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CHEMISTRY

PAPER 3
(80 marks)

Monday 3 JUNE 2024 12:00 NOON–1:30 P.M.
(1 hr. 30 mins)

Additional materials:
Graph paper
Calculator

MINISTRY OF EDUCATION NATIONAL EXAMINATIONS
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BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INSTRUCTIONS AND INFORMATION TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your school number, candidate number, surname and initials at the top of this page as well as at the top of all lined paper submitted.

Answer **ALL** questions in **Section A** in the spaces provided on this question booklet and any **TWO** questions from **Section B** on the lined paper provided at the back of this question booklet.

Equations and diagrams should be given wherever they are helpful.

Essential working must be shown.

The intended marks for each question or part question are given in brackets [].

Relative atomic masses are given in the Periodic Table printed on page 2.

ADDITIONAL INFORMATION

s.t.p. ($t = 0^{\circ}\text{C}$, $p = 1 \text{ atm.}$)



The volume of one mole of gas at room temperature and pressure (r.t.p.) is $24\,000 \text{ cm}^3$ (24 dm^3).

For Examiner's Use	
Section A	
1	
2	
3	
4	
Section B	
5	
6	
7	
TOTAL	

This question paper consists of 14 printed pages, 2 blank pages and 4 lined pages.



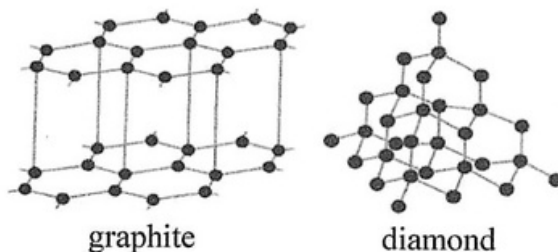
The Periodic Table of the Elements

SECTION A

Answer **all** questions in this Section.

1. Carbon exists in different structural forms of the same element in the same physical state.

- (a) Graphite and diamond are forms of carbon.



- (i) Give **one** structural difference between graphite and diamond.

graphite: _____

diamond: _____

[2]

- (ii) Explain why diamond has a very high melting point.

_____ [2]

- (iii) Give **one** reason why graphite conducts electricity and diamond does not.

_____ [1]

- (b) Carbon dioxide is a simple molecular substance.

State **two** properties of carbon dioxide.

1 _____

2 _____

[2]

[Turn over

- (c) Copper oxide reacts with hydrogen to form copper oxide and water.

The equation for the reaction is:



Explain how this reaction is both oxidation and reduction.

[3]

TOTAL MARKS [10]



2. (a) Describe the structure and bonding in metals.

[3]

- (b) Copper, nickel and silver are transition elements. Typical physical properties of transition elements are a high density and a high melting point.

Give **two** different properties of transition metals which are **not** typical of other metals.

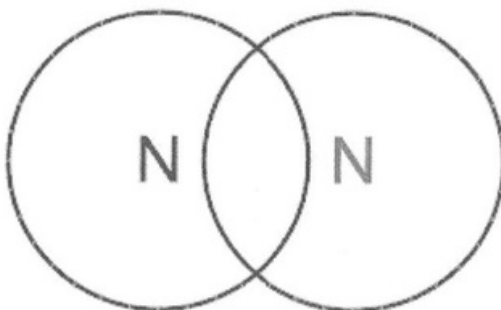
1

2

[2]

- (c) Complete the dot and cross diagram to show the covalent bonding in a nitrogen molecule.

(Show only the electrons in the outer shell.)



[2]

- (d) Explain why nitrogen is a gas at room temperature.

[3]

TOTAL MARKS [10]

[Turn over



3. Le Chatelier's Principle is a vital part of industrial chemistry. One process that relies on this principle is the Contact process which is used to manufacture sulphuric acid.

(a) Name the **three** conditions for the Contact process to take place.

- 1 _____
2 _____
3 _____

[3]

(b) In the Contact process sulphur dioxide reacts with oxygen to produce sulphur trioxide.

Write the balanced chemical equation for this reaction.

[2]

(c) (i) In order to make sulphuric acid, sulphur trioxide is dissolved in concentrated sulphuric acid to make a substance called oleum.

Give the chemical formula for oleum.

_____ [1]

(ii) Explain why sulphuric acid is **not** made by simply adding sulphur trioxide to water.

