Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2024

Single Award Science

Unit 4

Booklet B

Higher Tier

[GSA44]

GSA44

TUESDAY 11 JUNE, MORNING

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **9(a)(i)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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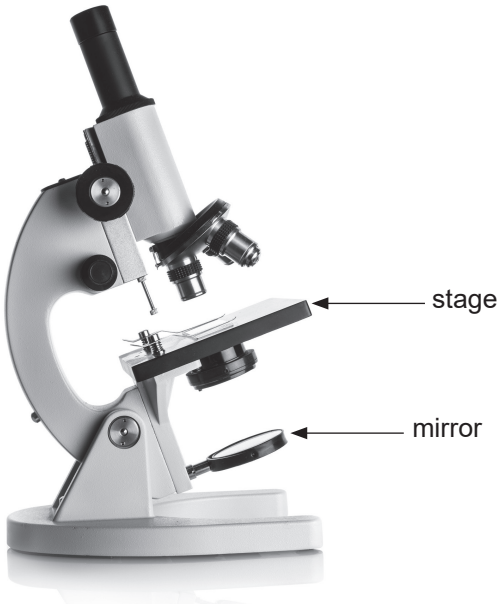
Section A – Biology

1 The diagram below shows a light microscope that can be used to view cells.



(a) Give the function of the following parts of the microscope.

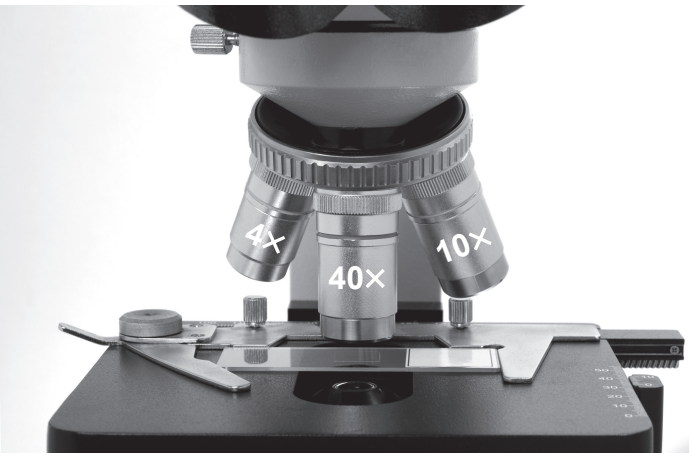
stage _____

_____

mirror _____

_____ [2]

(b) The photograph below shows the three objective lenses on the microscope.



(i) How many times bigger will the cells appear when using the **40×** objective lens compared to the **4×** objective lens?

_____ [1]

(ii) Complete the following sentences to describe good practice when using a microscope.

Choose from:

smallest (4×) : **largest (40×)** : **close to** : **far away from**

To view the cells on a slide, start with the _____

objective lens, which should be _____ the slide.

Then turn the focus knob until the cells are in focus. [2]

[Turn over

(c) The photograph below shows a person collecting a sample of cheek cells using a cotton bud.

(i) Suggest why a **soft** cotton bud is used to collect the sample of cheek cells.

_____

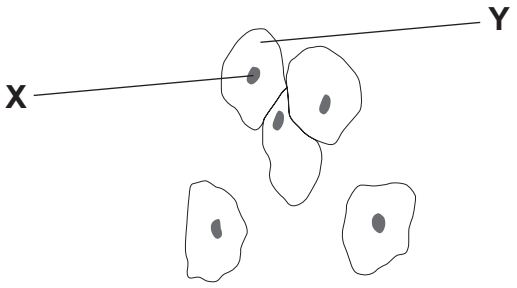
_____ [1]

(ii) In order to prevent the spread of infection, suggest what should be done with the cotton bud before it is disposed of.

_____

_____ [1]

The diagram below shows cheek cells as viewed under a microscope.



(iii) Name the parts labelled **X** and **Y**.

X _____

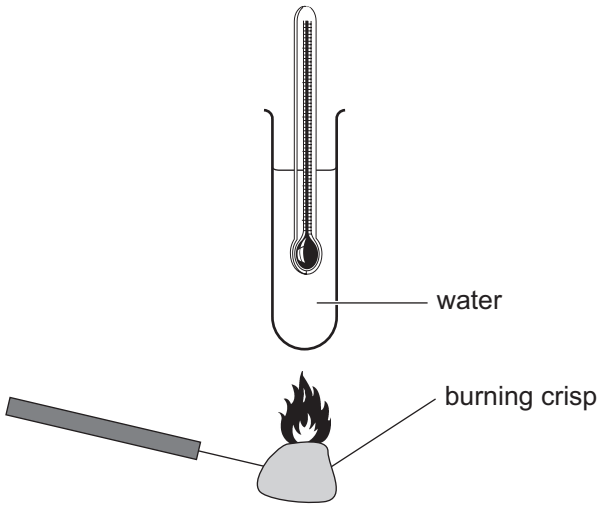
Y _____ [2]

(d) Name the solution used to stain **onion** cells on a microscope slide.

