

Candidate Name

Candidate Number

Centre Name

Centre Number

**Paper 1: Chemistry (6211)**  
(2 hours)**For Examination December 2023**

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

**INSTRUCTIONS:**

- You must write your name, candidate number, centre name and centre number on the answer sheets in the designated spaces.
- Objective section consists of 25 questions, and it is essential that you attempt all of them.
- Each question has four options labelled A, B, C, and D. Select the option that you think is correct. Mark it on the multiple choice answer sheet using a soft pencil.
- Attempt all the questions from subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.
- You are allowed to use a calculator if needed.

**INFORMATION:**

- This paper has a total of 100 marks.
- In objective section there are 25 questions, each carries one mark. There is no negative marking for incorrect responses.
- In subjective section, 45 marks are for extended theory and 30 marks for practical component.
- The number of marks assigned for every question or its parts is indicated within brackets [ ].
- Rough work must be completed on this question paper.

1	2	Key										3	4	5	6	7	0	
		relative atomic mass atomic symbol name atomic (proton) number																
7	9	45	48	51	52	55	56	59	59	63.5	65	70	73	75	79	80	84	
Li lithium 3	Be beryllium 4	Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25	Fe iron 26	Co cobalt 27	Ni nickel 28	Cu copper 29	Zn zinc 30	Ga gallium 31	Ge germanium 32	As arsenic 33	Se selenium 34	Br bromine 35	Kr krypton 36	
23	24	89	91	93	96	[97]	101	103	106	108	112	115	119	122	128	127	131	
Na sodium 11	Mg magnesium 12	Y yttrium 39	Zr zirconium 40	Nb niobium 41	Mo molybdenum 42	Tc technetium 43	Ru ruthenium 44	Rh rhodium 45	Pd palladium 46	Ag silver 47	Cd cadmium 48	In indium 49	Sn tin 50	Sb antimony 51	Te tellurium 52	I iodine 53	Xe xenon 54	
133	137	139	178	181	184	186	190	192	195	197	201	204	207	209	[209]	[210]	[222]	
Cs caesium 55	Ba barium 56	La* lanthanum 57	Hf hafnium 72	Ta tantalum 73	W tungsten 74	Re rhenium 75	Os osmium 76	Ir iridium 77	Pt platinum 78	Au gold 79	Hg mercury 80	Tl thallium 81	Pb lead 82	Bi bismuth 83	Po polonium 84	At astatine 85	Rn radon 86	
[223]	[226]	[227]	[267]	[270]	[269]	[270]	[270]	[278]	[281]	[281]	[285]	[286]	[289]	[289]	[293]	[293]	[294]	
Fr francium 87	Ra radium 88	Ac* actinium 89	Rf rutherfordium 104	Db dubnium 105	Sg seaborgium 106	Bh bohrium 107	Hs hassium 108	Mt meitnerium 109	Ds darmstadtium 110	Rg roentgenium 111	Cn copernicium 112	Nh nihonium 113	Fl flerovium 114	Mc moscovium 115	Lv livermorium 116	Ts tennessine 117	Og oganeson 118	

Page | 2

**MCQ section 25 marks:**

Q1) The diagram shows a glass cup containing hot tea, it was prepared by placing a tea bag into a glass cup, followed by adding boiling water.



Which statement best describes what happens to the particles of the glass cup after adding the boiling water?

- A: Free to move but still touching
- B: Vibrate faster
- C: Free to move but no longer touching
- D: Dissolve to form a solution

Q2) Which change of state causes the distance between particles to increase the most?

- A: Freezing
- B: Boiling
- C: Melting
- D: Sublimation

Q3) A substance was analysed, and it was found to have a boiling point of  $-34^{\circ}\text{C}$  and a melting point of  $-101^{\circ}\text{C}$ .

Correctly identify the state of matter at the different temperatures.

	Room temp	$-150^{\circ}\text{C}$	$-50^{\circ}\text{C}$
A	Solid	Gas	Liquid
B	Liquid	Gas	Solid
C	Gas	Solid	Liquid
D	Solid	Solid	Gas

Q4) Pure water has a boiling point of 100°C and a melting point of 0°C.

