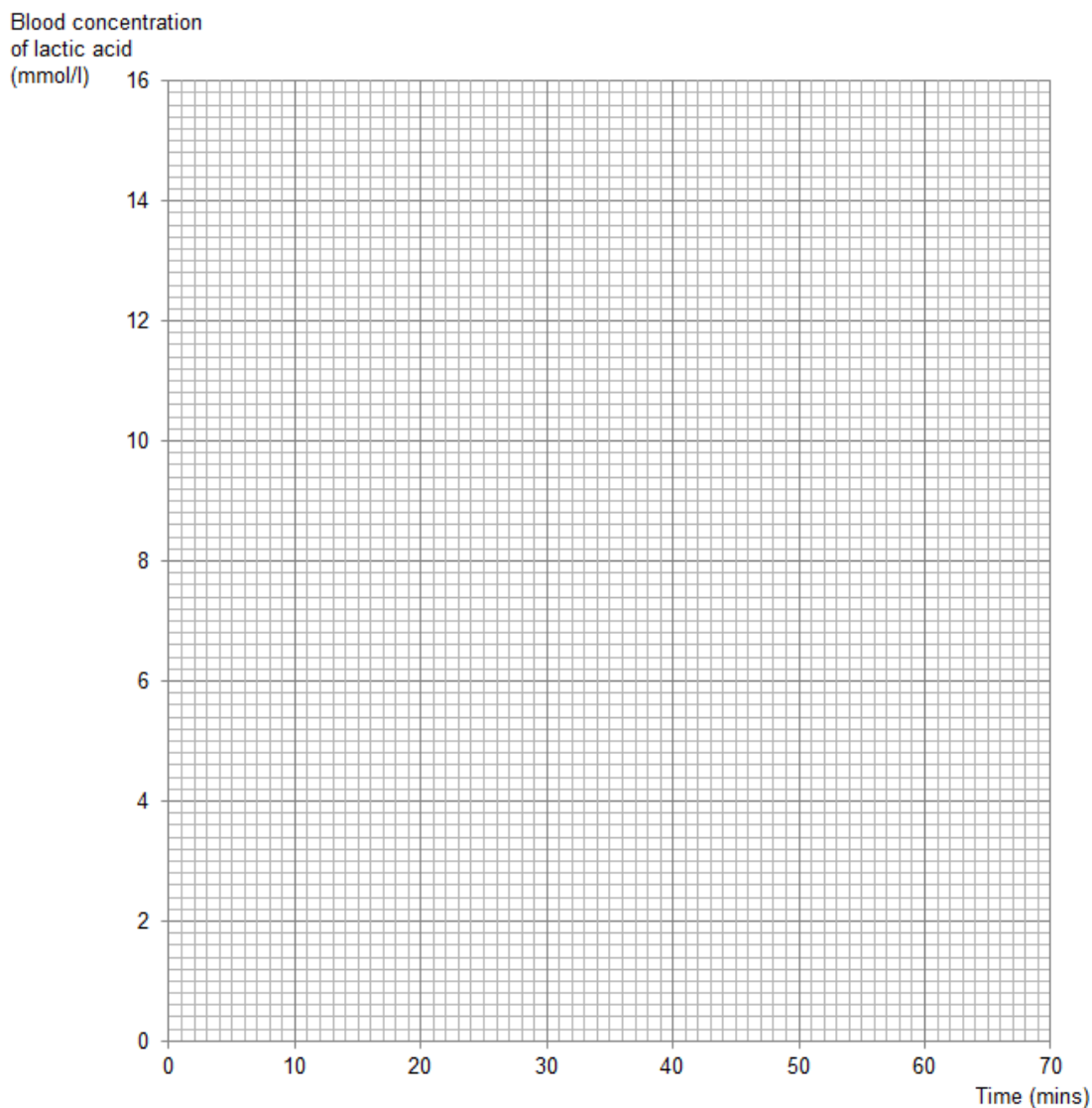
copper oxide + hydrochloric acid → +

2. A sports physiologist monitored the concentration of lactic acid in the blood of a rower when he is training. The rower exercised on a rowing machine for 20 minutes and then rested for 40 minutes.

The physiologist took a blood sample every ten minutes and tested it for lactic acid. The results are shown in the table below.

Time (minutes)	Blood concentration of lactic acid (mmol/l)
0	2
10	8
20	15
30	10
40	6
50	2
60	2

- (a) (i) Use the data to plot a graph on the grid below. [3]



- (ii) State what happened to the lactic acid concentration in the blood during exercise. [1]

.....

- (iii) Use the graph to find the concentration of lactic acid 5 minutes after exercise has started. [1]

.....mmol/l

- (iv) Use the graph to find the time taken for the lactic acid to return to a normal concentration after exercise finished. [1]

time = minutes

- (b) Before starting exercise, the rower was respiring aerobically.

Describe the process of **aerobic** respiration. Include a word equation in your answer. [6 QER]

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(c) Complete the sentences by underlining the correct word(s) in the brackets. [2]

- (i) During vigorous exercise, the muscles do not get (**carbon dioxide, nitrogen, oxygen**) quickly enough.
- (ii) After vigorous exercise, athletes still breathe quickly because of (**oxygen credit, oxygen balance, oxygen debt**).

3. Wind turbines need to be placed in windy locations to produce electricity. Before the wind turbines are built, wind speeds are measured in the area to see if they are suitable to drive the turbine.

The amount of electricity generated will also depend upon the size of the blades of the wind turbine.

Table 1 gives information about different wind turbines. The blades are not identical in shape.

Table 1

Wind turbine	Blade diameter (m)	Swept area (m ²)	Power density (m ² /kW)	Number of blades	Min wind speed (m/s)	Nominal wind speed (m/s)	Max wind speed (m/s)	Max power output (kW)
A	44	1520	1.69	3	3	14	34	900
B	70	3959	1.72	3	3	14	34	2300
C	90	6361	2.54	3	6	13	25	2500

Table 2 shows how the **mean** wind speed and density of air vary with altitude.

Table 2

Altitude (m)	Annual mean wind speed (m/s)	Density of air (kg/m ³)
12	7.8	1.192
60	9.5	1.187
100	10.3	1.182
160	10.9	1.173
200	11.3	1.167

The kinetic energy (KE) of wind delivered to a wind turbine every second is given by:

$$\text{KE/second} = \frac{1}{2} \times \text{Air Density} \times \text{Swept Area} \times (\text{Wind Speed})^3$$

(a) Use the information in the tables to answer the questions below.

(i) State the range of wind speeds that wind turbine **B** will operate in. [1]

.....

(ii) State the value of the swept area for wind turbine **C**. [1]

(iii) State the maximum power output of wind turbine **A**. [1]

(iv) Explain the effect of altitude on the kinetic energy delivered to the wind turbine every second. [2]

.....
.....

(b) A wind turbine of blade diameter 80m is placed at an altitude of 160m.

(i) Calculate the radius of the blades. [1]

radius = m

(ii) Calculate the swept area of the blades using the equation: [2]

$$\text{area} = \pi r^2 \quad (\pi = 3.14)$$

swept area = m²

- (iii) State the air density at 160m. [1]

air density = kg/m³

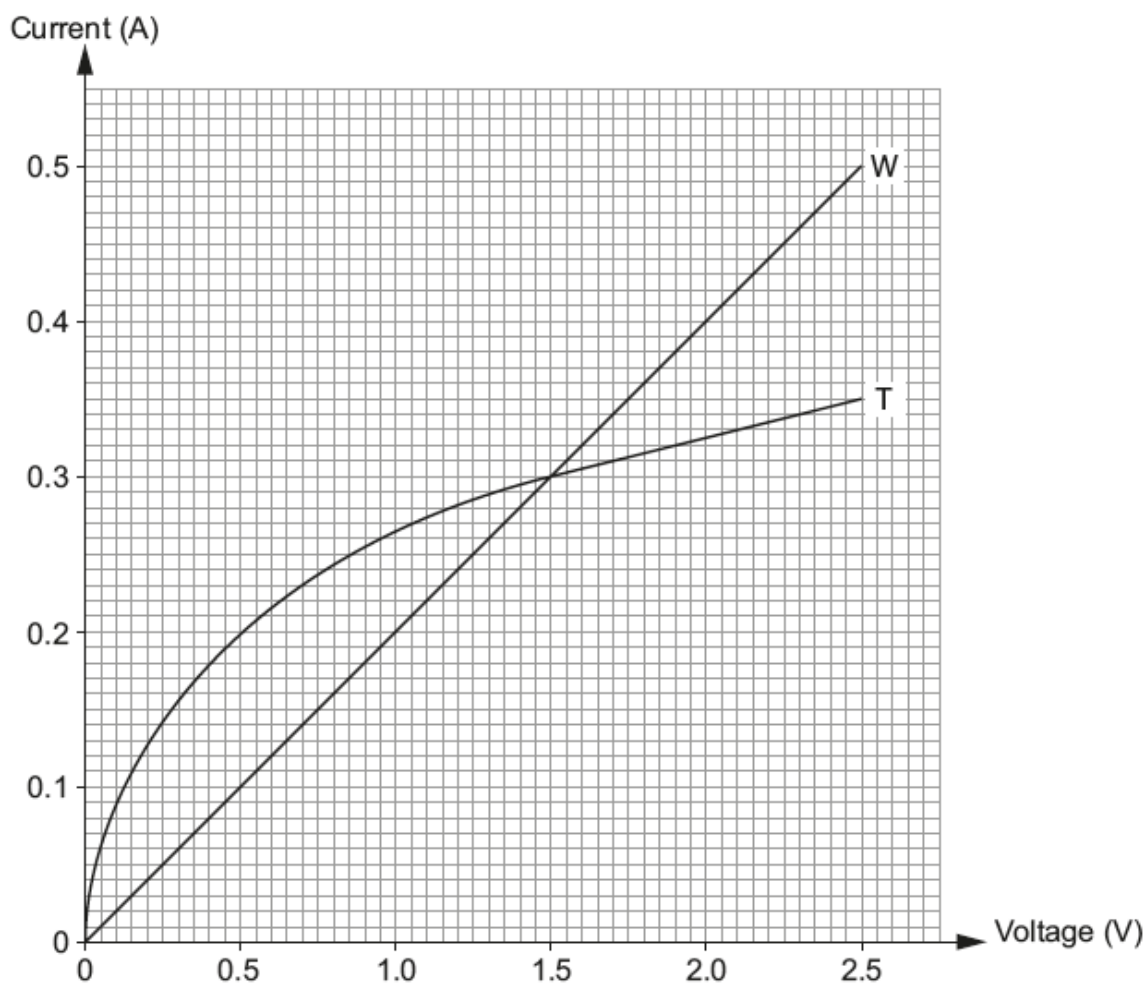
- (iv) Calculate the mean kinetic energy/second delivered to the turbine, using the equation: [2]

$$\text{KE/second} = \frac{1}{2} \times \text{Air Density} \times \text{Swept Area} \times 1300$$

KE/second = J/s

11

4. The graph shows how the current depends upon the voltage for a torch bulb (T) and a long copper wire (W).



- (a) (i) Compare how the current in the wire and bulb varies as the voltage increases from 0 to 2.5 V. [3]

.....

.....

.....

.....

- (ii) Use the graph to find the voltage at which the currents in the bulb and wire are the same. [1]

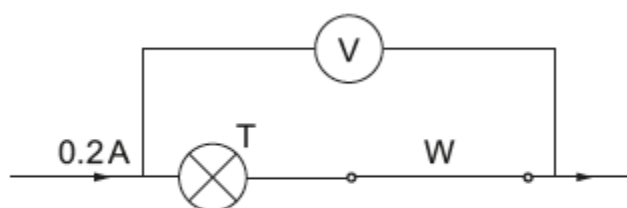
current = A

- (iii) Calculate the resistance of the wire at this voltage using the equation: [3]

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

resistance = Ω

- (b) The torch bulb and wire are shown connected in series with a current of 0.2 A flowing through them.

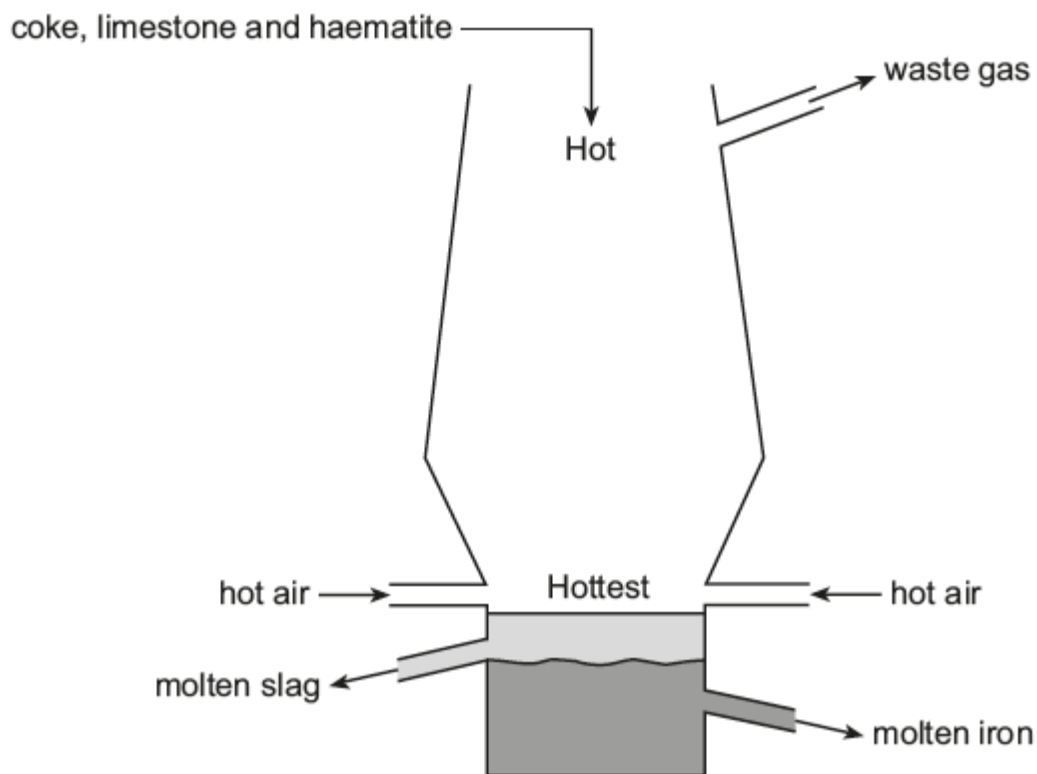


Use the graph to calculate the reading on the voltmeter. [3]

voltmeter reading = V

10

5. The diagram below shows the blast furnace which is used to extract iron.



(a) The table shows some information about the raw materials used in the process.
Complete the table.

[3]

Raw material	Chemical name	Symbol or formula	Type of material
haematite	.....	\text{Fe_2O_3	compound
coke	carbon	C	.....
limestone	calcium carbonate	.....	compound

- (b) In the blast furnace there are several chemical reactions taking place that result in iron being extracted.

The coke burns with oxygen to produce carbon dioxide. This reaction is exothermic. The carbon dioxide then reacts with more coke to give carbon monoxide.

Carbon monoxide reacts with the iron oxide to give molten iron, which trickles to the bottom of the furnace where it is collected.

Carbon dioxide is also produced as a waste gas.

- (i) State what happens in an exothermic reaction. [1]

.....
.....

- (ii) Give **one** reason why an exothermic reaction is important in this process. [1]

.....
.....

- (iii) Waste plastic can be used in the blast furnace as a reducing agent instead of coke. By using 220 000 tonnes of mixed plastic the following savings can be made:

1. 880 000 m³ of saved landfill, amounting to 11 000 trailer truck-loads.
2. Over 10 million GJ of energy saved, equal to the heating and warm water supply for 410 000 inhabitants in Germany per year.
3. Over 400 000 tonnes of CO₂ saved per year and further reduction in emissions such as SO₂ and dust into the air.

State **one** way in which each of the savings identified above is beneficial to the environment. [3]

Saving 1:

.....

Saving 2:

.....

Saving 3:

.....

6. Engineers for a car manufacturer are investigating the efficiency of different energy sources. They test model cars running on diesel, gas, batteries and hydrogen. The results of their tests are shown in the table below.

Energy source	Input energy (J)	Useful output energy (J)	Wasted energy (J)	Efficiency (%)	Range on full energy source (km)	Time to refuel
gas	1 000	350	650	35	400	5 minutes
batteries	1 000	800	200	80	100	5 hours
diesel	1 000	200	800	20	600	3 minutes
hydrogen	1 000	400	600			

- (a) (i) Explain what is meant by the statement 'the efficiency of a gas-fuelled car is 35%'. [2]

.....

- (ii) Explain why no energy source can be 100% efficient. [2]

.....

- (b) Calculate the % efficiency of hydrogen as an energy source using the equation:

[2]

$$\% \text{ efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}}$$

% efficiency =

(c) Use the data in the table to state **two** disadvantages of cars running on batteries. [2]

1.

2.

(d) (i) The batteries are charged with a 2 kW power source. Calculate the energy used when charging the batteries for 5 hours using the equation: [2]

$$\text{energy used (kWh)} = \text{power (kW)} \times \text{time (h)}$$

$$\text{energy used} = \dots\dots\dots \text{ kWh}$$

(ii) One unit of electricity costs 16 p. Calculate the cost of charging the batteries for this time using the equation: [2]

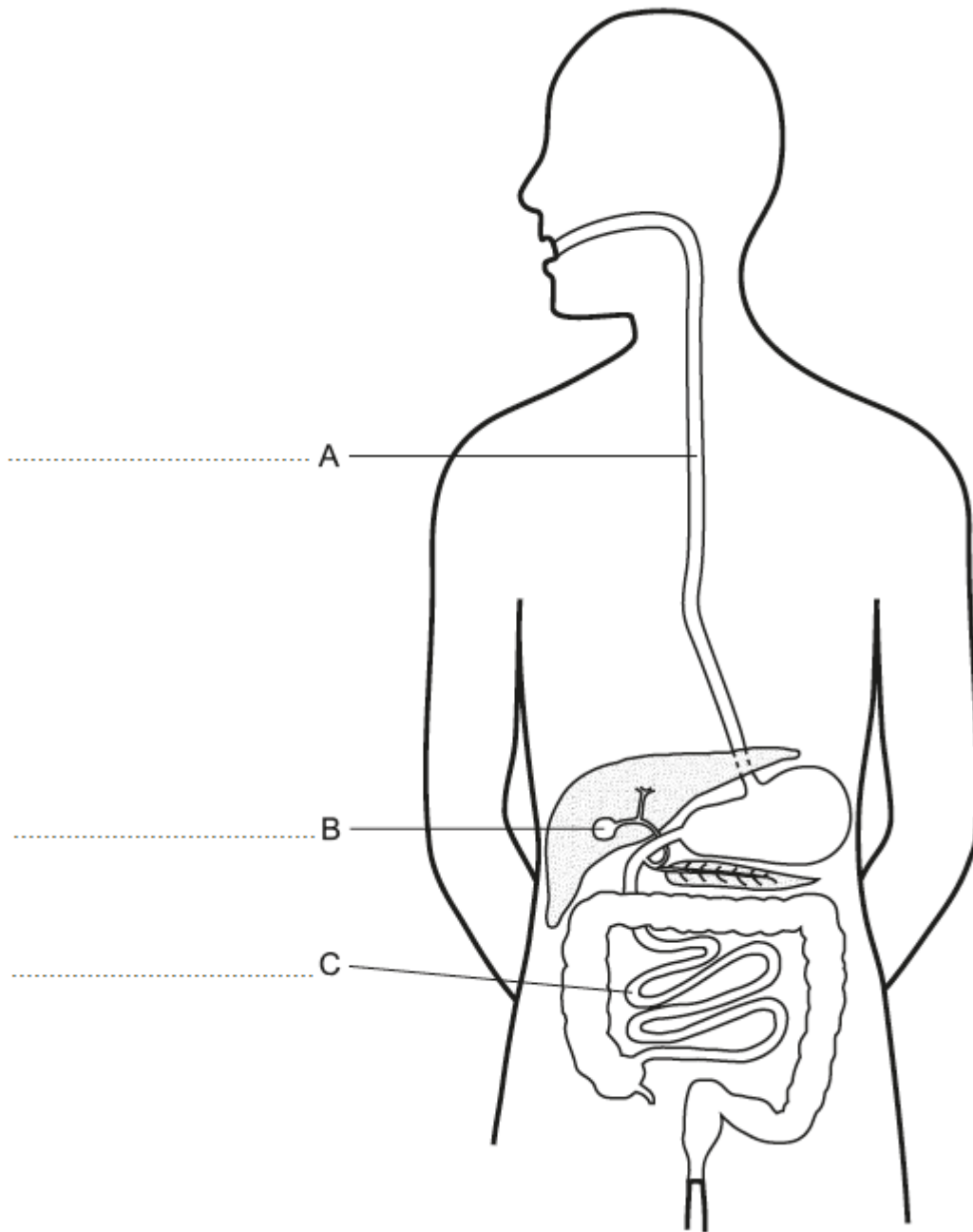
$$\text{total cost} = \text{energy used (kWh)} \times \text{cost per unit (p)}$$

$$\text{total cost} = \dots\dots\dots \text{ p}$$

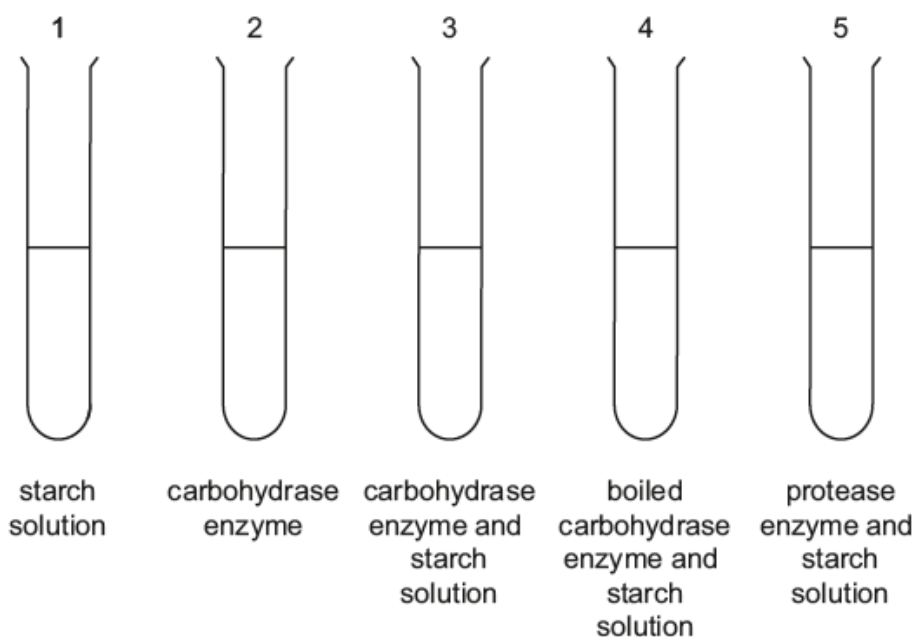
7. (a) The diagram below is of the human digestive system.

Label parts **A**, **B** and **C**.

[3]



- (b) An experiment was set up to investigate the digestion of starch by enzymes. Five test tubes were set up as follows and kept in a water bath at 35°C.



After 2 minutes a drop was taken from each tube and added to iodine solution on a white tile.

This was repeated after 60 minutes. Iodine is a yellow-brown solution which changes colour in the presence of starch.

The results are shown below.

Tube number	Colour after 2 minutes	Colour after 60 minutes
1	blue black	blue black
2	brown	brown
3	blue black	brown
4	blue black	blue black
5	blue black	blue black

- (i) Explain why a colour change occurs in tube **3** but not in tube **4**. [3]

.....

.....

.....

(ii) Explain why tube 1 and tube 2 were included in the experiment. [2]

.....
.....
.....
.....

(iii) Explain the results in tube 5. [1]

.....
.....

(iv) **On the diagram** of the digestive system in part (a), mark with the letter **X** where you could expect the reaction in tube 3 to take place. [1]

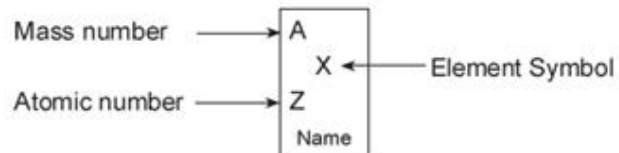
(v) Describe the test for simple sugars and the expected positive result. [3]

.....
.....
.....

PERIODIC TABLE OF ELEMENTS

1		2		Group																3		4		5		6		7		0			
				$\begin{matrix} 1 & \text{H} \\ & \text{Hydrogen} \end{matrix}$																												$\begin{matrix} 2 & \text{He} \\ & \text{Helium} \end{matrix}$	
$\begin{matrix} 7 & \text{Li} \\ 3 & \end{matrix}$ Lithium	$\begin{matrix} 9 & \text{Be} \\ 4 & \end{matrix}$ Beryllium																	$\begin{matrix} 11 & \text{B} \\ 5 & \end{matrix}$ Boron	$\begin{matrix} 12 & \text{C} \\ 6 & \end{matrix}$ Carbon	$\begin{matrix} 14 & \text{N} \\ 7 & \end{matrix}$ Nitrogen	$\begin{matrix} 16 & \text{O} \\ 8 & \end{matrix}$ Oxygen	$\begin{matrix} 19 & \text{F} \\ 9 & \end{matrix}$ Fluorine	$\begin{matrix} 20 & \text{Ne} \\ 10 & \end{matrix}$ Neon										
$\begin{matrix} 23 & \text{Na} \\ 11 & \end{matrix}$ Sodium	$\begin{matrix} 24 & \text{Mg} \\ 12 & \end{matrix}$ Magnesium																	$\begin{matrix} 27 & \text{Al} \\ 13 & \end{matrix}$ Aluminium	$\begin{matrix} 28 & \text{Si} \\ 14 & \end{matrix}$ Silicon	$\begin{matrix} 31 & \text{P} \\ 15 & \end{matrix}$ Phosphorus	$\begin{matrix} 32 & \text{S} \\ 16 & \end{matrix}$ Sulfur	$\begin{matrix} 35 & \text{Cl} \\ 17 & \end{matrix}$ Chlorine	$\begin{matrix} 40 & \text{Ar} \\ 18 & \end{matrix}$ Argon										
$\begin{matrix} 39 & \text{K} \\ 19 & \end{matrix}$ Potassium	$\begin{matrix} 40 & \text{Ca} \\ 20 & \end{matrix}$ Calcium	$\begin{matrix} 45 & \text{Sc} \\ 21 & \end{matrix}$ Scandium	$\begin{matrix} 48 & \text{Ti} \\ 22 & \end{matrix}$ Titanium	$\begin{matrix} 51 & \text{V} \\ 23 & \end{matrix}$ Vanadium	$\begin{matrix} 52 & \text{Cr} \\ 24 & \end{matrix}$ Chromium	$\begin{matrix} 55 & \text{Mn} \\ 25 & \end{matrix}$ Manganese	$\begin{matrix} 56 & \text{Fe} \\ 26 & \end{matrix}$ Iron	$\begin{matrix} 59 & \text{Co} \\ 27 & \end{matrix}$ Cobalt	$\begin{matrix} 59 & \text{Ni} \\ 28 & \end{matrix}$ Nickel	$\begin{matrix} 64 & \text{Cu} \\ 29 & \end{matrix}$ Copper	$\begin{matrix} 65 & \text{Zn} \\ 30 & \end{matrix}$ Zinc	$\begin{matrix} 70 & \text{Ga} \\ 31 & \end{matrix}$ Gallium	$\begin{matrix} 73 & \text{Ge} \\ 32 & \end{matrix}$ Germanium	$\begin{matrix} 75 & \text{As} \\ 33 & \end{matrix}$ Arsenic	$\begin{matrix} 79 & \text{Se} \\ 34 & \end{matrix}$ Selenium	$\begin{matrix} 80 & \text{Br} \\ 35 & \end{matrix}$ Bromine	$\begin{matrix} 84 & \text{Kr} \\ 36 & \end{matrix}$ Krypton																
$\begin{matrix} 86 & \text{Rb} \\ 37 & \end{matrix}$ Rubidium	$\begin{matrix} 88 & \text{Sr} \\ 38 & \end{matrix}$ Strontium	$\begin{matrix} 89 & \text{Y} \\ 39 & \end{matrix}$ Yttrium	$\begin{matrix} 91 & \text{Zr} \\ 40 & \end{matrix}$ Zirconium	$\begin{matrix} 93 & \text{Nb} \\ 41 & \end{matrix}$ Niobium	$\begin{matrix} 96 & \text{Mo} \\ 42 & \end{matrix}$ Molybdenum	$\begin{matrix} 99 & \text{Tc} \\ 43 & \end{matrix}$ Technetium	$\begin{matrix} 101 & \text{Ru} \\ 44 & \end{matrix}$ Ruthenium	$\begin{matrix} 103 & \text{Rh} \\ 45 & \end{matrix}$ Rhodium	$\begin{matrix} 106 & \text{Pd} \\ 46 & \end{matrix}$ Palladium	$\begin{matrix} 108 & \text{Ag} \\ 47 & \end{matrix}$ Silver	$\begin{matrix} 112 & \text{Cd} \\ 48 & \end{matrix}$ Cadmium	$\begin{matrix} 115 & \text{In} \\ 49 & \end{matrix}$ Indium	$\begin{matrix} 119 & \text{Sn} \\ 50 & \end{matrix}$ Tin	$\begin{matrix} 122 & \text{Sb} \\ 51 & \end{matrix}$ Antimony	$\begin{matrix} 128 & \text{Te} \\ 52 & \end{matrix}$ Tellurium	$\begin{matrix} 127 & \text{I} \\ 53 & \end{matrix}$ Iodine	$\begin{matrix} 131 & \text{Xe} \\ 54 & \end{matrix}$ Xenon																
$\begin{matrix} 133 & \text{Cs} \\ 55 & \end{matrix}$ Caesium	$\begin{matrix} 137 & \text{Ba} \\ 56 & \end{matrix}$ Barium	$\begin{matrix} 139 & \text{La} \\ 57 & \end{matrix}$ Lanthanum	$\begin{matrix} 179 & \text{Hf} \\ 72 & \end{matrix}$ Hafnium	$\begin{matrix} 181 & \text{Ta} \\ 73 & \end{matrix}$ Tantalum	$\begin{matrix} 184 & \text{W} \\ 74 & \end{matrix}$ Tungsten	$\begin{matrix} 186 & \text{Re} \\ 75 & \end{matrix}$ Rhenium	$\begin{matrix} 190 & \text{Os} \\ 76 & \end{matrix}$ Osmium	$\begin{matrix} 192 & \text{Ir} \\ 77 & \end{matrix}$ Iridium	$\begin{matrix} 195 & \text{Pt} \\ 78 & \end{matrix}$ Platinum	$\begin{matrix} 197 & \text{Au} \\ 79 & \end{matrix}$ Gold	$\begin{matrix} 201 & \text{Hg} \\ 80 & \end{matrix}$ Mercury	$\begin{matrix} 204 & \text{Tl} \\ 81 & \end{matrix}$ Thallium	$\begin{matrix} 207 & \text{Pb} \\ 82 & \end{matrix}$ Lead	$\begin{matrix} 209 & \text{Bi} \\ 83 & \end{matrix}$ Bismuth	$\begin{matrix} 210 & \text{Po} \\ 84 & \end{matrix}$ Polonium	$\begin{matrix} 210 & \text{At} \\ 85 & \end{matrix}$ Astatine	$\begin{matrix} 222 & \text{Rn} \\ 86 & \end{matrix}$ Radon																
$\begin{matrix} 223 & \text{Fr} \\ 87 & \end{matrix}$ Francium	$\begin{matrix} 226 & \text{Ra} \\ 88 & \end{matrix}$ Radium	$\begin{matrix} 227 & \text{Ac} \\ 89 & \end{matrix}$ Actinium																															

Key:



**UNIT 1: (Double Award) ENERGY, RESOURCES AND THE ENVIRONMENT
FOUNDATION TIER**

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1		(i)		Ticks in boxes 1,3 & 5 (3)		3		3		3
		(ii)		Filtration (1) evaporates (1)	2			2		2
		(iii)		Copper chloride (1) water (1)		2		2		
				Question 1 total	2	5	0	7	0	5

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	Points all correct – 2 marks; six points correct – 1 mark; less than six points correct – 0 marks Point to point line (Not: best fit) (1)		3		3	3	
		(ii)	(Lactic acid) increases			1	1		
		(iii)	5 (mmol/l)		1		1		
		(iv)	30 (minutes)			1	1	1	
	(b)		<p>Indicative content</p> <p>Aerobic respiration is a process that occurs in cells when oxygen is present. It involves a series of enzyme-controlled reactions. Glucose and oxygen react to release energy. Waste products produced are carbon dioxide and water.</p> <p>oxygen + glucose → carbon dioxide + water</p> <p>5 – 6 marks</p> <p>Detailed description of the process including reactants, products and a correct word equation.</p> <p><i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3 – 4 marks</p> <p>Description includes reactants and products. May not include an equation.</p> <p><i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks</p> <p>A basic description is given.</p> <p><i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks</p> <p><i>No attempt made or no response worthy of credit.</i></p>	6			6		

	(c)	(i)	oxygen	1			1		
		(ii)	oxygen debt	1			1		
			Question 2 total	8	4	2	14	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		3 to 34 <u>m/s</u>		1		1		
		(ii)		6 361 <u>m²</u>		1		1		
		(iii)		900 <u>kW</u>		1		1		
		(iv)		As altitude increase the wind speed increases (1) When wind speed increases more kinetic energy is delivered (1) or as altitude increases density decreases (1) therefore kinetic energy decreases (1)			2	2		
	(b)	(i)		40 m		1		1	1	
		(ii)		$r^2 = 1\,600$ (1) $= 5027.2 \text{ m}^2$ / accept 5027 (1)		2		2	2	
		(iii)		1.173		1		1		
		(iv)		subs $\frac{1}{2} \times 1.173 \times 5027$ (allow ecf) $\times 1300$ (1) Answer 3 832 836 (accept correctly rounded answers) (1)	1	1		2	2	
				Question 3 total	1	8	2	11	5	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Current increases as voltage increases in both wire and bulb (1) They are proportional to each other for the wire (1) The rate of increase reduces with the bulb (1)			3	3		
		(ii)	1.5 V		1		1	1	
	(iii)	Current read from graph = 0.3 A (1) Subs $\frac{1.5}{0.3}$ (1) = 5 Ω (1)	1	1		3	3		
	(b)		1.0 V read from graph (1) 0.5 V read from graph (1) so total voltage = 1.5 V (1)		3		3	3	
			Question 4 total	1	6	3	10	7	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Iron oxide (1) element (1) CaCO ₃ (1)	3			3		
	(b)	(i)		Energy released / temperature rises	1			1		
		(ii)		To melt the iron ore	1			1		
		(ii)		1. Less land used for landfill / so less effect on habitats. (1) 2. Less fossil fuels used /last longer/less drilling/mining. (1) 3. Lowers additions to greenhouse effect / reduces acid rain. (1)			3	3		
				Question 5 total	5	0	3	8	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		35% of input energy (1) is transferred usefully (1)		2		2		
		(ii)		Always some wasted energy (1) so useful output energy always less than input energy (1)	2			2		
	(b)			Subs of 400 (1) 40% (1)	1	1		2	2	
	(c)			Short range(1) long recharge time(1)			2	2		
	(d)	(i)		Energy used = 2×5 (1) = 10 (1)	1	1		2	2	
		(ii)		Cost = 10 (ecf) x 16 (1) = 160 p (1)	1	1		2	2	
				Question 6 total	5	5	2	12	6	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Oesophagus (1) gall bladder (1) small intestine (1)	3			3		
	(b)	(i)	tube 3 - carbohydrase digests all starch/no starch left (to react with iodine) (not: starch there/starch used up) (1) tube 4 – (boiling) denatures /destroys enzyme (1) so no digestion of starch/starch remains(1)			3	3		3
		(ii)	to show that both starch (1) and enzyme are required (for reaction to occur) (1) Award one mark only for they are controls (1)	2			2		2
		(iii)	tube 5 - protease does not digest starch/only carbohydrase (digests starch)		1		1		1
		(iv)	X in mouth or small intestine		1		1		
		(v)	Benedict's test for simple sugar (1) Heated strongly/boiled (not: heated/warmed) (1) Result - blue to red/orange (1)	3			3		3
			Question 7 total	8	2	3	13	0	9

