Write your details here

Surname	Other names

Scholarship Examination

Subject: Science
Paper: Chemistry C1
Time: 1 Hour

You must have:
Ruler
Calculator

Total Marks
/58
%

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name.
- Answer **all** questions.
- Answer the questions in the spaces provided
  - *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is **58**
- The marks for **each** question are shown in brackets
  - *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

The Periodic Table

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	63.5 **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** paladium 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	[209] **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	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.*

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Q1.

Techniques used in the separation of mixtures include

A crystallisation

B filtration

C fractional distillation

D simple distillation

For each separation, select the most suitable technique, A, B, C or D, used to obtain the first named substance from the mixture.

Each letter may be used once, more than once or not at all.

(a) Pure water from sea water

(1)

.....

(b) Ethanol from a mixture of ethanol and water

(1)

.....

(c) Calcium carbonate from a mixture of calcium carbonate and water

(1)

.....

(d) $CuSO_4.5H_2O(s)$ from $CuSO_4(aq)$

(1)

.....

(Total for question = 4 marks)

Q2.

This is a description of how the orange colouring can be extracted from rose petals.

- crush the petals using a pestle and mortar
- add the crushed petals to some ethanol in a beaker
- heat to about 60°C and stir to produce an orange solution
- separate the orange solution from the petals

(a) (i) Suggest why ethanol is used instead of water.

(1)

.....

.....

(ii) Ethanol is a flammable liquid.

Suggest how it could be heated safely.

(1)

.....

.....

(iii) How could the orange solution be separated from the petals?

(1)

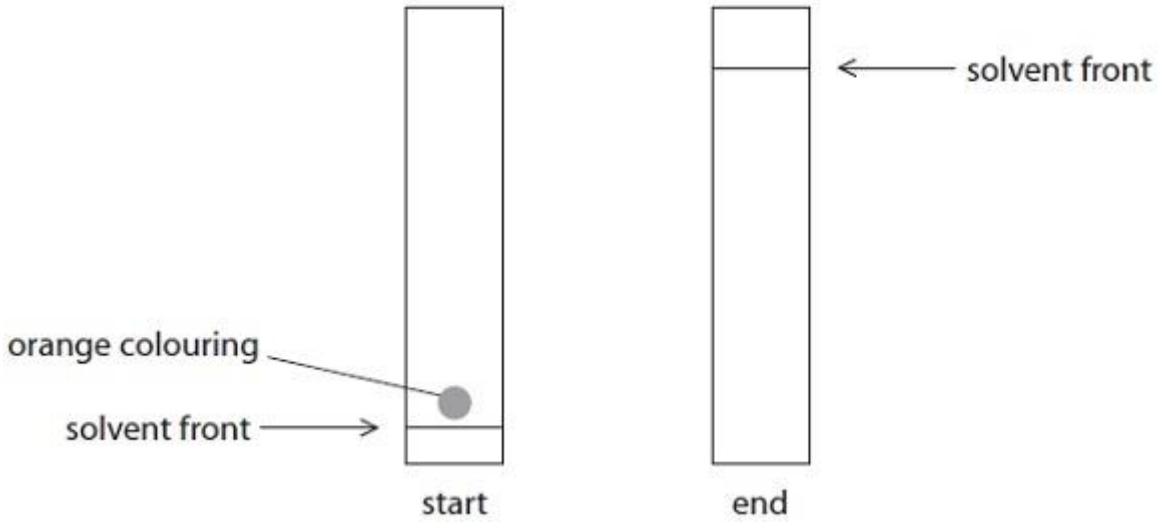
.....

(b) The orange colouring is analysed using chromatography and is found to consist of two different colours, red and yellow.

The diagram shows the chromatography paper at the start of the experiment.

Complete the diagram to show a possible result at the end of the experiment.