During the winter months in countries such as the UK add salt to the roads to reduce the risk of car accidents. The addition of salt to road surface affects the physical properties of water. How is the addition of salt useful in this context?

- A: It will increase the melting point
- B: No affect
- C: It will decrease the melting point
- D: It will decrease the boiling point

Q5) The following passage describes what process:

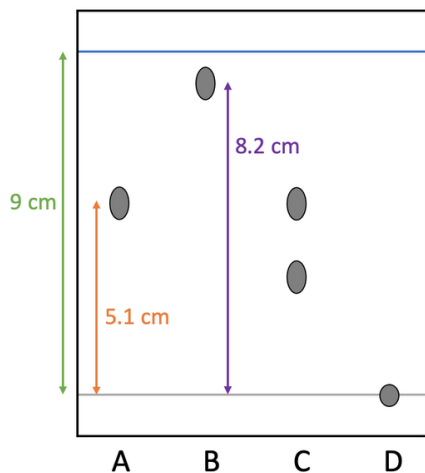
“The random movement of visible particles in solution / gas is the result of random bombardment of smaller non-visible particles.”

- A: Brownian motion
- B: Diffusion
- C: Dissolving
- D: Evaporation

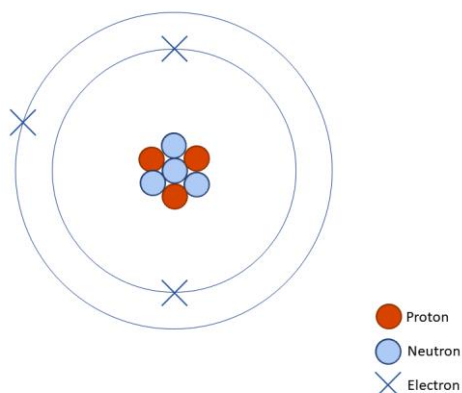
Q6) Pure water was accidentally contaminated with a white soluble solid. Which method can be used to obtain pure water from the aqueous solution?

- A: Crystallisation
- B: Filtration
- C: Distillation
- D: Chromatography

Q7) The image below shows the results of a separate technique used to separate pigments, and deduce which substance has an  $R_f$  value of 0.



Q8) Correctly deduce the best way to describe this image of the element lithium:



- A: Isotope
- B: Ion
- C: Molecule
- D: Electrically neutral atom

Q9) Scientists found a sample of an element, and they were able to deduce atomic number of the element was 115.

Using the Periodic table deduce the number of outer shell electrons of this element.

- A: 15
- B: 5
- C: 3
- D: 7

Q10) Isotopes of different elements exist naturally. Which word correctly describes a difference between isotopes of the same element?

- A: Density
- B: Chemical reactivity
- C: Charge
- D: Number of protons

Q11) Which statement correctly describes the change of properties down Group 1 elements?

	Density	Melting point	Reactivity
A	Increases	Decreases	Increases
B	Increases	Increases	Increases
C	Decreases	Decreases	Decreases
D	Decreases	Increases	Increases

Q12) Nitrogen is an element that exists as a diatomic molecule. What type of bonding is observed between the nitrogen atoms?

- A: Simple covalent
- B: Giant covalent
- C: Ionic bonding
- D: Intermolecular

Q13) Element Y reacts with chlorine to form a compound with the formula  $YCl_3$ .

Deduce what element Y could be.

- A: Aluminum
- B: Lithium
- C: Phosphorus
- D: Copper

Q14) How many non-bonding electrons are present in the outer shell of the noble gas Helium?

- A: 4
- B: 8
- C: 6
- D: 2

Q15) How many transition elements in the Periodic table could be used as the liquid in thermometers?

- A: 2
- B: 10
- C: 1
- D: 0

Q16) Copper is used in electrical wiring, which of the following statements refers to the type of bonding observed in copper?

- A: Electrostatic forces of attraction between oppositely charged ions.
- B: Electrostatic forces of attraction between the nuclei and shared pair of electrons
- C: Electrostatic forces of attraction between the nuclei and delocalized electrons
- D: Electrostatic forces of attraction between charged molecules.