_____ [1]

(d) Sulphuric acid is a dehydrating agent.

Briefly describe the reaction in which sulphuric acid acts as a dehydrating agent. Include the reactants, products and observations made during the reaction.

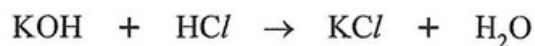
_____ [3]

TOTAL MARKS [10]



4. Devon added 30 cm^3 of potassium hydroxide with an unknown concentration into a conical flask using a pipette. The potassium hydroxide reacted with exactly 25 cm^3 of 0.4 mol/dm^3 hydrochloric acid.

The equation for this reaction is:



- (a) Name the apparatus used to deliver the hydrochloric acid into the conical flask.

_____ [1]

- (b) (i) Calculate the number of moles of hydrochloric that was used in the reaction.

[1]

- (ii) Determine the number of moles of potassium hydroxide in the reaction.

[1]

- (iii) Calculate the concentration of potassium hydroxide in grams per dm^3 (g/dm^3).

[2]

- (c) Acids can be strong or weak. Hydrochloric acid is an example of a strong acid.

Name a weak acid and state one way it is different from hydrochloric acid.

Name of acid _____

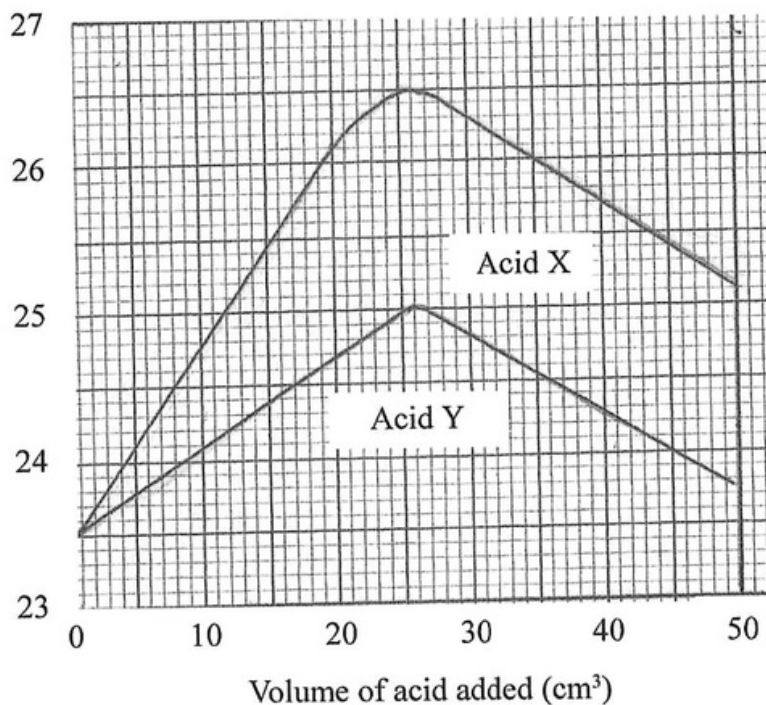
Difference _____

_____ [2]

[Turn over

- (d) The graphs show the temperature change when acids X and Y are added separately to a potassium hydroxide solution.

Temperature ($^{\circ}\text{C}$)



- (i) Use the graphs to find the volume of acid required to neutralise the potassium hydroxide in both experiments.

Acid X _____

Acid Y _____

[1]

- (ii) State the maximum temperature rise by acid X.

_____ [1]

- (iii) State which acid, X or Y, is more concentrated and give a reason for your answer.