FOUNDATION TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	5	0	7	0	5
2	8	4	2	14	4	0
3	1	8	2	11	5	0
4	1	6	3	10	7	0
5	5	0	3	8	0	0
6	5	5	2	12	6	0
7	8	2	3	13	0	9
TOTAL	30	30	15	75	22	14

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 1: (Double Award) ENERGY, RESOURCES AND THE ENVIRONMENT****HIGHER TIER****SAMPLE ASSESSMENT MATERIALS****(1 hour 30 minutes)**

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	13	
2.	11	
3.	8	
4.	14	
5.	10	
6.	7	
7.	12	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

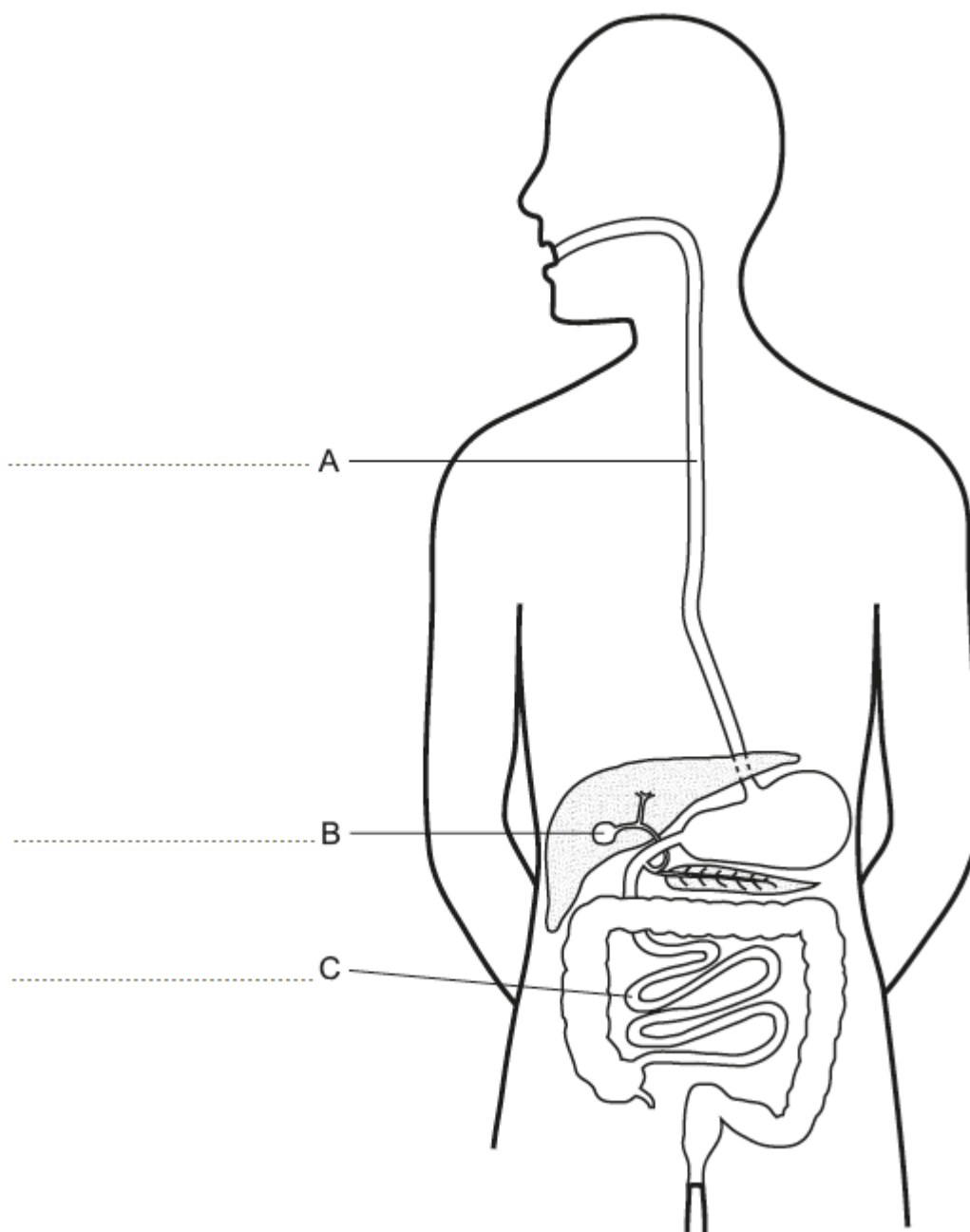
The number of marks is given in brackets at the end of each question or part-question.
Question 7(i) is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** questions

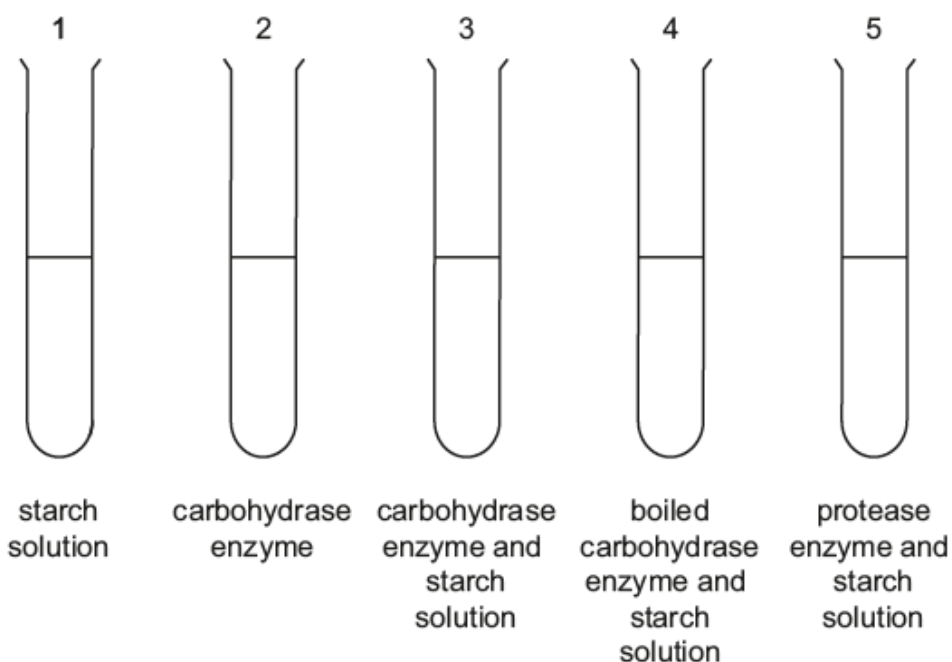
1. (a) The diagram below is of the human digestive system.

Label parts **A**, **B** and **C**.

[3]



- (b) An experiment was set up to investigate the digestion of starch by enzymes. Five test tubes were set up as follows and kept in a water bath at 35°C.



After 2 minutes a drop was taken from each tube and added to iodine solution on a white tile.

This was repeated after 60 minutes. Iodine is a yellow-brown solution which changes colour in the presence of starch.

The results are shown below.

Tube number	Colour after 2 minutes	Colour after 60 minutes
1	blue black	blue black
2	brown	brown
3	blue black	brown
4	blue black	blue black
5	blue black	blue black

- (i) Explain why a colour change occurs in tube **3** but not in tube **4**. [3]

.....

.....

.....

(ii) Explain why tube 1 and tube 2 were included in the experiment. [2]

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.....
.....
.....

(iii) Explain the results in tube 5. [1]

.....
.....

(iv) **On the diagram** of the digestive system in part (a), mark with the letter **X** where you could expect the reaction in tube 3 to take place. [1]

(v) Describe the test for simple sugars and the expected colour change. [3]

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.....

2. Engineers for a car manufacturer are investigating the efficiency of different energy sources. They test model cars running on diesel, gas, batteries and hydrogen. The results of their tests are shown in the table below.

Energy source	Input energy (J)	Useful output energy (J)	Wasted energy (J)	Efficiency (%)	Range on full energy source (km)	Time to refuel
gas	1 000	350	650	35	400	5 minutes
batteries	1 000	800	200	80	100	5 hours
diesel	1 000	200	800	20	600	3 minutes
hydrogen	1 000	400	600			

- (a) (i) Explain what is meant by the statement ‘the efficiency of a gas-fuelled car is 35%’. [2]

.....

- (ii) Explain why no energy source can be 100% efficient. [2]

.....

- (b) Calculate the efficiency of hydrogen as an energy source using the equation: [2]

$$\% \text{ efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}}$$

% efficiency =

- (c) Use the data in the table to explain why cars using batteries as the energy source are currently not very popular. [2]

.....
.....

- (d) The batteries are charged with a 2 kW power source.

Find the cost of charging the batteries for 5 hours (h) if one unit of electricity costs 16 p using the equations: [3]

$$\text{energy used (kWh)} = \text{power (kW)} \times \text{time (h)}$$

$$\text{total cost} = \text{energy used (kWh)} \times \text{cost per unit (p)}$$

total cost =

11

3. Copper(II) sulfate can be made by reacting copper(II) carbonate with an acid.

(i) State the **name** of the acid used. [1]

.....

(ii) The first stage of the preparation is the addition of excess copper(II) carbonate to the acid. State **two** observations that show a reaction is taking place. [2]

1

2

(iii) Describe how you would prepare copper(II) sulfate crystals from the mixture obtained by mixing excess copper(II) carbonate to the acid in part (i). [2]

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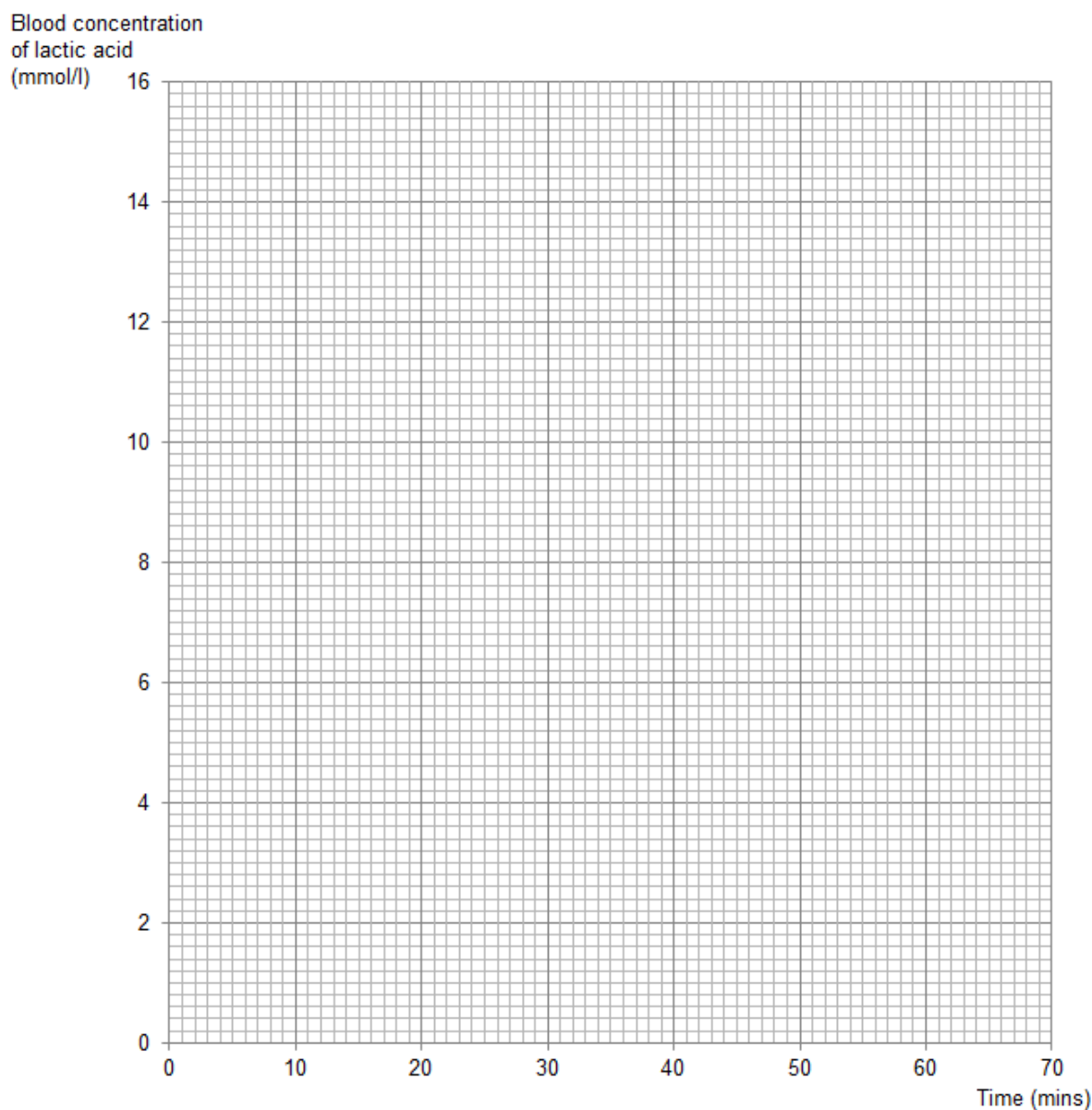
(iv) A different salt can be made by reacting copper(II) oxide with dilute hydrochloric acid. Complete the balanced equation for the reaction that takes place. [3]



4. A sports physiologist monitored the concentration of lactic acid in the blood of a rower while he was training. The rower exercised on a rowing machine for 20 minutes and then rested for 40 minutes. The physiologist took a blood sample every ten minutes and tested it for lactic acid. The results are shown in the table.

Time (minutes)	Blood concentration of lactic acid (mmol/l)
0	2
10	8
20	15
30	10
40	6
50	2
60	2

- (a) (i) Use the data to plot a graph on the grid below. [3]



(ii) Explain the pattern shown by the graph. [2]

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.....
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(b) Before starting exercise, the rower was respiring aerobically. Describe the process of **aerobic** respiration and write down the word equation. [4]

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(c) Explain the changes in concentration of lactic acid during exercise. [2]

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.....

(d) When exercise stopped, the physiologist monitored the oxygen debt.

(i) For how long was there an oxygen debt? [1]

(ii) Explain what is meant by the term 'oxygen debt'. [2]

.....
.....

5. Wind turbines need to be placed in windy locations to produce electricity. Before the wind turbines are built, wind speeds are measured in the area to see if they are suitable to drive the turbine.

The amount of energy generated will also depend on the size of the blades of the wind turbine

Table 1 gives information about different wind turbines. The blades are not identical in shape.

Table 1

Blade diameter (m)	Swept area (m ²)	Power density (m ² /kW)	Number of blades	Min wind speed (m/s)	Nominal wind speed (m/s)	Max wind speed (m/s)	Max power output (kW)
44	1520	1.69	3	3	14	34	900
70	3959	1.72	3	3	14	34	2300
90	6361	2.54	3	6	13	25	2500

Table 2 shows how the **mean** wind speed and density of air vary with altitude.

Table 2

Altitude(m)	Annual mean wind speed (m/s)	Density of air (kg/m ³)
12	7.8	1.192
60	9.5	1.187
100	10.3	1.182
160	10.9	1.173
200	11.3	1.167

The kinetic energy (KE) of wind delivered to a wind turbine every second is given by:

$$\text{KE/second} = \frac{1}{2} \times \text{Air Density} \times \text{Swept Area} \times (\text{Wind Speed})^3$$

(a) Use the information in **Table 1** to answer the questions below.

(i) State the **two** properties that affect power density. [2]

.....

(ii) Complete the equation below. [1]

power density =

(b) A wind turbine of blade diameter 80m is placed at an altitude of 160m.

(i) Calculate the swept area of the blades. [2]

(Use $\pi = 3.142$)

swept area = m²

(ii) Calculate the mean kinetic energy/second delivered to the turbine. [3]

mean kinetic energy/second = J/s

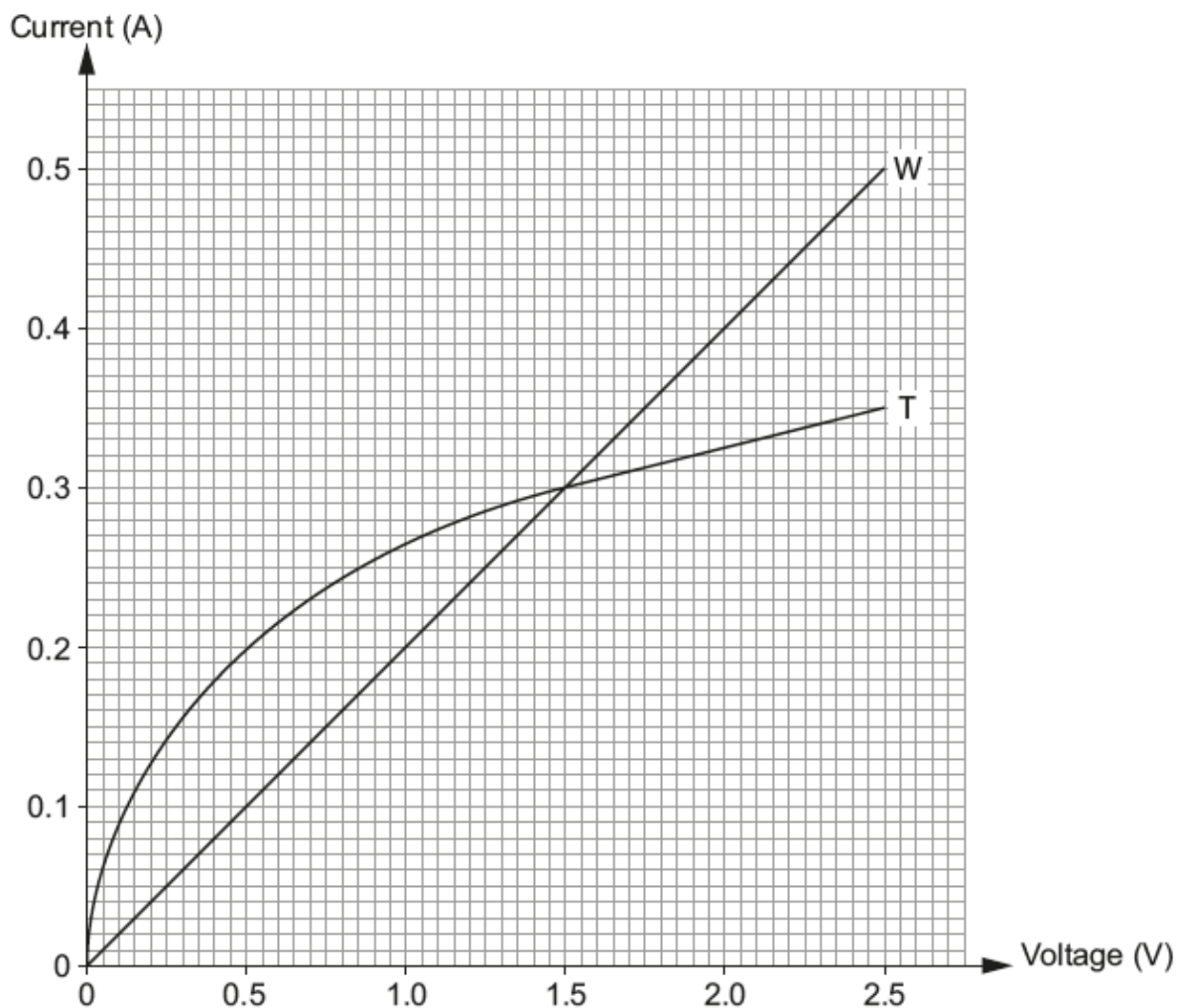
(iii) Explain how and why your answer in (b)(ii) will be different if the wind turbine is placed at an altitude of 60m. [2]

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6. The graph shows how the current depends upon the voltage for a torch bulb (T) and a long copper wire (W) of resistance 5Ω .



- (a) Compare the resistances of the wire and bulb as the voltage increases from 0 to 2.5V. [3]

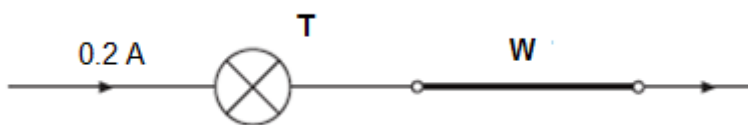
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- (b) The torch bulb and wire are shown connected in series with a current of 0.2 A through them.



Answer the following questions using the equation:

$$\text{current} = \frac{\text{voltage}}{\text{resistance}}$$

- (i) Use data from the graph to calculate the resistance of the torch bulb in this arrangement. [2]

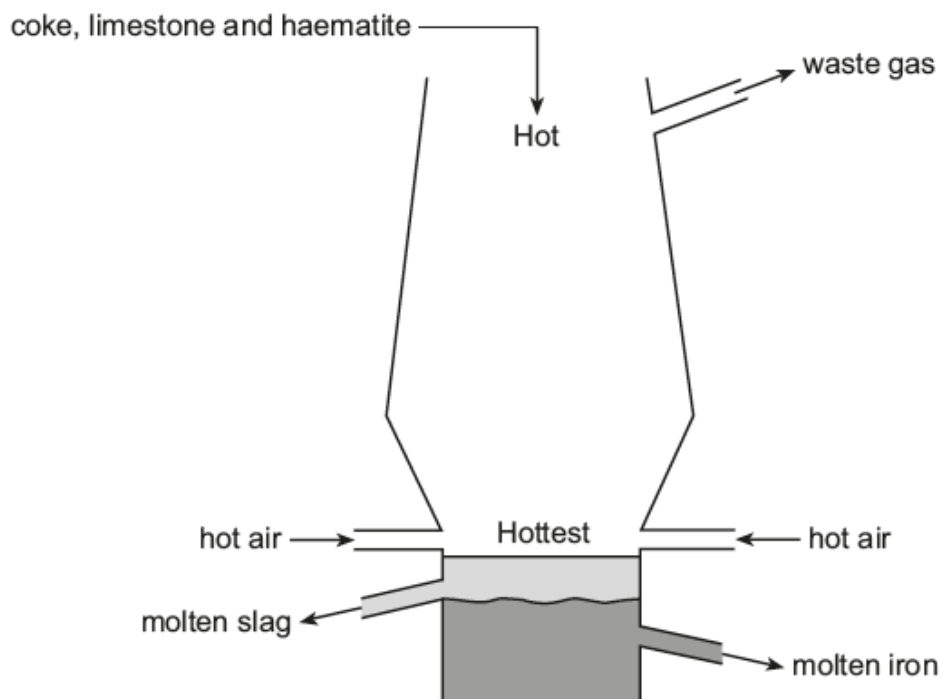
resistance = Ω

- (ii) Calculate the voltage required to drive a current of 0.2 A through the two components connected in series. [2]

voltage = V

7

7. (i) The diagram below shows the blast furnace which is used to extract iron.



Give a detailed description, including chemical equations, of the extraction of iron. [6 QER]

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(ii) Waste plastic can be used in the blast furnace as a reducing agent instead of coke. By using 220 000 tonnes of mixed plastic the following savings can be made:

1. 880 000 m³ of saved landfill, amounting to 11 000 trailer truck-loads.
2. Over 10 million GJ of energy saved, equal to the heating and warm water supply for 410 000 inhabitants in Germany per year.
3. Over 400 000 tonnes of CO₂ saved per year and further reduction in emissions such as SO₂ and dust into the air.

Explain why each of the savings identified in the information above is beneficial to the environment. [6]

Saving 1:

.....
.....

Saving 2:

.....
.....

Saving 3:

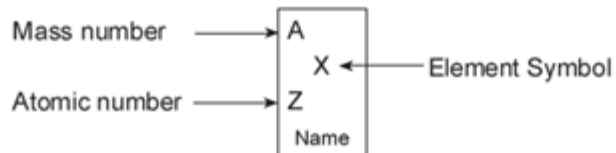
.....
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END OF PAPER

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
		^1_1H Hydrogen												^4_2He Helium			
^7_3Li Lithium	^9_4Be Beryllium											$^{11}_5\text{B}$ Boron	$^{12}_6\text{C}$ Carbon	$^{14}_7\text{N}$ Nitrogen	$^{16}_8\text{O}$ Oxygen	$^{19}_9\text{F}$ Fluorine	$^{20}_{10}\text{Ne}$ Neon
$^{23}_{11}\text{Na}$ Sodium	$^{24}_{12}\text{Mg}$ Magnesium											$^{27}_{13}\text{Al}$ Aluminium	$^{28}_{14}\text{Si}$ Silicon	$^{31}_{15}\text{P}$ Phosphorus	$^{32}_{16}\text{S}$ Sulfur	$^{35}_{17}\text{Cl}$ Chlorine	$^{40}_{18}\text{Ar}$ Argon
$^{39}_{19}\text{K}$ Potassium	$^{40}_{20}\text{Ca}$ Calcium	$^{45}_{21}\text{Sc}$ Scandium	$^{48}_{22}\text{Ti}$ Titanium	$^{51}_{23}\text{V}$ Vanadium	$^{52}_{24}\text{Cr}$ Chromium	$^{55}_{25}\text{Mn}$ Manganese	$^{56}_{26}\text{Fe}$ Iron	$^{59}_{27}\text{Co}$ Cobalt	$^{59}_{28}\text{Ni}$ Nickel	$^{64}_{29}\text{Cu}$ Copper	$^{65}_{30}\text{Zn}$ Zinc	$^{70}_{31}\text{Ga}$ Gallium	$^{73}_{32}\text{Ge}$ Germanium	$^{75}_{33}\text{As}$ Arsenic	$^{79}_{34}\text{Se}$ Selenium	$^{80}_{35}\text{Br}$ Bromine	$^{84}_{36}\text{Kr}$ Krypton
$^{86}_{37}\text{Rb}$ Rubidium	$^{88}_{38}\text{Sr}$ Strontium	$^{89}_{39}\text{Y}$ Yttrium	$^{91}_{40}\text{Zr}$ Zirconium	$^{93}_{41}\text{Nb}$ Niobium	$^{96}_{42}\text{Mo}$ Molybdenum	$^{99}_{43}\text{Tc}$ Technetium	$^{101}_{44}\text{Ru}$ Ruthenium	$^{103}_{45}\text{Rh}$ Rhodium	$^{106}_{46}\text{Pd}$ Palladium	$^{108}_{47}\text{Ag}$ Silver	$^{112}_{48}\text{Cd}$ Cadmium	$^{115}_{49}\text{In}$ Indium	$^{119}_{50}\text{Sn}$ Tin	$^{122}_{51}\text{Sb}$ Antimony	$^{128}_{52}\text{Te}$ Tellurium	$^{127}_{53}\text{I}$ Iodine	$^{131}_{54}\text{Xe}$ Xenon
$^{133}_{55}\text{Cs}$ Caesium	$^{137}_{56}\text{Ba}$ Barium	$^{139}_{57}\text{La}$ Lanthanum	$^{179}_{72}\text{Hf}$ Hafnium	$^{181}_{73}\text{Ta}$ Tantalum	$^{184}_{74}\text{W}$ Tungsten	$^{186}_{75}\text{Re}$ Rhenium	$^{190}_{76}\text{Os}$ Osmium	$^{192}_{77}\text{Ir}$ Iridium	$^{195}_{78}\text{Pt}$ Platinum	$^{197}_{79}\text{Au}$ Gold	$^{201}_{80}\text{Hg}$ Mercury	$^{204}_{81}\text{Tl}$ Thallium	$^{207}_{82}\text{Pb}$ Lead	$^{209}_{83}\text{Bi}$ Bismuth	$^{210}_{84}\text{Po}$ Polonium	$^{210}_{85}\text{At}$ Astatine	$^{222}_{86}\text{Rn}$ Radon
$^{223}_{87}\text{Fr}$ Francium	$^{226}_{88}\text{Ra}$ Radium	$^{227}_{89}\text{Ac}$ Actinium															

Key:



**UNIT 1: (Double Award) ENERGY, RESOURCES AND THE ENVIRONMENT
HIGHER TIER**

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Oesophagus (1) gall bladder (1) small intestine (1)	3			3		
	(b)	(i)		tube 3 - carbohydrase digests all starch/no starch left (to react with iodine) (not: starch there/starch used up) (1) tube 4 – (boiling) denatures /destroys enzyme, (1) so no digestion of starch/starch remains (1)			3	3		3
		(ii)		to show that both starch (1) and enzyme are required (for reaction to occur) (1) Award one mark for they are controls (1)	2			2		2
		(iii)		tube 5 - protease does not digest starch/only carbohydrase (digests starch)		1		1		1
		(iv)		X in mouth or small intestine		1		1		
		(v)		Benedict's test for simple sugar (1) Heated strongly/boiled (not: heated/warmed) (1) Result - blue to red/orange (1)	3			3		3
				Question 1 total	8	2	3	13	0	9

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		35% of input energy (1) is transferred usefully (1)		2		2		
		(ii)		Always some wasted energy (1) so useful output energy always less than input energy (1)	2			2		
	(b)			Subs of 400, (1) 40% (1)	1	1		2	2	
	(c)			Short range (1) long recharge time (1)			2	2		
	(d)			Energy used = $2 \times 5 = 10$ (1) Cost = 10×16 (1) = 160 p or £1.60 (1)	1	2		3	3	
				Question 2 total	4	5	2	11	5	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3		(i)		sulfuric acid	1			1		
		(ii)		Any 2 x (1) from: <ul style="list-style-type: none"> bubbles / fizzing / effervescence blue solution / colour change temperature increases 		2		2		2
		(iii)		Filter (1) evaporate (water) (1)	2			2		2
		(iv)		$\text{CuO} + 2\text{HCl} (1) \rightarrow \text{CuCl}_2 (1) + \text{H}_2\text{O} (1)$		3		3		
				Question 3 total	3	5	0	8	0	4

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Scales - x-axis in 10s & y-axis in 2s (1) Points all correct (1) Point to point line (Not: best fit) (1)		3		3	3	
		(ii)		Lactic acid increases during exercise/anaerobic respiration (1) Then (gradually) drops to normal (not just 'drops') (1)			2	2		
	(b)			Reaction between glucose and oxygen (1) Releasing energy (1) And producing carbon dioxide and water (1) Oxygen + glucose → carbon dioxide + water (1)	4			4		
	(c)			Lack of oxygen (1) Glucose not completely broken down (1)	2			2		
	(d)	(i)		30 minutes		1		1	1	
		(ii)		amount of oxygen required (1) To break down lactic acid (1)	2			2		
				Question 4 total	8	4	2	14	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		swept area (1) & maximum power (1)		2		2		
		(ii)		power density = swept area/maximum power		1		1		
	(b)	(i)		radius 40m (1) = 5027.2 m ² / accept 5027 (1)		2		2	2	
		(ii)		extraction of 1.173 and 10.9 (1) subs $\frac{1}{2} \times 1.173 \times 5027$ (allow ecf) $\times 10.9^3$ (1) Answer 3 818 180 (1)	1	1		3	3	
		(iii)		Then wind speed decreases the air density is hardly changed (1) so power output decreases (1) or wind speed is cubed its change has greater effect (1) so power decreases (1)			2	2		
				Question 5 total	1	7	2	10	5	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			From 0 to 1.5 V the resistance of the bulb is lower, (1) At 1.5 V their resistances are the same (1) Above 1.5 V the resistance of the bulb is greater.(1)		3		3		
	(b)	(i)		0.5 V read from graph (1) $\frac{0.5}{2.5} = 2.5 \Omega$ (1)		2		2	2	
		(ii)		1.0 V read from graph (1) so total voltage = 1.5 V (1) or Total resistance = $2.5 + 5 = 7.5$ (1) $V = 0.2 \times 7.5 = 1.5$ V (1)		2		2	2	
				Question 6 total	0	7	0	7	4	0

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
7	(i)	<p>Indicative content Temperature very high. Coke is oxidized to carbon monoxide. ($2C + O_2 \rightarrow 2CO$) Carbon monoxide reduced the iron ore to iron. ($3CO + Fe_2O_3 \rightarrow 2Fe + 3CO_2$) Molten iron flows to the bottom of the furnace. Limestone is decomposed by heat to calcium oxide and carbon dioxide. The calcium oxide reacts with the impurities (sand/silica) to form slag which flows to the bottom of the furnace and floats on the molten iron.</p> <p>5 – 6 marks Detailed description of stages including correctly balanced equations. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3 – 4 marks Detailed description of stages which may not include equations. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks A basic description of some stages is given. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate used limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit.</i></p>	6			6		
	(ii)	<p>1. Less land used for landfill (1) so less effect on habitats (1) 2. Less fossil fuels used (1) last longer/less drilling/mining. (1) 3. Lowers additions to greenhouse effect (1)</p>			6	6		

			reduces acid rain. (1)						
			Question 7 total	6	0	6	12	0	0

HIGHER TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	8	2	3	13	0	9
2	4	5	2	11	5	0
3	3	5	0	8	0	4
4	8	4	2	14	4	0
5	1	7	2	10	5	0
6	0	7	0	7	4	0
7	6	0	6	12	0	0
TOTAL	30	30	15	75	18	13



GCSE

APPLIED SCIENCE (Double Award)

UNIT 2: (Double Award) SPACE, HEALTH AND LIFE

PRE-RELEASE ARTICLE

SAMPLE ASSESSMENT MATERIALS

Information

The pre-release sets the scene for the questions in **Section B** of the foundation tier and **Section A** of the higher tier. Questions will be based around pre-release and related specification content.

There will be an emphasis on data handling/ analysis in this section. These questions will be worth 25 marks. Of these 25 marks, 19 will be common between the two tiers.

No recall or terminology is required over and above that in the specification. Students will be expected to have discussed and studied the article together with relevant specification content prior to the examination. However, they will not be expected to memorise any part of it as a copy will be provided in the examination paper.

Feeding relationships and energy transfer in a food web

Feeding relationships and energy transfer in an ecosystem can be represented by food chains, food webs and pyramids. **Table 1** shows the feeding relationships between living organisms present in a woodland habitat.

food source	eaten by
fruits and seeds	mice, badgers, blackbirds
leaves	aphids, rabbits
flowers	butterflies & bees
mice	kestrels & shrews
aphids	ladybirds
rabbits	badgers and stoats
butterflies	spiders
bees	spiders
ladybirds	spiders
blackbirds	stoats & kestrels
spiders	shrews
shrews	stoats & kestrels

Table 1 Living organisms in a woodland habitat

Badgers, kestrels & stoats have no natural predators.

Food chains vary in length from three trophic levels to four or more. A food chain consisting of fruits, mice and kestrels consists of three levels; whereas a food chain consisting of fruits, mice, shrews and finally a kestrel consists of four levels.

Diagrams of food chains and food webs only show qualitative information. Pyramids of numbers, biomass and energy provide us with quantitative information. **Table 2** shows the appearance of these ecological pyramids for two food chains, taken from a different habitat.

