

RADLEY

2025 Scholarship Examination Paper

CHEMISTRY

26 February – 27 February 2025

Time allowed – 30 min

Instructions

Calculators are NOT allowed

All rough working should be done on this paper.

Your working has to be properly and neatly laid out

Do not spend too much time on a question, move on and come back to it at the end if you can.

Name:

Marks: / 50

1. This question is about the nations favourite drink.



sugar.

- a. This hot cup of tea can dissolve up to twelve 5 g cubes of sugar. The cup is full and has a volume of 120 cm^3 . What is the solubility of the sugar in g per cm^3 **and** in g per dm^3 ?

.....

.....

Solubility in g cm^{-3} : Solubility in g dm^{-3} :

[2]

- b. What is the name given to the sugar in this mixture? Circle **one** word:

Solvent

Solute

Solution

Solvay

Solvate

[1]

- c. What word best describes how sugar particles dissolve in the tea? Circle **one** word.

Diffuse

Suffuse

Evaporate

Melt

React

[1]

- d. The cup of sugary tea was allowed to cool to room temperature and then filtered. The filter paper was dried and 10g of sugar was found to be present on the paper. What mass of sugar remained dissolved in the tea at room temperature?

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[1]

- e. What does this tell you about the solubility of sugar with temperature?

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[1]

- f. Explain the difference in the movement and arrangement of sugar molecules in the cube and when dissolved in the tea.

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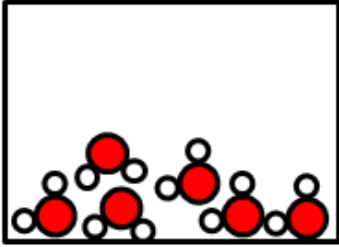
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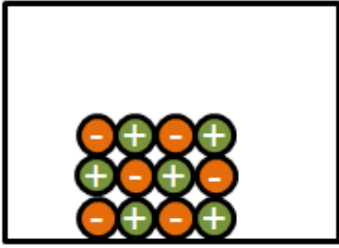
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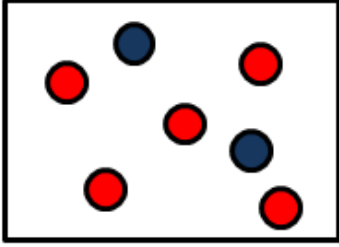
2. This question is about different forms of substances.

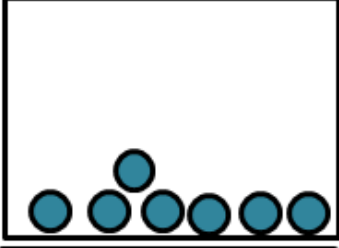
Next to each of the following diagrams in *Fig 2* choose **3 words** that best describe the contents. You can choose from the following list (words may be used once, more than once or not at all). You can also use appropriate words not on the list.

Solid	Liquid	Gas	Compound	Molecule	Element	Salt
Iron	Atom	water	Argon	Ionic	Mixture	Oxygen
						Carbon dioxide









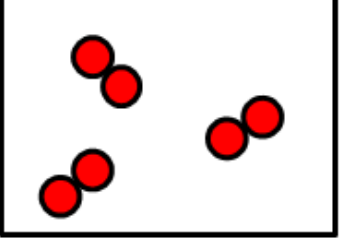


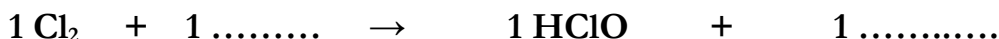
Fig 2

[10]

[Total 10]

3. Chlorine gas is a poisonous green gas. When chlorine dissolves in water in the lungs it forms hypochlorous acid (HClO) and hydrochloric acid.

- a. Fill in the blank to balance the following chemical equation showing the formation of these acids. The big number in front of each compound shows that every formula only appears once in the equation.



[2]

- b. What colour do you think universal indicator paper would go if placed in some water in which chlorine had been dissolved? Explain your answer.

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.....

[2]

- c. Hypochlorous acid is a compound that is used in the manufacture of bleach. What common purpose does bleach have?

.....

[1]

The relative masses of the substances in this reaction are: Cl_2 : 71, H_2O : 18, HClO: 52.5, HCl: 36.5 (this is the relative masses they have to each other). You can treat them as if they were grams.

- d. Using these values to calculate the mass of hypochlorous acid that could be made from 10 g of chlorine gas.

.....
.....

Mass of HClO: g
[2]

- e. Another highly toxic substance is the nerve agent *Sarin*. Fig. 3 shows the structure *Sarin*. The balls represent atoms and the type of atoms are indicated by their symbols (C: carbon, H: hydrogen etc).

The chemical formula of a compound can be written using chemical symbols and subscript numbers representing the number of each atom present in each molecule, e.g. H_2O or $\text{C}_6\text{H}_{12}\text{O}_6$. Conventionally, carbon is written first; then hydrogen; then any other atoms in alphabetical order.

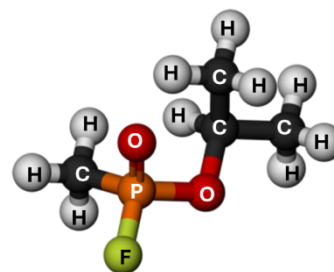


Fig. 3

Using these rules write the chemical formula of *Sarin* as shown in Fig 3.