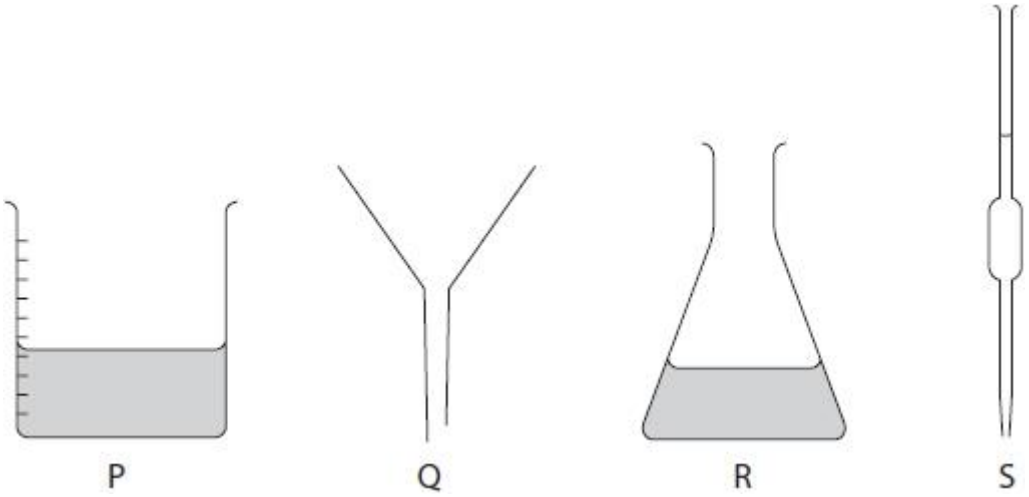
(2)



(Total for Question = 5 marks)

Q3.

These pieces of apparatus are used in chemistry experiments.



(a) Name these pieces of apparatus.

(4)

P .....

Q .....

R .....

S .....

(b) Apparatus P contains dilute hydrochloric acid.

Litmus indicator is added to this acid.
What is the final colour of the litmus?

(1)

☒ **A** blue ☒ **B** green ☒ **C** orange ☒ **D** red

(c) Apparatus R contains potassium hydroxide solution.

Litmus indicator is added to this alkaline solution.
What is the final colour of the litmus?

(1)

☒ **A** blue ☒ **B** green ☒ **C** orange ☒ **D** red

(Total for question = 6 marks)

Q4.

The table gives information about the first three elements in Group 1 of the Periodic Table.

Element	Atomic number	Relative atomic mass	Electronic configuration	Density in g / cm³	Melting point in °C
lithium	3	7	2.1	0.53	180
sodium	11	23	2.8.1	0.97	98
potassium	19	39	2.8.8.1	0.86	64

(a) Which information shows that the elements have similar chemical properties?

Give a reason for your choice.

(2)

Information

.....

Reason

.....

.....

(b) The elements in Group 1 show a clear trend (regular pattern) in some of their **physical** properties.

Identify the physical property that shows a clear trend.

(1)

.....

.....

(c) The elements also show a clear trend in their **chemical** properties, such as their reaction with water.

When a small piece of lithium is added to water it fizzes gently and eventually disappears to form a solution.

(i) Describe a test to show that the gas given off is hydrogen.

(1)

.....

.....

(ii) Complete the equation for the reaction by inserting the state symbols.

(1)

$2Li(.....) + 2H_2O(.....) \rightarrow 2LiOH(.....) + H_2(.....)$

(iii) State and explain the effect that the solution formed has on red litmus paper.

(2)

.....

.....

.....

.....

(d) State two similarities and two differences between the reactions of lithium and potassium with water.

(4)

Similarities

.....

.....

.....

Differences

.....

.....

.....

(e) When lithium burns in oxygen it forms lithium oxide (Li_2O).

(i) Write a chemical equation for the reaction between lithium and oxygen.

(2)

.....

(ii) When sodium burns in oxygen, one of the products is sodium peroxide (Na_2O_2).

Balance the equation to show the formation of sodium peroxide.

(1)

..... Na + ... O_2 → .....Na_2O_2

(Total for Question = 14 marks)

Q5.

Bromine is an element in Group 7 of the Periodic Table.

(a) What is the name given to the Group 7 elements?

(1)

☒ **A** alkali metals ☒ **B** alkaline earth metals ☒ **C** halogens ☒ **D** noble gases

(b) The symbols of two isotopes of bromine are $^{79}_{35}Br$ and $^{81}_{35}Br$.

(i) State what is meant by the term **isotopes**.

(2)

.....

.....

.....

.....

(ii) Complete the table to show the number of protons, neutrons and electrons in one atom of $^{79}_{35}Br$ and in one atom of $^{81}_{35}Br$.

(3)

Isotope	Number of protons	Number of neutrons	Number of electrons
$^{79}_{35}Br$			
$^{81}_{35}Br$			

Q6.

Bedri and Jay planned an experiment to find the temperature rise in a neutralisation reaction. This is their method.

- Use a measuring cylinder to add 25 cm^3 of an alkali to a 100 cm^3 beaker
- Record the temperature of the alkali
- Use a burette to add an acid to the alkali in 5.0 cm^3 portions
- Record the temperature of the mixture after adding each portion of acid
- Stop the experiment when the neutralisation is complete

(a) The teacher asked the students about their method. Suggest an answer to each of his questions.