_____ [1]

[Turn over

2 **(a)** The diagram below shows some of the apparatus a student used to investigate the energy content of four types of crisp.



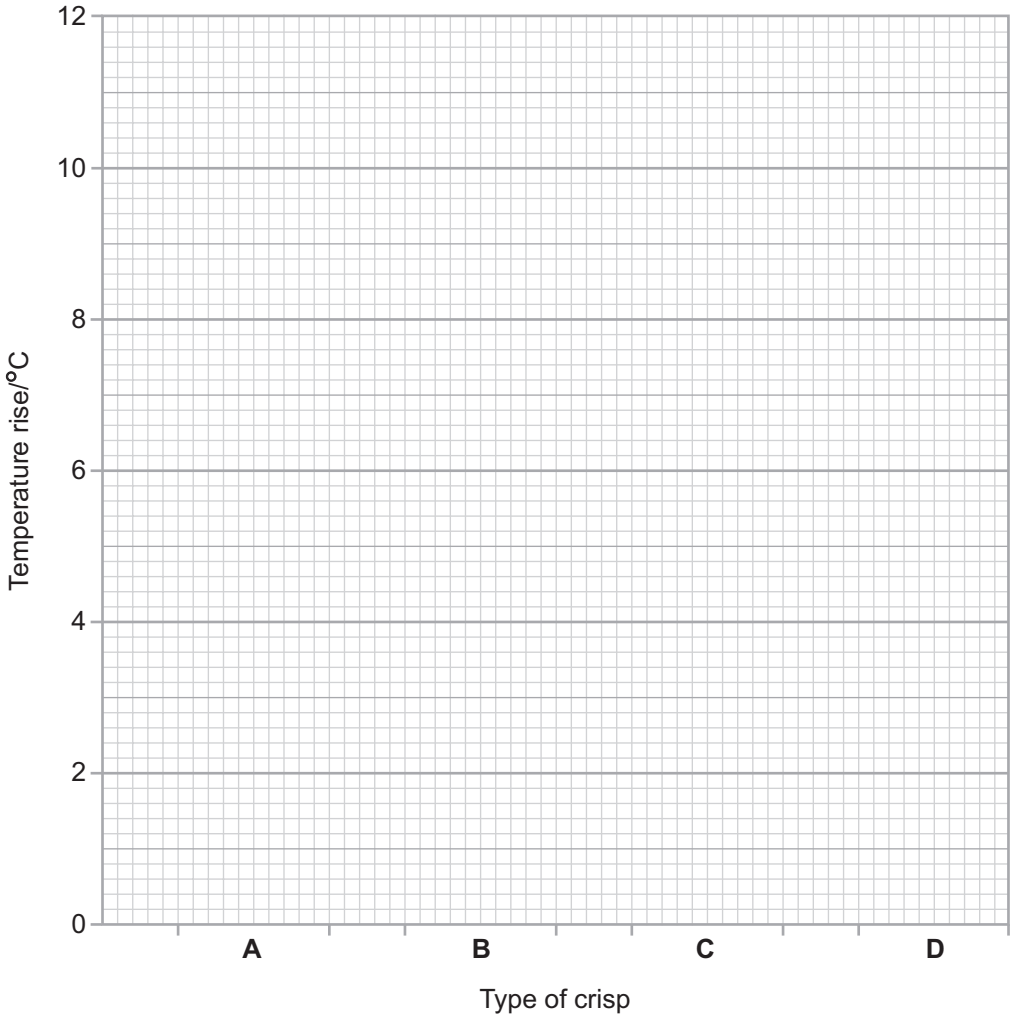
The student used the burning crisps to heat the water.
Her results are shown below.

Crisp	Temperature at the start /°C	Temperature at the end/°C	Temperature rise /°C
A	16	24	8
B	15	26	11
C	18	28	10
D	16		4

(i) Calculate the temperature at the end of the experiment for crisp **D**.

_____ °C [1]

(ii) On the grid below, complete the bar chart to show the **temperature rise** for these crisps.



[2]

(iii) The student thought that crisp **B** contained the most energy.

Explain why her conclusion is **correct**.

_____

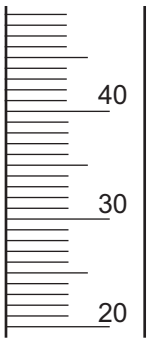
_____ [1]

(iv) Suggest how the student made sure that as much energy as possible was released from the crisps.