	Fox ↑ Rabbit ↑ Nettle plant	Two-spot ladybird ↑ Small nettle aphid ↑ Nettle plant
Pyramid of numbers compares the number of organisms at each trophic level		
Pyramid of biomass compares the mass of biological material at each trophic level		
Pyramid of energy compares the amount of energy passing through each trophic level over a period of time		

Table 2 Pyramids of numbers, biomass and energy for two food chains

Pyramid of numbers

Organisms are counted in a given area and grouped into trophic levels. The number of organisms is represented as a rectangle whose length is proportional to the number of organisms counted in the given area.

Usually there are decreasing numbers as you go through the trophic levels but there can be exceptions as shown in **table 2**. The problems associated with pyramids of numbers are overcome if a pyramid of biomass is used.

Pyramid of biomass

A pyramid of biomass shows the dry mass of living tissue at each stage of the food chain at any one time. It is measured in units of mass per unit area e.g. grams per square metre. In water ecosystems it is measured in mass per unit volume. There is a smaller amount of biomass at each level of a food chain.

Pyramid of energy

The third type of pyramid is a pyramid of energy. An example of a pyramid of energy is shown in **figure 1**. This shows the amount of energy at each trophic level of a food chain. Due to the energy losses between each stage of the food chain, a pyramid of energy is always pyramid-shaped. Each rectangle represents energy per unit area or volume per unit time. An example of a unit is $\text{kJ}/\text{m}^2/\text{yr}$. The idea of the transfer of energy allows us to consider the efficiency with which light energy is transferred to energy in producers, as well as the efficiency with which energy in the producers is then transferred from one trophic level to the next.

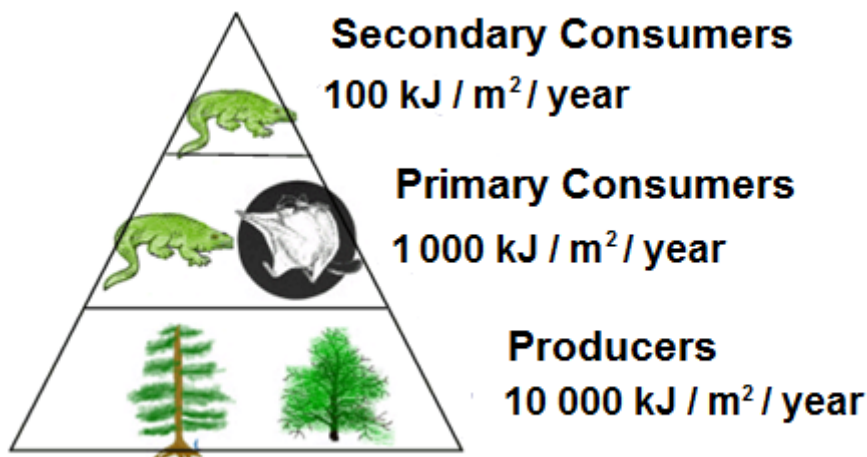


Figure 1 Pyramid of Energy

http://www.world-builders.org/worlds/planets_03/kronos/kh10b.htm

The efficiency of transferring energy between trophic levels can be calculated using the equation:

$$\text{efficiency} = \frac{\text{useful energy at next trophic level}}{\text{available energy at previous trophic level}} \times 100$$

Candidate Name	Centre Number				Candidate Number			
					0			



GCSE

APPLIED SCIENCE (Double Award)

UNIT 2: (Double Award) SPACE, HEALTH AND LIFE

FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 30 minutes)

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	10	
2.	9	
3.	7	
4.	6	
5.	8	
6.	10	
7.	25	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

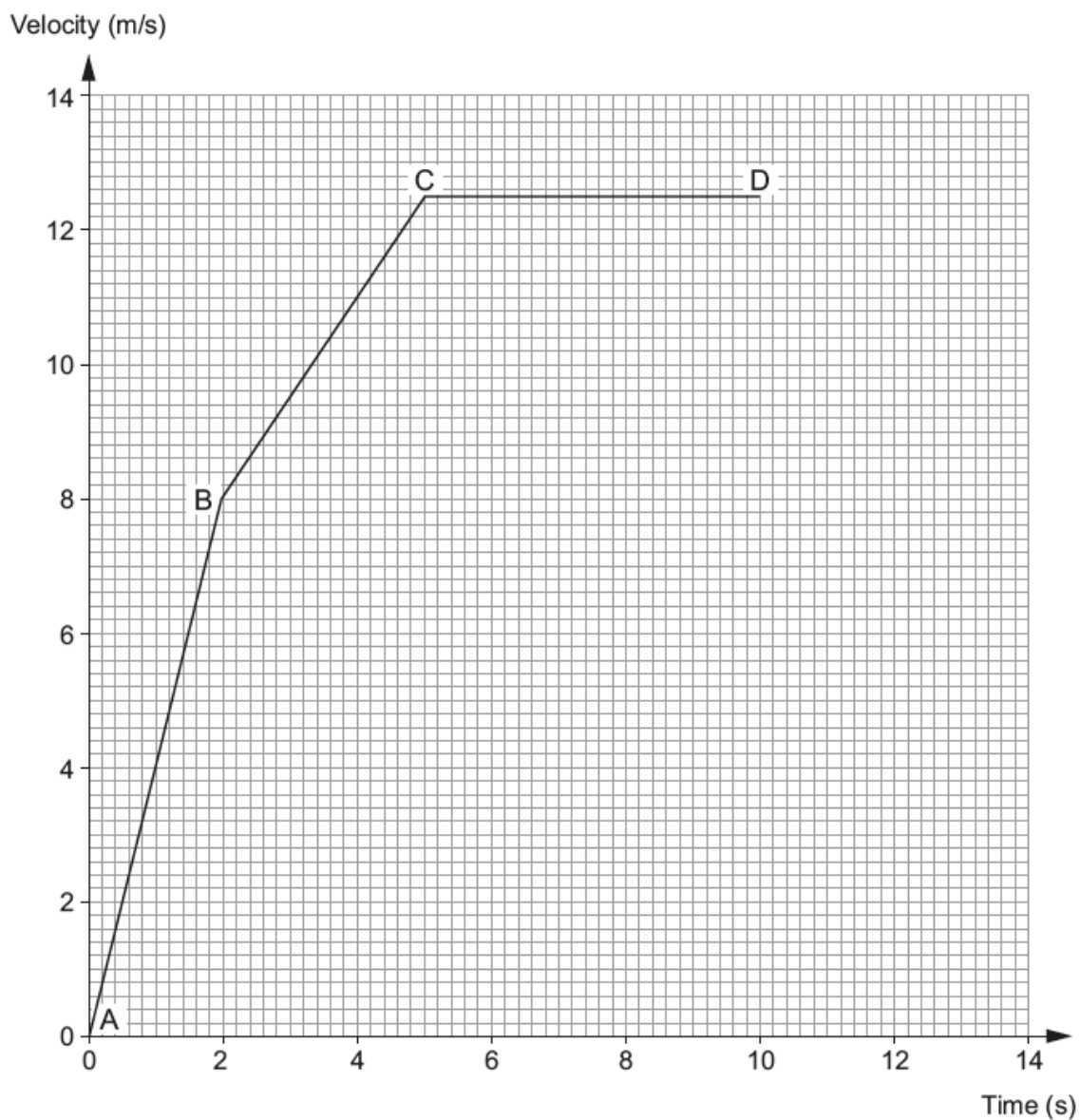
INFORMATION FOR CANDIDATES

Section B is based upon the Pre-Release Article.
The number of marks is given in brackets at the end of each question or part-question.
Question 6(a) is a quality of extended response (QER) question where your writing skills will be assessed.

SECTION A

Answer **all** questions

1. The graph shows the velocity of a top athlete running a 100m race.



- (a) (i) State the change in velocity of the athlete between **A** and **B**. [1]

change in velocity = m/s

- (ii) Calculate the athlete's acceleration between **A** and **B** using the equation: [2]

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

acceleration = m/s²

- (b) (i) How long did the athlete run at a constant velocity (**CD**)? [1]

time = s

- (ii) Calculate the distance ran by the athlete between points **C** and **D**. [2]

distance = m

- (c) The distance ran by the athlete between **A** and **D** is 102m.

Calculate the mean velocity of the athlete between points **A** and **D** using the equation: [2]

$$\text{velocity} = \frac{\text{distance}}{\text{time}}$$

mean velocity = m/s

- (d) At the end of the race the athlete takes 4s to uniformly slow down to rest. **Complete the graph** to show this. [2]

2. (a) The table gives some information about the planets in our solar system. Use the information in the table to answer the questions that follow.

Planet	Mean distance from sun (AU)	Diameter (1 000s km)	Time to spin once on axis (Earth days)	Time to orbit Sun (Earth years)	Average temperature (°C)	Content of atmosphere	Known moons
Mercury	0.4	5	59	0.2	427	none	0
Venus	0.7	12	243	0.6	480	carbon dioxide (96%), nitrogen (3.5%)	0
Earth	1.0	13	1	1	14	nitrogen (77%), oxygen (21%)	1
Mars	1.5	7	1	2	-63	carbon dioxide (95.3%), argon	2
Jupiter	5.2	143	0.4	12	-130	hydrogen, helium	63
Saturn	9.5	120	0.4	29	-130	hydrogen, helium	61
Uranus	19.2	51	0.7	84	-200	hydrogen, helium, methane	27
Neptune	30.0	50	0.7	165	-200	hydrogen, helium, methane	13

- (i) Place a tick (✓) in the box next to the correct statements. [3]

Gas giant planets have more moons than rocky planets.

The time taken by Earth to spin once on its axis is the same as the time taken to orbit the Sun once.

The further a planet from the Sun the bigger it is.

A day on Mars is the same duration as on Earth.

There is no greenhouse effect on Mercury.

Mars has the closest orbit to Earth.

- (ii) The dwarf planet Ceres is the largest object in the asteroid belt, which lies between the orbits of Mars and Jupiter. Estimate the temperature on Ceres. [1]

temperature =°C

- (b) Complete the sentences below about the Universe. [5]

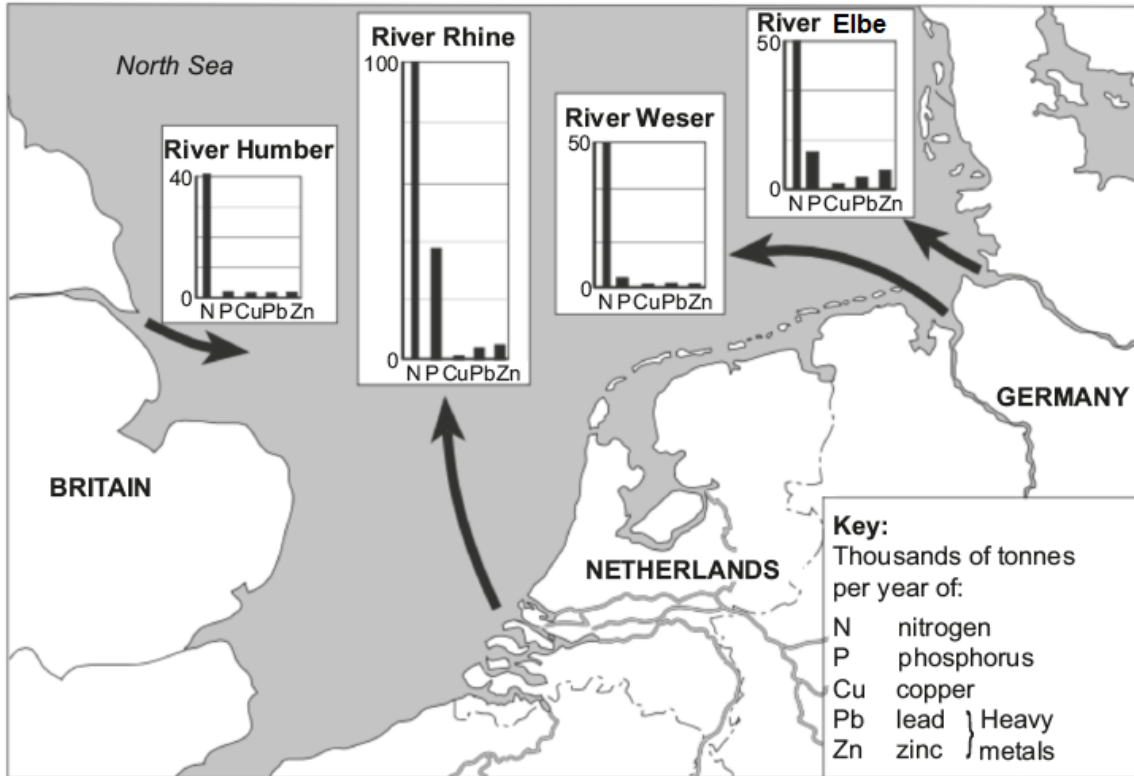
(i) The Universe began as the result of an known as the Big Bang.

(ii) The Universe continues to away from the Big Bang.

(iii) The Universe is estimated to be 13.5 thousand years old.

7

3. Over 80% of sea pollution comes from land-based activities. Rivers are one common path of entry of pollution into the sea. The map shows the main pollution levels in some rivers that enter the North Sea.



- (a) Use the information above to answer this question.
- (i) State **one** way farming adds to water pollution. [1]
-
- (ii) State **one** way industry adds to water pollution. [1]
-
- (b) Explain why the lowest concentration of oxygen is found at the mouth of the river Rhine. Use the information above to give **one** reason why. [2]
-
-
- (c) It is observed that many fish-eating birds have been found dead near the mouth of the rivers Elbe and Rhine.
- (i) Use the information above to give **one** reason why. [1]
-
-

(ii) Explain why dead birds are found rather than dead fish. [2]

.....

.....

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.....

7

4. (a) The table shows how lions and tigers are classified by zoologists.

Classification group	Feature of classification group	Lion	Tiger
Kingdom	moves in search of its food	Animalia	Animalia
Phylum	have a vertebral column	Chordata	Chordata
Class	feed young on milk	Mammalia	Mammalia
Order	canine teeth with jaws that move up and down	Carnivora	Carnivora
Family	can sheath their claws	Felidae	Felidae
Genus	roaring cats over 3 m long	<i>Panthera</i>	<i>Panthera</i>
Species	produce fertile offspring when they breed	<i>leo</i>	<i>tigris</i>

(i) What information shows that lions and tigers both belong to the Kingdom Animalia? [1]

.....

(ii) The scientific name for a tiger is *Panthera tigris*. What is the scientific name for a lion? [1]

.....

(iii) Give **one** reason why zoologists use scientific names rather than common names. [1]

.....

.....

- (b) Hyenas are meat-eating vertebrates that feed their young on milk. They have the scientific name *Crocuta crocuta*. Use this information to complete the table below for hyenas. [3]

Classification group	Hyenas
Kingdom	Animalia
Phylum	.....
Class	.....
Order	.....
Family	Hyaenida
Genus	.....
Species	.....

5. Radiotherapy is a branch of medicine used for the treatment of cancerous tumours.

External radiotherapy uses a powerful gamma emitter which is heavily shielded. The gamma-ray beam is aimed at the tumour for short periods of time from different directions. The tumour cells are killed by absorbing large amounts of heat from the energy of the radiation.



Internal radiotherapy is carried out by inserting a small radioactive source, which has a short half-life, directly into the tumour. They give a very high dose of radiation to the area of the cancer cells. The radiation emitted by the source destroys the tumour from the inside. Internal radiotherapy is generally more effective than external radiotherapy.

- (a) (i) State **one** reason why the therapist may shield parts of the patient's body. [1]

.....

- (ii) State **one** reason why the gamma-ray beam in external radiotherapy is directed at the tumour for short periods of time from different directions. [1]

.....

- (iii) State **two** reasons why internal radiotherapy is considered to be more effective than external radiotherapy. [2]

.....

.....

.....

(b) A patient receives an implant of 200 units of iodine-125 directly into a prostate gland tumour. The patient was injected with the implant on Jan 1st 2015. On March 2nd only 100 units remain.

(i) Calculate how many units of the implant remain on May 1st 2015. [2]

January						
SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April						
SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May						
SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June						
SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

number of units =

- (ii) Patients who have undergone this treatment are given the following advice:

<p><u>DO NOT:</u></p> <ul style="list-style-type: none">• use public transport• share cups, glasses, utensils or towels• visit young children or pregnant mothers• spend more than 30 minutes with visitors

Explain why the patient should not visit young children and pregnant mothers. [2]

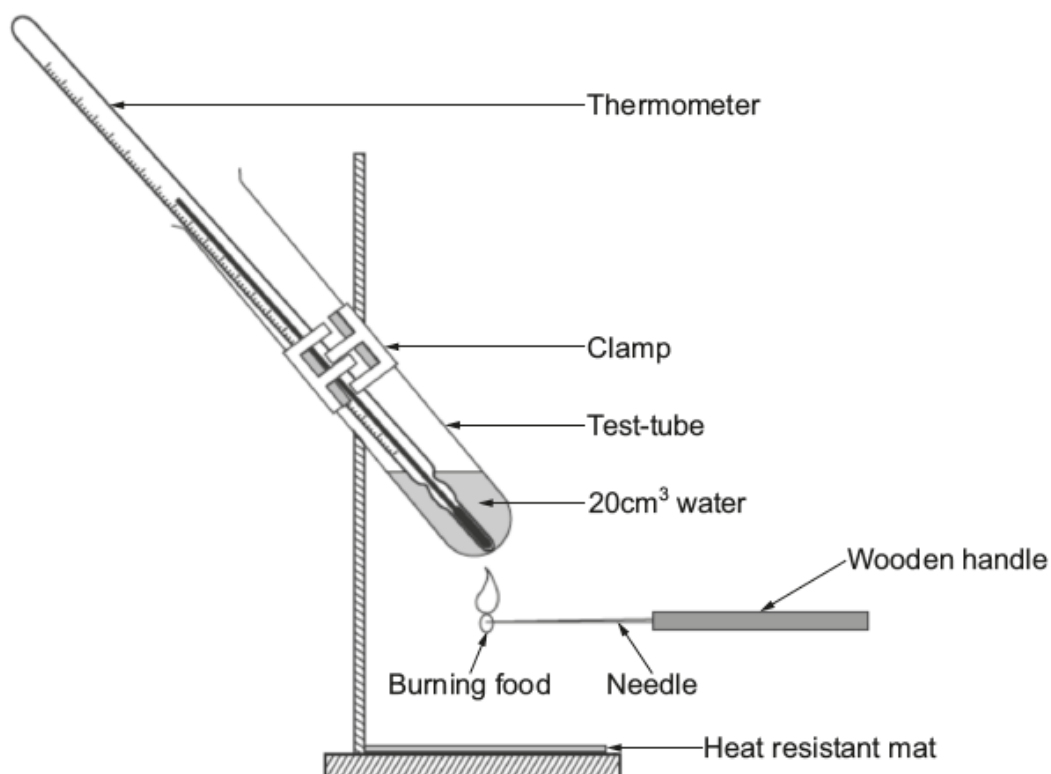
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6. The apparatus below is set up to find the energy content of food.



In one experiment, the energy content of a food was found to be 6450 J/g. When the experiment was repeated the following results were obtained.

Repeat	Energy content of food (J/g)
1	5049
2	7260
3	6800
4	4896
5	5724

- (b) Food energy is measured in kilojoules (kJ) and kilocalories (kcal). These units of measurement allow us to talk about how much energy a food contains and how much energy is burned up during exercise.

The energy value **per gram** of various food components includes:

- **fat** – 37 kJ
- **carbohydrates** – 16 kJ
- **protein** – 17 kJ
- **dietary fibre** – 13 kJ
- **water** – 0 kJ

When we regularly eat more energy than our body needs, the excess is stored inside fat cells.

- (i) State **one** reason why foods high in fat should be eaten in moderation. [1]

.....

- (ii) State **two** medical problems linked to obesity. [2]

.....

- (iii) Calculate the energy content of 1 kg of fat. [1]

energy content = kJ

- (iv) An overweight person hopes to lose 1 kg of body fat in 30 days. Calculate by how much they need to reduce their calorie intake each day. [2]

The conversion factors for joules and calories are:

$$1 \text{ kJ} = 0.24 \text{ kcal}$$

answer = kcal /day

SECTION B

Answer **all** questions

7. National Trust wardens supervise a group of students who are monitoring the wildlife living in woodland.
- (a) **Table 1** shows their observations about the feeding relationships between organisms. Use the information in **Table 1** to complete a food web for the woodland habitat in the space below. [5]

Fruits & seeds

leaves

flowers

(b) Give **one** example, from this food web, of a woodland organism that is: [6]

(i) at more than one trophic level

(ii) a primary consumer

(iii) a secondary consumer

(iv) a tertiary consumer

(v) a herbivore

(vi) a carnivore

(c) The government has announced that badger culls (killing) will be allowed. The Mammalian Society is against this policy since badgers could disappear in certain areas. This would affect woodland habitats.

(i) Explain the effect of culling badgers on their food sources. [3]

.....
.....
.....
.....

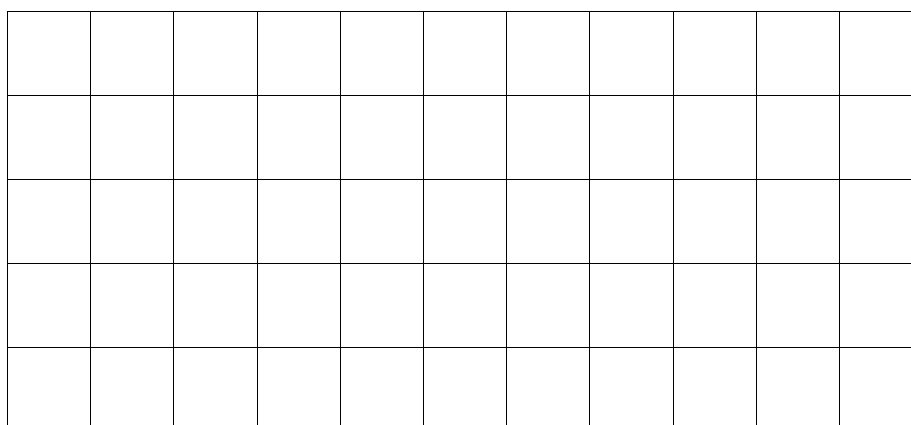
(ii) Explain the effect of badger culling on the number of stoats. [2]

.....
.....
.....
.....

- (d) (i) Complete the table below for one food chain in the woodland habitat. [1]

Organism	Number in chain	Average mass of each organism (g)	Total mass (g)
leaves	100	0.5	.....
caterpillars	20	1.0	.....
shrew	1	2.0	2

- (ii) Draw on the grid below, a pyramid of biomass to scale, for the food chain shown in the table above. [3]



- (e) The table shows information about the energy transfer through the trophic levels of the woodland habitat.

Trophic level	Energy (J/m ² /year)	Efficiency of energy transfer to next level
1	25 000	15.0%
2	3 750	12.3%
3	460	.....
4	23	

- (i) Calculate the energy loss between trophic level 1 and level 4. [1]

energy loss = J/m²/year

- (ii) Complete the table. [2]

(Space for working)

- (f) Explain the role of green plants in energy transfer in a food web. [2]

.....

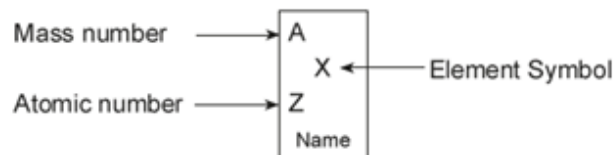
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0	
		${}^1_1\text{H}$ Hydrogen																${}^4_2\text{He}$ Helium
${}^7_3\text{Li}$ Lithium	${}^9_4\text{Be}$ Beryllium											${}^{11}_5\text{B}$ Boron	${}^{12}_6\text{C}$ Carbon	${}^{14}_7\text{N}$ Nitrogen	${}^{16}_8\text{O}$ Oxygen	${}^{19}_9\text{F}$ Fluorine	${}^{20}_{10}\text{Ne}$ Neon	
${}^{23}_{11}\text{Na}$ Sodium	${}^{24}_{12}\text{Mg}$ Magnesium											${}^{27}_{13}\text{Al}$ Aluminium	${}^{28}_{14}\text{Si}$ Silicon	${}^{31}_{15}\text{P}$ Phosphorus	${}^{32}_{16}\text{S}$ Sulfur	${}^{35}_{17}\text{Cl}$ Chlorine	${}^{40}_{18}\text{Ar}$ Argon	
${}^{39}_{19}\text{K}$ Potassium	${}^{40}_{20}\text{Ca}$ Calcium	${}^{45}_{21}\text{Sc}$ Scandium	${}^{48}_{22}\text{Ti}$ Titanium	${}^{51}_{23}\text{V}$ Vanadium	${}^{52}_{24}\text{Cr}$ Chromium	${}^{55}_{25}\text{Mn}$ Manganese	${}^{56}_{26}\text{Fe}$ Iron	${}^{59}_{27}\text{Co}$ Cobalt	${}^{59}_{28}\text{Ni}$ Nickel	${}^{64}_{29}\text{Cu}$ Copper	${}^{65}_{30}\text{Zn}$ Zinc	${}^{70}_{31}\text{Ga}$ Gallium	${}^{73}_{32}\text{Ge}$ Germanium	${}^{75}_{33}\text{As}$ Arsenic	${}^{79}_{34}\text{Se}$ Selenium	${}^{80}_{35}\text{Br}$ Bromine	${}^{84}_{36}\text{Kr}$ Krypton	
${}^{86}_{37}\text{Rb}$ Rubidium	${}^{88}_{38}\text{Sr}$ Strontium	${}^{89}_{39}\text{Y}$ Yttrium	${}^{91}_{40}\text{Zr}$ Zirconium	${}^{93}_{41}\text{Nb}$ Niobium	${}^{96}_{42}\text{Mo}$ Molybdenum	${}^{99}_{43}\text{Tc}$ Technetium	${}^{101}_{44}\text{Ru}$ Ruthenium	${}^{103}_{45}\text{Rh}$ Rhodium	${}^{106}_{46}\text{Pd}$ Palladium	${}^{108}_{47}\text{Ag}$ Silver	${}^{112}_{48}\text{Cd}$ Cadmium	${}^{115}_{49}\text{In}$ Indium	${}^{119}_{50}\text{Sn}$ Tin	${}^{122}_{51}\text{Sb}$ Antimony	${}^{128}_{52}\text{Te}$ Tellurium	${}^{127}_{53}\text{I}$ Iodine	${}^{131}_{54}\text{Xe}$ Xenon	
${}^{133}_{55}\text{Cs}$ Caesium	${}^{137}_{56}\text{Ba}$ Barium	${}^{139}_{57}\text{La}$ Lanthanum	${}^{179}_{72}\text{Hf}$ Hafnium	${}^{181}_{73}\text{Ta}$ Tantalum	${}^{184}_{74}\text{W}$ Tungsten	${}^{186}_{75}\text{Re}$ Rhenium	${}^{190}_{76}\text{Os}$ Osmium	${}^{192}_{77}\text{Ir}$ Iridium	${}^{195}_{78}\text{Pt}$ Platinum	${}^{197}_{79}\text{Au}$ Gold	${}^{201}_{80}\text{Hg}$ Mercury	${}^{204}_{81}\text{Tl}$ Thallium	${}^{207}_{82}\text{Pb}$ Lead	${}^{209}_{83}\text{Bi}$ Bismuth	${}^{210}_{84}\text{Po}$ Polonium	${}^{210}_{85}\text{At}$ Astatine	${}^{222}_{86}\text{Rn}$ Radon	
${}^{223}_{87}\text{Fr}$ Francium	${}^{226}_{88}\text{Ra}$ Radium	${}^{227}_{89}\text{Ac}$ Actinium																

Key:



**UNIT 2: (Double Award) SPACE, HEALTH AND LIFE
FOUNDATION TIER**

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		8 m/s		1		1	1	
		(ii)		Subs of change in v of 8 m/s and time of 2 s (1) Answer = 4 m/s ² (1)	1	1		2	2	
	(b)	(i)		5 s		1		1	1	
		(ii)		5 x 12.5 (1) 62.5 m (1)		2		2	2	
	(c)	(i)		Subs $\frac{102}{10}$ (1) = 10.2 m/s (1)	1	1		2	2	
	(d)			Straight line (1) to 0,14 (1)		2		2	2	
				Question 1 total	2	8	0	10	10	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Ticks in boxes 1,4 and 5			3	3		
		(ii)		Values within the range -70 to -120 °C			1	1		
	(b)	(i)		explosion	1			1		
		(ii)		expand	1			1		
		(iii)		million	1			1		
				Question 2 total	3	0	4	7	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		run off/leaching of (fertiliser / pesticides)	1			1		
		(ii)		Heavy metal pollution or named copper/Cu, lead/Pb, zinc/Zn.	1			1		
	(b)			Most/highest nitrate/nitrogen OR phosphate. (1) eutrophication / Fish suffocate. (1)			2	2		
	(c)	(i)		High levels of heavy metal pollution			1	1		
		(ii)		Heavy metal/lead cause poisoning (1) build up to a toxic level / bioaccumulation in birds (1)	2			2		
				Question 3 total	4	0	3	7	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Move in search of food		1		1		
		(ii)		<i>Panthera leo</i>		1		1		
		(iii)		No confusion between different common names used in different parts of the world	1			1		
	(b)			Down: Chordata, Mammalia, Carnivora (1) Crocuta (1) crocuta (1)		3		3		
				Question 4 total	1	5	0	6	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Prevent radiation passing through healthy organs	1			1		
		(ii)		Different directions so does not always pass through the same healthy tissue / Short time so dose to healthy tissues is limited		1		1		
		(iii)		Provides a steady & continuous source of radiation to the tumour (1) Less risk of damaging healthy surrounding tissue (1)	2			2		
	(b)	(i)		Time difference is same or 60 days (1) So halves again to 50 units (1)		1	1	2	2	
		(ii)		Radiation more damaging to {growing/dividing} cells (1) Radiation is ionising / damages DNA (1)	2			2		
				Question 5 total	5	2	1	8	2	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	<p>Indicative content: Measure and record the mass of the water in a boiling tube. Measure and record the temperature of the water. Measure the mass of the food sample. When the flame goes out measure and record the temperature of the water. The variation in the results could be due to differing times between igniting the food and placing it under the boiling tube. The distance of the burning food from the boiling tube could have varied/ not been placed in the same spot. Also there could have been incomplete burning of the food.</p> <p>5 – 6 marks Describes fully all measurements and possible causes of the variation. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3 – 4 marks Describes measurements and possible causes of the variation with few omissions <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks Some relevant measurements or causes of variation included. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate used limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit.</i></p>	3		3	6		6

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)	They have the highest energy content.	1			1		
		(ii)	Diabetes (1) Cardiovascular disease (1)	2			2		
		(iii)	37 000 kJ		1		1	1	
		(iv)	kcal equivalent = $37\,000 \times 0.24 = 8\,880$ kcal/month (1) = 296 kcal/day (1)		2		2	2	
			Question 6 total	6	3	3	12	3	6

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
7	(a)	<pre> graph BT FS[Fruits & seeds] --> B[blackbirds] FS --> M[mice] L[leaves] --> R[rabbits] L --> A[aphids] F[flowers] --> BU[butterflies] F --> BE[bees] M --> BAD[badgers] R --> BAD A --> BAD B --> K[kestrels] A --> LB[ladybirds] LB --> SP[spiders] BU --> SP BE --> SP BAD --> SH[shrews] SP --> SH BE --> SH M --> KE[kestrels] B --> KE SH --> ST[stoats] BAD --> ST </pre> <p>Any 5 x (1) from:</p> <ul style="list-style-type: none"> • Flowers to butterflies/bees to spiders to shrews to kestrels/stoats • Leaves to aphids to ladybirds to spiders • Leaves to rabbits to badgers/stoats • Fruits & seeds to badgers • Fruits & seeds to mice to kestrel • Fruits & seeds to blackbirds to kestrels/stoats 				5		5

	(b)	(i)	badgers/spiders/ kestrels/ stoats/spiders	1			1		
		(ii)	blackbirds/mice/rabbits/aphids/butterflies/bees	1			1		
		(iii)	kestrels/badgers/ladybirds/spiders/stoats	1			1		
		(iv)	spiders/shrews	1			1		
		(v)	blackbirds/mice/rabbits/aphids/butterflies/bees	1			1		
		(vi)	kestrels/ spiders/ ladybirds/shrews/ stoats	1			1		
	(c)	(i)	two food sources named(1) rabbits would increase (1) fruits & seeds would increase (1)		1	2	3		
		(ii)	Less competition for food (1) so numbers increase (1)			2	2		
	(d)	(i)	50, 20, (all correct for 1 mark)		1		1	1	
		(ii)	labelling of levels, (1) appropriate scale (1) correct ratio between levels (25 – 10 – 1) (1)		3		3	3	3
	(e)	(i)	24 977		1		1	1	
		(ii)	substitution of values $\frac{23}{460}$ (1) answer 5% (1)	1	1		2	2	
	(f)		Transfer energy from sunlight by photosynthesis (1) Into chemical energy for food web. (1)	2			2		
			Question 7 total	9	12	4	25	7	8

FOUNDATION TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	8	0	10	10	0
2	3	0	4	7	0	0
3	4	0	3	7	0	0
4	1	5	0	6	0	0
5	5	2	1	8	2	0
6	6	3	3	12	3	6
7	9	12	4	25	7	8
TOTAL	30	30	15	75	22	14

Candidate Name	Centre Number				Candidate Number			
					0			



GCSE

APPLIED SCIENCE (Double Award)

UNIT 2: (Double Award) SPACE, HEALTH AND LIFE

HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 30 minutes)

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	25	
2.	11	
3.	10	
4.	10	
5.	7	
6.	12	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Section A is based upon the Pre-Release Article

The number of marks is given in brackets at the end of each question or part-question.

Question 1(f) is a quality of extended response (QER) question where your writing skills will be assessed.

SECTION A

Answer **all** questions

1. National Trust wardens supervise a group of students who are monitoring the wildlife living in woodland.
- (a) **Table 1** shows their observations about the feeding relationships between organisms. Use the information in **Table 1** to complete a food web for the woodland habitat in the space below. [5]

fruits & seeds

leaves

flowers

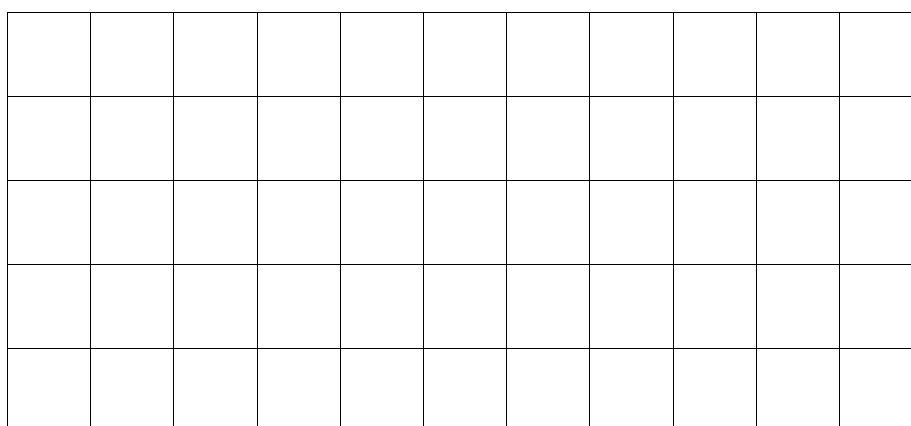
(b) Give **one** example, from this food web, of a woodland organism that is: [6]

- (i) at more than one trophic level
- (ii) a primary consumer
- (iii) a secondary consumer
- (iv) a tertiary consumer
- (v) a herbivore
- (vi) a carnivore

(c) (i) Complete the table below for one food chain in the woodland habitat. [1]

Organism	Number in chain	Average mass of each organism (g)	Total mass (g)
leaves	100	0.5	.....
caterpillars	20	1.0	.....
shrew	1	2.0	2

(ii) Draw on the grid below, a pyramid of biomass to scale, for the food chain shown in the table above. [3]



- (d) The table shows information about the energy transfer through the trophic levels of the woodland habitat.