(i) Why would it be better to use a pipette instead of a measuring cylinder?

(1)

.....

.....

(ii) What vessel would be better than a beaker?

(1)

.....

.....

(iii) What extra step should there be between adding each portion of acid and measuring the temperature?

(1)

.....

.....

(iv) How would you know when the neutralisation was complete?

(1)

.....

.....

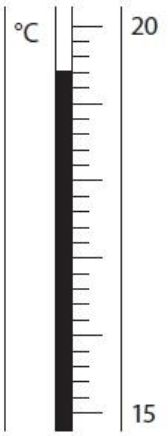
(b) The diagrams show the readings on the thermometer before and after Murigi added a portion of acid. Write down the thermometer readings and calculate the temperature change.

(3)

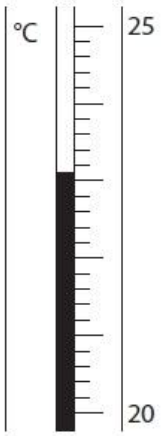
Temperature before adding acid .....°C

Temperature after adding acid .....°C

Temperature change .....°C



before adding acid



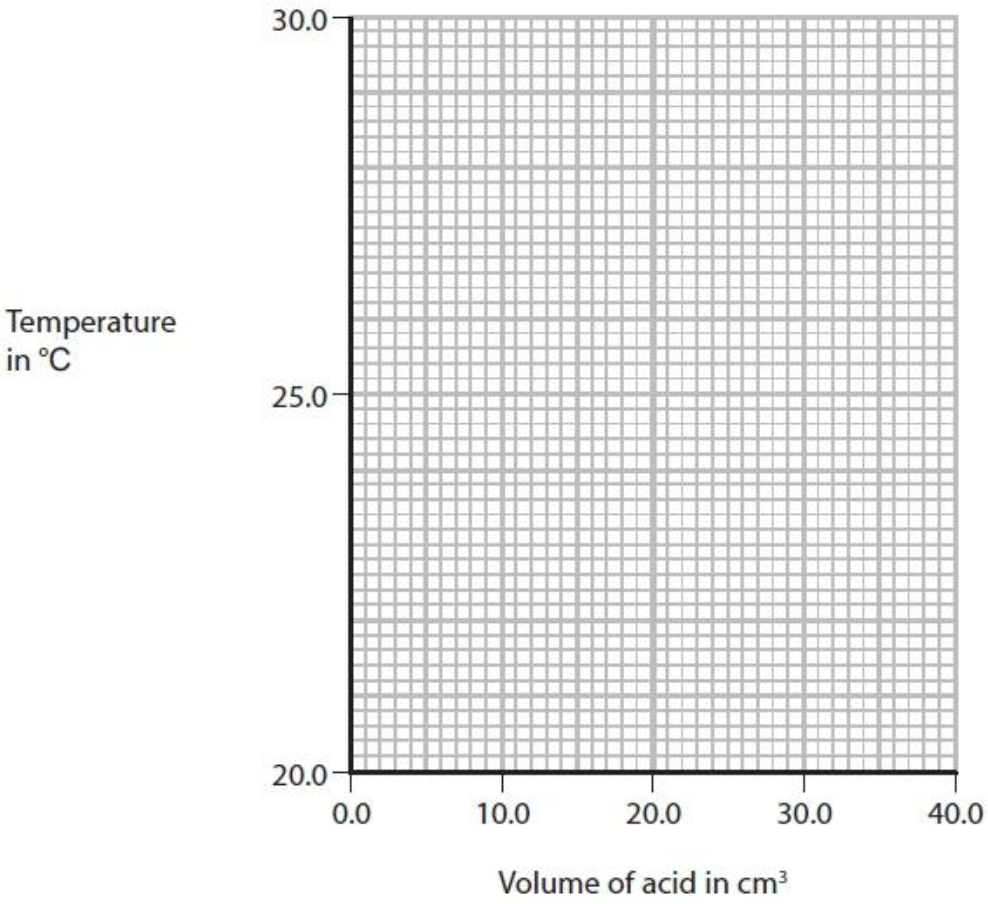
after adding acid

(c) Murigi obtained these results from an experiment in which he added a total of 40.0 cm^3 of hydrochloric acid to 25 cm^3 of sodium hydroxide solution.