Q17) Solid hydrogen chloride is added to water, and it dissolves to form a hydrogen chloride solution.

Which ions will determine the chemical nature of this solution?

- A:  $\text{Cl}^-$
- B:  $\text{OH}^-$
- C:  $\text{Na}^+$
- D:  $\text{H}^+$

Q18) What is the correct name given to different versions of the same element that have a distinctively different molecular formula?

- A: Isomers
- B: Allotropes
- C: Polymers
- D: Isotopes

Q19) Describe the correct chemical property of Magnesium oxide.

- A: Neutral
- B: Basic
- C: Acidic
- D: Amphoteric

20) Calcium carbonate has the formula of  $\text{CaCO}_3(\text{s})$  using Avogadro's constant  $6.02 \times 10^{23}$  how many molecules are present in 50g of Calcium carbonate?

$A_r \text{ Ca} = 40 \text{ C} = 12 \text{ O} = 16$

- A:  $6.02 \times 10^{23}$
- B:  $6.02 \times 10^{11.5}$
- C:  $3.01 \times 10^{23}$
- D:  $3.01 \times 10^{11.5}$

21) Calculate the percentage mass of iron in the compound  $\text{FeSO}_4(\text{s})$ .

$A_r \text{ Fe} = 56 \text{ S} = 32 \text{ O} = 16$

- A: 54%
- B: 17%
- C: 86%
- D: 37%

22) Which row correctly describes some of the observations of the reaction between potassium and water?

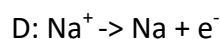
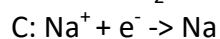
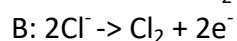
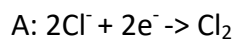
	Observations	Gas given off	Colour observed after adding Phenolphthalein
A	Lilac flame	Hydrogen	Purple
B	Orange flame	Carbon dioxide	Pink
C	Lilac flame	Hydrogen	Pink
D	No flame just fizzes on the surface	Oxygen	Purple

23) A precipitation reaction was used to determine the halide present in a solution. The halide shows a positive result for the halide Iodine when adding silver nitrate.

Correctly identify the other solution that was added and the observed colour.

	Colour observed
A	Brown
B	Yellow
C	White
D	Cream

24) Electrolysis can be used to separate compounds. Molten sodium chloride was separated using this method. What is the reaction occurring at the anode?



25) Solder is an alloy of which two metals?

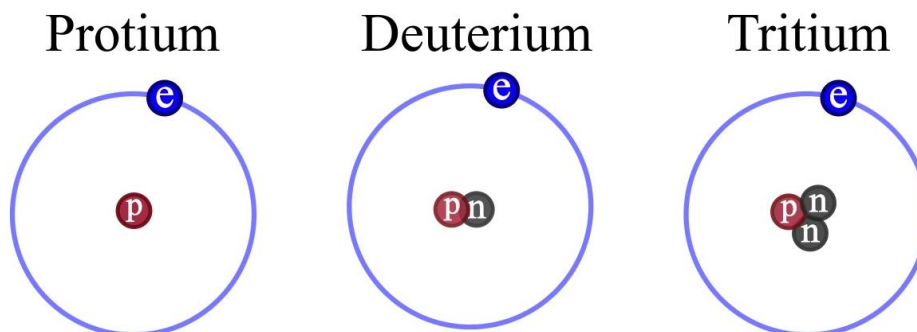
A:	Lead	Tin
B:	Iron	Copper
C:	Lead	Zinc
D:	Tin	Zinc

*End of MCQ [25 mark]*



**Part 2 Extended Theory: [45 marks]**

Q1) Hydrogen is the only element to have special names for its isotopes. The diagram below shows the three stable isotopes of Hydrogen.



ai) Correctly state the period that these isotopes are located. [1 mark]

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aii) Explain why Deuterium and Tritium are both isotopes of hydrogen. [2 marks]

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b) State two reasons why Hydrogen is a unique element of group 1 and not placed above Lithium on the Periodic table. [1 mark]