Trophic level	Energy (J/m ² /year)	Efficiency of energy transfer to next level
1	25 000	15.0%
2	3 750	12.3%
3	460	.....
4	23	

Complete the table. [2]

(Space for working)

- (e) Explain the role of green plants in energy transfer in a food web. [2]

.....

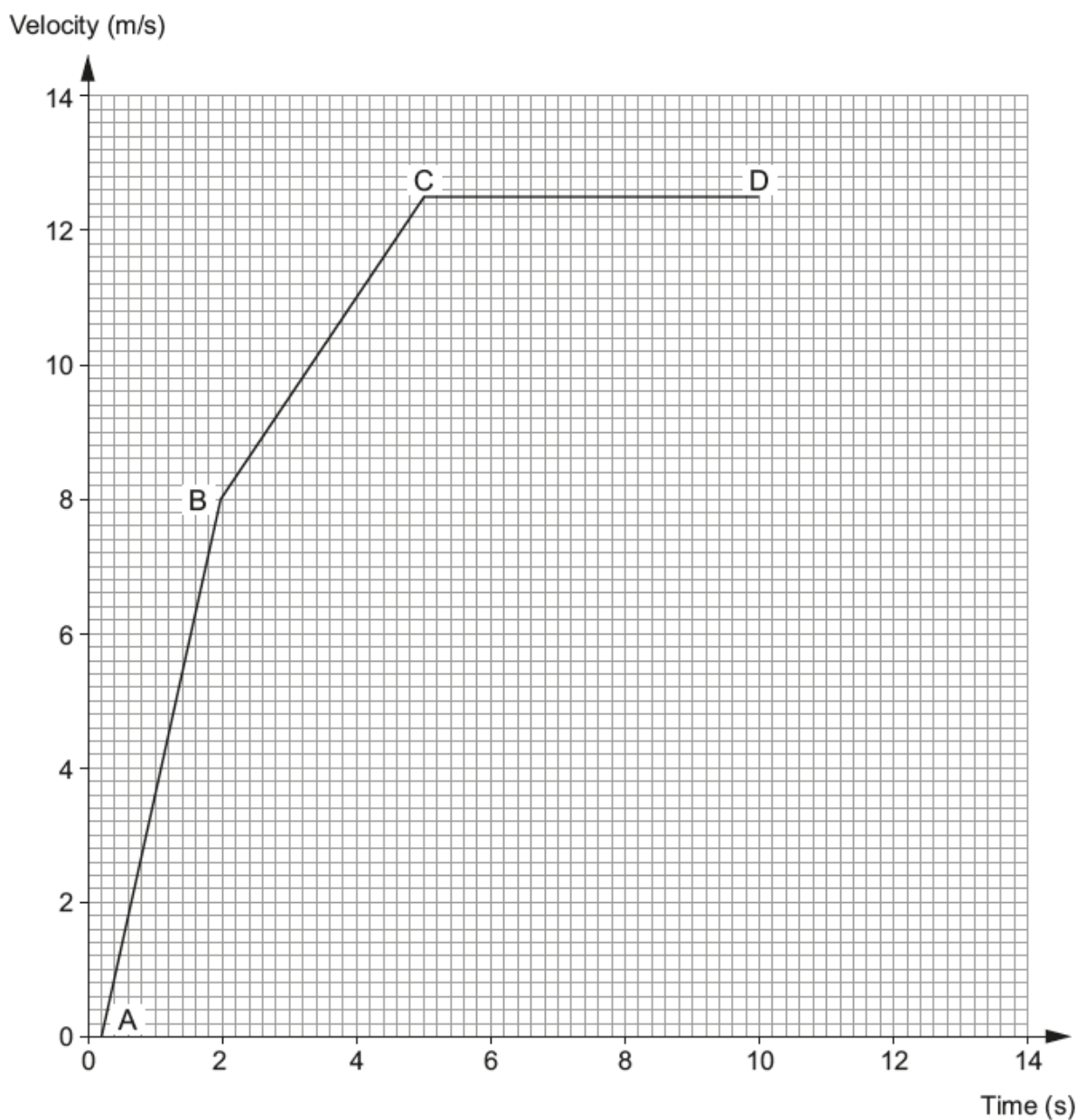
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.....

SECTION B

Answer **all** questions

2. The graph shows the velocity of a top athlete running a 100 m race. The gun is fired at 0 s to start the race.



- (a) (i) Use the graph to find the athlete's reaction time. [1]

.....s

- (ii) Calculate the athlete's acceleration between **A** and **B** using the equation: [3]

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

acceleration =

- (b) At the end of the race the athlete takes 2.5 s to slow down uniformly to rest. **Complete the graph** to show this. [2]

- (c) (i) Calculate the distance ran by the athlete between points **B** and **D**. [3]

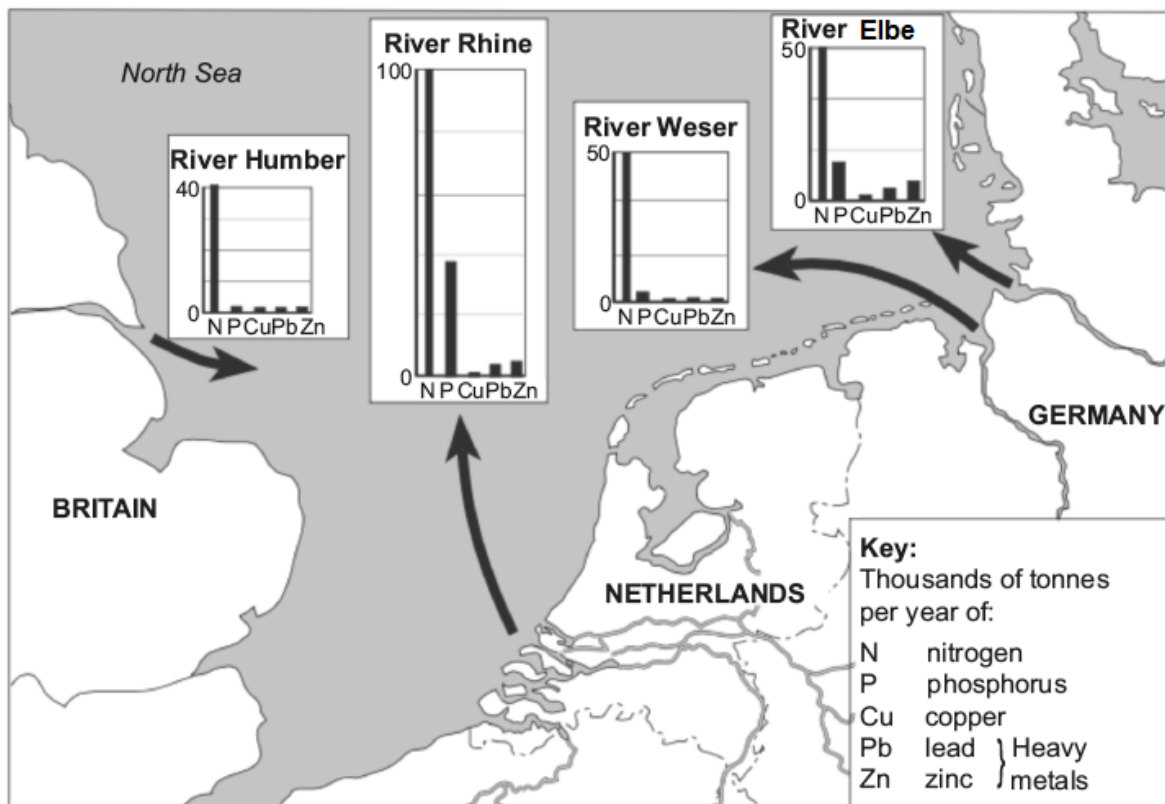
distance = m

- (ii) Calculate the mean velocity of the athlete between points **B** and **D** using the equation: [2]

$$\text{velocity} = \frac{\text{distance}}{\text{time}}$$

mean velocity = m/s

3. Over 80% of sea pollution comes from land-based activities. Rivers are one common path of entry of contaminants to the sea. The map shows the main pollution levels in some rivers that enter the North Sea.



Use the information above to answer this question.

- (a) Explain how farming and industry cause water pollution. [3]

.....

.....

.....

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- (b) (i) At the mouth of which river would you expect to find the lowest concentration of oxygen? [1]

.....

- (ii) Explain why this is the case. [3]

.....

.....

- (c) (i) Many birds die as a result of bioaccumulation. Explain what is meant by the term bioaccumulation. [2]

.....
.....

- (ii) At the mouth of which river will this have the most significant effect? [1]

.....

10

4. Radiotherapy is a branch of medicine used for the treatment of cancerous tumours.

External radiotherapy uses a powerful gamma emitter which is heavily shielded. The gamma-ray beam is aimed at the tumour for short periods of time from different directions. The tumour cells are killed by absorbing large amounts of heat from the energy of the radiation.



Internal radiotherapy is carried out by inserting a small radioactive source, which has a short half-life, directly into the tumour. They give a very high dose of radiation to the area of the cancer cells. The radiation emitted by the source destroys the tumour from the inside. Internal radiotherapy is generally more effective than external radiotherapy.

- (a) (i) Give **two** reasons why the gamma-ray beam in external radiotherapy is directed at the tumour for short periods of time from different directions. [2]

1.....

2.....

- (ii) Explain why internal radiotherapy is considered to be more effective than external radiotherapy. [2]

.....

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.....

(b) A patient receives an implant of 200 units of iodine-125 directly into a prostate gland tumour. The half life of iodine-125 is 60 days.

(i) If the patient was injected with iodine-125 on Jan 1st 2015. Calculate the activity of the implant on May 1st 2015. [3]

January						
SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April						
SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

May						
SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June						
SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

activity = units

- (ii) Patients who have undergone this treatment are given the following advice:

<p><u>DO NOT:</u></p> <ul style="list-style-type: none">• use public transport• share cups, glasses, utensils or towels• visit young children or pregnant mothers• spend more than 30 minutes with visitors

Explain why this advice should be strictly followed. [3]

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5. The table gives some information about the planets in our solar system. Use the information in the table to answer the questions that follow.

Planet	Mean distance from sun (AU)	Diameter (Mm or 10^6 m)	Time to spin once on axis (Earth days)	Time to orbit Sun (Earth years)	Average temperature ($^{\circ}$ C)	Content of atmosphere	Known moons
Mercury	0.4	5	59	0.2	427	none	0
Venus	0.7	12	243	0.6	480	carbon dioxide (96%), nitrogen (3.5%)	0
Earth	1.0	13	1	1	14	nitrogen (77%), oxygen (21%)	1
Mars	1.5	7	1	2	-63	carbon dioxide (95.3%), argon	2
Jupiter	5.2	143	0.4	12	-130	hydrogen, helium	63
Saturn	9.5	120	0.4	29	-130	hydrogen, helium	61
Uranus	19.2	51	0.7	84	-200	hydrogen, helium, methane	27
Neptune	30.0	50	0.7	165	-200	hydrogen, helium, methane	13

(i) Place a tick in the box next to the correct statements. [3]

Larger rocky planets have more moons than smaller planets

The time a planet takes to spin on its axis is proportional to distance from the Sun

The asteroid Ceres has a temperature of -50°C

The asteroid Ceres is 3.1 Au from the Sun

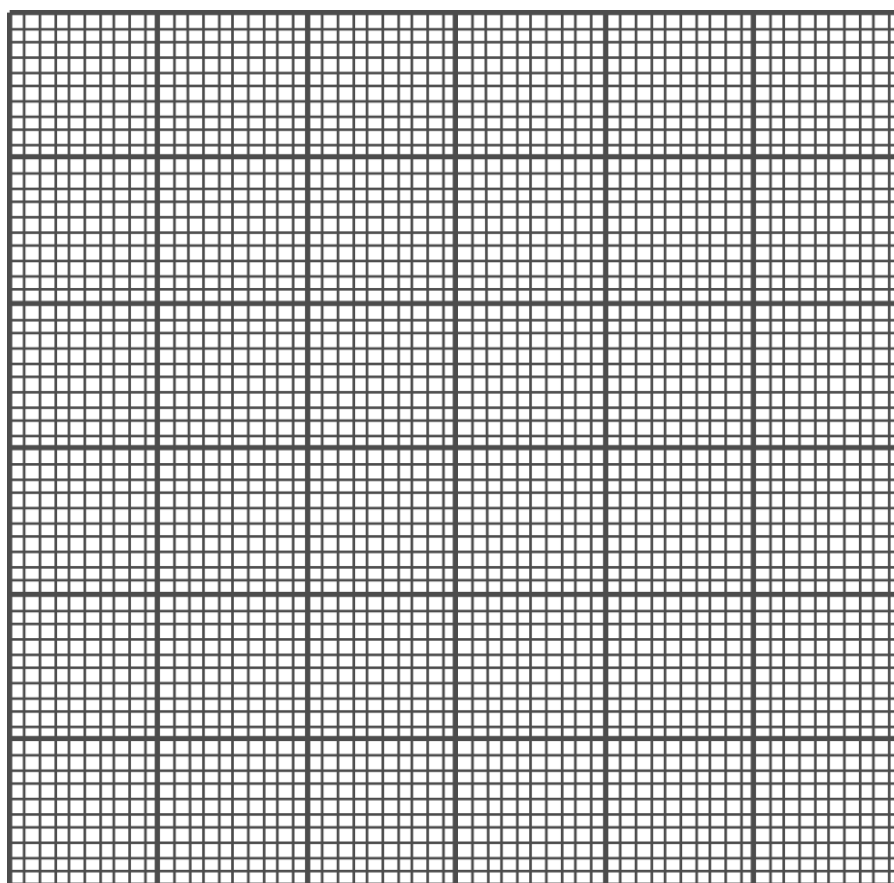
Venus has a day length longer than its year

The days on all the gas giants are shorter than on Earth

(ii) It was once thought that the time of orbit of a planet around the Sun would be proportional to distance from the Sun.

Use data from the table to plot a graph to determine whether this statement is true. **Only** include the planets **Earth, Mars, Jupiter, Saturn** and **Uranus** in your graph.

[4]



.....

7

6. (a) (i) Describe an experiment to find the energy content of food. [5]

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- (ii) In one experiment, the energy content of a food was found to be 6450 J/g. When the experiment was repeated the following results were obtained.

Repeat	Energy content of food (J/g)
1	5049
2	7260
3	6800
4	4896
5	5724

- State three possible causes for the variation in results. [3]

1

2

3

- (b) We eat food to fuel our bodies for energy. Carbohydrates are the body's preferred fuel, although proteins and fats can also be converted into energy. Food energy is measured in kilojoules (kJ) and kilocalories (kcal). These units of measurement allow us to talk about how much energy a food contains and how much energy is burned up during exercise.

The conversion factors for joules and calories are:

$$1 \text{ kJ} = 0.239 \text{ kcal}; \text{ and } 1 \text{ kcal} = 4.184 \text{ kJ}$$

Foods which are high in fats, added sugars or alcohol are by far the most energy-dense foods. This is why they should only be consumed in moderation, particularly if you are overweight or obese.

The energy value **per gram** of various food components includes:

- **fat** – 37 kJ
- **carbohydrates** – 16 kJ
- **protein** – 17 kJ
- **dietary fibre** – 13 kJ
- **water** – 0 kJ

When we regularly eat more energy than our body needs, the excess is stored inside fat cells. Just one kg of body fat contains the equivalent of 37 000 kJ.

Use the information above to describe the advice you would give an overweight person who plans to lose 1 kg of body fat in a month. Include in your answer a calculation of the daily reduction of kcal consumption. [4]

(Space for calculation)

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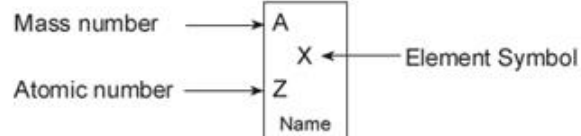
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END OF PAPER

PERIODIC TABLE OF ELEMENTS

1		2		Group										3	4	5	6	7	0		
				<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 1H Hydrogen </div>																<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 2He Helium </div>	
3Li Lithium	4Be Beryllium											5B Boron	6C Carbon	7N Nitrogen	8O Oxygen	9F Fluorine	10Ne Neon				
11Na Sodium	12Mg Magnesium											13Al Aluminium	14Si Silicon	15P Phosphorus	16S Sulfur	17Cl Chlorine	18Ar Argon				
19K Potassium	20Ca Calcium	21Sc Scandium	22Ti Titanium	23V Vanadium	24Cr Chromium	25Mn Manganese	26Fe Iron	27Co Cobalt	28Ni Nickel	29Cu Copper	30Zn Zinc	31Ga Gallium	32Ge Germanium	33As Arsenic	34Se Selenium	35Br Bromine	36Kr Krypton				
37Rb Rubidium	38Sr Strontium	39Y Yttrium	40Zr Zirconium	41Nb Niobium	42Mo Molybdenum	43Tc Technetium	44Ru Ruthenium	45Rh Rhodium	46Pd Palladium	47Ag Silver	48Cd Cadmium	49In Indium	50Sn Tin	51Sb Antimony	52Te Tellurium	53I Iodine	54Xe Xenon				
55Cs Caesium	56Ba Barium	57La Lanthanum	72Hf Hafnium	73Ta Tantalum	74W Tungsten	75Re Rhenium	76Os Osmium	77Ir Iridium	78Pt Platinum	79Au Gold	80Hg Mercury	81Tl Thallium	82Pb Lead	83Bi Bismuth	84Po Polonium	85At Astatine	86Rn Radon				
87Fr Francium	88Ra Radium	89Ac Actinium																			

Key:



**UNIT 2: (Double Award) SPACE, HEALTH AND LIFE
HIGHER TIER**

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question		Marking details		Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)	<p>Any 5 x (1) from:</p> <ul style="list-style-type: none"> • Flowers to butterflies/bees to spiders to shrews to kestrels/stoats • Leaves to aphids to ladybirds to spiders • Leaves to rabbits to badgers/stoats • Fruits & seeds to badgers • Fruits & seeds to mice to kestrel • Fruits & seeds to blackbirds to kestrels/stoats 					5		5
	(b)	(i)	badgers/spiders/ kestrels/ stoats/spiders	1			1		
		(ii)	blackbirds/mice/rabbits/aphids/butterflies/bees	1			1		
		(iii)	kestrels/badgers/ladybirds/spiders/stoats	1			1		

	(iv)	spiders/shrews	1			1		
	(v)	blackbirds/mice/rabbits/aphids/butterflies/bees	1			1		
	(vi)	kestrels/ spiders/ ladybirds/shrews/ stoats	1			1		
(c)	(i)	50, 20 (all correct for mark)		1		1	1	
	(ii)	labelling of trophic levels (1) appropriate scale (1) correct ratio between levels (25 – 10 – 1) (1)		3		3	3	3
(d)		substitution of values ($\frac{23}{460}$) (1) = 5% (1)	1	1		2	2	
(e)		Transfer energy from sunlight by photosynthesis (1) into chemical energy for food web(1)	2			2		
(f)		Organisms that badgers feed on (rabbits, fruits & seeds) will become more plentiful; more availability of fruits & seeds will cause an increase in herbivores that feed on them (mice & blackbirds); more food available for kestrels & stoats could increase their numbers; rabbit population will increase; lower supply of leaves so aphids may decrease; result in decrease in ladybirds; spiders will depend more on butterflies & bees so their numbers will decrease. 5 – 6 marks Detailed description of effects on prey and predators linked with consequential effects on other organisms. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i> 3 – 4 marks Detailed description of effects on direct prey and predators. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i> 1 – 2 marks A basic description of some effects is given. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate used</i>			6	6		

			<i>limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i>						
			0 marks <i>No attempt made or no response worthy of credit.</i>						
			Question 1 total	9	10	6	25	6	8

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		0.2 (s)	1			1		
		(ii)		correct values (8 m/s) (1) Subs of time of 1.8 s (1) Answer = 4.4 m/s ² (1)	1	1		3	2	
	(b)			Straight line (1) to 0,12.5 (1)		2		2	2	
	(c)	(i)		5 x 12.5 = 62.5 m (1) $\frac{20.5}{2} \times 3 = 30.75 \text{ m (1)}$ = 93.25 m (1) OR 8 x 8 = 64 m (1) $\frac{13}{2} \times 4.5 = 29.25 \text{ m (1)}$ = 93.25 m (1)		3		3	3	
		(ii)		93.25 (ecf) /8 (1) = 11.66 m/s or 11.7 m/s (1)	1	1		2	2	
				Question 2 total	3	8	0	11	9	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Fertiliser/nitrates/phosphates (1) Leaching into water/rivers/sea (1) Heavy metal pollution or named copper/Cu, lead/Pb, zinc/Zn. (1)	3			3		
	(b)	(i)		Rhine			1	1		
		(ii)		Most/highest nitrate/nitrogen OR phosphate (1) Plant/algal growth (1) Decay/decompose by bacteria which takes out oxygen (1)	3			3		
	(c)	(i)		Heavy metal/lead build/more concentrated (1) to a toxic level at the end of the food chain (1)	2			2		
		(ii)		Elbe			1	1		
				Question 3 total	8	0	2	10	0	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Short time because gamma rays are harmful (1) Different directions so does not always pass through the same healthy tissue (1)	2			2		
		(ii)	Less risk of damaging healthy surrounding tissue (1) Provides a steady & continuous source of radiation to the tumour (1)	2			2		
	(b)	(i)	Time = 120 days (1) Equivalent to 2 half lives (1) 50 units (1)	1	1		3	3	
		(ii)	Reduce exposure of other people to radiation (1) Radiation more damaging to {growing/dividing} cells(1) Radiation is ionising / damages DNA (1)		3		3		
			Question 4 total	5	5	0	10	3	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5		(i)	Ticks in boxes 4, 5 & 6			3	3		
		(ii)	Scales occupying at least half of the grid on both axes (1) all points correct (1) Line of best fit (1) Line is curved so statement is incorrect. (1)		3	1	4	2	
			Question 5 total	0	3	4	7	2	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Measure and record the mass of the water in a boiling tube. (1) Measure and record the temperature of the water. (1) Measure the mass of the food sample. (1) Hold the burning food sample close to the base of the boiling tube. (1) When the flame goes out measure and record the temperature of the water. (1)	5			5		5
		(ii)	Time between igniting the food and placing it under the boiling tube varies (OWTTE) (1) Distance of the burning food from the boiling tube varied/ not placed in the same spot (1) Incomplete burning (1) Do not accept {mass/size} of food varied/different volume of water/ not burnt for same length of time/ different food			3	3		3
	(b)		kcal equivalent = $\frac{37\,000}{4.184}$ (1) = 8 843.2 kcal/month (1) = 295 kcal/day (1) Dietary intake/fat intake needs to reduce by 295 kcal per day. (1)		4		4	2	
			Question 6 total	5	4	3	12	2	8

HIGHER TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	9	10	6	25	6	8
2	3	8	0	11	9	0
3	8	0	2	10	0	0
4	5	5	0	10	3	0
5	0	3	4	7	2	0
6	5	4	3	12	2	8
TOTAL	30	30	15	75	22	16

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 3: (Double Award) FOOD, MATERIALS AND PROCESSES****FOUNDATION TIER****SAMPLE ASSESSMENT PAPER****(1 hour 30 minutes)**

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	15	
3.	6	
4.	11	
5.	9	
6.	9	
7.	8	
8.	11	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid. Write your name, centre number and candidate number in the spaces at the top of this page. Answer all questions. Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

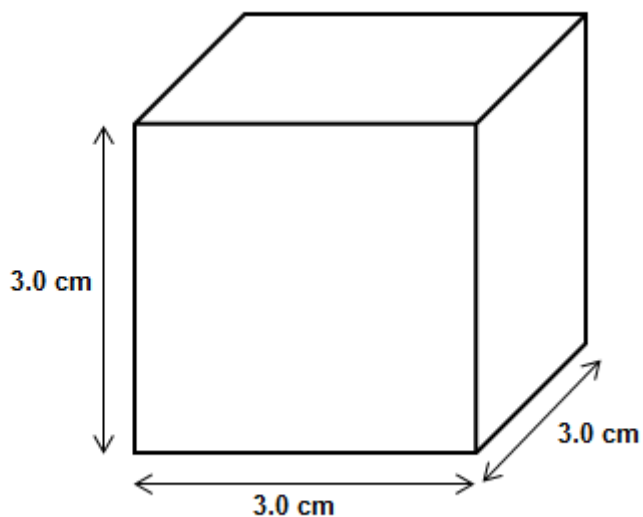
The number of marks is given in brackets at the end of each question or part-question. Question 3 is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** questions

1. The table below contains information on the density of metals.

Metal	Melting point (°C)	Density (g/cm ³)
lead	327	11.3
cobalt	1 495	8.9
aluminum	660	2.7
stainless steel	1 489	8.0

(a) A block of metal has been found in a laboratory. It has a mass of 72.0g with three sides of the same length (3 cm).



(i) Calculate the volume of the metal block using the equation:

$$\text{volume} = \text{width} \times \text{depth} \times \text{length} \quad [1]$$

.....cm³

- (ii) Identify the metal in the block. You will need to use your answer to part (i) and the equation below. [2]

$$\text{density} = \frac{\text{mass (g)}}{\text{volume (cm}^3\text{)}}$$

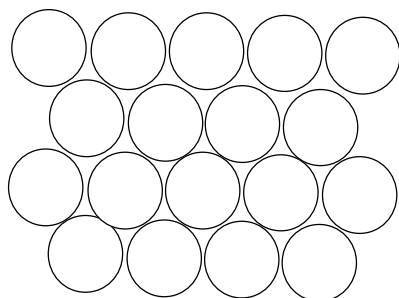
metal =

(b) The table below shows some information about three alloys of iron.

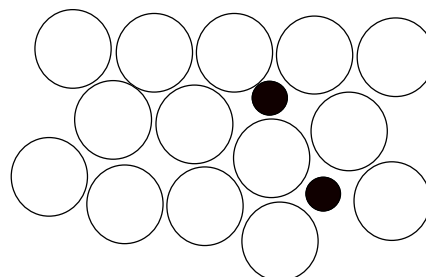
Alloy of iron	Composition	Properties
mild steel	99.8% iron 0.2% carbon	easily pressed into shape will rust
high carbon steel	98% iron 1.7% carbon 0.3% manganese	hard but brittle
stainless steel	74% iron 0.3% carbon% chromium 7.7% nickel	hard rust resistant

(i) State which diagram below represents the *stainless steel*. Give **one** reason for your choice. [2]

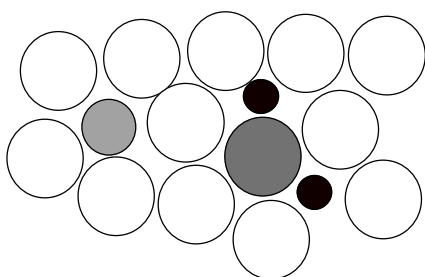
A



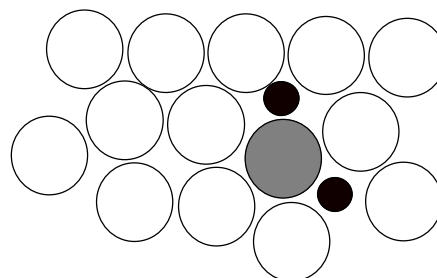
B



C



D



Stainless steel:

Reason:

.....

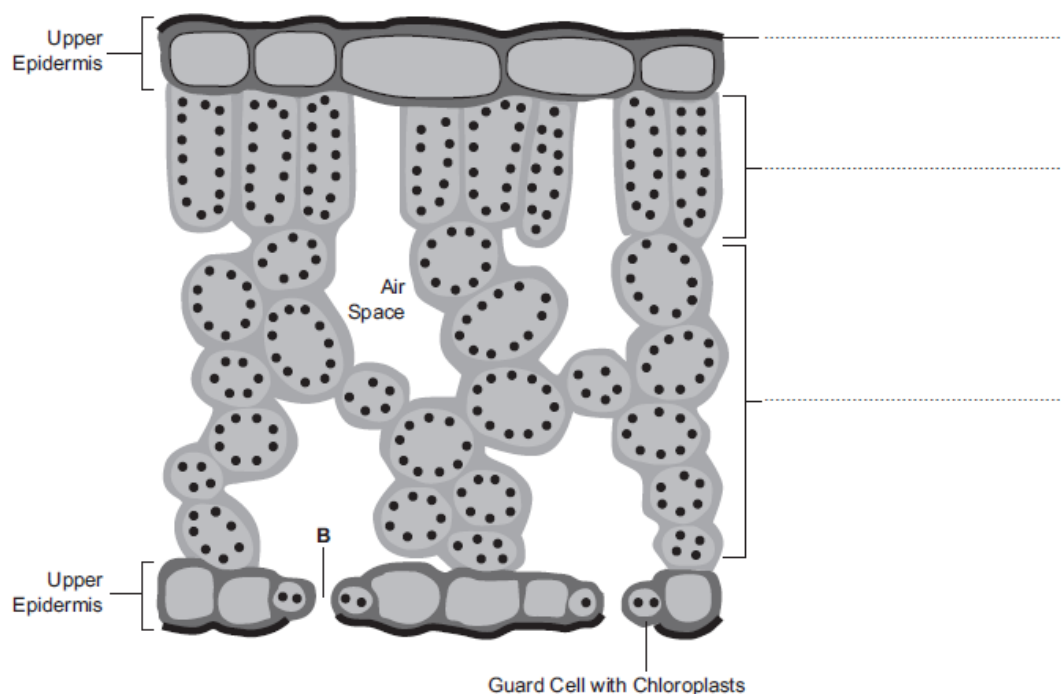
- (ii) Calculate the percentage (%) chromium in stainless steel. Use your answer to complete the table. [1]

6

2. Students are investigating photosynthesis. They started by observing the structure of a leaf under the microscope.

(a) (i) Complete the labelling of the leaf below using only the terms in the box. [2]

palisade mesophyll layer waxy cuticle spongy mesophyll layer



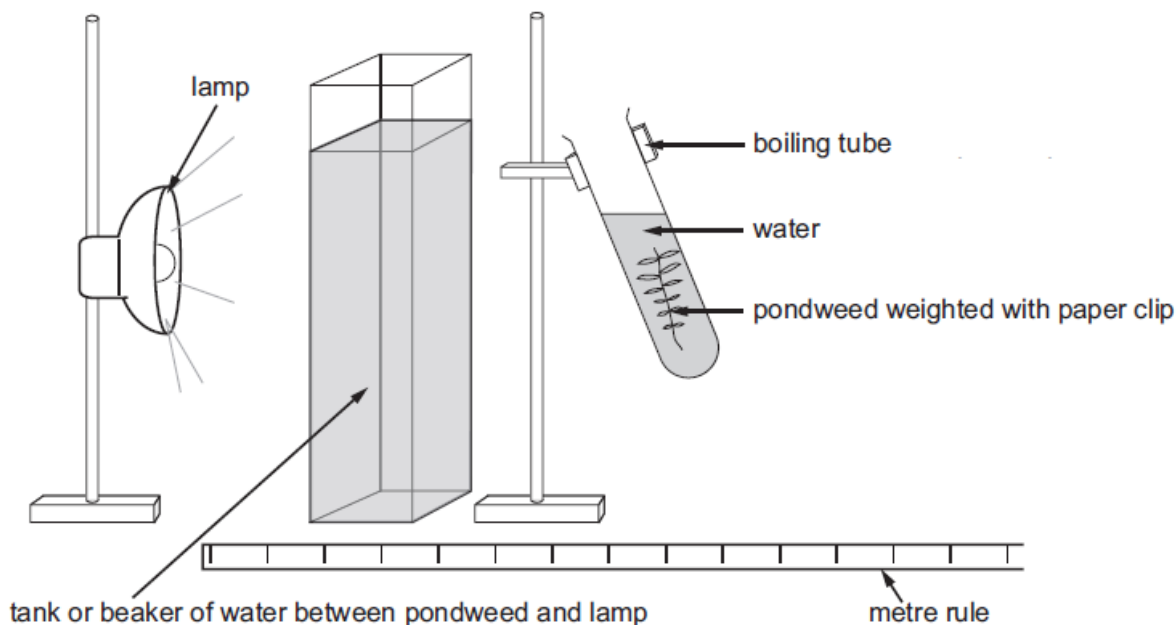
(ii) The letter **B** is used on the diagram to label the space between two guard cells. State its scientific name and describe its function in photosynthesis. [2]

Name:.....

Function:.....

.....

- (b) The diagram below shows an experiment to investigate the effect of light intensity on the rate of photosynthesis.



- (i) Complete the word equation for photosynthesis. [2]

carbon dioxide + → glucose +

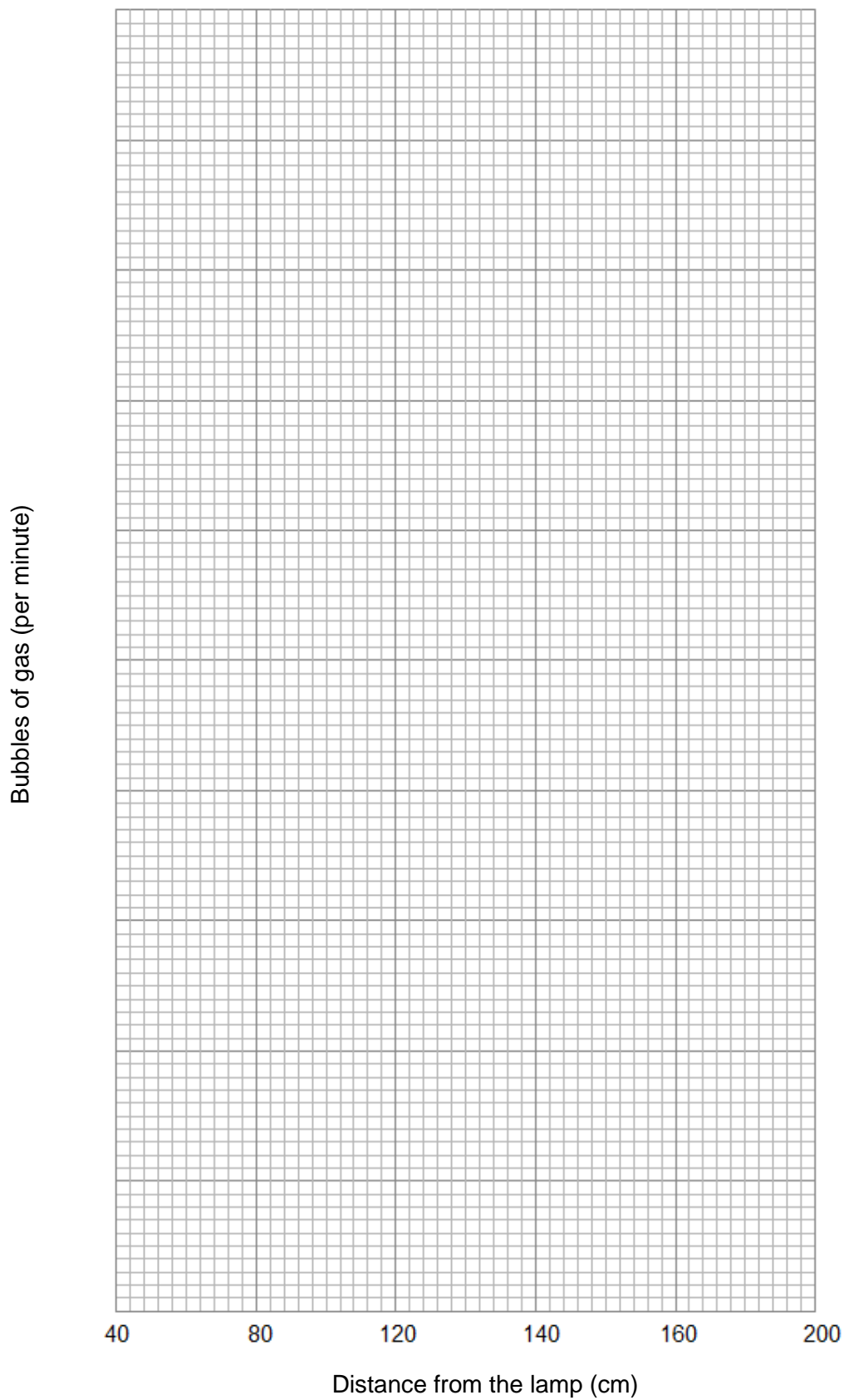
- (ii) The number of bubbles produced by the pondweed per minute was counted.