_____ [1]

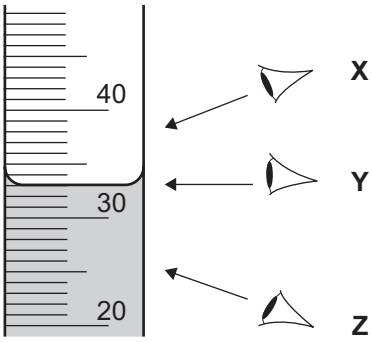
[Turn over

(b) The diagram below shows part of a measuring cylinder.



(i) Draw a line on the measuring cylinder above to show a volume of 25 cm^3 of water. [1]

(ii) When the student is reading the value on the measuring cylinder, from which position, **X**, **Y** or **Z**, should she take the reading?



_____ [1]

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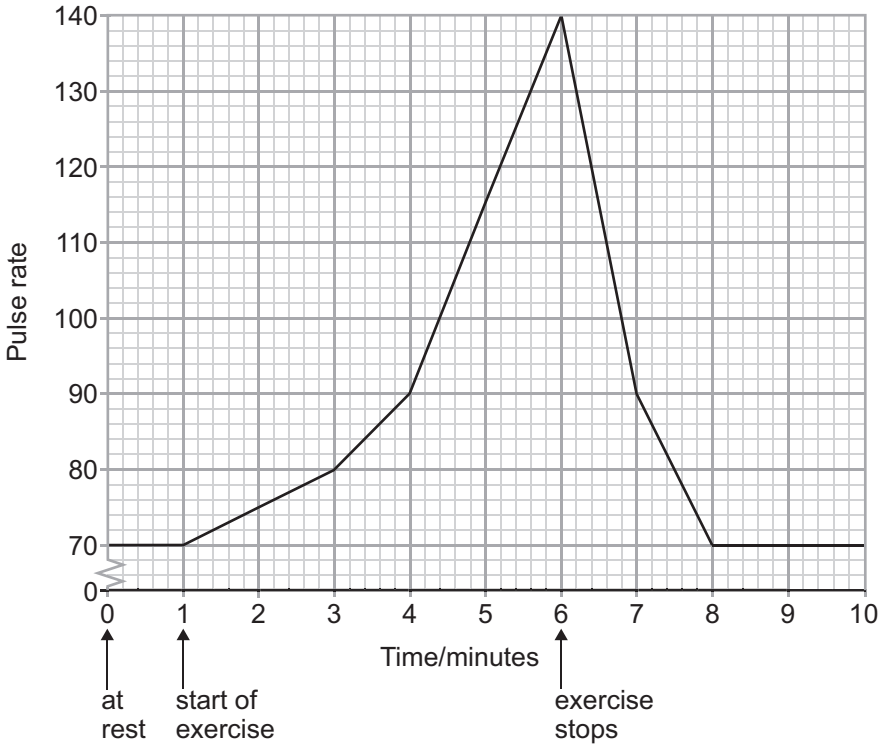
(Questions continue overleaf)

3 **(a)** A student investigated the effect of exercise on his pulse rate.

He measured his pulse rate at rest and then ran for 5 minutes.

After he stopped running, the student measured the time it took his pulse rate to return to its resting rate.

The graph below shows his pulse rate during the investigation.



(i) Between which two times was the student running the fastest?

from _____ to _____ minutes [1]

(ii) How many minutes did it take for the student's pulse rate to return to its resting pulse rate after exercise stopped?

_____ [1]

The unit is missing from the y-axis of the graph.

(iii) What is the unit for pulse rate?

_____ [1]

(b) Give **one** safety precaution the student should take before carrying out this investigation.

_____ [1]

The student was told by his teacher that if he exercised regularly his fitness would improve.

(c) Give **two** changes the student would notice in his pulse rate when his fitness improves.