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c) Lithium is another group 1 element, using a periodic table draw the **ion** of lithium in the space below, including a suitable key including all subatomic particles. [2 marks]

d) Lithium has two main isotopes with the following relative abundance:

Lithium – 6	Lithium – 7
7.5%	92.5%

Calculate the relative atomic mass for Li to 2 decimal places. [2 marks]

Answer: \_\_\_\_\_

ei) Group 1 elements are highly reactive with water, oxygen, and acids. Describe a suitable method of storing these elements to prevent them from reacting with oxygen. [1 mark]

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eii) Write the balanced chemical equation for the reaction between potassium and water, including state symbols. [3 marks]

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eiii) Describe and explain why the reactivity of group 1 elements changes as you go down the group. [3 marks]

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[Total 15 marks]

Q2)

Figure 1 shows a version of the Periodic table published in 1869.

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Period 1	H						
Period 2	Li	Be	B	C	N	O	F
Period 3	Na	Mg	Al	Si	P	S	Cl
Period 4	K Cu	Ca Zn	* *	Ti *	V As	Cr Se	Mn Br
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	* I

Figure 1

Figure 2 shows an example of the published Periodic Table from 1915.

H																	He														
Li	Be											B	C	N	O	F	Ne														
Na	Mg											Al	Si	P	S	Cl	Ar														
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr														
Rb	Sr	Y	Zr	Nb	Mo		Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe														
Cs	Ba	La		Ta	W		Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po		Rn														
	Ra	Ac	Th		U																										
<table><tr><td>Ce</td><td>Pr</td><td>Nd</td><td></td><td>Sm</td><td>Eu</td><td>Gd</td><td>Tb</td><td>Dy</td><td>Ho</td><td>Er</td><td>Tm</td><td>Yb</td><td>Lu</td></tr></table>																		Ce	Pr	Nd		Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ce	Pr	Nd		Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																		

Figure 2

2a) Which scientist first organised the Periodic Table based on atomic weight? [1 mark]

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b) Tennessine (Ts) is located below Iodine in the Periodic table. Why is it not present on the Figure 1 and Figure 2? [1 mark]

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c) Using your knowledge of the halogens, deduce the chemical formula of Ts and draw a molecule of Ts using a cross and dot diagram. [3 marks]

Formula: \_\_\_\_\_

Diagram:

d) Predict the colour and state of matter of Ts? [1 mark]

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[Total 6 marks]

Q3) Magnesium (Mg) is a metal often used in laboratory experiments.



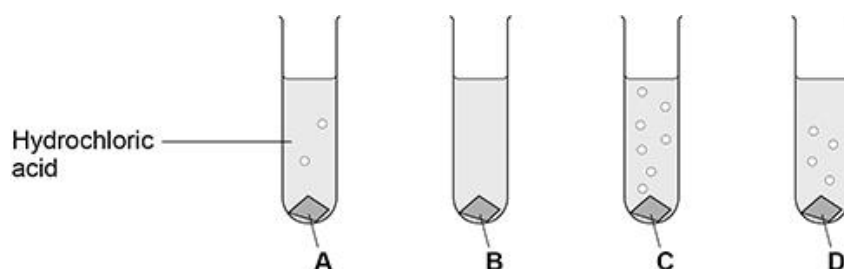
- a) Magnesium is classified as metal as it can be pulled into thin wires. Describe two other physical properties of magnesium. [2 marks]

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bi) Magnesium and three other metals were added to hydrochloric acid. The observations of the experiment are below:



The element labelled C was Magnesium. The other metals include copper, zinc, and iron. In order of reactivity match the correct element with the observation starting from most reactive to least reactive. The first one has been done for you. [2 marks]

	Letter	Element
Most reactive	C	Magnesium
Least reactive		

bii) State two other method to determine reactivity other than the rate of gas production. [2 marks]

Method 1:

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Method 2:

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bii) Give one reason for the observation of metal B? [1 mark]

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ci) The reaction between metals and acid produces salt + hydrogen.