The experiment was repeated with the lamp at different distances from the pondweed and the results shown in the table. In each case the temperature was kept constant.

Distance from lamp to the beaker (cm)	Bubbles of gas per minute
40	49
80	39
120	25
160	12
200	12

Use the data to plot a graph on the grid below.

[4]



- (iii) Use your graph to estimate the rate of photosynthesis at a distance of 100 cm [1]

.....

- (iv) Use the results of the experiment to describe the effect of light intensity on the rate of photosynthesis. [2]

.....

.....

.....

.....

- (c) It was necessary to carefully control the conditions in the investigation.

- (i) Give **one** reason why it was necessary to keep the temperature constant in the investigation. [1]

.....

.....

- (ii) State **one** other condition that needs to be controlled in the investigation. [1]

.....

4. Vinegar contains a weak acid called ethanoic acid. The concentration of ethanoic acid in vinegar can be found using a titration with sodium hydroxide.

(a) Complete the word equation for the reaction. [2]

ethanoic acid + sodium hydroxide → ethanoate +

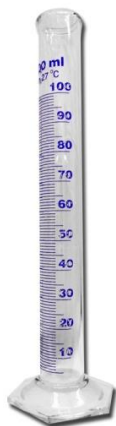
(b) A laboratory technician is checking the concentration of ethanoic acid in vinegar which is to be sold in a local supermarket.

He measures exactly 25.00 cm³ of sodium hydroxide solution into a conical flask. State the letter of the instrument that he should use to measure this volume. [1]

A



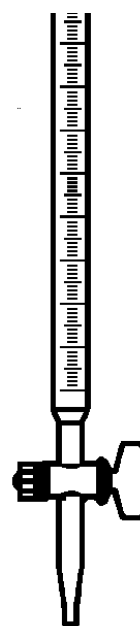
B



C



D

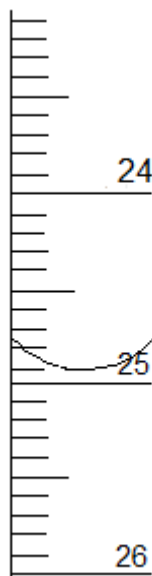


answer:

- (c) The technician carries out the titration by adding ethanoic acid to the sodium hydroxide using a 50.0 cm³ burette. He records his results in the table below.

	Rough titration	Titration 1	Titration 2	Titration 3
Final volume (.....)	.....	24.30	24.30	24.50
Start Volume (.....)	0.05	0.20	0.25	0.50
Titre (.....)	.....	24.10	24.05	24.00

- (i) The technician has not added the units used in the titration to his table. Add the units to the table. [1]
- (ii) The first burette reading is shown in the diagram below. Add this volume to the table and use it to find the missing titre. [2]



- (iii) Calculate the **mean** titre. [3]

mean titre cm³

- (iv) The vinegar should have a concentration between 0.780 and 0.860 mol/dm³. If it does not the technician must report the vinegar as 'out of range'.

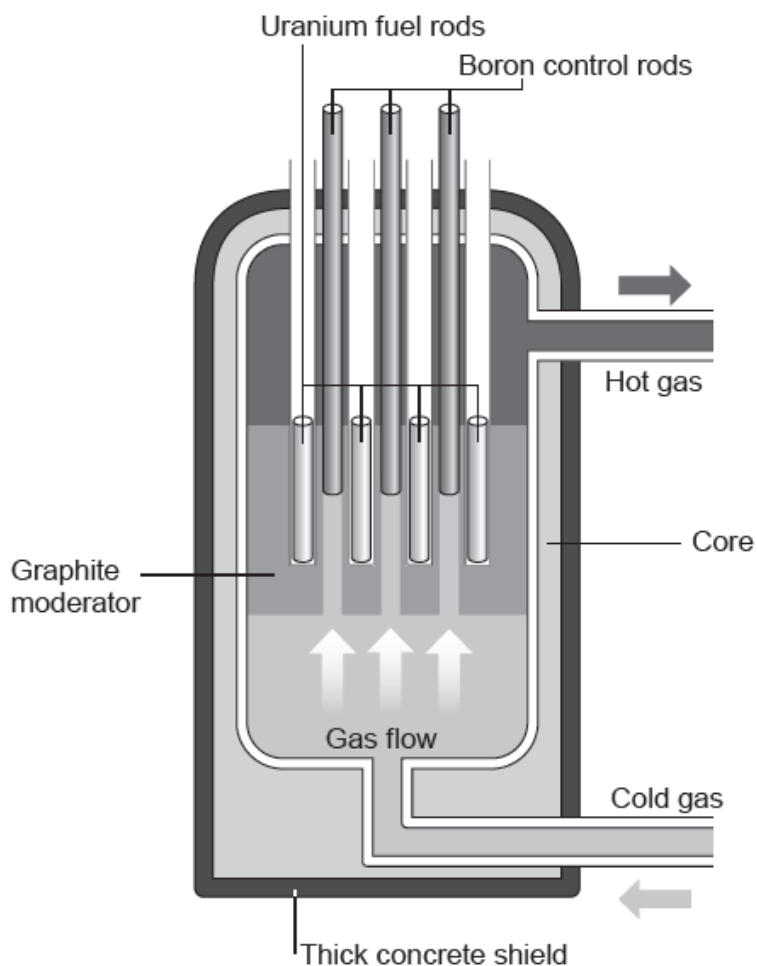
The concentration of the ethanoic acid in vinegar can be found by multiplying the mean titre by 0.0327. Explain whether the technician should report the vinegar as 'out of range'. [2]

.....

.....

5. In a nuclear reactor, energy is released by fission and is the result of a controlled chain reaction. Fuel rods are made of uranium. The graphite moderator surrounds the fuel rods. The boron control rods can be raised and lowered.

The diagram shows the important parts in the core of a gas-cooled nuclear reactor.



- (a) In the Chernobyl disaster the reactor nearly melted down due to mistakes made by the engineers. Which of the following statements could **cause** a meltdown in a reactor? Place a tick (✓) in the box next to the correct statements.

- Adding more moderator
- Pouring sand over the reactor
- Removing the fuel rods
- Withdrawing the control rods
- Switching off the coolant

[2]

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

- (b) Explain the risks caused by damaging the thick concrete shield. [2]

.....

.....

- (c) The table below shows different isotopes of uranium (U)

Isotope	Nuclear symbol
U-230	${}_{92}^{230}\text{U}$
U-234	${}_{92}^{234}\text{U}$
U-235	${}_{92}^{235}\text{U}$
U-238	${}_{92}^{238}\text{U}$

- Use the table to complete the sentences. [3]

All the isotopes have a nucleus that containsprotons.

The isotope that contains 143 neutrons in its nuclei is

The isotope containing the fewest neutrons is

- (d) Complete the following nuclear equations which show the decay of two of these uranium isotopes listed in the table above. [2]



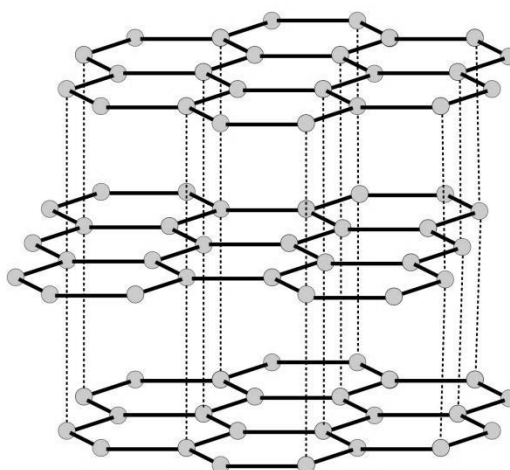
6. The correct choice of material can have a major effect on the success and performance of sporting equipment.

(a) Complete the table by adding one tick (✓) in each row to identify the properties of ionic and covalent compounds. [3]

Feature	Ionic bond	Covalent bond
sharing electrons		
strong electrostatic attraction		
found between non-metals		

(b) The diagrams below show two forms or allotropes of carbon.

(i) Identify each allotrope. [2]



1.

2.

(ii) State the type of bond that is common to both allotropes. [1]

.....

- (c) Performance of cyclists in the Olympic Games can be improved by using the best materials available to build their bikes.



Information about materials that can be used in racing bikes is show in the table below.

Material	Tensile strength (GPa)	Density (g/cm ³)	Melting point (°C)
carbon fibre	3.90	1.75	3 500
steel	1.30	7.90	2 750
aluminium	0.70	2.70	660
titanium	2.02	4.50	1 668

State which material is the most suitable for use in a racing bike, giving **two** reasons for your answer. [3]

.....

.....

.....

.....

7. **DNA profiling** is a forensic technique used to identify individuals by characteristics of their DNA. A **DNA profile** is a small set of DNA variations that is very likely to be different in all unrelated individuals. DNA profiling can be used in paternity disputes.

The image below shows the DNA profile from such a paternity dispute.



- (a) Explain how the DNA profiles above show that **male 1** is the father of the child. [2]

.....

.....

- (b) State **two** other important uses of genetic profiling. [2]

.....

.....

- (c) (i) Describe the principle upon which the use of genetic profiling for identification of individuals depends. [1]

.....

.....

- (ii) Give **one** example when this principle will not be valid. [1]

.....

- (d) '23andMe' is a home DNA testing kit which is on sale in the UK. Give **two** reasons why there is concern about the widespread use of this type of DNA testing. [2]

.....

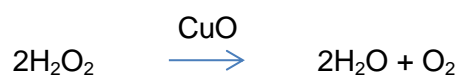
.....

.....

8

8. Students are investigating how effective the catalyst copper (II) oxide works on the decomposition of hydrogen peroxide. The students performed two experiments.

In both experiments 5 g of copper(II) oxide was added to a flask containing 100 cm³ hydrogen peroxide solution. The balanced symbol equation for the reaction is given below.



The gas oxygen is released.

In **Procedure 1** the students counted the number of bubbles of gas given off every 10 seconds.

In **Procedure 2** the students measured the volume of gas given off with a burette.

The results of the students' experiments are below.

Time (s)	Procedure 1 <i>Number of bubbles of oxygen</i>	Procedure 2 <i>Total volume of gas given off (cm³)</i>
10	> 25	15
20	18	27
30	15	37
40	10	45
50	4	50
60	2	51
70	1	51
80	0	51
90	0	51

(a) Explain which method of measuring gas gives the most valid results. [2]

.....
.....
.....
.....

(b) Describe how the rate of the reaction changes during this experiment. [2]

.....
.....
.....
.....

(c) Use data from the table to calculate the maximum rate of reaction. [2]

rate = cm³/min

(d) Explain what is meant by the term 'catalyst'. [2]

.....
.....

(e) State how much copper(II) oxide would be left in the flask at the end of the reaction. [1]

.....g

(f) State **two** ways that the students could speed up the rate of this reaction. [2]

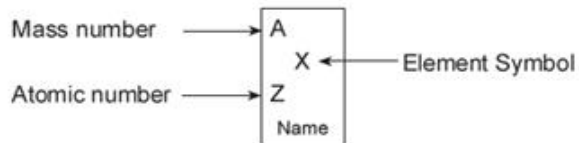
1

2

PERIODIC TABLE OF ELEMENTS

1		2		Group																3	4	5	6	7	0			
				$\begin{array}{c} 1 \\ \text{H} \\ 1 \\ \text{Hydrogen} \end{array}$																								$\begin{array}{c} 4 \\ \text{He} \\ 2 \\ \text{Helium} \end{array}$
$\begin{array}{c} 7 \\ \text{Li} \\ 3 \end{array}$ Lithium	$\begin{array}{c} 9 \\ \text{Be} \\ 4 \end{array}$ Beryllium																	$\begin{array}{c} 11 \\ \text{B} \\ 5 \end{array}$ Boron	$\begin{array}{c} 12 \\ \text{C} \\ 6 \end{array}$ Carbon	$\begin{array}{c} 14 \\ \text{N} \\ 7 \end{array}$ Nitrogen	$\begin{array}{c} 16 \\ \text{O} \\ 8 \end{array}$ Oxygen	$\begin{array}{c} 19 \\ \text{F} \\ 9 \end{array}$ Fluorine	$\begin{array}{c} 20 \\ \text{Ne} \\ 10 \end{array}$ Neon					
$\begin{array}{c} 23 \\ \text{Na} \\ 11 \end{array}$ Sodium	$\begin{array}{c} 24 \\ \text{Mg} \\ 12 \end{array}$ Magnesium																	$\begin{array}{c} 27 \\ \text{Al} \\ 13 \end{array}$ Aluminium	$\begin{array}{c} 28 \\ \text{Si} \\ 14 \end{array}$ Silicon	$\begin{array}{c} 31 \\ \text{P} \\ 15 \end{array}$ Phosphorus	$\begin{array}{c} 32 \\ \text{S} \\ 16 \end{array}$ Sulfur	$\begin{array}{c} 35 \\ \text{Cl} \\ 17 \end{array}$ Chlorine	$\begin{array}{c} 40 \\ \text{Ar} \\ 18 \end{array}$ Argon					
$\begin{array}{c} 39 \\ \text{K} \\ 19 \end{array}$ Potassium	$\begin{array}{c} 40 \\ \text{Ca} \\ 20 \end{array}$ Calcium	$\begin{array}{c} 45 \\ \text{Sc} \\ 21 \end{array}$ Scandium	$\begin{array}{c} 48 \\ \text{Ti} \\ 22 \end{array}$ Titanium	$\begin{array}{c} 51 \\ \text{V} \\ 23 \end{array}$ Vanadium	$\begin{array}{c} 52 \\ \text{Cr} \\ 24 \end{array}$ Chromium	$\begin{array}{c} 55 \\ \text{Mn} \\ 25 \end{array}$ Manganese	$\begin{array}{c} 56 \\ \text{Fe} \\ 26 \end{array}$ Iron	$\begin{array}{c} 59 \\ \text{Co} \\ 27 \end{array}$ Cobalt	$\begin{array}{c} 59 \\ \text{Ni} \\ 28 \end{array}$ Nickel	$\begin{array}{c} 64 \\ \text{Cu} \\ 29 \end{array}$ Copper	$\begin{array}{c} 65 \\ \text{Zn} \\ 30 \end{array}$ Zinc	$\begin{array}{c} 70 \\ \text{Ga} \\ 31 \end{array}$ Gallium	$\begin{array}{c} 73 \\ \text{Ge} \\ 32 \end{array}$ Germanium	$\begin{array}{c} 75 \\ \text{As} \\ 33 \end{array}$ Arsenic	$\begin{array}{c} 79 \\ \text{Se} \\ 34 \end{array}$ Selenium	$\begin{array}{c} 80 \\ \text{Br} \\ 35 \end{array}$ Bromine	$\begin{array}{c} 84 \\ \text{Kr} \\ 36 \end{array}$ Krypton											
$\begin{array}{c} 86 \\ \text{Rb} \\ 37 \end{array}$ Rubidium	$\begin{array}{c} 88 \\ \text{Sr} \\ 38 \end{array}$ Strontium	$\begin{array}{c} 89 \\ \text{Y} \\ 39 \end{array}$ Yttrium	$\begin{array}{c} 91 \\ \text{Zr} \\ 40 \end{array}$ Zirconium	$\begin{array}{c} 93 \\ \text{Nb} \\ 41 \end{array}$ Niobium	$\begin{array}{c} 96 \\ \text{Mo} \\ 42 \end{array}$ Molybdenum	$\begin{array}{c} 99 \\ \text{Tc} \\ 43 \end{array}$ Technetium	$\begin{array}{c} 101 \\ \text{Ru} \\ 44 \end{array}$ Ruthenium	$\begin{array}{c} 103 \\ \text{Rh} \\ 45 \end{array}$ Rhodium	$\begin{array}{c} 106 \\ \text{Pd} \\ 46 \end{array}$ Palladium	$\begin{array}{c} 108 \\ \text{Ag} \\ 47 \end{array}$ Silver	$\begin{array}{c} 112 \\ \text{Cd} \\ 48 \end{array}$ Cadmium	$\begin{array}{c} 115 \\ \text{In} \\ 49 \end{array}$ Indium	$\begin{array}{c} 119 \\ \text{Sn} \\ 50 \end{array}$ Tin	$\begin{array}{c} 122 \\ \text{Sb} \\ 51 \end{array}$ Antimony	$\begin{array}{c} 128 \\ \text{Te} \\ 52 \end{array}$ Tellurium	$\begin{array}{c} 127 \\ \text{I} \\ 53 \end{array}$ Iodine	$\begin{array}{c} 131 \\ \text{Xe} \\ 54 \end{array}$ Xenon											
$\begin{array}{c} 133 \\ \text{Cs} \\ 55 \end{array}$ Caesium	$\begin{array}{c} 137 \\ \text{Ba} \\ 56 \end{array}$ Barium	$\begin{array}{c} 139 \\ \text{La} \\ 57 \end{array}$ Lanthanum	$\begin{array}{c} 179 \\ \text{Hf} \\ 72 \end{array}$ Hafnium	$\begin{array}{c} 181 \\ \text{Ta} \\ 73 \end{array}$ Tantalum	$\begin{array}{c} 184 \\ \text{W} \\ 74 \end{array}$ Tungsten	$\begin{array}{c} 186 \\ \text{Re} \\ 75 \end{array}$ Rhenium	$\begin{array}{c} 190 \\ \text{Os} \\ 76 \end{array}$ Osmium	$\begin{array}{c} 192 \\ \text{Ir} \\ 77 \end{array}$ Iridium	$\begin{array}{c} 195 \\ \text{Pt} \\ 78 \end{array}$ Platinum	$\begin{array}{c} 197 \\ \text{Au} \\ 79 \end{array}$ Gold	$\begin{array}{c} 201 \\ \text{Hg} \\ 80 \end{array}$ Mercury	$\begin{array}{c} 204 \\ \text{Tl} \\ 81 \end{array}$ Thallium	$\begin{array}{c} 207 \\ \text{Pb} \\ 82 \end{array}$ Lead	$\begin{array}{c} 209 \\ \text{Bi} \\ 83 \end{array}$ Bismuth	$\begin{array}{c} 210 \\ \text{Po} \\ 84 \end{array}$ Polonium	$\begin{array}{c} 210 \\ \text{At} \\ 85 \end{array}$ Astatine	$\begin{array}{c} 222 \\ \text{Rn} \\ 86 \end{array}$ Radon											
$\begin{array}{c} 223 \\ \text{Fr} \\ 87 \end{array}$ Francium	$\begin{array}{c} 226 \\ \text{Ra} \\ 88 \end{array}$ Radium	$\begin{array}{c} 227 \\ \text{Ac} \\ 89 \end{array}$ Actinium																										

Key:



**UNIT 3: (Double Award) FOOD, MATERIALS AND PROCESSES
FOUNDATION TIER**

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)	27 cm ³		1		1	1	
		(ii)	$\frac{72}{27} = 2.7 \text{ cm}^3$ (1) metal = aluminium (1)	1	1		2	2	
	(b)	(i)	C(1) mixture of four elements (1)		2		2		
		(ii)	18% (1)		1		1		
			Question 1 total	1	5	0	6	3	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	All labels correct (2) One or two labels correct (1) Order labels: waxy cuticle – palisade layer - spongy mesophyll layer	2			2		
		(ii)	Name: Stoma (accept stomata) (1) Function: Gas exchange/ transfer of gases (1) (allow - CO ₂ in O ₂ out)	2			2		
	(b)	(i)	water (1) oxygen (1)	2			2		
		(ii)	Appropriate scale y axis (1) Plot / All correct (2) Four points correctly plotted (1) Line (1)		4		4	4	4
		(iii)	32 (accept 31-33)			1	1	1	1
		(iv)	Reduce light intensity/further from lamp – {fewer bubbles / less oxygen}/ less photosynthesis (1) After 160 cm graph levels/flattens/ photosynthesis levels off (1)			2	2		3
	(c)	(i)	The rate of photosynthesis also depends upon the temperature	1			1		1
		(ii)	Any 1 x (1) from : <ul style="list-style-type: none"> • CO₂ concentration • quality of light(colour) • mineral requirements 	1			1		1
			Question 2 total	8	4	3	15	5	10

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
3	(a)	<p>Indicative content</p> <ul style="list-style-type: none"> • Food poisoning is caused by bacteria • Bacteria on raw food • Transferred by dirty hands/ to knife / other food preparation materials • Use same knife – transferred to cooked food • Uncooked food contains bacteria – transferred to human • Use different/clean knife/cook food – reduce the transfer of bacteria <p>5 – 6 marks Detailed explanation of actions that should be taken to reduce food poisoning <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3 – 4 marks Detailed explanation of some actions that should be taken to reduce food poisoning <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks A basic explanation of some actions that should be taken to reduce food poisoning <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate used limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p>	4	2		6		

				<p>0 marks <i>No attempt made or no response worthy of credit.</i></p>						
				Question 3 total	4	2	0	6	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			sodium (1) water (1)		2		2		
	(b)			C		1		1		1
	(c)	(i)		cm ³ added three times (1) cm ³ added once or twice only (0)		1		1		1
		(ii)		24.90 (1) 24.85 (1) (do not accept 24)		2		2	1	2
		(iii)		Use final three titres (1) 24.10+24.05+24.00 (1) =24.05 (1)			3	3	2	3
		(iv)		The conc vinegar = 24.05 x 0.0327 = 0.80115 (mol/dm ³) (1) which means that it is within the acceptable range/ technician does not report it out of tolerance (1) Allow ecf. The candidate's conclusion should be consistent with the calculated concentration.			2	2	1	2
				Question 4 total	0	6	5	11	4	9

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			Tick in boxes 4(1) and 5(1)		2		2		
	(b)			Escape of radioactive material into the environment (1) Which may damage human health/cause cancer (1)	2			2		
	(c)			92 (1) U-235 (1) U-230 (1)		3		3		
	(d)			234 (1) $^{234}_{92}\text{U}$ (1)		2		2		
				Question 5 total	2	7	0	9	0	0

Question				Marking details			Marks Available					
							AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Feature	Ionic Bond	Covalent bond	3		3			
				sharing electrons		✓(1)						
				strong electrostatic attraction	✓(1)							
				found between non-metals		✓(1)						
	(b)	(i)	1.	fullerene			1					
			2.	graphite			1					
		(ii)		covalent			1					
	(c)			carbon fibre (1) lightest/least dense material (1) strongest material/ material with highest tensile strength (1)				3	3			
				Question 6 total			6	0	3	9	0	0

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
7	(a)			All bands in child profile that do not match mothers (1) matches male 1 profile (1)		2		2			2
	(b)			Forensic investigation (1) Criminal investigations (1)	2			2			
	(c)	(i)		DNA is unique to the individual	1			1			
		(ii)		In twins/clones	1			1			
	(d)			Lack of understanding of the information (1) Results of the test may be inappropriately used (1)		2		2			
				Question 7 total	4	4	0	8	0		2

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)		Volume of gas evolved (1) since all gas is captured in the burette where it is relatively easy to measure the volume / it is difficult to count bubbles accurately / easy miss a bubble when counting in other method (1)			2	2		2
	(b)		High rate at the start (1) Rate drops (1)			2	2		2
	(c)		15 x 6 (1) = 90 (1) cm ³ /min		2		2	2	
	(d)		Substance that increases the rate (1) remaining chemically unchanged (1)	2			2		
	(e)		5 g	1			1		1
	(f)		Any 2 x (1) from: <ul style="list-style-type: none"> • Increase temp • add more CuO • Stir • increase conc of H₂O₂ (do not accept the term amount) 	2			2		2
			Question 8 total	5	2	4	11	2	7

FOUNDATION TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	1	5	0	6	3	0
2	8	4	3	15	5	10
3	4	2	0	6	0	0
4	0	6	5	11	4	9
5	2	7	0	9	0	0
6	6	0	3	9	0	0
7	4	4	0	8	0	2
8	5	2	4	11	2	7
TOTAL	30	30	15	75	14	28

Candidate Name	Centre Number				Candidate Number			
					0			



GCSE

APPLIED SCIENCE (Double Award)

**UNIT 3: (Double Award) FOOD, MATERIALS
AND PROCESSES**

HIGHER TIER

SAMPLE ASSESSMENT PAPER

(1 hour 30 minutes)

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	11	
3.	14	
4.	15	
5.	12	
6.	7	
7.	8	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

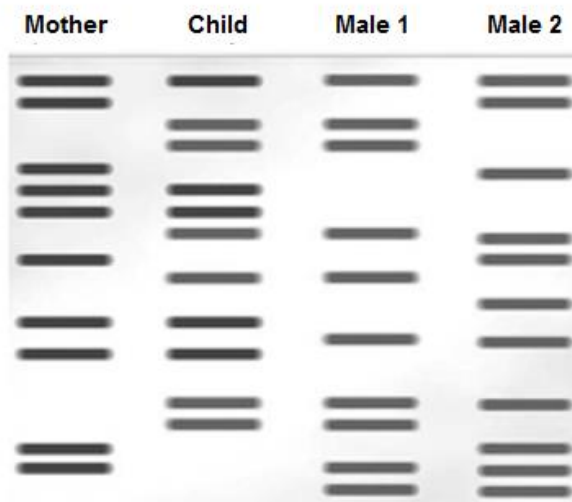
INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
Question 3(c) is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** questions

1. **DNA profiling** is a forensic technique used to identify individuals by characteristics of their DNA. A **DNA profile** is a small set of DNA variations that is very likely to be different in all unrelated individuals. DNA profiling can be used in paternity disputes.

The image below shows the DNA profile from such a paternity dispute



- (a) Explain how the DNA profiles above show that **male 1** is the father of the child. [2]

.....

- (b) State **two** other important uses of genetic profiling. [2]

.....

- (c) (i) Describe the principle upon which the use of genetic profiling for identification of individuals depends. [1]

.....

- (ii) Give **one** example when this principle will not be valid. [1]

.....

- (d) '23andMe' is a home DNA testing kit which is on sale in the UK. Give **two** reasons why there is concern about the widespread use of this type of DNA testing. [2]

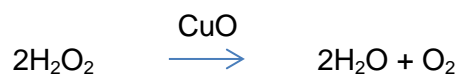
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8

2. Students are investigating how effective the catalyst copper (II) oxide works on the decomposition of hydrogen peroxide. The students performed two experiments.

In both experiments 5 g of copper (II) oxide was added to a flask containing 100 cm³ hydrogen peroxide solution. The balanced chemical equation is given below.



The gas oxygen is released.

In **Procedure 1** the students counted the number of bubbles of gas given off every 10 seconds.

In **Procedure 2** the students measured the volume of gas given off with a burette.

The results of the students' experiments are below.

Time (s)	<i>Procedure 1</i>	<i>Procedure 2</i>
	Number of bubbles of oxygen	Total volume of gas given off (cm ³)
10	> 25	15
20	18	27
30	15	37
40	10	45
50	4	50
60	2	51
70	1	51
80	0	51
90	0	51

- (a) Explain which method of measuring gas gives the most valid results. [2]

.....
.....
.....

- (b) Describe how the rate of the reaction changes during this experiment. [2]

.....
.....
.....

- (c) Use data from the table to calculate the maximum rate of reaction. [2]

rate = cm³/min

- (d) Explain what is meant by the term 'catalyst'. [2]

.....
.....
.....

- (e) State how much copper(II) oxide would be left in the flask at the end of the reaction. [1]

.....g

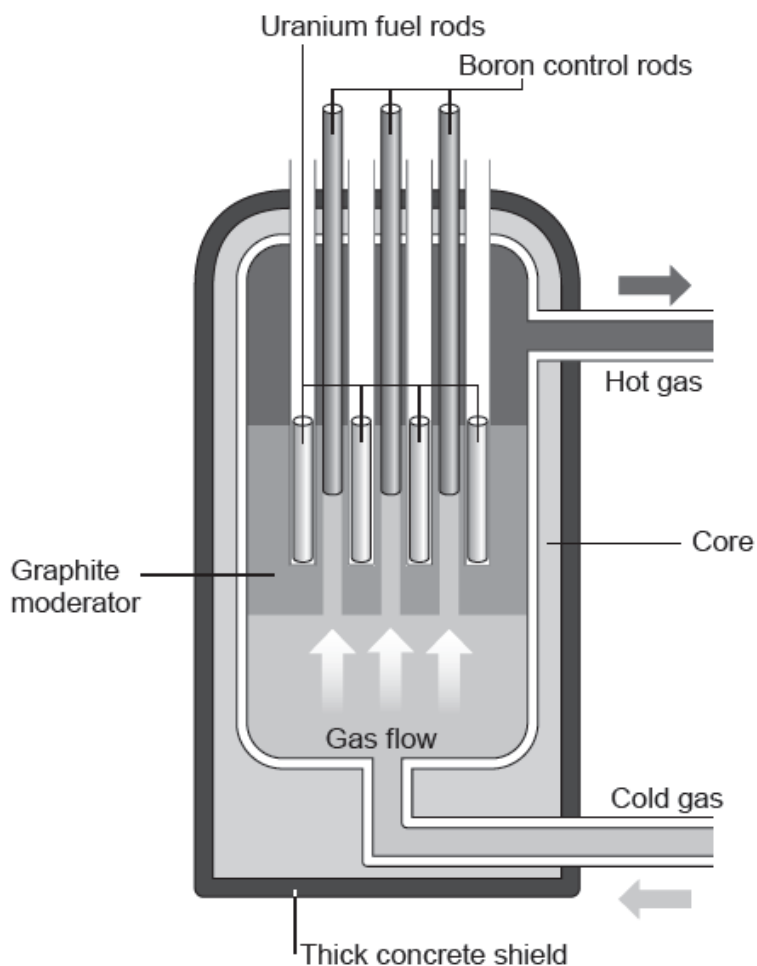
- (f) State **two** ways that the students could speed up the rate of of this reaction. [2]

1

2

3. Many governments are researching new carbon-free sources of energy. Nuclear power stations use the principle of nuclear fission in a controlled chain reaction. The fuel source is a radioactive isotope, uranium-235. Uranium-235 has a half-life of 703800000 years. When uranium-235 captures a neutron, nuclear fission occurs which starts a chain reaction. This causes the release of two daughter nuclei and two neutrons as well as the release of large amounts of energy. This energy is captured and harnessed in a nuclear power station

A typical nuclear power reactor is shown below.



- (a) (i) Uranium-235 can be written ${}_{92}^{235}\text{U}$.
 The number neutrons in the uranium-235 nucleus is: [1]
- A 235
 B 327
 C 143
 D 92

answer:.....

- (d) Describe the consequences of an uncontrolled 'chain reaction' in a nuclear power station. [2]

.....

.....

.....

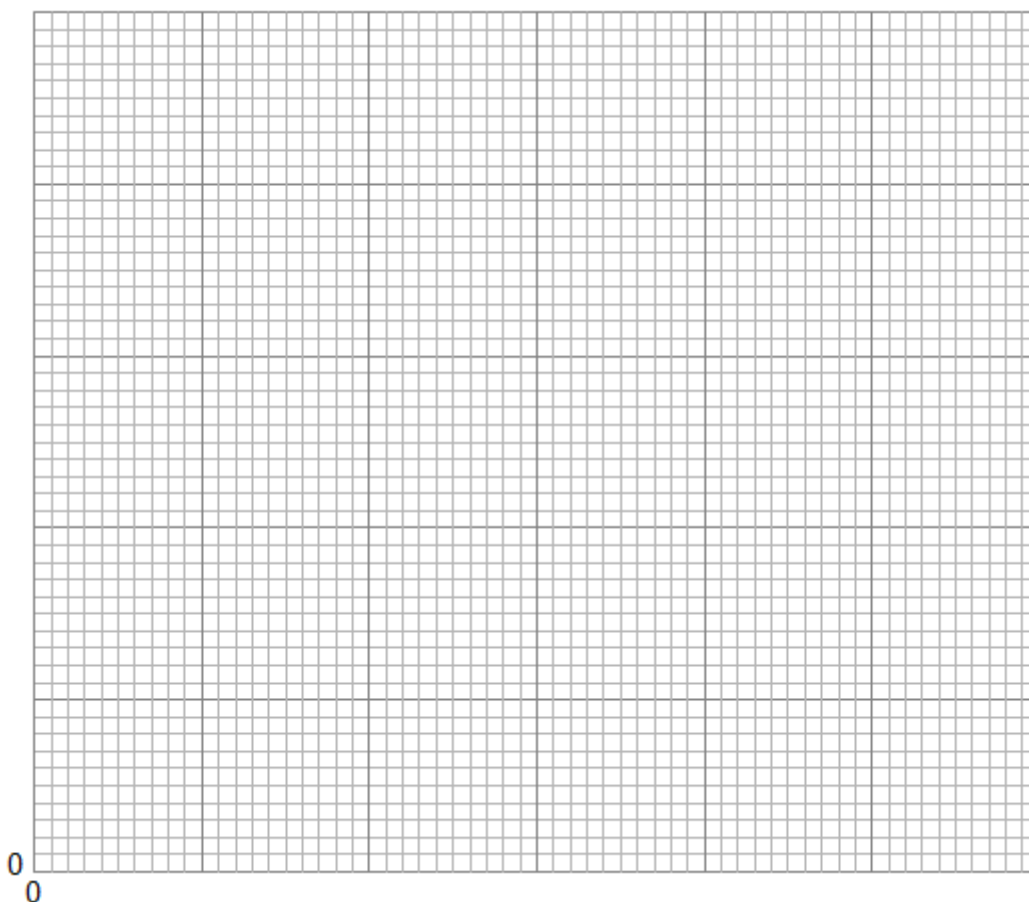
4. During the development of new crops and fertilisers many universities have specialist departments researching all aspects of plant growth. The scientists are referred to as agro-chemists. These scientists consistently develop new strategies to increase the yield of crops.

Research into the effect of a new fertiliser on the yield of a crop produce the following results.

Fertiliser (kg per hectare)	Crop yield (kg per hectare)
10	3400
20	4200
40	5600
80	8000
120	9000
200	9000

- (a) Use the data to plot a graph on the grid below.

[4]



(b) Use your graph to answer the following questions.

(i) Estimate the yield when no fertiliser is used. [1]

.....kg/per hectare

(ii) Determine the mass of fertiliser that would have to be added to double this yield. [1]

..... kg/per hectare

(iii) Explain why it is not economical to add 250 kg of fertiliser per hectare. [2]

.....
.....

(c) Describe the process of photosynthesis in plants. Include a word equation in your answer. [3]

.....
.....
.....
.....
.....