1. _____

_____

2. _____

_____ [2]

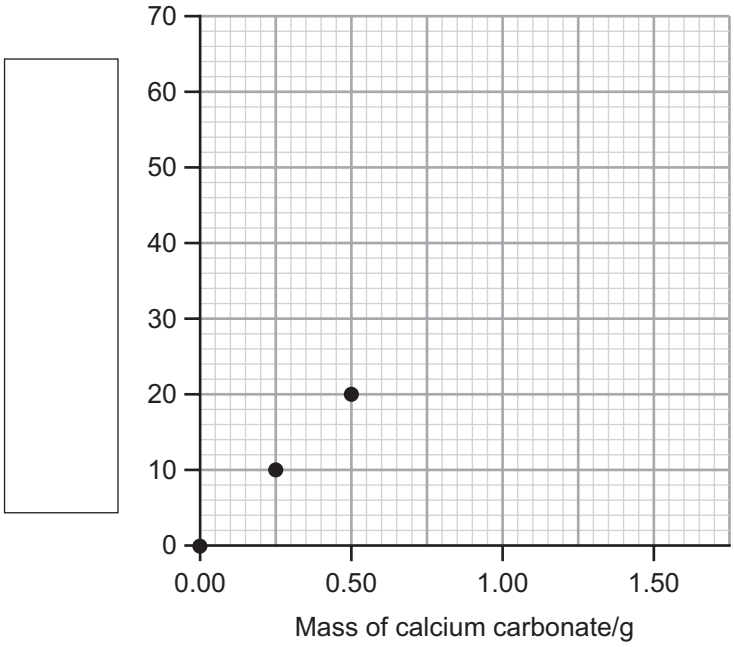
Section B – Chemistry

4 **(a)** The table below shows the volume of acid needed to neutralise different masses of calcium carbonate.

Mass of calcium carbonate/g	Volume of acid /cm^3
0.00	0
0.25	10
0.50	20
0.75	30
1.00	38
1.25	52
1.50	60

(i) On the grid below, add a suitable label to the y-axis. [1]

(ii) On the grid below, plot and draw a line graph for these results. The first three points have been plotted for you.



[3]

(iii) State the trend shown by these results.

_____

_____ [1]

The graph can be represented by the equation:

$$\mathbf{y = mx + c}$$

where **m** is the gradient of the line and **c** is the intercept on the y-axis.

(iv) What is the value for **c** on this graph?

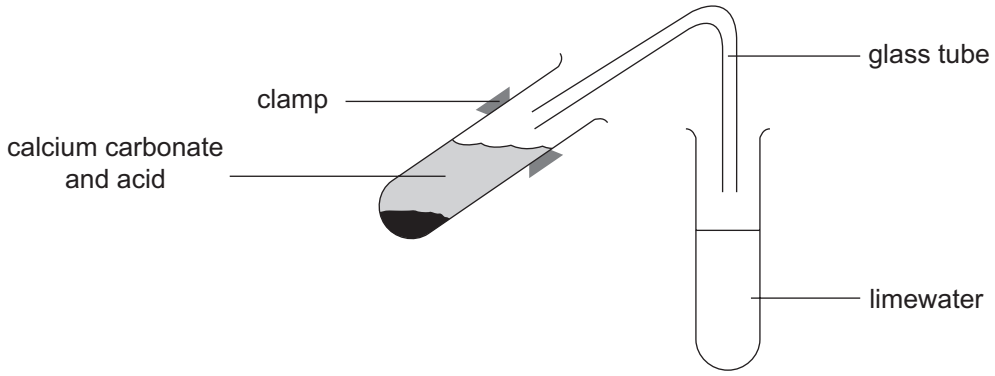
_____ cm^3 [1]

(v) Predict the volume of acid that would be needed to neutralise **2.00 g** of calcium carbonate.

_____ cm^3 [1]

(b) This reaction produces carbon dioxide, which can be tested for using limewater.

To test the gas, a student used the apparatus shown below.



(i) Suggest **one** reason why this set-up of apparatus will **not** work.

_____

_____ [1]

(ii) Describe the colour change of the limewater when carbon dioxide is present.

from _____ to _____ [2]

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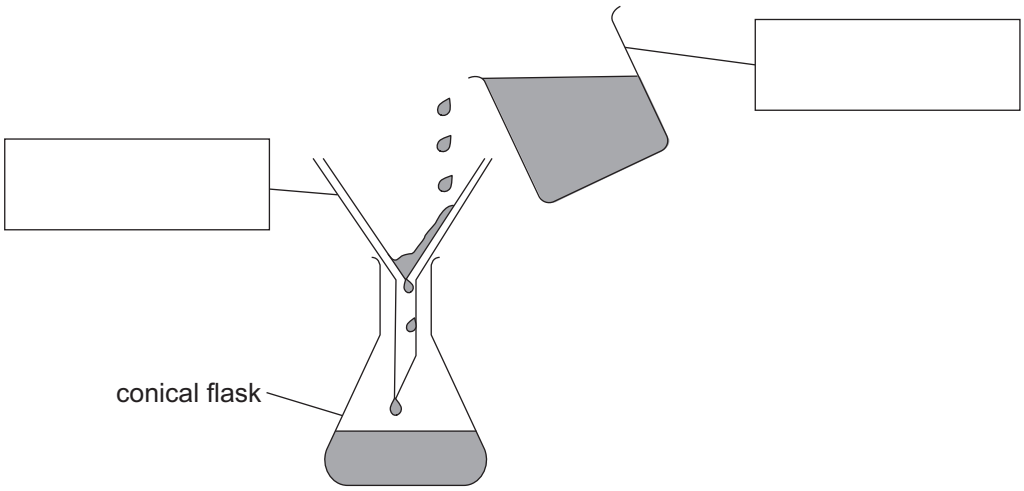
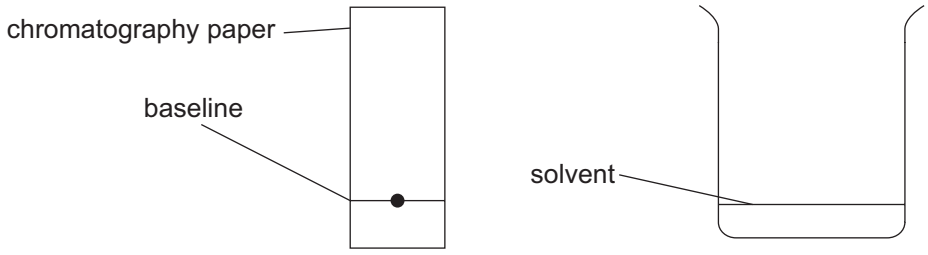
(Questions continue overleaf)