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[2]
[Total 9]

4. Some magnesium is added to excess hydrochloric acid. The reaction produces hydrogen gas.
- a. Which chemical test could you carry out that shows that hydrogen is produced in this reaction? Describe how you would carry out the test and state the result.

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.....

[2]

Curve **A** in *Fig. 5* below shows the volume of hydrogen gas produced with time when 50 g of **powdered** magnesium is added to an excess of hydrochloric acid of concentration 5 g dm^{-3} . (5 g of hydrochloric acid are dissolved in 1 dm^3 of water).

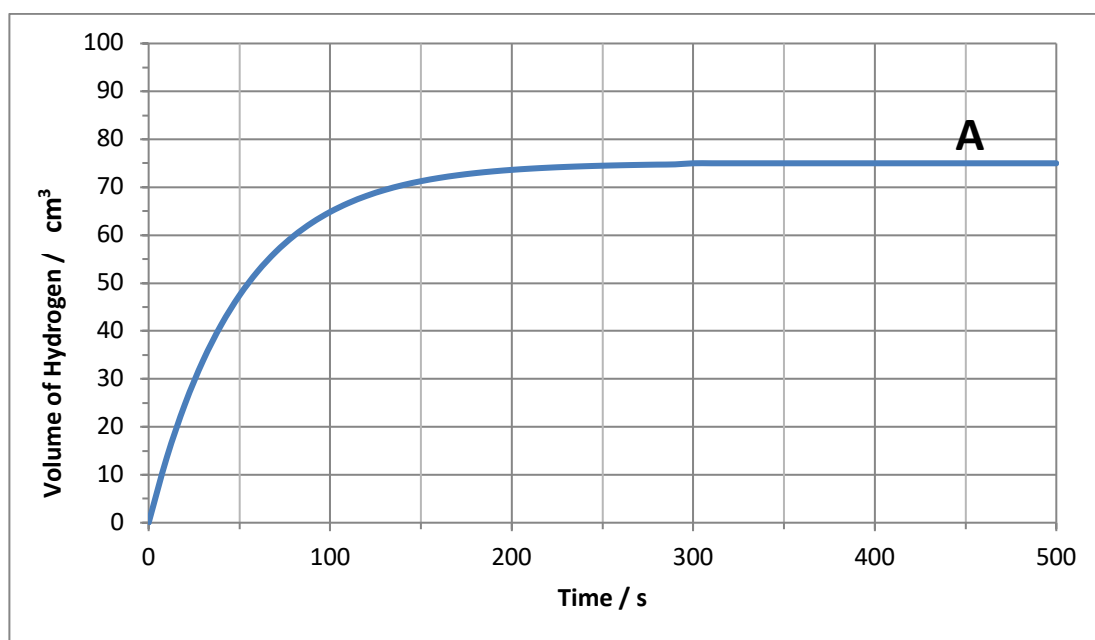


Fig. 5

- b. After how many seconds had the magnesium powder run out? Annotate the graph with construction lines to show your working clearly.

.....

[2]

- c. What is the maximum volume of hydrogen produced in cm^3 ? Annotate the graph with construction lines to show your working clearly.

.....

[2]

- d. Draw another line on *Fig. 5* and label **C** to show how much hydrogen is produced over time when **25 g** of magnesium is added to excess hydrochloric acid.

[2]

- e. Draw another line on *Fig. 5* and label **D** to show how much hydrogen is produced over time when **50 g** of magnesium is added to excess hydrochloric acid but this time the hydrochloric acid is twice as concentrated as before, 10 g dm^{-3} .

[2]

- f. Predict at which point the reaction would be the fastest and explain your answer in terms of the reactants (the particles reacting).

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.....
.....

[2]

- g. Another student used a piece of magnesium ribbon of the same mass as the powder. Compare the rate of this reaction with the rate of the reaction that used the powdered magnesium. Circle the correct answer.

The reaction with the ribbon is: *faster* / *the same* / *slower*

[1]

- h. In another experiment the same mass of powdered magnesium was used but this time with a hydrochloric acid solution of the concentration 10 g dm^{-3} . Compare the rate of this reaction with the rate of the reaction that used the initial concentration 5 g dm^{-3} . Explain your answer in terms of the particles reacting.

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.....
.....

[2]

- i. Which hydrochloric acid solution is most concentrated (has the most hydrochloric acid particles dissolved in the water)? Support your answer with calculations.

Solution **A**: $0.25 \text{ g in } 200 \text{ cm}^3$ **or**

Solution **B** $0.9 \text{ g in } 0.9 \text{ dm}^3$ **or**

Solution **C** $1.0 \text{ g in } 500 \text{ cm}^3$

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

Solution: **A** / **B** / **C** (*circle the correct letter*)

[2]

[Total 17]

5. Do you know some general facts about Chemistry? Answer the following questions

State the colour of the following substances.

Substance	Colour
Solid sodium chloride	
Solid anhydrous copper sulfate	
Solid sulfur	
Solid magnesium	
Copper sulfate solution (in water)	
Potassium permanganate solution (in water)	
Sodium chloride solution (in water)	

[4]

[Total 4]

END