(d) Explain why NPK fertilisers improve crop yield. [4]

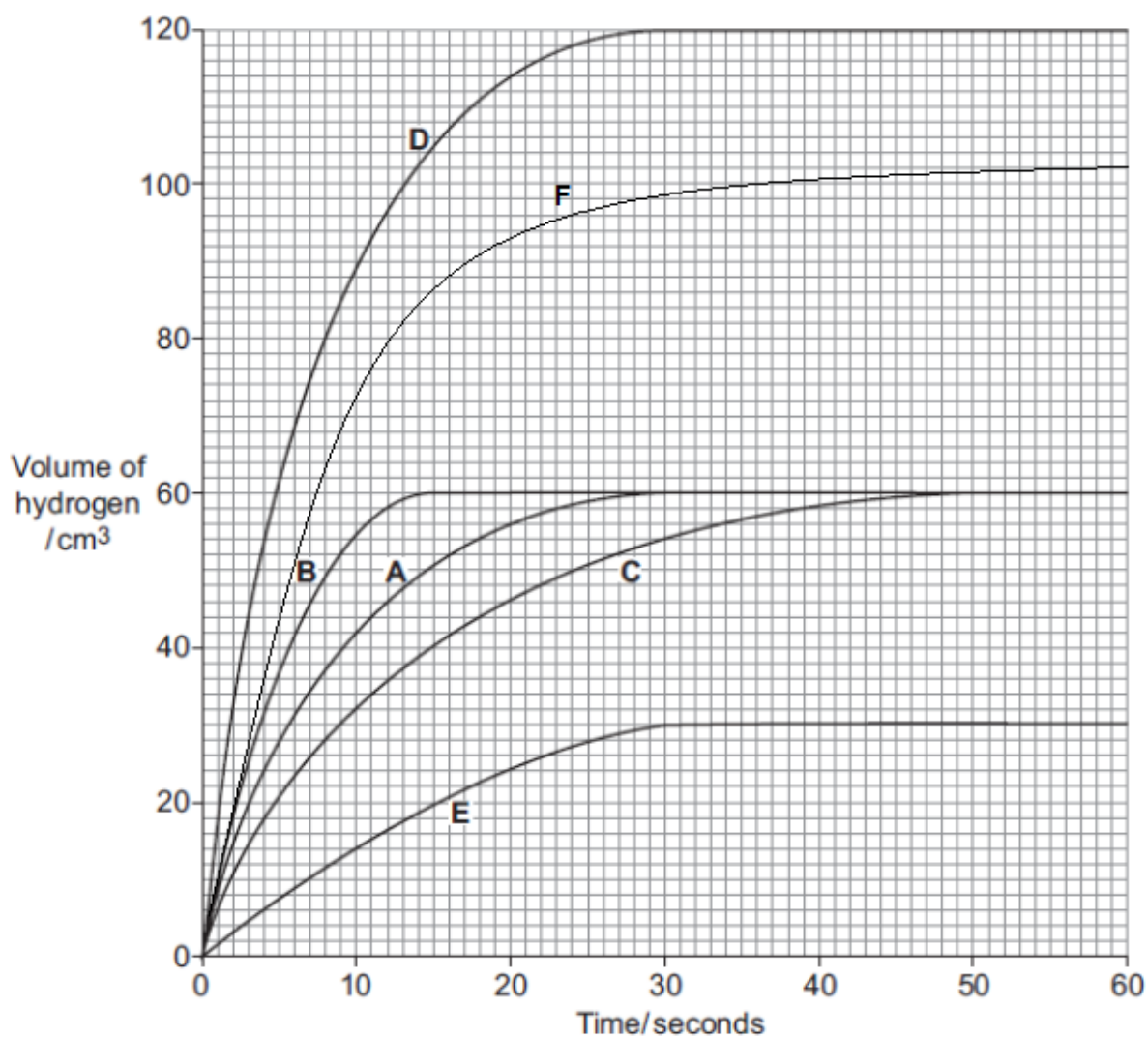
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5. Phillip and Elizabeth are investigating factors that affect the rate of chemical reactions. In their experiment they have used the reaction of magnesium metal with excess hydrochloric acid.

The equation below summarises the reaction:



The graphs below show the results the students have collected by changing different factors.



Graph A was obtained when the students used 0.06 g of magnesium ribbon and excess 1.0 mol dm^{-3} hydrochloric acid at 40°C .

- (a) (i) Explain why graph **C** shows 0.06 g of magnesium ribbon and excess 1.0 mol/dm³ hydrochloric acid at 20°C. [3]

.....
.....
.....

- (ii) Explain why graph **E** shows 0.03 g of magnesium ribbon and excess 1.0 mol / dm³ hydrochloric acid at 20°C. [3]

.....
.....
.....

- (iii) Explain which graph is consistent with 0.06 g of magnesium **powder** and excess 1.0 mol / dm³ hydrochloric acid at 40°C. [4]

Graph:

.....
.....
.....

- (b) For graph **E** calculate the mean rate of reaction for the first 10 s. [2]

.....cm³/s

6. The table below contains information on the density of metals.

Metal	Melting point (°C)	Density (g/cm ³)
lead	327	11.3
cobalt	1495	8.9
aluminum	660	2.7
stainless steel	1489	8.0

mass = density x volume

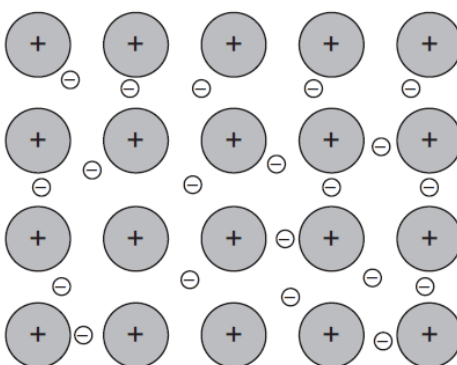
(a) A cube of metal of side length 3.0 cm has a mass of 72.0g.

Use the equation to identify the metal.

[3]

metal =

(b) The structure below shows how the atoms of pure metals like iron or aluminium are held together.



Use your understanding of metallic bonding to explain the following properties of metals.

(i) Metals are good conductors of electricity. [2]

.....

.....

.....

(ii) Most metals are ductile. [2]

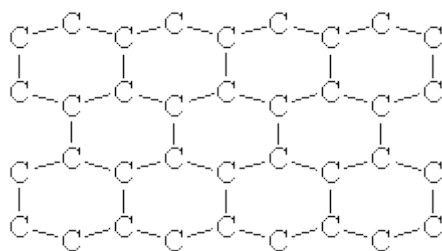
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7

7. There are an increasing number of applications of carbon fibres. A small piece of carbon fibre appears as follows:



- (a) Compare the structures of graphite and carbon fibre. [4]

.....

.....

.....

.....

.....

.....

Performance of cyclists in the Olympic Games can be improved by using the best materials available to build their bikes.



Information about materials that can be used in making racing bike frames is shown in the table below.

Material	Tensile strength (GPa)	Density (g/cm ³)	Hardness (Mohs)
carbon fibre	3.90	1.75	10.0
steel	1.30	7.90	8.0
aluminium	0.70	2.70	2.0
titanium	2.02	4.50	9.0

- (b) Analyse the data and explain which material would be best to produce a high performance racing bike frame. [4]

.....

.....

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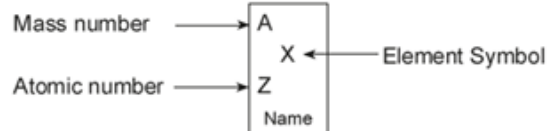
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PERIODIC TABLE OF ELEMENTS

1		2		Group										3		4	5	6	7	0		
				<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 1H Hydrogen </div>																		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> 2He Helium </div>
3Li Lithium	4Be Beryllium											5B Boron	6C Carbon	7N Nitrogen	8O Oxygen	9F Fluorine	10Ne Neon					
11Na Sodium	12Mg Magnesium											13Al Aluminium	14Si Silicon	15P Phosphorus	16S Sulfur	17Cl Chlorine	18Ar Argon					
19K Potassium	20Ca Calcium	21Sc Scandium	22Ti Titanium	23V Vanadium	24Cr Chromium	25Mn Manganese	26Fe Iron	27Co Cobalt	28Ni Nickel	29Cu Copper	30Zn Zinc	31Ga Gallium	32Ge Germanium	33As Arsenic	34Se Selenium	35Br Bromine	36Kr Krypton					
37Rb Rubidium	38Sr Strontium	39Y Yttrium	40Zr Zirconium	41Nb Niobium	42Mo Molybdenum	43Tc Technetium	44Ru Ruthenium	45Rh Rhodium	46Pd Palladium	47Ag Silver	48Cd Cadmium	49In Indium	50Sn Tin	51Sb Antimony	52Te Tellurium	53I Iodine	54Xe Xenon					
55Cs Caesium	56Ba Barium	57La Lanthanum	72Hf Hafnium	73Ta Tantalum	74W Tungsten	75Re Rhenium	76Os Osmium	77Ir Iridium	78Pt Platinum	79Au Gold	80Hg Mercury	81Tl Thallium	82Pb Lead	83Bi Bismuth	84Po Polonium	85At Astatine	86Rn Radon					
87Fr Francium	88Ra Radium	89Ac Actinium																				

Key:



**UNIT3: (Double Award) FOOD, MATERIALS AND PROCESSES
HIGHER TIER**

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
1	(a)			All bands in child profile that do not match mothers (1) matches male 1 profile (1)		2		2			2
	(b)			Forensic investigation (1) Criminal investigations (1)	2			2			
	(c)	(i)		DNA is unique to the individual	1			1			
		(ii)		In twins/clones	1			1			
	(d)			Lack of understanding of the information (1) Results of the test may be inappropriately used (1)		2		2			
				Question 1 total	4	4	0	8	0		2

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		Volume of gas evolved (1) since all gas is captured in the burette where it is relatively easy to measure the volume / it is difficult to count bubbles accurately / easy miss a bubble when counting in other method (1)			2	2		2
	(b)		High rate at the start (1) Rate drops (1)			2	2		2
	(c)		15 x 6 (1) = 90 (1) cm ³ /min		2		2	2	
	(d)		Substance that increases the rate (1) remaining chemically unchanged (1)	2			2		
	(e)		5 g	1			1		1
	(f)		Any 2 x (1) from: Increase temp add more CuO Stir increase conc of H ₂ O ₂ (do not accept the term amount)	2			2		2
			Question 2 total	5	2	4	11	2	7

Question				Marking details			Marks Available			
							AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		C / 143				1		
		(ii)		89 (1) 36 (1) 3 (1)				3		
	(b)			703800000 years is the time taken (1) for the mass/activity /count rate to decrease by half (1)	2			2		
	(c)			<p>Indicative content: Coolant: control/maintain the temperature of reactor/prevent reactor temperature becoming too high Moderator: slows down neutrons so that they can maintain the chain reaction Control rods: absorb some neutrons to control the rate of the nuclear reaction To raise the temperature, raise the control rods To lower the temperature, lower the control rods Refer to the diagram and explain how the temperature of the nuclear reactor is controlled.</p> <p>5 – 6 marks Candidates have referred to all the relevant components (coolant, control rods and moderator) on the diagram and given a full explanation on how these components help to control the temperature in a nuclear reactor. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3 – 4 marks Candidates have identified some of the components from the diagram and how they can control the temperature in the nuclear reactor. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.</i></p>	2	4		6		

			<p><i>The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks A basic description of some of the relevant components that can control the temperature in a nuclear reactor. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit</i></p>						
	(d)		<p>Excess heat/energy – released (1) An explosion may occur (1)</p>	2			2		
			Question 3 total	6	8	0	14	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Scale – 1 Plot – 2 (All correct (2), five correct (1)) Line – 1		4		4	4	
	(b)	(i)		2400 – 2600			1	1	1	
		(ii)		28-32		1		1	1	
		(iii)		Above 120 kg/hectare (1) graph crop yield levels off (1) or Adding more than 120 kg/hectare (1) no increase in yield (1)			2	2	2	
	(c)			absorb light energy (1) convert carbon dioxide and water into glucose and oxygen(1) carbon + water → glucose + oxygen (1) dioxide	3			3		
	(d)			NPK – contains Nitrate, phosphate and potassium N – produce amino acids / protein / growth P – chlorophyll formation / DNA synthesis K – needed for root growth	4			4		
				Question 4 total	7	5	3	15	8	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		less kinetic energy/particles move more slowly/less collisions (1) faster rate/ gas given off quicker (1) same volume given off (1)		3		3		3
		(ii)		half the quantity Mg (1) less particle collisions (1) half quantity of gas given off (1)		3		3		3
		(iii)		Graph B (1) greater surface area (1) faster rate /more collisions (1) same volume given off (1)			4	4		4
	(c)			14 x 6 (1) = 84 (1)		2		2	2	
				Question 5 total	0	8	4	12	2	10

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		Volume = $3 \times 3 \times 3 = 27$ (1) density = $72/27 = 2.7 \text{ g/cm}^3$ (1) = aluminium (1)		3		3	3	
	(b)	(i)		Free electrons move (1) carry charge (1)	2			2		
		(ii)		No rigid bonds / regular rows of atoms/no covalent bonds (1) layers of ions slide over each other (1)	2			2		
				Question 6 total	4	3		7	3	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Similarity: Both graphite and carbon fibres are made up of carbon in hexagonal rings (1) Differences graphite layers lie in ordered structure one on top of another carbon fibre less ordered structure/ layers fold over one another	4			4		
	(b)	(i)	Carbon fibre is the best material (1) Tensile strength is highest (1) Carbon fibre lowest density (1) Therefore bike is stronger and lighter (1)			4	4	4	
			Question 7 total	4		4	8	4	

HIGHER TIER**SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES**

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	4	0	8	0	2
2	5	2	4	11	2	7
3	6	8	0	14	0	0
4	7	5	3	15	8	0
5	0	8	4	12	2	10
6	4	3	0	7	3	0
7	4	0	4	8	4	0
TOTAL	30	30	15	75	19	19



GCSE

APPLIED SCIENCE (Double Award)

UNIT 4: (Double Award) TASK BASED ASSESSMENT

Effectiveness of Antimicrobial Agents

INSTRUCTIONS TO TEACHERS/EXAMS OFFICERS

Confidential

**To be opened on receipt for immediate use by
TEACHERS / EXAMS OFFICERS**

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

A. General Instructions

1. Candidates are required to submit one complete pack which will contain three activities.

The tasks will need to be completed in the second half of the autumn term (i.e. November-December). The unit will be completed in five sessions each of 60 minutes duration.

Activity 1 will be completed in sessions 1-3 and will involve the obtaining of results. This should be securely stored by the teacher between sessions. Activity 2 will be completed in session 4 and will involve the analysis and evaluation of given data. This should be collected in at the end of session 4. Activity 3 should be completed in session 5 and will involve a risk assessment. This should be collected in at the end of session 5.

2. A foundation tier paper is also available. Use of this paper will limit candidates to grades C-G.
3. The task should be supervised at all times by a member of staff responsible for teaching GCSE Science. Centres may use additional laboratories, provided that a subject teacher is available to supervise all candidates at all times.
4. The question papers for all activities will be made available to the examinations officer in each centre at the start of November. Teachers may open the “**List of apparatus required**” document at the start of September. **This is for the purpose of ensuring that centres have the required apparatus.**

5. **Activity 1:** Activity Candidates should work individually to produce their plan. It is permissible for candidates to work in small groups to perform the practical procedure (no more than three candidates) **provided their plans are sufficiently similar**. Teachers should ensure that each group has adequate working space and that the groups are set a reasonable distance apart. Each candidate requires uninterrupted access to the allocated apparatus. This is carried out under a limited level of control, i.e. learners may work with others to obtain results but they must provide their own responses to the questions set. Teacher assistance should not normally be required, but may be given if equipment failure occurs. Candidates should complete the analysis and evaluation sections of activity 1 individually under a high level of control, learners must work individually. This section is to be completed with no teacher feedback or assistance allowed and under formal supervision.
6. When activity 1 is completed, it should be securely stored by the teacher and passed to the Examination Officer when all three activities are complete. **Candidates should not** have access to activity 1 after they have started activity 2 or activity 3.
7. **Activity 2:** This is carried out under a high level of control, i.e. candidates work individually, set a suitable distance apart and under supervision. When activity 2 is complete, it should be securely stored by the teacher and passed to the examination officer when all three activities are complete. **Candidates should not** have access to activity 2 after they have started activity 3.
8. **Activity 3:** This is carried out under a high level of control, i.e. candidates work individually, set a suitable distance apart and under supervision.
9. Candidates should write their answers in the spaces provided on the question paper. Should there be a need for additional space then a standard extension/answer booklet should be provided.
10. If candidates fail to obtain results for activity 1, it is acceptable for them to be given unformatted teacher results.
11. As soon as all assessments have taken place, the completed activities for each candidate should be attached to each other and then securely stored by the exams officer before they are sent to the examiner by at the latest. Teachers should not be given access to the completed examination papers after the actual assessments have taken place.
12. The examination papers will be externally marked by a WJEC examiner. The name and address of the examiner will be issued to centres by the end of April.
13. Monitoring visits will take place on a random sample of centres to ensure the task based assessment is being administered correctly.



GCSE

APPLIED SCIENCE (Double Award)

UNIT 4: (Double Award) TASK BASED ASSESSMENT

Information for teachers and technicians

Details of the apparatus and materials required for the assessment follow.

If any difficulty is experienced in providing the apparatus, WJEC should be informed as soon as possible.

Contacts:

Subject Officer: Llinos Wood **029 2026 5384** llinos.wood@wjec.co.uk

Support Officer: Sarah Price **029 2026 5103** sarah.price@wjec.co.uk

ACTIVITY 1

Apparatus Required

The following apparatus is required for each candidate or group of candidates:
(each group should consist of no more than three candidates)

- cotton wool
- 8 petri dishes containing nutrient agar
- 8 boiling tubes
- forceps
- Bunsen burner
- 70% (v/v) Ethanol
- filter paper
- hole punch
- 4 different anti-microbial agents (label one of the agents as CBAC teriocidal)
- sticky tape
- pipettes
- 2 microbial sources
- measuring cylinders
- water
- pencil
- ruler
- inoculating loops

Please note that candidates will not be required to use all the apparatus.

Activity 2

No specific equipment is required for this activity, however candidates should have access to a calculator.

Activity 3

Candidates are required to carry out a risk assessment on the procedure given. They are not required to perform the investigation. Candidates should have CLEAPSS Student Safety sheets available to them.

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 4: (Double Award) TASK BASED ASSESSMENT****ACTIVITY 1****FOUNDATION TIER****SAMPLE ASSESSMENT PAPER****(3 hours)**

For Examiner's use only		
Skill Area	Maximum Mark	Mark Awarded
Planning	10	
Collecting and Recording	10	
Analysis	10	
Evaluation	5	
Total	35	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Assessment will take into account the quality of your writing.

Background

CBACteriocidal is a company who manufacture cleaning products. They claim that their antimicrobial cleaning agent is better than other brands at killing micro-organisms.



In this assessment you need to investigate whether CBACteriocidal's claim is true.

Assessment summary

You will need to:

1. Plan (task A)

Plan a procedure that will allow you to test whether CBACteriocidal's claim is true.

2. Collect and record data (task B)

Use your procedure to **collect and record** data to test the claim made by CBACteriocidal that their anti-microbial cleaning agent is better than other brands.

3. Analyse the data and draw conclusions (task C)

Use your data test the claim:

"CBACteriocidal's antimicrobial cleaning agent is better than other brands"

4. Evaluate the data and procedure (task D)

Evaluate (comment on) the **quality** of your data and the **method** you used. Consider the **changes** you could make to the procedure to improve your investigation.

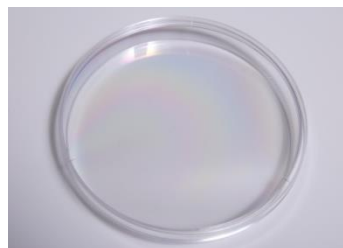
Task A: Planning

Plan suitable procedure(s) that will allow you to test the claim made by CBACteriocidal that their anti-microbial cleaning agent is better than other brands.

You should test a **minimum** of four different anti-microbial cleaning agents on **two different** microbial sources.

What equipment/materials will be available to you?

- cotton wool
- petri dishes
- nutrient agar
- boiling tubes
- forceps
- Bunsen burner
- 70% (v/v) ethanol
- filter paper
- hole punch
- anti-microbial agents
- sticky tape
- pipettes
- microbial sources
- measuring cylinders
- water
- pencil
- ruler
- inoculating loops



Points to note:

- Do not feel that you have to use all the equipment above when you plan your investigation.
- Do not feel that you are restricted to the equipment above – you may wish to use other equipment if it is available.

Task A Planning

What variable(s) will you change in your experiment?

.....
.....
.....

What variable(s) will you keep the same in your experiment?

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.....

What will you measure in your experiment?

.....
.....

What equipment will you use?

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Task C Analyse your data and make conclusions.

You must now **present** and **analyse** the data that you have gained from your experiment.

Your teacher may also give you some extra experimental results.

Graph paper is included.

Which cleaning product was the best at killing microbes?

.....

How do you know this?

.....

Put the cleaning products in order of effectiveness (the best first).

.....

.....

Are the cleaning products equally good at killing both sources of microbes?

.....

.....

What advice would you give CBACteriocidal's customers?

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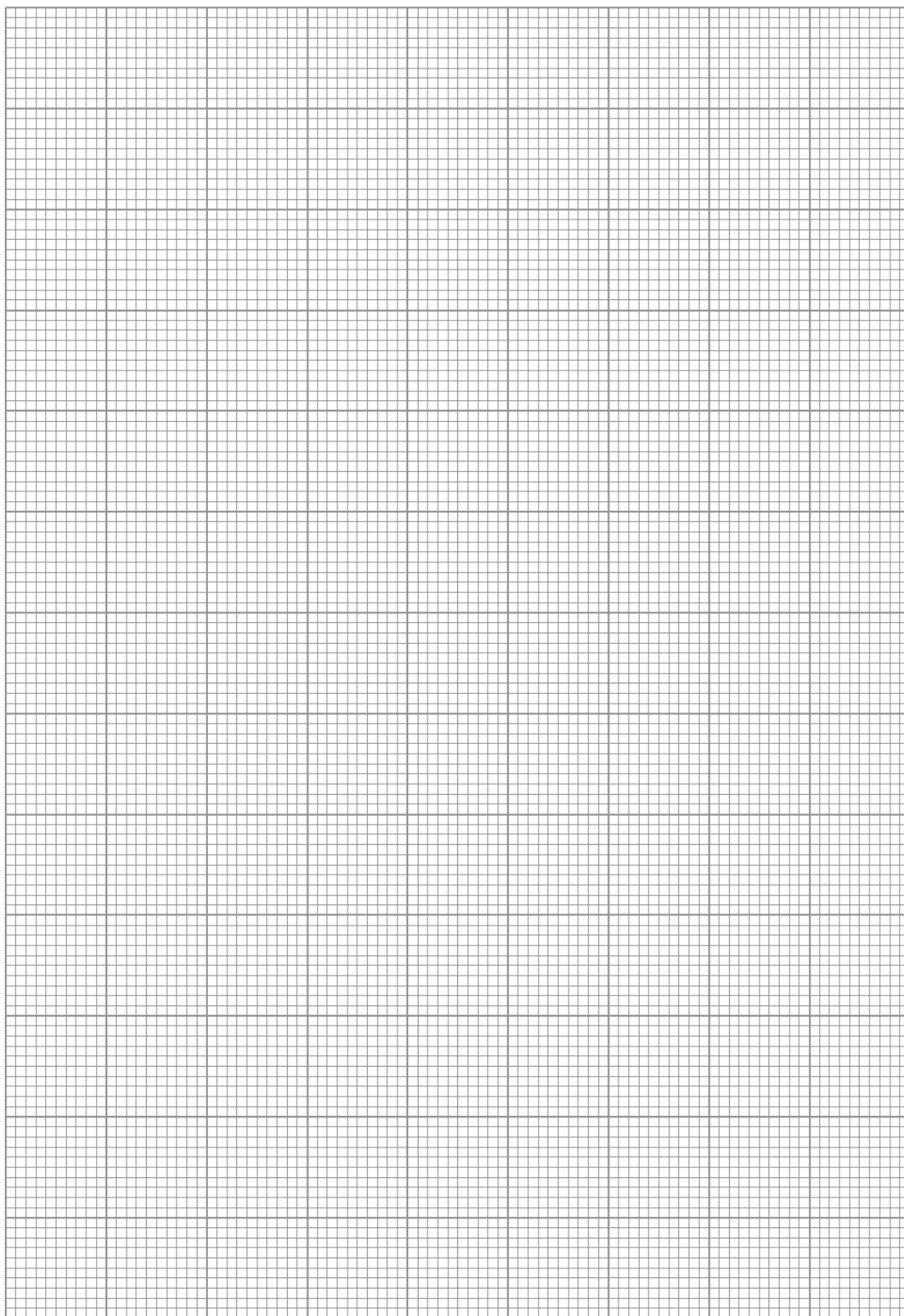
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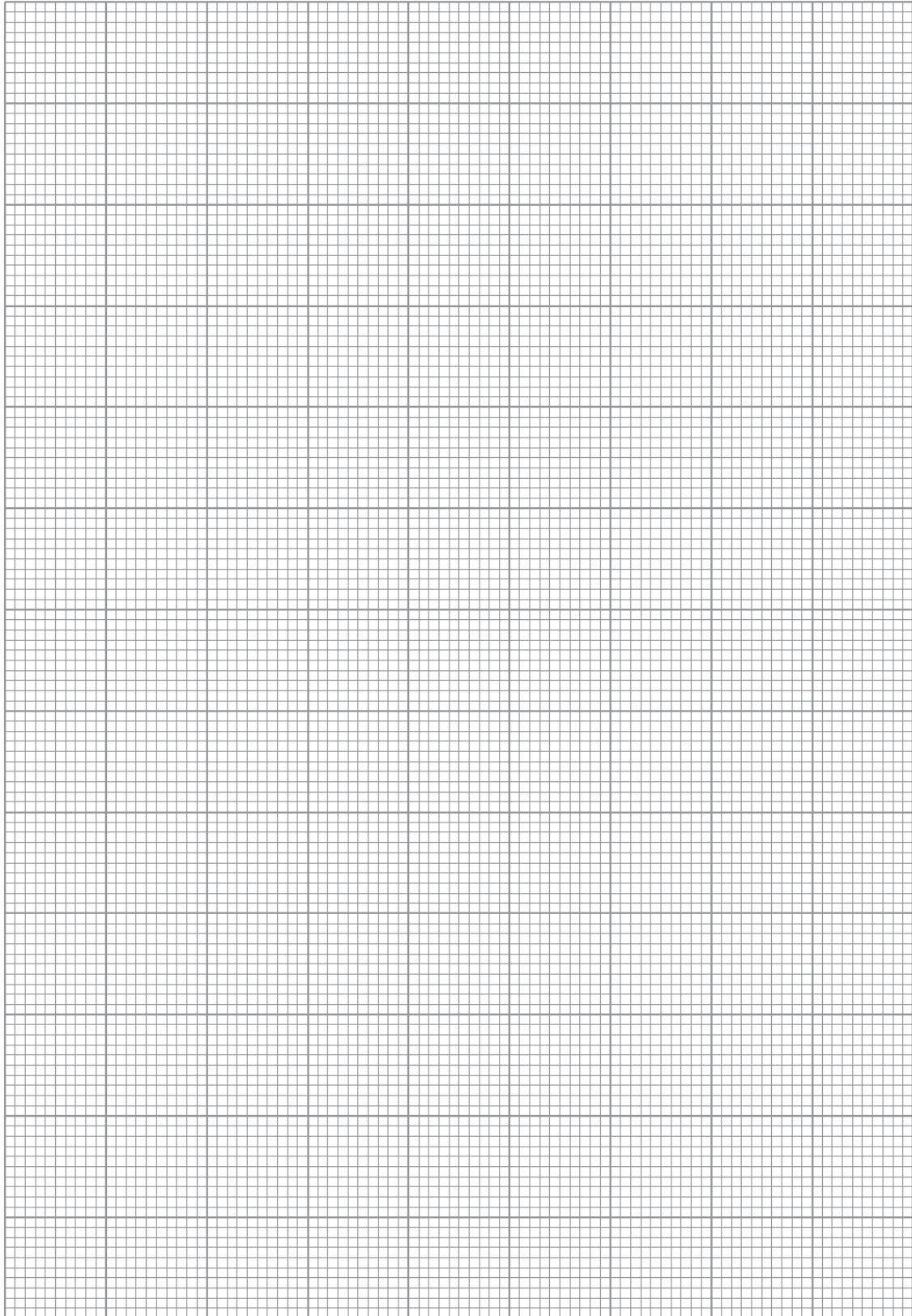
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Task D Evaluate

Evaluate the **methods** which have been used:

➤ how suitable was your method?

.....

.....

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.....

.....

➤ were there any causes of inaccuracy in your method?

.....

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➤ were there any ways to improve your method?

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Evaluate the **quality** of your data/evidence:

➤ were your results repeatable?

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➤ were there any anomalies or uncertainties in your data?

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➤ were you fully convinced about your conclusions?

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END OF PAPER



GCSE

APPLIED SCIENCE (Double Award)

**UNIT 4: (Double Award): TASK BASED
ASSESSMENT**

FOUNDATION TIER

**RESOURCE FOLDER FOR USE WITH
ACTIVITY 2**

Dilution of Antimicrobial Agents

Background

CBACteriocidal is a company who manufacture cleaning products. They produce an antibacterial agent which is sold as a spray.



In this assessment you need to investigate the most cost-efficient way of using CBACteriocidal's product.

What do you need to do?

Microbiologists have counted microbial number by two different methods.

You will analyse the data given and decide which is the most cost-efficient way to use CBACteriocidal's product.

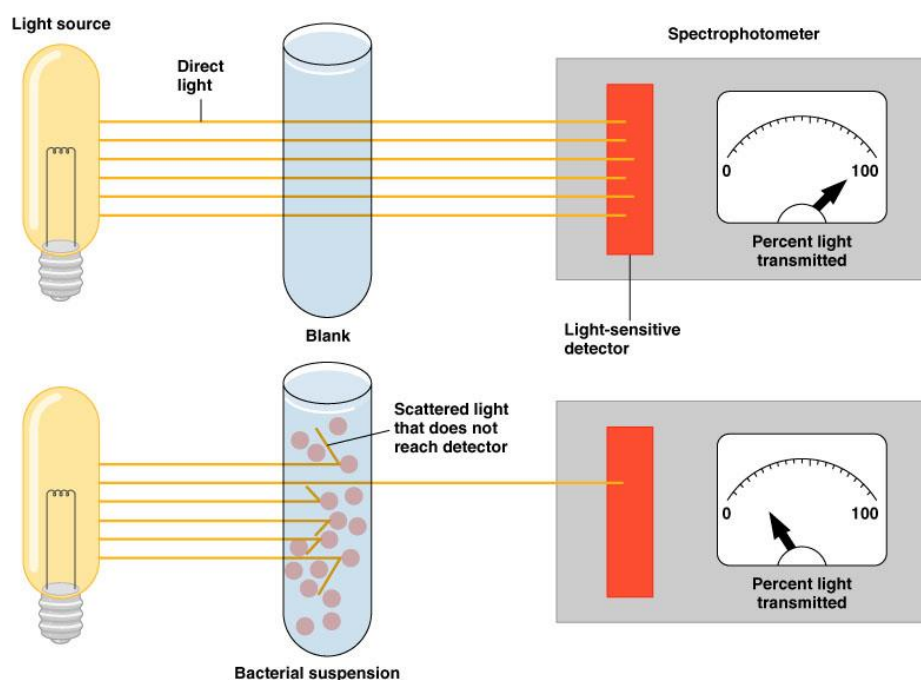
Method 1: Turbidity

A spectrophotometer is used to determine turbidity ("cloudiness") by measuring the amount of light that passes through a suspension of cells.

More cells = more turbidity; more turbidity = less light passing through the suspension

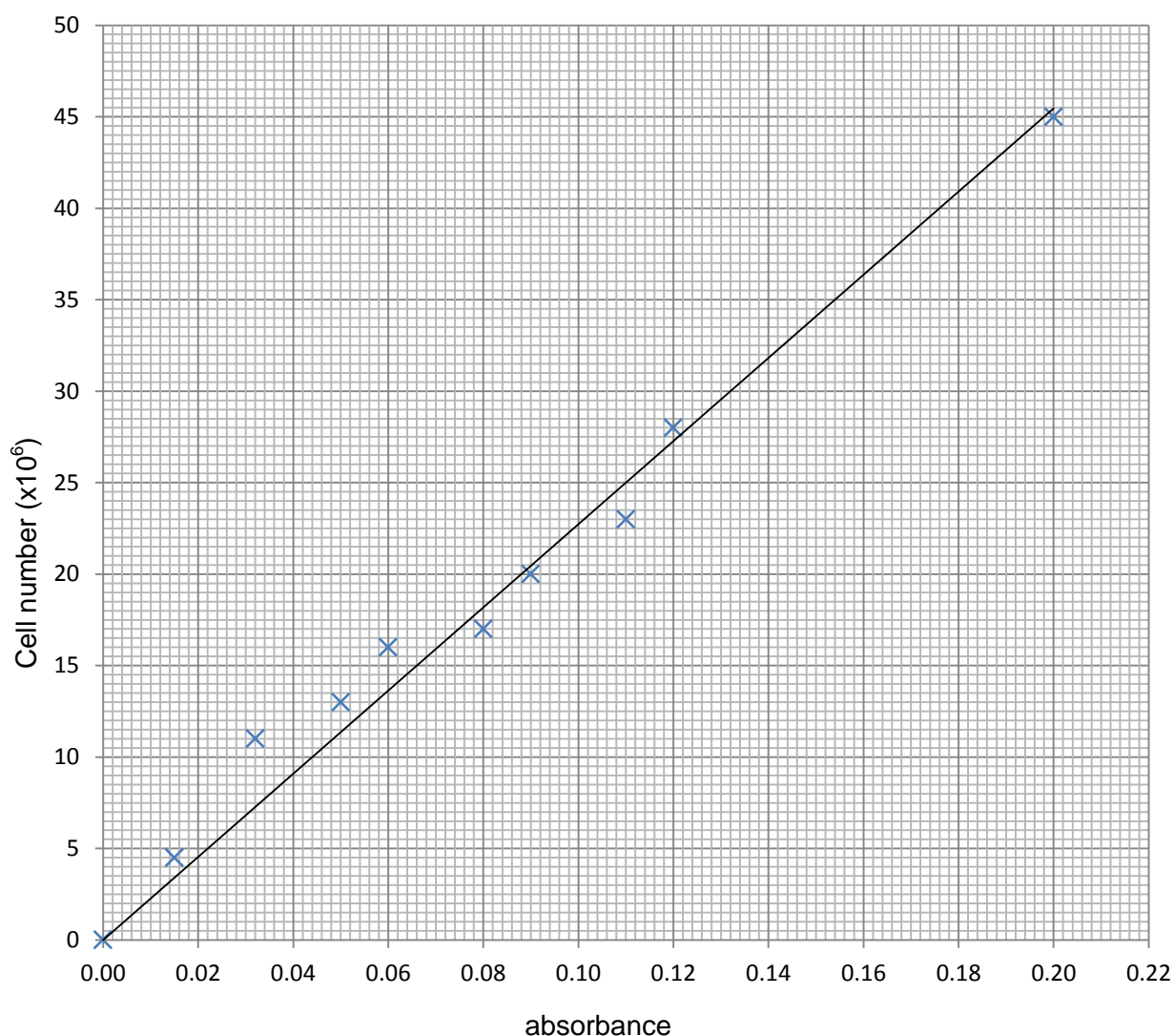
%T is percent transmission - fewer cells present (less turbidity) will allow more light to pass through, the %T is higher when the cell number is lower.