5 The diagram below shows how filtration can be used to separate a mixture of sand and water.

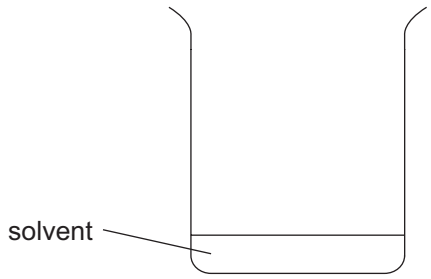


(a) Complete the diagram by adding the names of the **two** pieces of apparatus in the boxes provided. [2]

(b) Another method of separation is chromatography which is used to separate colours in ink. Shown below is the apparatus used for chromatography.

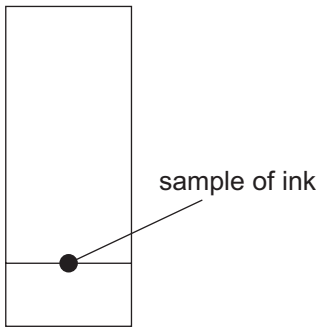


(i) Complete the diagram below to show how this apparatus is set up at the start of the experiment.



[2]

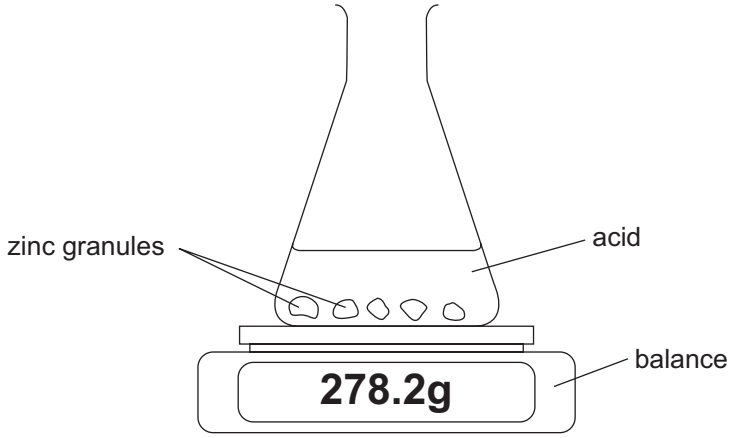
(ii) On the diagram below, draw the results of this experiment if the sample of ink contained **three different** colours.



[1]

[Turn over

6 **(a)** The diagram below shows the apparatus used to investigate the rate of reaction between zinc granules and acid.



A student used the following method.

1. Measure 150 cm^3 of acid and pour it into the conical flask.
2. Add 0.5 g of zinc granules to the conical flask.
3. Record the mass of the flask and contents every 20 seconds.
4. Repeat steps 1–3 increasing the temperature of the acid each time.

(i) Suggest which hypothesis can be tested using this method.

Circle your answer.

the higher the temperature, the better the reaction

the higher the temperature, the faster the reaction

the higher the temperature, the bigger the reaction

[1]

(ii) Give **two** ways the student will know that the reaction is finished.

1. _____

2. _____ [2]

(b) The results of the investigation are shown below.

Temperature of acid/°C \ Time/s	Mass of conical flask and contents/g					
	0	**20**	**40**	**60**	**80**	**100**
20	280.0	279.2	278.6	278.3	278.1	278.0
30	280.0	279.0	278.4	278.2	278.2	278.0
40	280.0	278.8	278.2	278.1	278.0	278.0
50	280.0	278.6	278.1	278.0	278.0	278.0
60	280.0	278.5	278.0	278.0	278.0	278.0

(i) State the range of **temperatures** used in this investigation.

_____ °C [1]

(ii) Calculate the total loss in mass during the reaction carried out at 20°C.