Volume of acid in cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
Temperature in °C	21.0	22.3	24.4	26.2	27.8	27.8	27.5	26.7	26.2

(i) Plot a graph of these results on the grid below. Draw a straight line of best fit through the first five points and another straight line of best fit through the last four points. Make sure that the two lines cross.

(4)



(ii) The point where the lines cross indicates the volume of acid needed to exactly neutralise the alkali, and also the maximum temperature reached. Use your graph to record these values.

(2)

Volume of acid ..... cm^3

Maximum temperature .....°C

(d) Aman used the same method and found that 30.0 cm^3 of acid were needed to neutralise 25 cm^3 of alkali. He obtained a temperature rise of 5.5 °C in his experiment. Calculate the heat energy change in this experiment using the expression: heat energy change = total volume of mixture × 4.2 × temperature change

(2)

Heat energy change = ... J

(Total for Question = 15 marks)

Q7.

A group of students investigated the reaction between marble chips (calcium carbonate) and dilute hydrochloric acid.

The equation for this reaction is

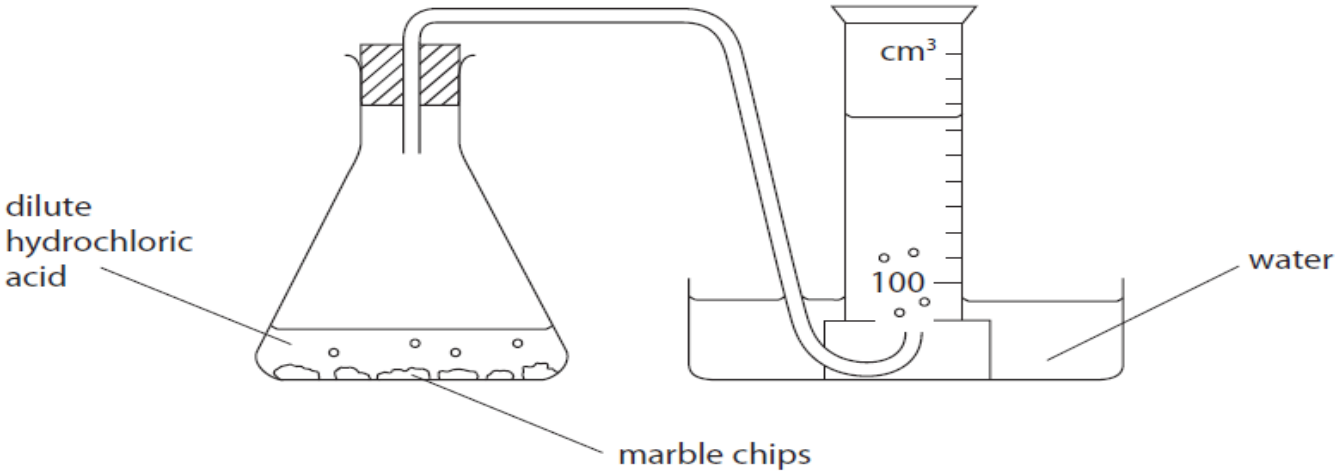
$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

They wanted to find the effect of changing the concentration of hydrochloric acid on the rate of reaction. The teacher provided a solution that she had labelled 100% hydrochloric acid.

The teacher told them to do all their experiments

- Using different concentrations of hydrochloric acid made by diluting the 100% hydrochloric acid.
- By timing how long it took to collect carbon dioxide
- At room temperature.

The students used this apparatus.



(a) The students tried to keep the amount of calcium carbonate constant by using the same number of marble chips in each experiment.

State two other properties of the marble chips that should be the same in each experiment.

(2)

1 ……

2 ……

(b) The table shows how some of the students wrote down their results.

Student	Results
1	I used 6 marble chips and 100% hydrochloric acid and collected 100 cm^3 of gas in 40 seconds.
2	In my experiment there were 6 marble chips and 80% hydrochloric acid and I collected 100 cm^3 of carbon dioxide by the end of the experiment.
3	The marble chips and 60% hydrochloric acid formed 100 cm^3 of gas in 70 seconds.
4	I used 40% hydrochloric acid and 6 marble chips. It took 105 seconds to collect the gas.
5	I collected 100 cm^3 of gas in 135 seconds when I used 6 marble chips.

The teacher said that she could only use the results from student 1 because the other students had not recorded enough information.

Identify the piece of information that each student failed to record.

(4)

Student 2 .....

Student 3 .....

Student 4 .....

Student 5 .....

(C) Explain, in terms of particles, why the rate of a reaction increases as the concentration of a reactant increases.

(2)

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.....

.....

.....

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.....

(Total for Question = 8 marks)