Absorbance is the opposite of %T. More light is absorbed when more cells are present - some people like this measure better because absorbance goes up as turbidity (or cell number) goes up.



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The graph on the next page shows the linear part of a standard curve for absorbance against cell number.



Microbiologists made the following dilutions of their antimicrobial cleaning product.

Microbial sample	Dilution of antimicrobial agent
a	undiluted
b	1/2
c	1/4
d	1/10
e	1/50
f	1/100

They then treated microbial samples (containing the same number of microbes) with each dilution of the CBACteriocidal's cleaning product.

They measured the turbidity of the microbial samples. Absorbance values are given in the table below.

Microbial sample	Absorbance		
	Test 1	Test 2	Test 3
a	0.058	0.041	0.054
b	0.061	0.058	0.044
c	0.115	0.129	0.136
d	0.215	0.301	0.198
e	0.444	0.413	0.428
f	0.809	0.915	0.945

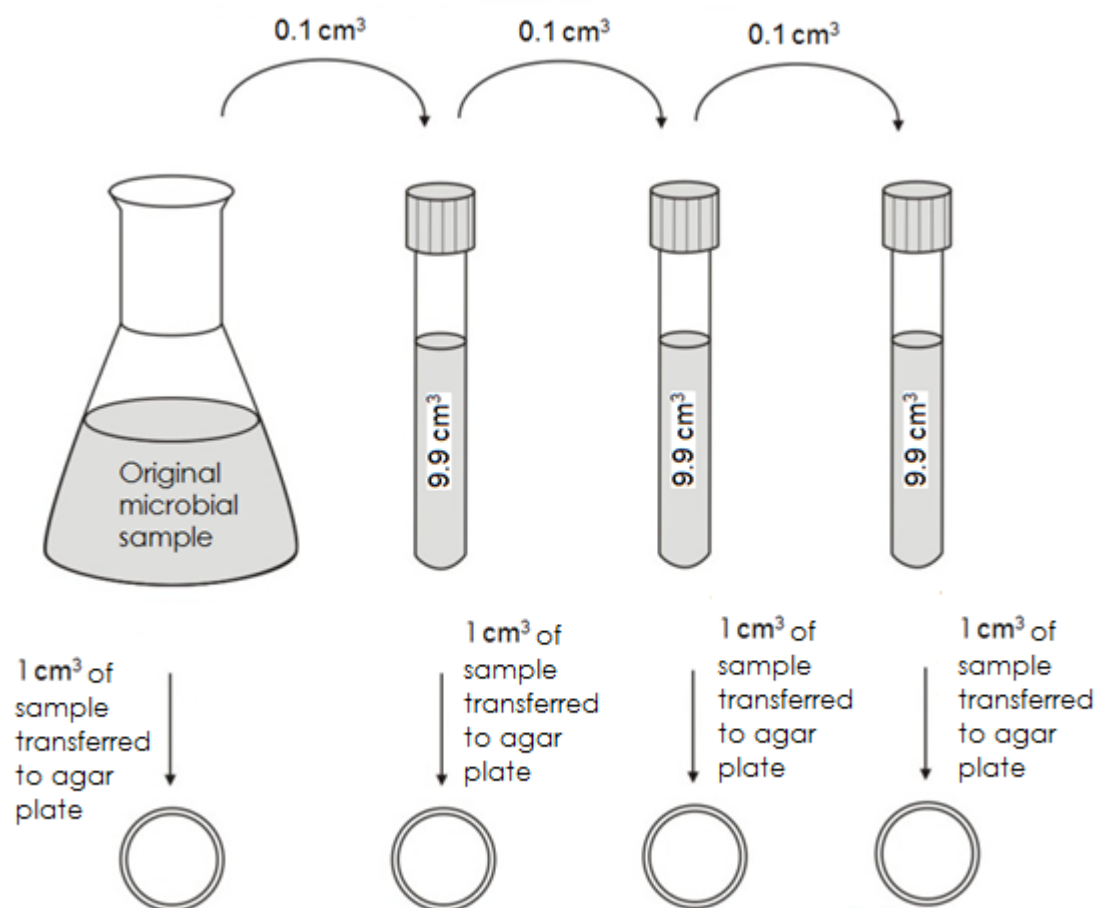
(note that some values are too high to read off the standard curve)

Method 2: Dilution Plating

Microbiologists performed the following investigation:

Microbial samples which had been treated with undiluted (sample A), the 1/2 dilution (sample B), and the 1/4 dilution (sample C), of antimicrobial agent were grown on agar plates.

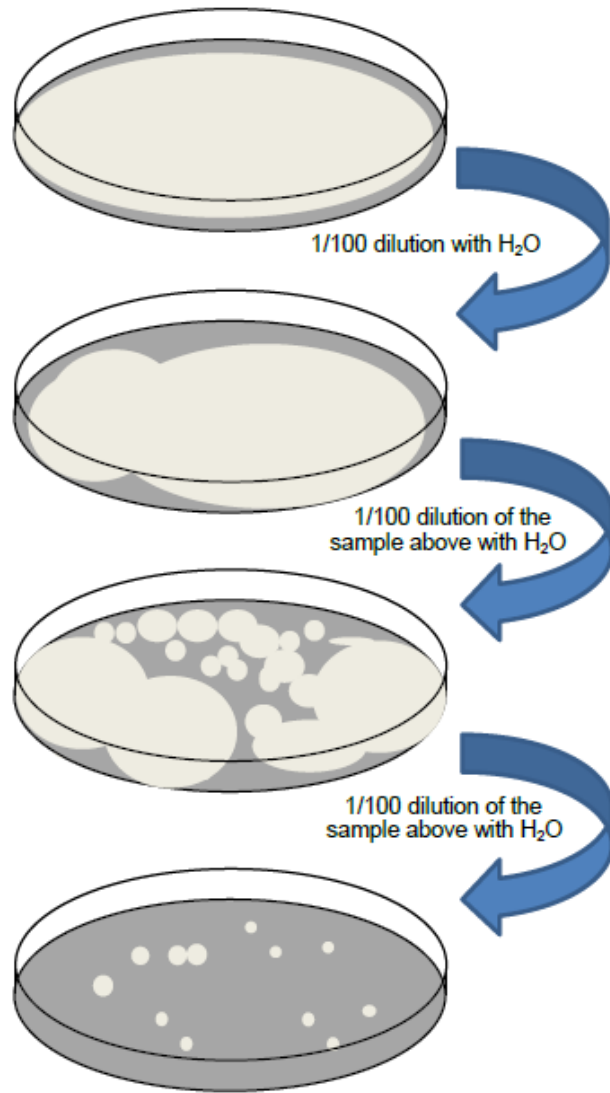
Each microbial sample was further diluted so that distinct colonies could be counted:



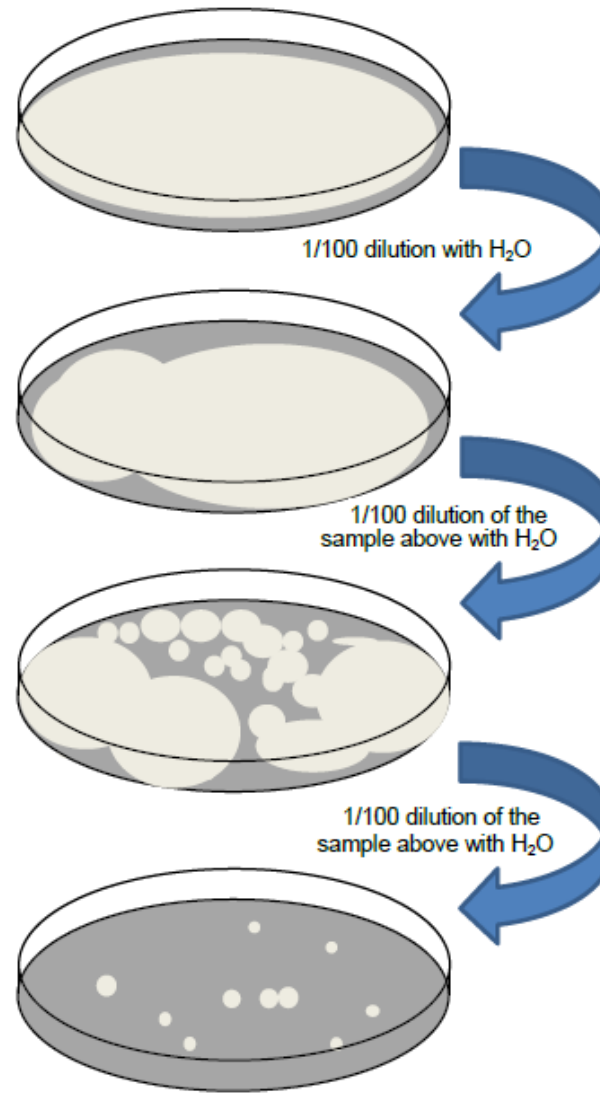
The plates were incubated for 24 hours at 37°C.

The results of the experiment are shown overpage.

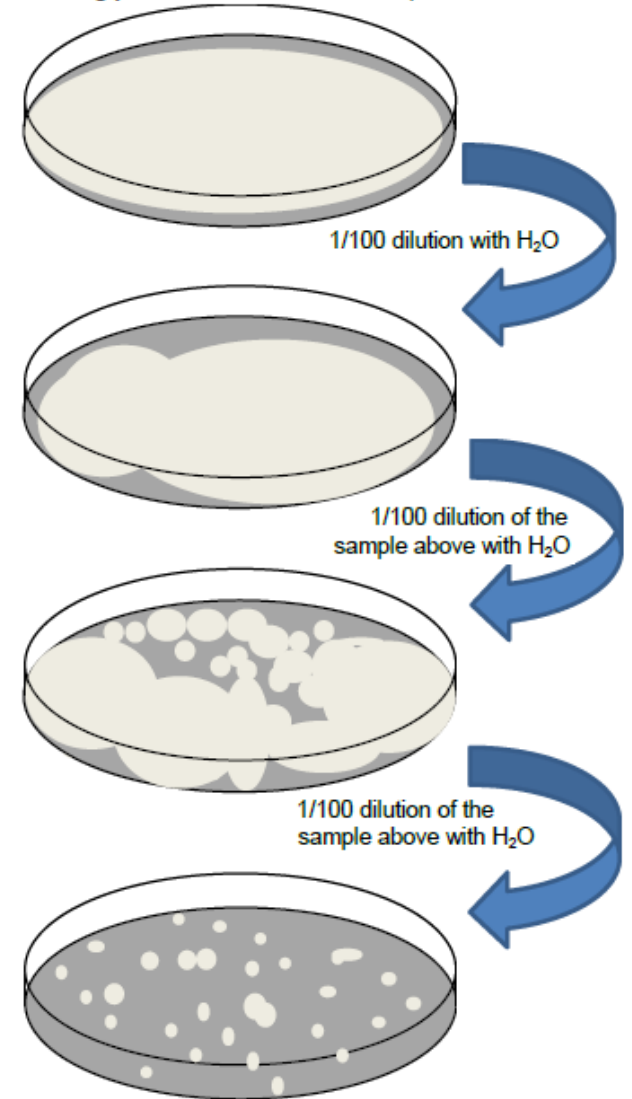
Sample A (undiluted cleaning product)



Sample B (the microbes were treated with cleaning product that was diluted 1/2)



Sample C (the microbes were treated with cleaning product that was diluted 1/4)



Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 4: (Double Award) TASK BASED ASSESSMENT****ACTIVITY 2****FOUNDATION TIER****SAMPLE ASSESSMENT PAPER****(1 hour)**

For Examiner's use only		
Skill Area	Maximum Mark	Mark Awarded
Analysis	10	
Evaluation	5	
Total	15	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a copy of the **resource folder**.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Assessment will take into account the quality of your writing.

Task A: Analysis

Analyse the data given from the turbidity experiment (method 1):

- Calculate the mean absorbance for each sample and enter your value into the table below.
- Using the standard curve find the number of cells present in each sample. You may not be able to find results for all samples. Enter your values in the table below.

Microbial sample	Absorbance				Number of cells (x 10 ⁶)
	Test 1	Test 2	Test 3	Mean	
a	0.058	0.041	0.054	.....	.....
b	0.061	0.058	0.044	.....	.....
c	0.115	0.129	0.136	.....	.....
d	0.215	0.301	0.198	.....	.....
e	0.444	0.413	0.428	.....	.....
f	0.809	0.915	0.945

State what dilution of cleaning agent was best at killing microbes.

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What dilution of cleaning agent would you recommend as the most cost effective way of using CBACteriocidal's cleaning agent?

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The space below is for any other points you wish to make about the results of method 1.

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Evaluate the **quality** of the data for **method 1**:

➤ were the results repeatable?

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➤ were there any anomalies or uncertainties in the data?

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➤ were you fully convinced about your conclusions?

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The space below is for any other points you wish to make about method 1.

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Evaluate **method 2** (dilution plating):

➤ how suitable was the method?

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➤ were there any causes of inaccuracy in the method?

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➤ were there any ways to improve the method?

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Evaluate the **quality** of the data for **method 2**:

➤ were the results repeatable?

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➤ were there any anomalies or uncertainties in the data?

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➤ were you fully convinced about your conclusions?

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The space below is for any other points you wish to make about method 2.

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END OF PAPER

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 4: (Double Award) TASK BASED ASSESSMENT****ACTIVITY 3****FOUNDATION TIER****SAMPLE ASSESSMENT PAPER****(1 hour)**

For Examiner's use only		
Skill Area	Maximum Mark	Mark Awarded
Risk assessment	10	
Total	10	

ADDITIONAL MATERIALS

In addition to this paper you will require access to CLEAPSS student safety sheets.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Assessment will take into account the quality of your writing.

Background

Vitamin C is one of the most important vitamins to include in a person's diet. The human body needs vitamin C to function well by improving a person's immunity, preventing inflammation and helping the body process a diverse diet.

People can introduce vitamin C into a healthy diet by eating fruit and vegetables, smoothies, and fruit juices.

A group of students want to find out if fruit squash or fruit juice contains the most vitamin C.

The chemical name for vitamin C is ascorbic acid.



What you need to do

In this activity you are going to complete a **risk assessment** for the students who will use a titration to compare the amount of vitamin C in fruit squash and fruit juice.

You will need to include the following aspects in the risk assessment:

- Preparation of a 1 mol/dm³ sulfuric acid solution;
- Measurement of the amount of vitamin C (ascorbic acid) in fruit drinks by titration.

Apparatus list

- burette, stand and clamps
- funnel
- glass beakers (x2)
- conical flask
- 25 cm³ glass pipettes (x3)
- pipette fillers
- measuring cylinder

Chemical list

- 0.10 mol/dm³ sodium thiosulfate
- 0.01 mol/dm³ potassium iodate
- 0.20 mol/dm³ potassium iodide
- 1% starch solution
- concentrated sulfuric acid
- samples of fruit juice
- samples of fruit squash

Instructions

Step 1: Preparation of 1 mol/dm³ sulfuric acid solution

1. Measure 55 cm³ of concentrated sulfuric acid using a measuring cylinder.
2. Add to 500 cm³ of distilled water in a large beaker.
3. Add more distilled water to a total volume of 1000 cm³.

Step 2: Measure the amount of vitamin C by titration

1. Clamp the burette to a stand using suitable clamps.
2. Use a funnel to fill the burette with the 0.10 mol/dm³ sodium thiosulfate solution and run through the zero mark (use a beaker to collect the excess, ensuring removal of all air bubbles).
3. Use a glass pipette and pipette filler to add 25 cm³ of 0.01 mol/dm³ potassium iodate solution to a conical flask.
4. Use a measuring cylinder to measure 15 cm³ of 0.20 mol/dm³ potassium iodide solution, and then add this to the conical flask.
5. Add about 5 cm³ of 1.0 mol/dm³ sulfuric acid to the conical flask. The solution should turn to a yellow-brown colour due to the formation of iodine.
6. Use a glass pipette and pipette filler, add 50 cm³ of the fruit drink to the conical flask and slowly swirl.
7. Add a few drops of starch solution. A deep blue-black colour forms.
8. Titrate the remaining iodine against the sodium thiosulfate solution until the deep blue-black colour disappears.
9. Repeat this titration and calculate a mean value.
10. Repeat this procedure for the remaining fruit squash and fruit juice samples.

Material/activity	Hazard	Risk What might go wrong?	Control Measures What precaution should I take?

Material/activity	Hazard	Risk What might go wrong?	Control Measures What precaution should I take?

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 4: (Double Award) TASK BASED ASSESSMENT****ACTIVITY 1****HIGHER TIER****SAMPLE ASSESSMENT PAPER****(3 hours)**

For Examiner's use only		
Skill Area	Maximum Mark	Mark Awarded
Planning	10	
Collecting and Recording	10	
Analysis	10	
Evaluation	5	
Total	35	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Assessment will take into account the quality of your writing.

Background

CBACteriocidal is a company who manufacture cleaning products. They claim that their antimicrobial cleaning agent is better than other brands at killing micro-organisms.



In this assessment you need to investigate whether CBACteriocidal's claim is true.

Assessment summary

You will need to:

1. Plan (task A)

Plan a procedure that will allow you to test whether CBACteriocidal's claim is true.

2. Collect and record data (task B)

Use your procedure to **collect and record** data to test the claim made by CBACteriocidal that their anti-microbial cleaning agent is better than other brands.

3. Analyse the data and draw conclusions (task C)

Use your data test the claim:

"CBACteriocidal's antimicrobial cleaning agent is better than other brands"

4. Evaluate the data and procedure (task D)

Evaluate (comment on) the **quality** of your data and the **method** you used. Consider the **changes** you could make to the procedure to improve your investigation.

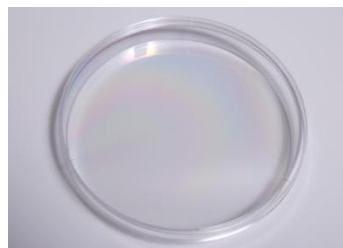
Task A: Planning

Plan suitable procedure(s) that will allow you to test the claim made by CBACteriocidal that their anti-microbial cleaning agent is better than other brands.

You should test a **minimum** of four different anti-microbial cleaning agents on **two different** microbial sources.

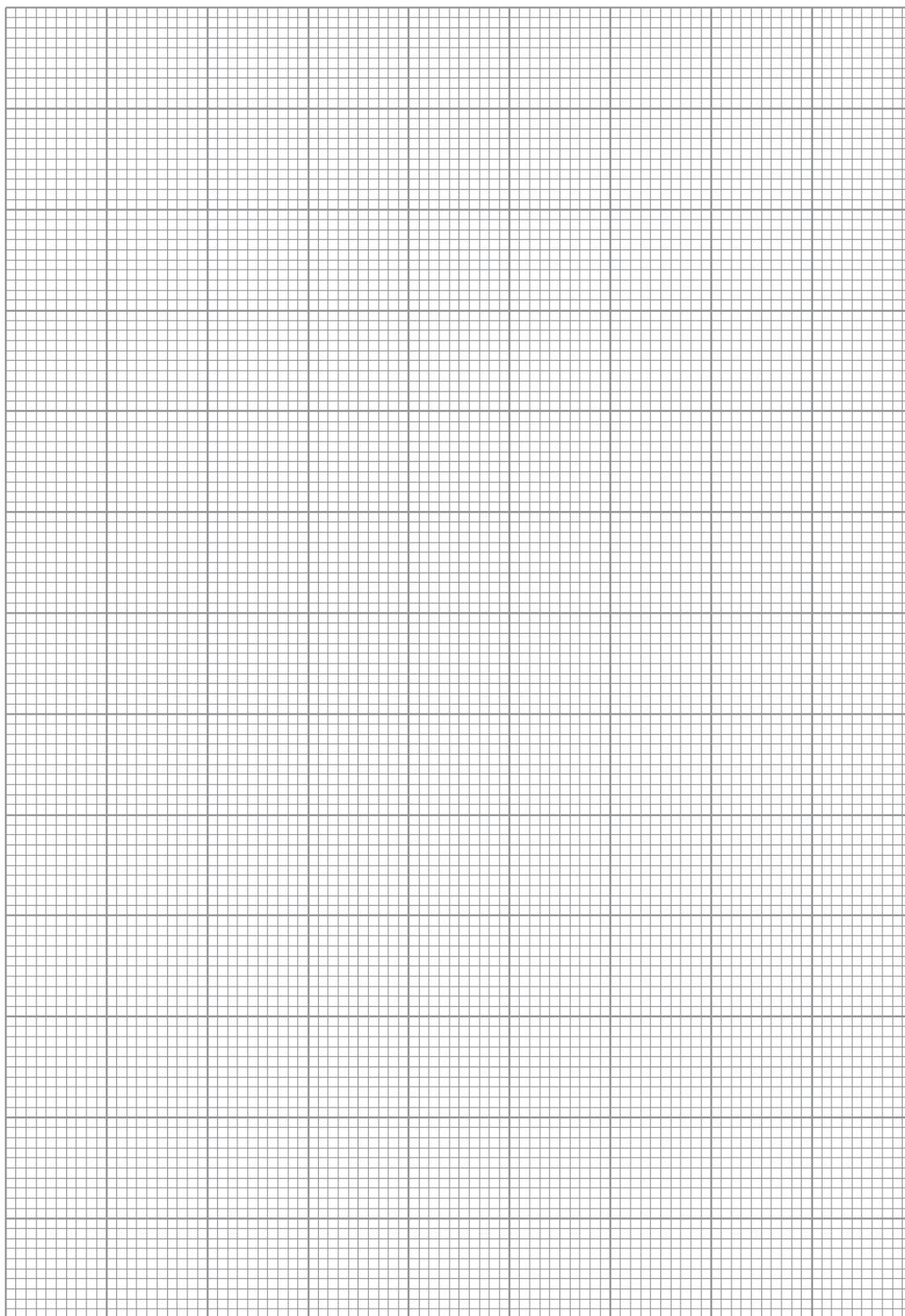
What equipment/materials will be available to you?

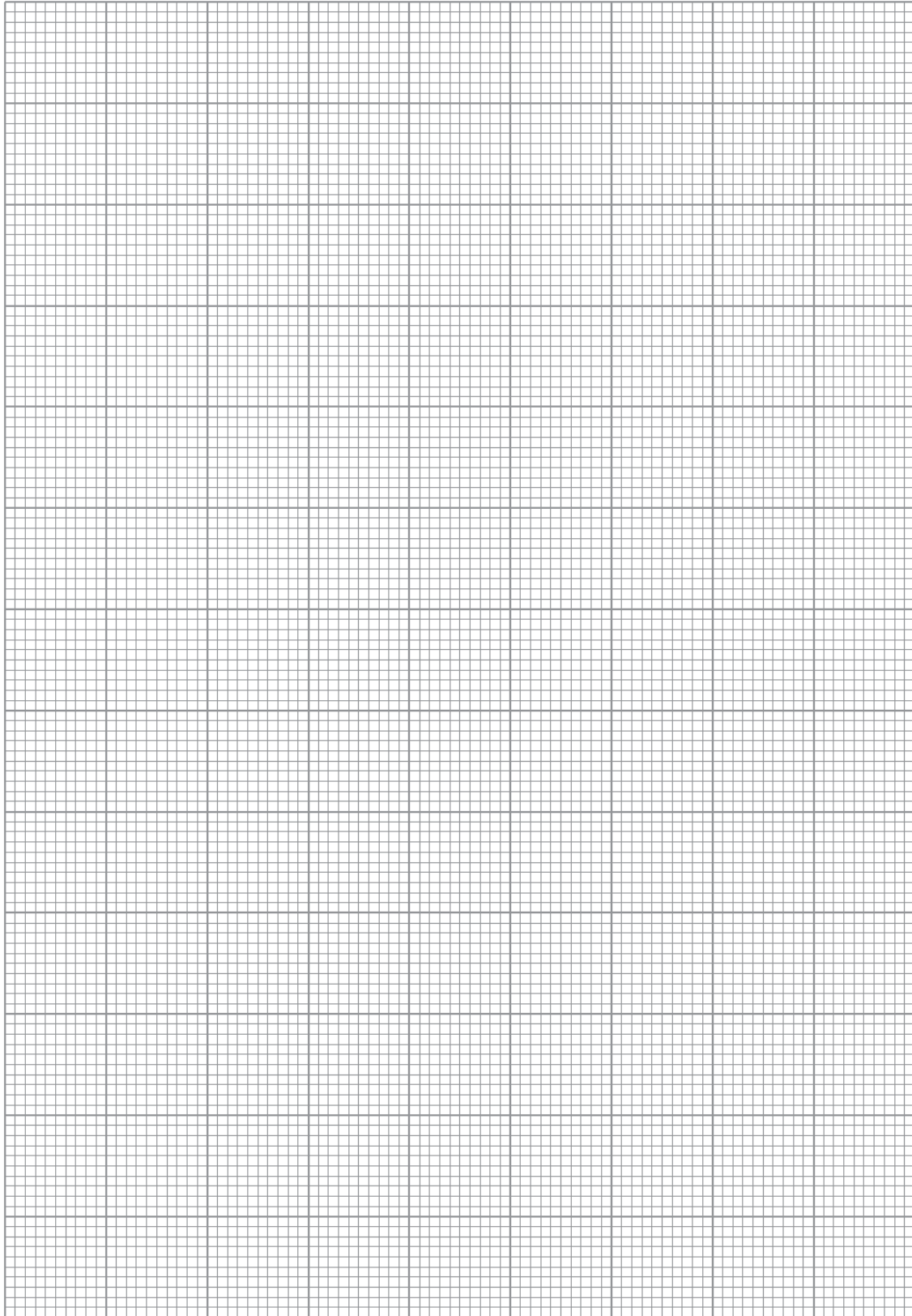
- cotton wool
- petri dishes
- nutrient agar
- boiling tubes
- forceps
- Bunsen burner
- 70% (v/v) ethanol
- filter paper
- hole punch
- anti-microbial agents
- sticky tape
- pipettes
- microbial sources
- measuring cylinders
- water
- pencil
- ruler
- inoculating loops



Points to note:

- Do not feel that you have to use all the equipment above when you plan your investigation.
- Do not feel that you are restricted to the equipment above – you may wish to use other equipment if it is available.







GCSE

APPLIED SCIENCE (Double Award)

**UNIT 4: (Double Award) TASK BASED
ASSESSMENT**

HIGHER TIER

**RESOURCE FOLDER FOR USE WITH
ACTIVITY 2**

Dilution of Antimicrobial Agents

Background

CBACteriocidal is a company who manufacture cleaning products. They produce an antibacterial agent which is sold as a spray.



In this assessment you need to investigate the most cost-efficient way of using CBACteriocidal's product.

What do you need to do?

Microbiologists have counted microbial number by two different methods.

You will analyse the data given and decide which is the most cost-efficient way to use CBACteriocidal's product.

Method 1: Turbidity

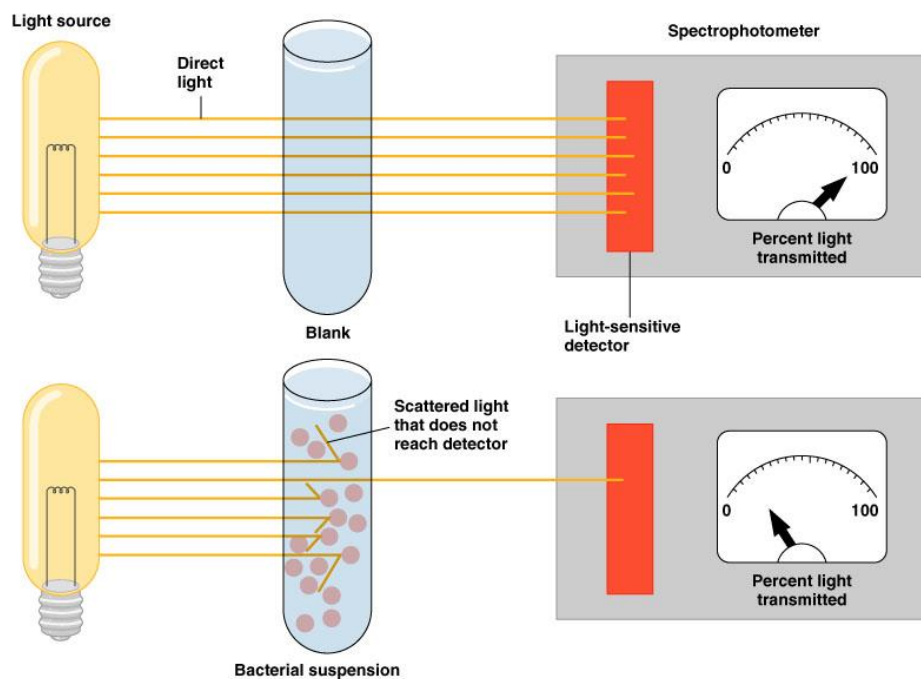
Microbiologists can measure the number of cells present using turbidity (cloudiness).

Cells form a suspension. This means the suspension will be turbid (cloudy). A spectrophotometer is used to determine turbidity ("cloudiness"). It does this by measuring the amount of light that passes through the suspension.

The less light that passes through the suspension the more turbid it is.
The more turbid the suspension, the greater the number of cells present.

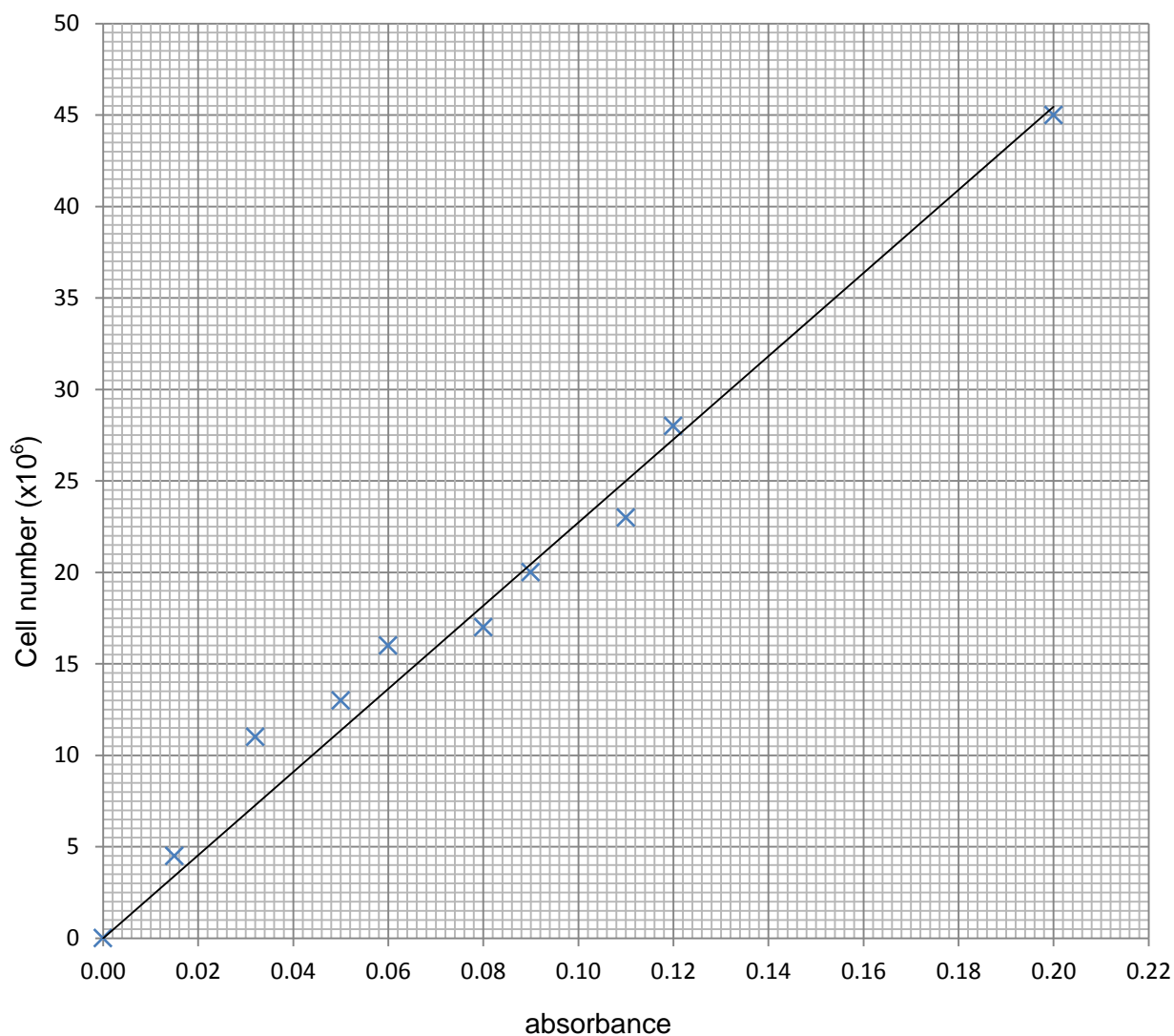
We can measure turbidity using percent transmission (%T). %T measures the amount of light passing through the suspension. A high %T value means more light is getting through. The more turbid the suspension the lower the %T value.

We can also use absorbance to measure turbidity. Absorbance measures the amount of light absorbed. More light is absorbed when more cells are present – in other words absorbance increases as turbidity (or cell number) goes up.



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The graph on the next page shows the linear part of a standard curve for absorbance against cell number.



Microbiologists made the following dilutions of their antimicrobial cleaning product.

Microbial sample	Dilution of antimicrobial agent
a	undiluted
b	1/2
c	1/4
d	1/10
e	1/50
f	1/100

They then treated microbial samples (containing the same number of microbes) with each dilution of CBACteriocidal's cleaning product.

They measured the turbidity of the microbial samples. Absorbance values are given in the table below.

Microbial sample	Absorbance		
	Test 1	Test 2	Test 3
a	0.058	0.041	0.054
b	0.061	0.058	0.044
c	0.115	0.129	0.136
d	0.215	0.301	0.198
e	0.444	0.413	0.428
f	0.809	0.915	0.945

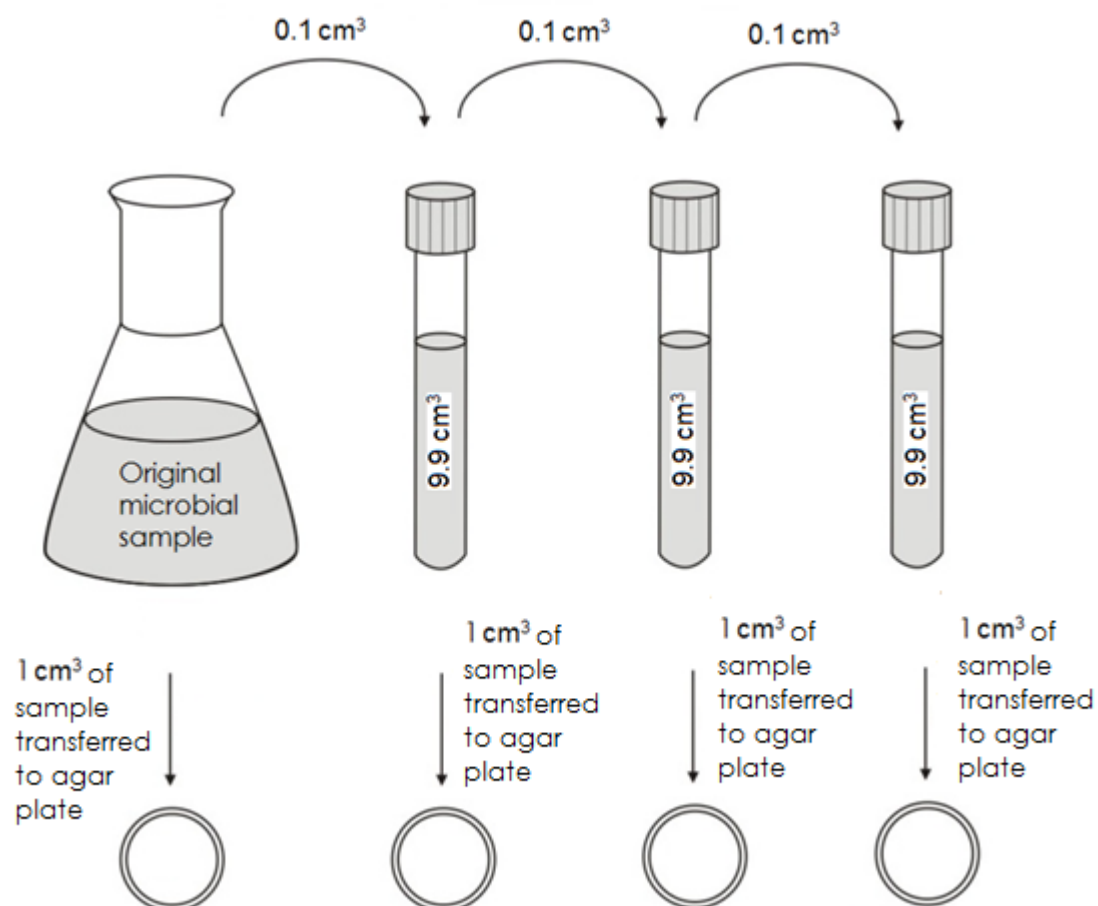
(note that some values are too high to read off the standard curve)

Method 2: Dilution Plating

Microbiologists performed the following investigation:

Microbial samples which had been treated with undiluted (sample A), the 1/2 dilution (sample B), and the 1/4 dilution (sample C), of antimicrobial agent were grown on agar plates.