_____ g [1]

[Turn over

(iii) The student wanted to find the **most** accurate finishing time for the reaction carried out at 60°C. How often should the student record the mass?

Circle your answer.

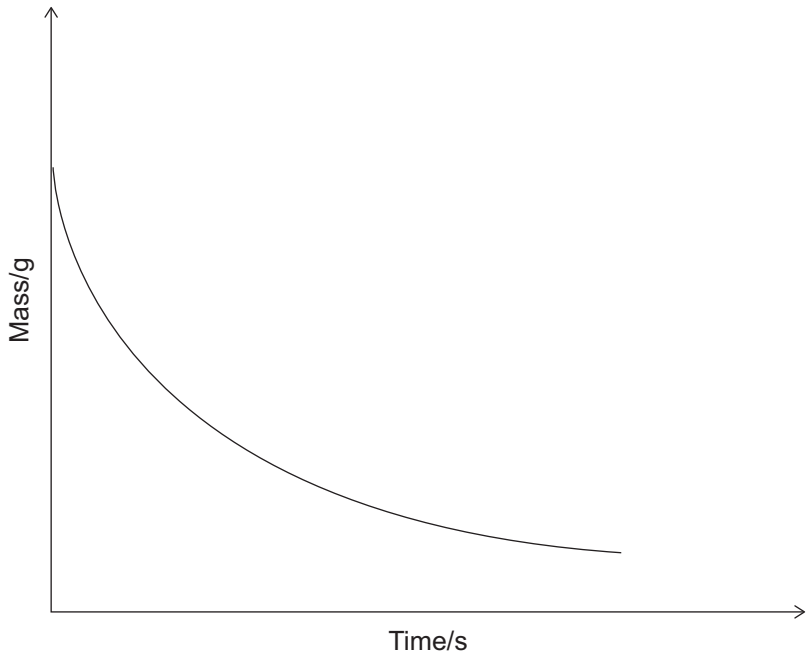
every 10 seconds

every 20 seconds

every 5 seconds

[1]

(iv) The graph below shows the results plotted for the reaction carried out at 20°C. On the same axes, sketch the shape of the graph expected for the reaction carried out at 60°C.



[2]

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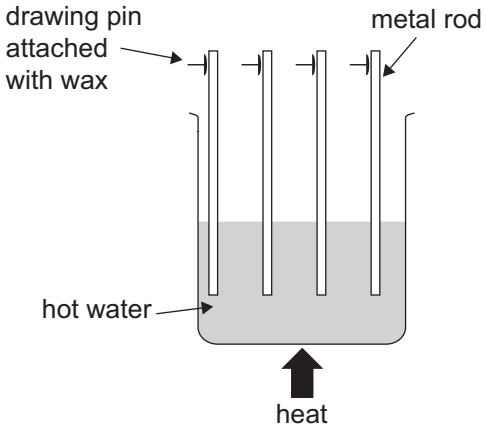
Section C – Physics

7 **(a)** A student wanted to investigate **four** metals to find out which was the best conductor of heat. The apparatus he used is shown below.



(i) Give **one** way this investigation was made a fair test (valid).

_____ [1]

He did the experiment three times and calculated the average. The results are shown below.

Metal rod	Time for pin to fall/s			
	Attempt 1	**Attempt 2**	**Attempt 3**	**Average**
copper	24	22	23	23
brass	83	83	86	84
aluminium	45	42	42	43
iron	136	140	90	138

(ii) Put the metals in order of how well they conducted heat. Start with the best conductor.

_____ _____ _____ _____ [2]

The student thought one of the results recorded in the table was an anomalous result.

(iii) Circle the anomalous result in the table. [1]

(iv) Look at the student's table of results and describe how he dealt with the anomalous result.

_____

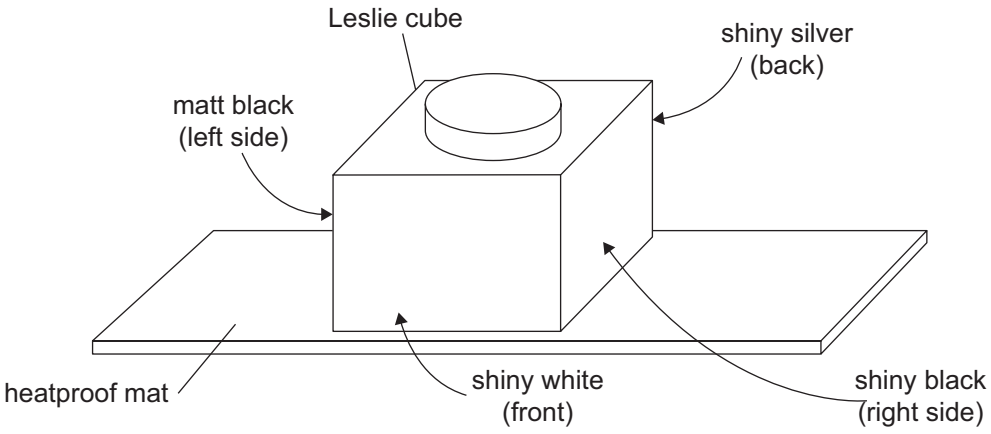
_____ [1]

(v) Why did the student carry out the investigation three times and calculate an average for each metal rod?