Write the balanced chemical equation for the reaction between hydrochloric acid and Magnesium. [2 marks]

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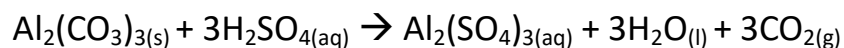
cii) Describe the correct test to confirm that the gas produced in these reactions is hydrogen? [2 marks]

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d) A student carried out a similar experiment, but they used the following substances Aluminium carbonate and sulphuric acid.



Atomic mass:

S = 32 Al = 27 C = 12 O = 16 H = 1

di) A student added 10g of Aluminum carbonate to 25 cm<sup>3</sup> of sulphuric acid.

Calculate the number of moles of Aluminum carbonate in 10g. [1 mark]

Show your working:

Number of moles: \_\_\_\_\_

dii) The Aluminium carbonate completely reacted with the acid.

Deduce the mass of Aluminum sulphate produced from this experiment? [2 marks]

Show your working and state the unit.

Mass: \_\_\_\_\_

diii)

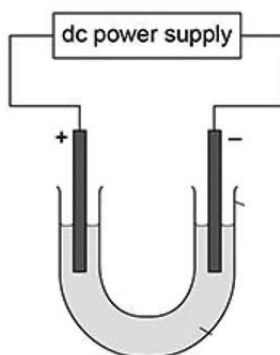
Calculate the minimum value that the sulphuric acid concentration could be in  $\text{mol/dm}^3$ . [3 mark]

Concentration: \_\_\_\_\_

[Total 17 marks]

Q4) Electrolysis is a process used to split ionic compounds using electricity into their elements.

The apparatus of the process is setup below:



a) Complete the table for the correct products formed at each electrode. [2 marks]

Electrolyte	Anode	Cathode
Molten lead chloride		
Copper Sulphate solution		

b) Copper sulphate is a blue solution, during the experiment the solution became paler in colour. Explain why? [1 mark]

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c) Write the half-reaction that is occurring for the formation of copper at one of the electrodes? [2 marks]

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[Total 7 marks]

*End of Extended theory [45 marks]*



### **Part 3: Practical component:**

Q1) This experiment is about determining the melting point of Stearic acid.

Method:

1. A sample of solid stearic acid was added to a test tube.
2. The sample was placed into a water bath with a temperature of  $90\text{ }^{\circ}\text{C}$
3. Left for 5 minutes in the water bath to ensure all the stearic acid was melted.
4. A thermometer was placed into the liquid stearic acid whilst still in the water bath for 5 minutes.
5. Using a stopwatch students measured the term every minute for 10 minutes.

a) Correctly identify the variables of this experiment: [1 mark]

	Variable
Independent	
Dependent	

b) In step 4 explain why the thermometer was added to stearic acid whilst still in the water bath? [2 marks]

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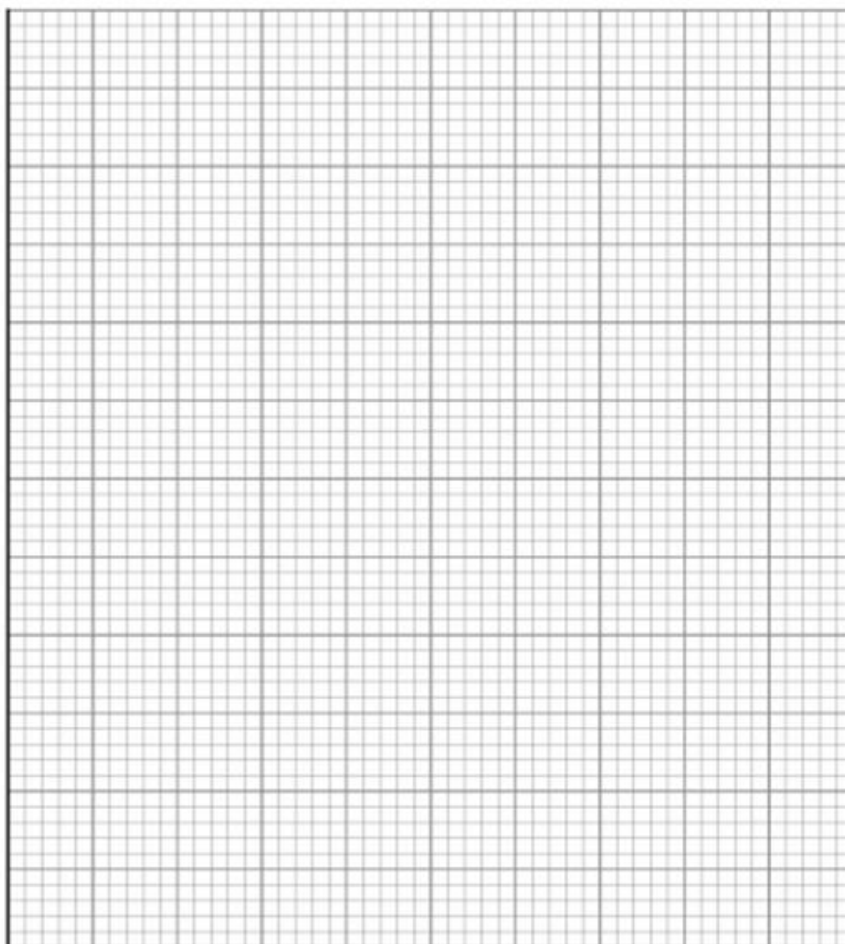
c) The following results were recorded by the students:

90, 84, 80, 82, 71, 70, 70, 70, 67, 65, 63

In the space below draw a suitable table for these results and populate the data. [3 marks]

d) Draw a line graph from the answer of part c) [5 marks]

Include a line of best fit:

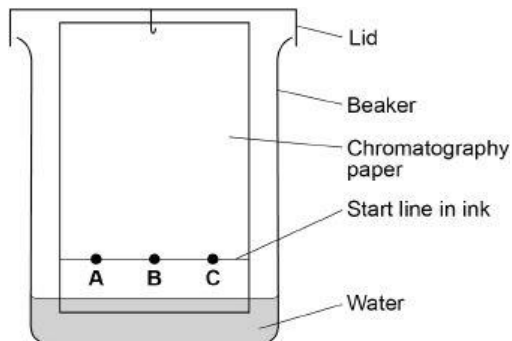


e) On your graph circle and label, it as the anomalous result. [1 mark]

f) Draw an arrow on your graph and correctly label the melting point of Stearic acid? [1 mark]

[Total 13 marks]

Q2) A student set up the following experiment below to separate a mixture of ink pigments.



- a) Identify the mistake in the student's setup and suggest the correction needed to be able to obtain accurate results? [2 marks]

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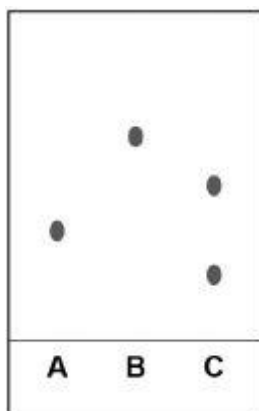
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The student had now setup the experiment correctly and achieved the following results:



- b) State the two factors which will determine how far the pigment will travel from the baseline? [1 mark]

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- c) How many different substances are observed in the results? [1 mark]

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[Total 4 marks]

Q3) Razeal and Richelle have been provided with a white solid power and an unlabeled bottle of acid.

Razeal predicts that the white powder is a metal carbonate.

a) Describe a suitable experiment for Razeal to test his prediction? [3 marks]

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Richelle predicts that the acid is sulphuric acid.

b) Describe a suitable experiment for Richelle to test her prediction? [2 marks]

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Razeal and Richelle want to make a sample of solid crystals using the unknown metal carbonate and sulphuric acid.

In preparation, they add excess metal carbonate to the acid.

c) Explain why they should add the metal carbonate in excess to the acid? [1 mark]

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d) Describe in detail how they should obtain pure dry solid crystals of this salt? [6 marks]

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

e) A flame test was carried out on the dry crystal afterwards and an Orange – red flame was observed. What was the ion present in the metal carbonate. [1 mark]

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[Total 13 marks]

*End of Practical component [30 marks]*