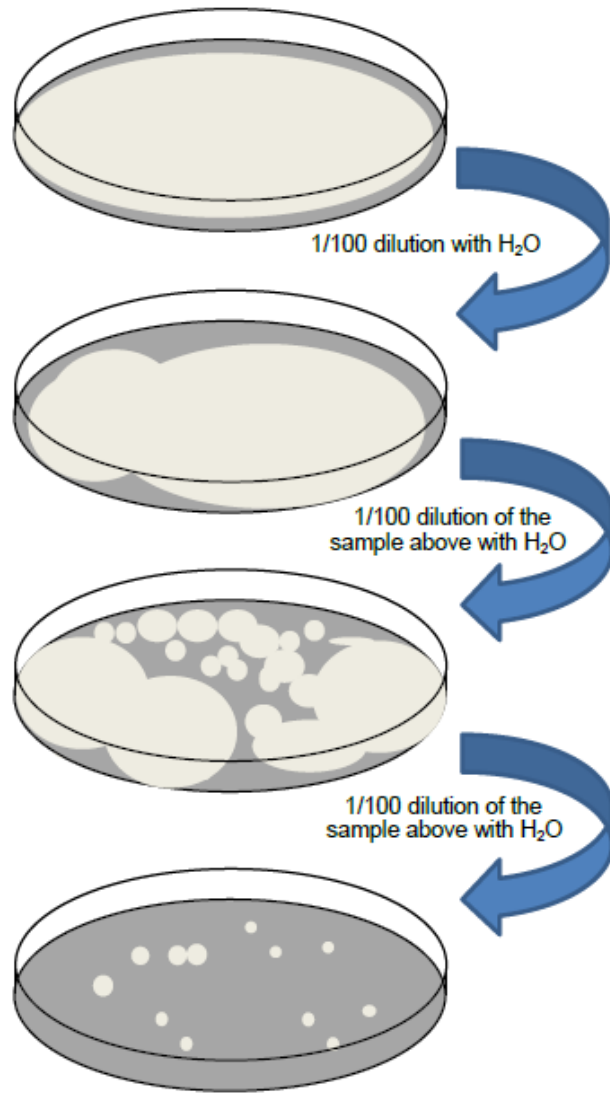
Each microbial sample was further diluted so that distinct colonies could be counted:



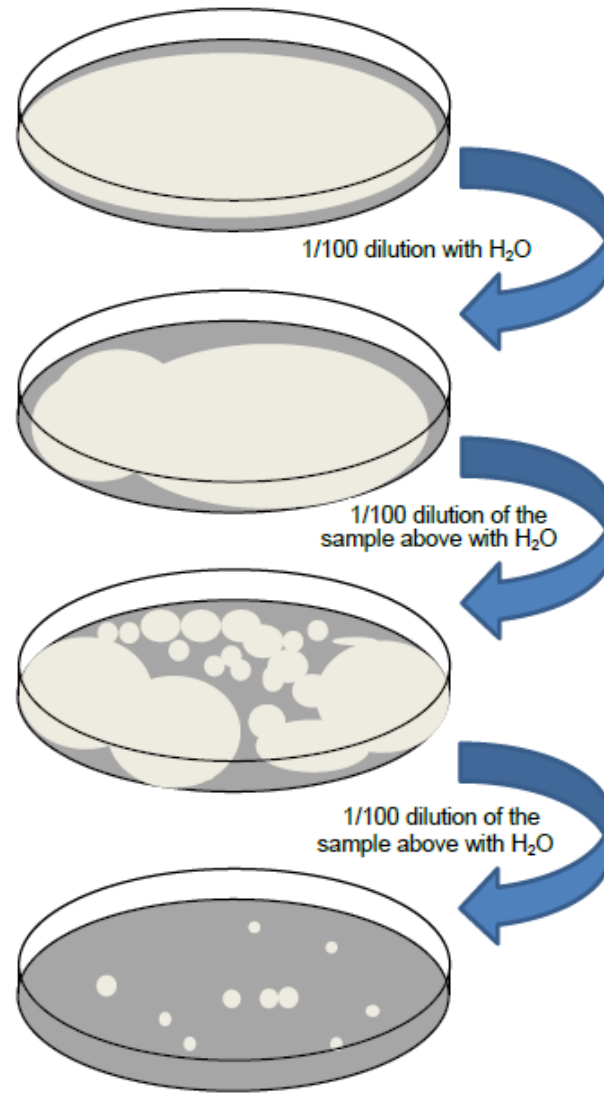
The plates were incubated for 24 hours at 37°C.

The results of the experiment are shown overpage.

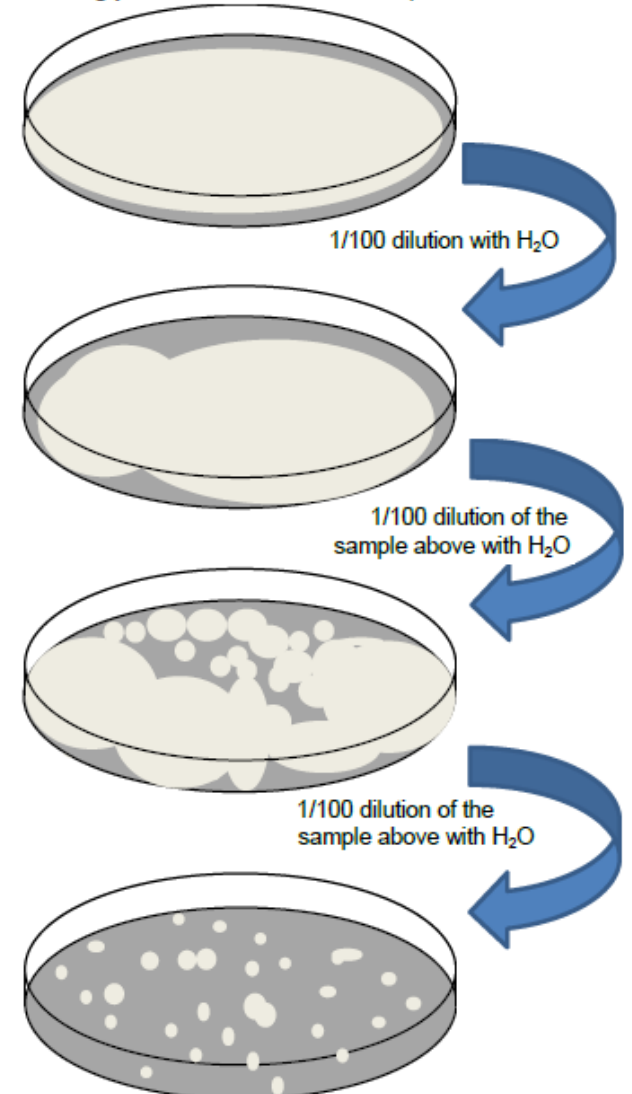
Sample A (undiluted cleaning product)



Sample B (the microbes were treated with cleaning product that was diluted 1/2)



Sample C (the microbes were treated with cleaning product that was diluted 1/4)



Candidate Name	Centre Number				Candidate Number			
					0			



GCSE

APPLIED SCIENCE (Double Award)

UNIT 4: (Double Award) TASK BASED ASSESSMENT

ACTIVITY 2

HIGHER TIER

SAMPLE ASSESSMENT PAPER

(1 hour)

For Examiner's use only		
Skill Area	Maximum Mark	Mark Awarded
Analysis	10	
Evaluation	5	
Total	15	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a copy of the **resource folder**.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Assessment will take into account the quality of your writing.

Candidate Name	Centre Number				Candidate Number			
					0			



GCSE

APPLIED SCIENCE (Double Award)

UNIT 4: (Double Award) TASK BASED ASSESSMENT

ACTIVITY 3

HIGHER TIER

SAMPLE ASSESSMENT PAPER

(1 hour)

For Examiner's use only		
Skill Area	Maximum Mark	Mark Awarded
Risk assessment	10	
Total	10	

ADDITIONAL MATERIALS

In addition to this paper you will require access to CLEAPSS student safety sheets.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer all questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Assessment will take into account the quality of your writing.

Activity 3: Measuring the amount of vitamin C in drinks

Background

Vitamin C is one of the most important vitamins to include in a person's diet. The human body needs vitamin C to function well by improving a person's immunity, preventing inflammation and helping the body process a diverse diet.

People can introduce vitamin C into a healthy diet by eating fruit and vegetables, smoothies, and fruit juices.

A group of students want to find out if fruit squash or fruit juice contains the most vitamin C.

The chemical name for vitamin C is ascorbic acid.



What you need to do

In this activity you are going to complete a **risk assessment** for the students who will use a titration to compare the amount of vitamin C in fruit squash and fruit juice.

You will need to include the following aspects in the risk assessment:

- Preparation of a 1 mol/dm³ sulfuric acid solution;
- Measurement of the amount of vitamin C (ascorbic acid) in fruit drinks by titration.

Apparatus list

- burette, stand and clamps
- funnel
- glass beakers (x2)
- conical flask
- 25 cm³ glass pipettes (x3)
- pipette fillers
- measuring cylinder

Chemical list

- 0.10 mol/dm³ sodium thiosulfate
- 0.01 mol/dm³ potassium iodate
- 0.20 mol/dm³ potassium iodide
- 1% starch solution
- concentrated sulfuric acid
- samples of fruit juice
- samples of fruit squash

Instructions

Step 1: Preparation of 1 mol/dm³ sulfuric acid solution

1. Measure 55 cm³ of concentrated sulfuric acid using a measuring cylinder
2. Add to 500 cm³ of distilled water in a large beaker.
3. Add more distilled water to a total volume of 1000 cm³.

Step 2: Measure the amount of vitamin C by titration

1. Clamp the burette to a stand using suitable clamps.
2. Use a funnel to fill the burette with the 0.10 mol/dm³ sodium thiosulfate solution and run through the zero mark (use a beaker to collect the excess, ensuring removal of all air bubbles).
3. Use a glass pipette and pipette filler to add 25 cm³ of 0.01 mol/dm³ potassium iodate solution to a conical flask.
4. Use a measuring cylinder to measure 15 cm³ of 0.20 mol/dm³ potassium iodide solution, and then add this to the conical flask.
5. Add about 5 cm³ of 1.0 mol/dm³ sulfuric acid to the conical flask. The solution should turn to a yellow-brown colour due to the formation of iodine.
6. Use a glass pipette and pipette filler, add 50 cm³ of the fruit drink to the conical flask and slowly swirl.
7. Add a few drops of starch solution. A deep blue-black colour forms.
8. Titrate the remaining iodine against the sodium thiosulfate solution until the deep blue-black colour disappears.
9. Repeat this titration and calculate a mean value.
10. Repeat this procedure for the remaining fruit squash and fruit juice samples.

Material/activity	Hazard	Risk	Control Measures

Material/activity	Hazard	Risk	Control Measures

UNIT 4: (Double Award) TASK BASED ASSESSMENT

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Crossed out responses not replaced should be marked.

A banded mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with all the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Generic Mark Scheme for Activity 1

	Level 1	Level 2	Level 3
Planning	<p>The candidate outlines a brief method to solve a practical problem. The candidate makes a plan to collect some relevant data without necessarily controlling variables.</p> <p>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>Some equipment is identified for the task. Guidance may be required.</p> <p style="text-align: center;">1-3</p>	<p>The candidate independently devises a method to solve a practical problem which, with some changes or elaboration, could be followed by another person. Most variables are controlled</p> <p>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>The candidate identifies the equipment needed for the task.</p> <p style="text-align: center;">4-7</p>	<p>The candidate independently devises a method to solve a practical problem, which would enable the investigation to be carried out successfully by another person. All variables are controlled.</p> <p>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>The candidate identifies the equipment needed for the task, without the inclusion of unnecessary apparatus.</p> <p style="text-align: center;">8-10</p>
	Total Available Marks: 10		

Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.

Generic Mark Scheme for Activity 1

	Level 1	Level 2	Level 3
Collecting and Recording Data	The candidate uses procedures to collect data of low quality or of limited value or relevance. The quantity of data may be limited 1	The candidate uses procedures to collect mainly appropriate data of reasonable quality. The quantity of data is adequate for purposes of investigation. 2-3	The candidate uses procedures to collect data of high quality. The data is suitable and relevant to their investigation. The candidate collects a wide range of data for the investigation. 4-5
	The candidate partially records data or observations into a given template. 1	The candidate independently devises methods to record data. Their records of data are clear and largely error free. 2-3	The candidate independently devises their own format for recording results and accurately records data or observations to an appropriate degree of precision. Their data is recorded to a high standard and is easy to follow. All units correctly recorded. 4-5
	Total Available Marks: 10		

Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.

Generic Mark Scheme for Activity 1 and 2

	Level 1	Level 2	Level 3
Analysis of Data	<p>The candidate carries out very simple and limited processing of data.</p> <p>The candidate makes a very limited attempt to analyse and interpret data.</p> <p>The candidate gives a simple statement of findings.</p> <p>The candidate demonstrates a limited ability to structure the work in an appropriate way.</p> <p style="text-align: center;">1-3</p>	<p>The candidate carries out mainly suitable and appropriate processing of data.</p> <p>The candidate makes an appropriate interpretation of the data using mainly appropriate methods of analysis.</p> <p>The candidate gives detailed conclusions largely consistent with the evidence.</p> <p>The work is well structured and logically argued with relatively minor errors.</p> <p style="text-align: center;">4-7</p>	<p>The candidate carries out suitable and appropriate processing of data, transforming data into useful information.</p> <p>The candidate makes a detailed interpretation of data using suitable methods of data analysis. All their work can be easily followed.</p> <p>The candidate makes detailed conclusions consistent with the evidence. They identify and explain all the patterns within the data.</p> <p>The work is logically argued and is well structured.</p> <p style="text-align: center;">8-10</p>
	Total Available Marks: 10		

Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.

Generic Mark Scheme for Activity 1 and 2

	Level 1	Level 2	Level 3
Evaluating	<p>The candidate gives a simple evaluation of the data or procedure.</p> <p style="text-align: center;">1</p>	<p>The candidate gives a clear evaluation of their investigation/ procedure.</p> <p>The candidate makes an assessment of the validity and quality of evidence.</p> <p style="text-align: center;">2-3</p>	<p>The candidate gives a detailed evaluation of their investigation/procedure. They suggest suitable/relevant improvements to their method.</p> <p>The candidate makes a detailed assessment of the validity and quality of data.</p> <p style="text-align: center;">4-5</p>
			Total Available Marks: 5

Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.

Generic Mark Scheme for Activity 3

	Level 1	Level 2	Level 3
Managing Safety	<p>The candidate identifies some hazards and risks associated with the activity. Not all significant hazards or risks are identified.</p> <p>The candidate demonstrates a limited ability to communicate their knowledge and understanding of safety issues.</p>	<p>The candidate writes a risk assessment which identifies the significant hazards with the activity and risks associated with the activity. They identify some suitable control measures.</p> <p>The candidate demonstrates a reasonable ability to communicate their knowledge and understanding of safety issues.</p>	<p>The candidate writes a complete and suitable risk assessment for the activity. They accurately describe all the reasonable hazards and risks associated with the activity. Where necessary, they identify suitable and sensible control measures for hazards/risks listed.</p> <p>The candidate demonstrates an ability to communicate their knowledge and understanding of safety issues to a high standard.</p>
	1-3	4-7	8-10
	Total Available Marks: 10		

Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.

Skill Area	AO1	AO2	AO3	Maths	Prac
Activity 1: Planning	5	5			10
Activity 1: Collecting and recording data	9	1		2	10
Activity 1: Analysis		9	1	4	10
Activity 1: Evaluation			5		5
Activity 2: Analysis		9	1	4	10
Activity 2: Evaluation			5		5
Activity 3: Risk Assessment	10				10
Total	24	24	12	10	60



GCSE
APPLIED SCIENCE (Double Award)
UNIT 5: (Double Award) PRACTICAL
ASSESSMENT
SAMPLE ASSESSMENT MATERIALS

INSTRUCTIONS TO TEACHERS / EXAMS OFFICERS

Confidential

To be opened on receipt for immediate use by
TEACHERS / EXAMS OFFICERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

A. General Instructions

1. Each candidate will have to submit the number of tasks indicated in the table below.

Qualification	Number of tasks to be submitted
Biology	1
Chemistry	1
Physics	1
Science (Double Award)	2
Applied Science (Double Award)	2
Applied Science (Single Award)	1

The assessment will need to be completed in the first half of the spring term (i.e. January-February). Each task will be completed in two sessions each of 60 minutes duration.

Each task will have a section A and a section B. Section A and section B will be two separate question papers.

Section A will be completed in session 1 and will involve obtaining results. This will be collected from the candidates at the end of session 1. Section B will be completed in session 2 and will involve the analysis and evaluation of the results. Candidates should be given access to their section A question paper in session 2. **Section B should not be given to candidates until the second session. Both sections should be collected in at the end of session 2.**

2. The assessment should be supervised at all times by a member of staff responsible for teaching GCSE Science. Centres may use additional laboratories, provided that a subject teacher is available to supervise all groups at all times.
3. Teachers may open the “**Setting up Instructions**” document at the start of January. **This is for the purpose of ensuring that the apparatus functions well enough for the candidates to complete the task fully. Teachers are encouraged to try out the task, whilst preserving the confidentiality of the assessment.**
4. The question papers for all tasks will be made available to the examinations officer in each centre at the start of January.
5. **Section A:** It is permissible for candidates to work in small groups, of no more than three candidates. Teachers should ensure that each group has adequate working space and that the groups are set a reasonable distance apart. Each group requires uninterrupted access to the allocated apparatus – one set of apparatus per group. This is carried out under a limited level of control, i.e. learners may work with others to obtain results but they must provide their own responses to the questions set. Teacher assistance should not normally be required, but may be given if equipment failure occurs.
6. Once section A is completed, the question paper should be securely stored by the teacher until section B takes place.
7. **Section B:** This is carried out under a high level of control i.e. learners must work individually. This section is to be completed with no teacher feedback or assistance allowed and under formal supervision. Candidates should have access to their section A question paper, as they need the results obtained in the first session to answer the questions in section B.
8. Candidates should write their answers in the spaces provided on the question paper. Should there be a need for additional space then a standard extension/answer booklet should be provided.
9. If candidates fail to obtain results for section A, it is acceptable for them to be given unformatted teacher results.
10. As soon as both section A and section B have taken place, the question papers for each candidate should be attached to each other and then securely stored by the exams officer before they are sent to the examiner by at the latest. Teachers should not be given access to the completed question papers after the actual assessments have taken place.
11. The assessment will be externally marked by a WJEC examiner. The name and address of the examiner will be issued to centres by the end of April.
12. Monitoring visits will take place on a random sample of centres to ensure the practical assessment is being administered correctly.

B. Specific Instructions

Details of the apparatus and materials required for the tasks follow.

If any difficulty is experienced in providing the apparatus, WJEC should be informed as soon as possible.

Contacts:

Subject Officer Llinos Wood, 029 2026 5384, llinos.wood@wjec.co.uk

Support Officer Sarah Price, 029 2026 5103, sarah.price@wjec.co.uk

INVESTIGATING THE RATE OF COOLING OF AN INSULATED CONICAL FLASK

Apparatus Required

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × 250 cm³ conical flask
- 1 × thermometer (-10 °C to 110 °C and resolution ± 1 °C)
- A **single** layer of bubble wrap to insulate the flask. The bubble wrap can be attached with sellotape or a rubber band
- 1 × stopwatch (resolution ± 0.01 second)

The following is required for each class:

- Access to recently boiled water (kettle)



GCSE

APPLIED SCIENCE (Double Award)

**UNIT 5: (Double Award) PRACTICAL
ASSESSMENT**

SAMPLE ASSESSMENT MATERIALS

**INVESTIGATING THE RATE OF COOLING OF AN INSULATED CONICAL
FLASK**

SETTING UP INSTRUCTIONS

Confidential

To be opened on (date) by TEACHERS

**This document should be stored securely by the exams officer when not
in use by the teacher. Its contents should not be divulged except to
those concerned with the preparation of the assessment.**

SECTION A

Introduction

Your task is to investigate the rate of cooling for an insulated flask.

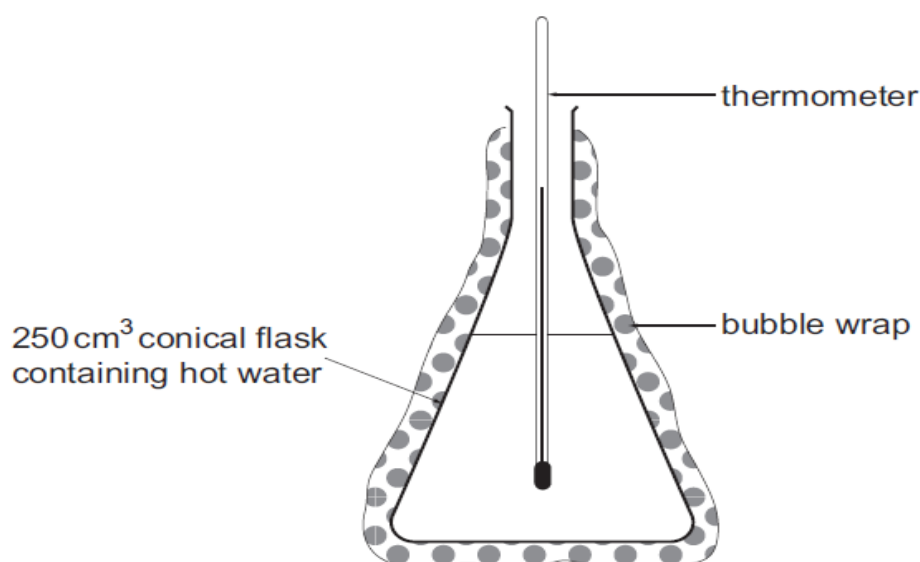
Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × 250 cm³ conical flask
- 1 × thermometer (-10 °C to 110 °C and resolution ± 1 °C)
- A **single** layer of bubble wrap to insulate the flask. The bubble wrap can be attached with sellotape or a rubber band
- 1 × stopwatch (resolution ± 0.01 second)

The following is required for each class:

- Access to recently boiled water (kettle)



Method

1. Fill a conical flask to three quarters full with water from a recently boiled kettle.
2. Measure the initial temperature of the water and start the stopwatch immediately.
3. Measure the temperature every minute for 15 minutes.

The remainder of the examination paper is not required for the purpose of checking the setting up of the task.

In order that the work of each candidate may be correctly assessed, information is required about the materials used in the task. Please ensure that the “**Information required from centres**” sheet on page ... is completed and given to the exams officer to be sent to the examiner with the completed examination papers.



GCSE

APPLIED SCIENCE (Double Award)

**UNIT 5; (Double Award) PRACTICAL
ASSESSMENT**

SAMPLE ASSESSMENT MATERIALS

**INVESTIGATING THE RATE OF COOLING OF AN INSULATED CONICAL
FLASK**

INFORMATION REQUIRED FROM CENTRES

Centre Number

(Please detach and send with the completed examination papers to the
examiner.)

SPECIFIC DATA REQUIRED:

NONE

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 5: (Double Award) PRACTICAL ASSESSMENT****SAMPLE ASSESSMENT MATERIALS****INVESTIGATING THE RATE OF COOLING OF AN INSULATED CONICAL FLASK****SECTION A****(1 hour)**

For Examiner's use only		
	Maximum Mark	Mark Awarded
Section A	6	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this section of the task is 6.

The number of marks is given in brackets at the end of each question or part question.

This task is in 2 sections, **A** and **B**. You will complete section **A** in one session and section **B** in the next session.

SECTION A

Introduction

Your task is to investigate the rate of cooling for an insulated flask.

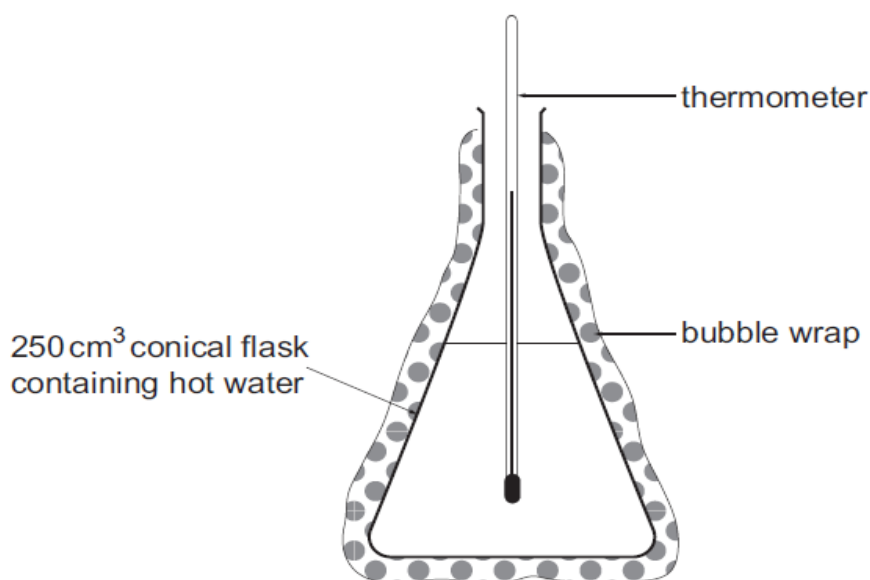
Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × 250 cm³ conical flask
- 1 × thermometer (-10 °C to 110 °C and resolution ± 1 °C)
- A **single** layer of bubble wrap to insulate the flask. The bubble wrap can be attached with sellotape or a rubber band
- 1 × stopwatch (resolution ± 0.01 second)

The following is required for each class:

- Access to recently boiled water (kettle)



Read the method and answer questions 1(a) and (b) before carrying out the experiment and recording your results.

Method

1. Fill a conical flask to three quarters full with water from a recently boiled kettle.
2. Measure the initial temperature of the water and start the stopwatch immediately.
3. Measure the temperature every minute for 15 minutes.

Answer **all** questions

1. (a) Identify the main hazard and risk associated with this experiment and describe an appropriate control measure. [2]

HAZARD	RISK	CONTROL MEASURE

- (b) Make a hypothesis for this experiment. [1]

.....

.....

You may record raw results in the space below.

(e) Present all your results in a table.

[3]

6

Candidate Name	Centre Number				Candidate Number			
					0			

**GCSE****APPLIED SCIENCE (Double Award)****UNIT 5: (Double Award) PRACTICAL ASSESSMENT****SAMPLE ASSESSMENT MATERIALS****INVESTIGATING THE RATE OF COOLING OF AN INSULATED CONICAL FLASK****SECTION B****(1 hour)**

For Examiner's use only		
	Maximum Mark	Mark Awarded
Section B	24	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and your section **A** exam paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this section of the task is 24.

The number of marks is given in brackets at the end of each question or part question.

This task is in 2 sections, **A** and **B**. You will have completed section **A** in a previous session.

SECTION B

Answer all questions

2 (a) (i) Identify the independent and dependent variables in this experiment. [2]

independent variable;

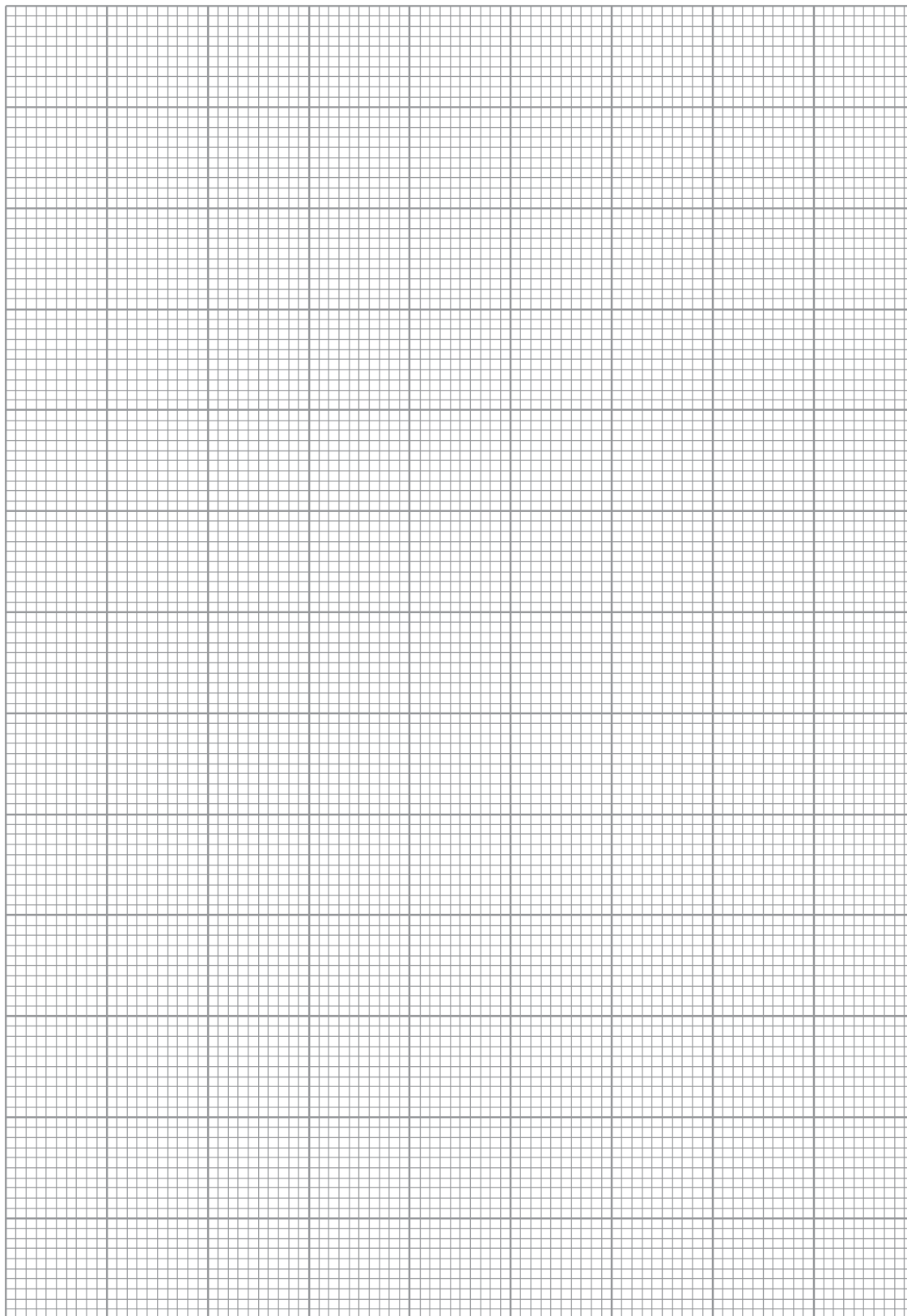
dependent variable:

(ii) Identify **two** variables (other than starting temperature) that you controlled in order to compare your results with other groups. [2]

.....

.....

(b) Use your results from section A to draw a graph on the grid below. [5]



- (c) Was your prediction in section A correct? Give a reason for your answer. [1]

.....
.....

- (d) Calculate the mean drop in temperature per minute. [2]

mean drop in temperature per minute = °C

- (e) (i) **Add a line to the graph** to show the how you would expect uninsulated flask to cool, label the line 'Uninsulated Flask'. [1]

- (ii) Explain the difference between the two lines. [2]

.....
.....
.....

- (f) For every 1 °C drop in temperature of 1 000 cm³ of water 4.2 kJ of energy is transferred to the surroundings. Calculate the amount of energy transferred in **Joules** when 250 cm³ water cools by 10 °C. [3]

Energy transferred = J

- (g) State **two** changes that would reduce the heat loss from the flask. [2]

.....
.....
.....
.....

UNIT 5: (Double Award) PRACTICAL ASSESSMENT

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

SECTION A

Question				Marking details			Marks Available					
							AO1	AO2	AO3	Total	Maths	Prac
1	(a)			HAZARD	RISK	CONTROL MEASURE	2			2		2
				Scalding by hot water	Hot water spilling from flask	Place the flask on a flat clear surface / take care not to tip the flask when taking thermometer readings						
				identification of hazard– 1 mark identification of risk and appropriate control measure – 1 mark								
	(b)			The temperature of the <u>water</u> in the flask will decrease with time				1		1		1
	(c)			All data recorded and logically organised (1) Headings - time/ temperature(1) Units – minutes/ °C (1)			3			3		3
				Section A total			5	1	0	6	0	6

SECTION B

Marking details				Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	Independent variable - time (1) Dependent variable - temperature (1)	2			2		2
		(ii)	Any 2 x (1) from: <ul style="list-style-type: none"> • Volume of water • thickness of bubble wrap • type of bubble wrap • material of flask 	2			2		2
	(b)		Axes labelled correctly with units (1) Scales & use of at least $\frac{1}{2}$ of graph paper (1) All plots correctly plotted with $\pm \frac{1}{2}$ small square tolerance (2) 1 error (1) >1 error (0) Smooth curve of best fit within $\pm \frac{1}{2}$ small square division of all points (1) Don't accept thick, double, wispy lines	1 1	2		5	5	5
	(c)		Suitable comment <u>related to graph</u> (1)	1			1		1
	(e)		Substitution: $\frac{\text{Total temperature drop}}{\text{Total time}}$ (1) Answer = (1)		2		2	2	2
	(f)	(i)	Line / curve drawn below the graph of the experiment		1		1		1
		(ii)	Gradient of uninsulated flask is greater (1) Because heat is lost quicker (1)		2		2		2
	(g)		4.2×10 (1) $42 \times 1\,000$ (1) $\frac{42\,000}{4} = 10\,500(1)$		3		3	3	
	(h)		Insulate the opening of the flask (1) Cover the flask with silver foil/ another layer of bubble wrap (1)			2	2		2
	(i)		Logical sequence planned (1) Two control variables stated (volume of water/ thickness of insulation/ starting temperature/ size of flask) (1) Clearly states temperature measured at set intervals (1)			4	4		4

			Clear statement as to how the results will be analysed to establish the most effective insulation – comparison of heat lost (1)						
			Section B total	7	11	6	24	10	21

WJEC GCSE Applied Science (Double Award) SAMs from 2016
02/12/15