_____ [1]

[Turn over

(b) The diagram below shows a Leslie cube. When filled with boiling water, it can be used to demonstrate the effect of colour on the radiation of heat. It has four sides made from the same metal but with different coloured surfaces.



Boiling water was poured into the Leslie cube and the temperature at each side was recorded every two minutes.

The results are shown below.

Time/min	Temperature/°C			
	Shiny silver	**Shiny white**	**Shiny black**	**Matt black**
0	80	80	80	80
2	72	66	60	52
4	66	57	47	34
6	61	52	38	24
8	58	43	26	16

(i) Which surface is the best emitter of heat? Explain your answer.

_____

_____ [2]

(ii) In which **two-minute** period is the shiny silver surface losing heat most slowly?

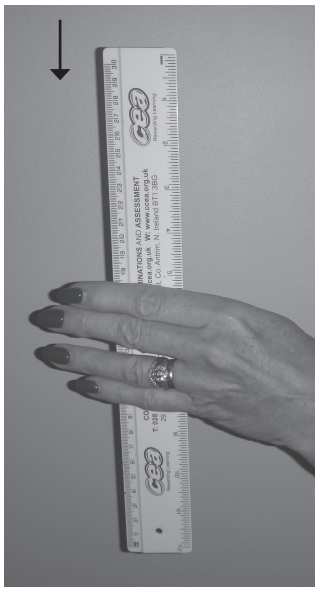
from _____ to _____ min [1]

[Turn over

8 The photographs below show a teacher measuring her reactions by catching a falling ruler. She started with her hand at the bottom of the ruler. She repeated the investigation three times.

Attempt 1

Attempt 2



Attempt 3

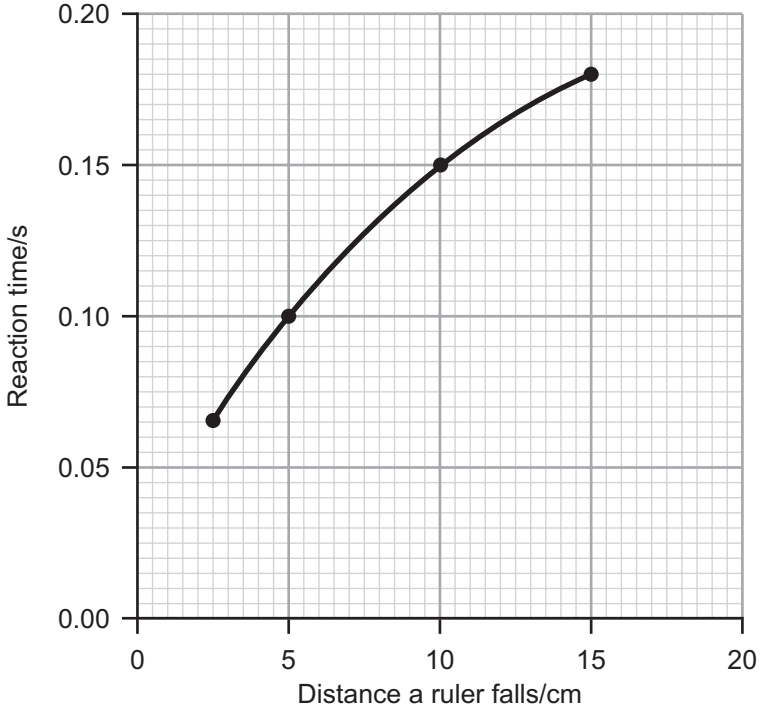
(a) Which attempt, **1**, **2** or **3**, showed the fastest reaction? Explain your answer.

_____

_____

_____ [2]

The graph below shows the relationship between the distance a ruler falls and reaction times.



(b) Use the graph to find the reaction time when the ruler has fallen a distance of 7.5 cm.

_____ s [1]

[Turn over

The table below shows the effect taking energy drinks has on reaction time.

Time after taking energy drink/min	Reaction time/s
0	0.15
5	0.14
10	0.12
15	0.09
20	0.08

(c) Describe the trend shown by these results.

_____

_____ [1]

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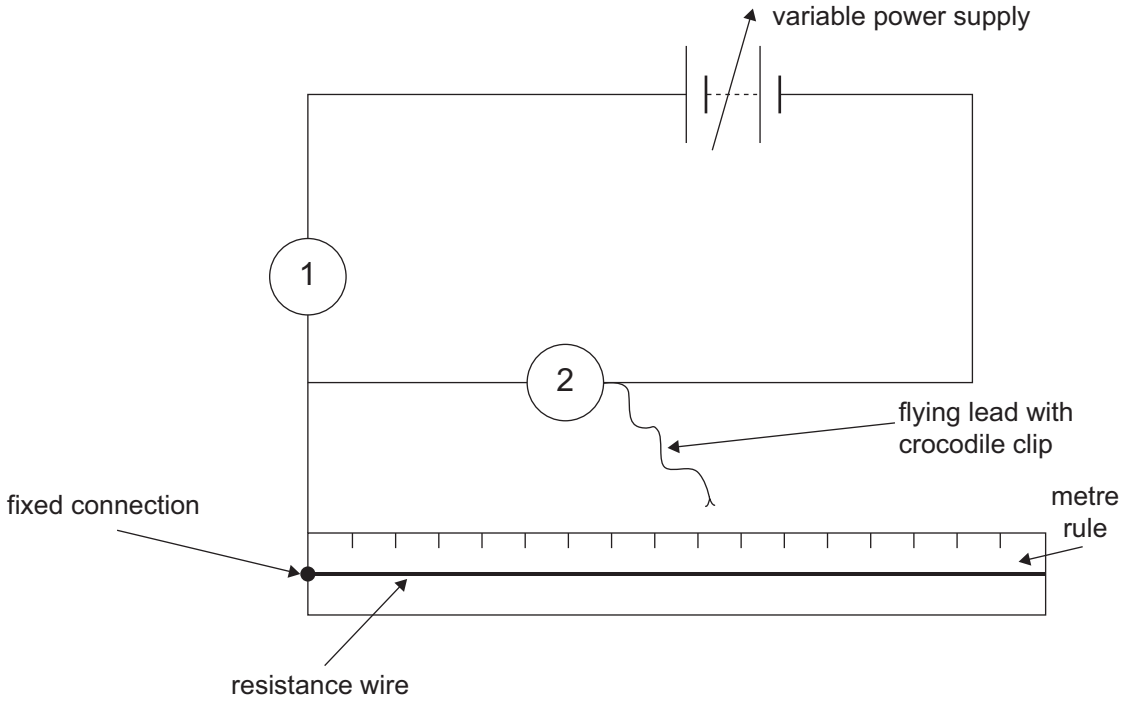
9 **(a)** The diagram below shows the electrical circuit used to investigate the effect of length on the resistance of a piece of wire.



(i) Describe how this circuit could be used to carry out the investigation.

Your answer should include:

- the names of the meters, **1** and **2**, and how they are connected in the circuit;
- the measurements that need to be taken;
- how the resistance would be calculated;
- the conclusion you would expect; and
- **one** risk in this investigation and how it could be dealt with.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

[Turn over

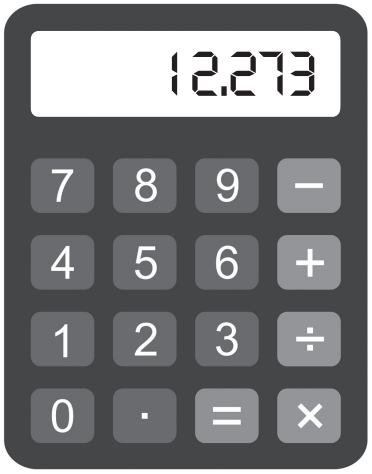
(ii) Name the independent variable in this investigation.

_____ [1]

(iii) Name a variable that should be controlled in this investigation.

_____ [1]

The student used his measurements to calculate the resistance of the wire.
The diagram below shows a calculator with a resistance value.



(b) Give the resistance to **one** decimal place.

_____ Ω [1]

The table below shows how the cross-sectional area of two types of nichrome wire affects their resistance.

Cross-sectional area/mm^2	Resistance/Ω per m	
	Nichrome 60 (60% nickel)	Nichrome 80 (80% nickel)
0.13	8.8	8.4
0.20	5.5	5.3
0.32	3.5	3.3
0.52	2.2	2.1
0.81	1.4	1.3

(c) Give **two** conclusions that can be made from these results.

1. _____

_____

2. _____

_____ [2]

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total Marks	

Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Butanoate	$C_3H_7COO^-$
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Propanoate	$C_2H_5COO^-$
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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Rewarding Learning

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Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations

gcse examinations

chemistry

11984.02

THE PERIODIC TABLE OF ELEMENTS

Group

1	2											3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	98 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	266 Sg Seaborgium 106	264 Bh Bohrium 107	277 Hs Hassium 108	268 Mt Meitnerium 109	271 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a X b

a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

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