_____ [1]

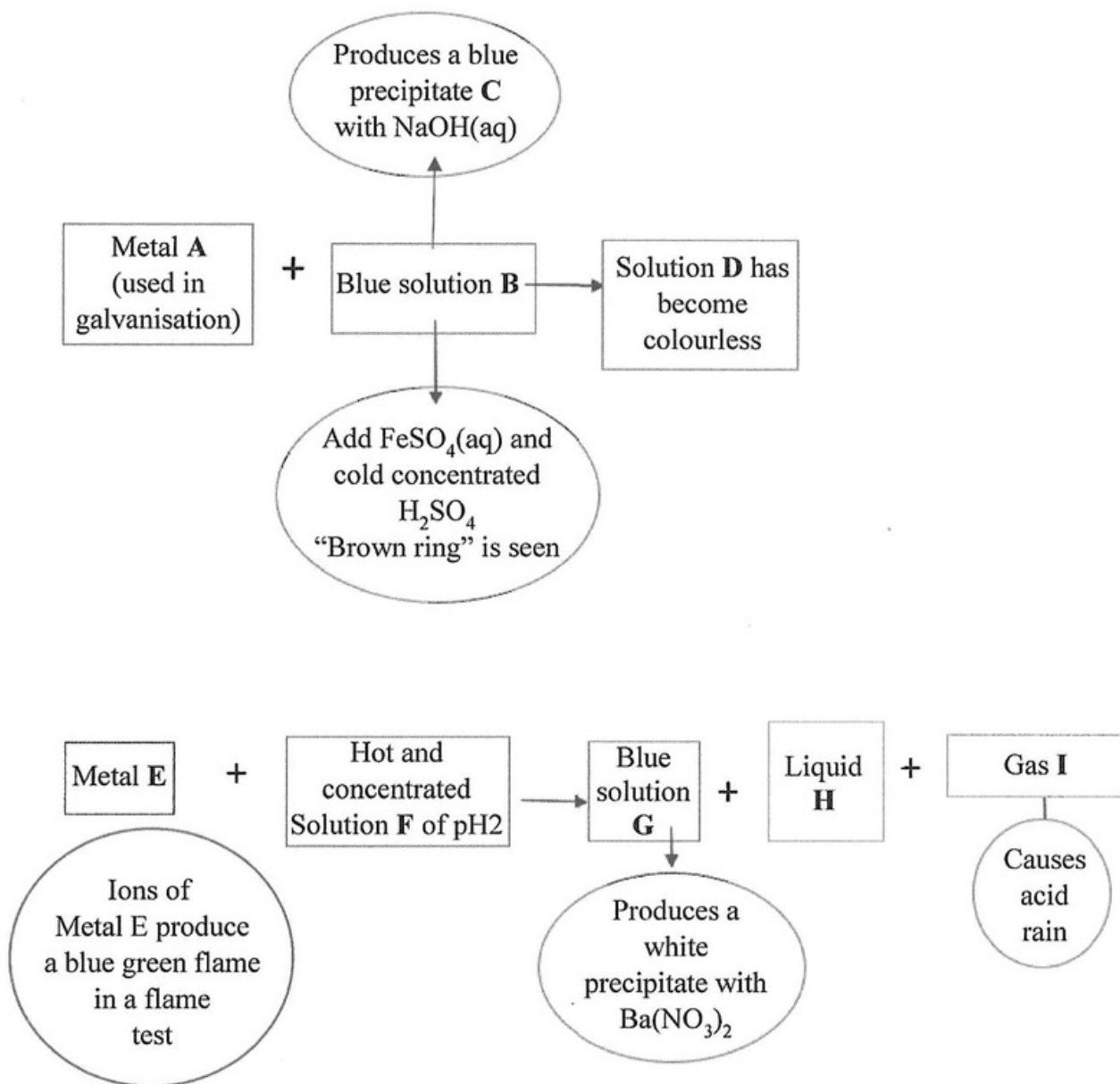
TOTAL MARKS [10]



SECTION B

Answer any **TWO** questions from this Section.

5. (a) Identify compounds represented by the letters **A, B, C, D, E, F, G, H** and **I**. [9]



- (b) A student mixes solutions of halogens with solutions of their potassium salts. The table shows some of the observations made by the student when halogens reacted with the potassium halide solutions.

(i) Complete the table to record observations occurring at **R**, **S** and **T**

halogen	potassium chloride	potassium bromide	potassium iodide
chlorine (colourless)	R	S	Solution turns brown
bromine (orange)	No change	No change	T
iodine (brown)	No change	No change	No change

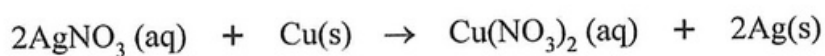
[3]

(ii) Explain how the reactivity of the halogens changes going down Group VII. [3]

(c) Write a balanced equation for the reaction:



(d) Use the equation to calculate the mass of silver produced from 1.6 g of copper in this displacement reaction.

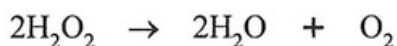


[3]

TOTAL MARKS [20]



6. Hydrogen peroxide is a colourless solution that decomposes very slowly at 20 °C to produce water and oxygen. In an experiment 30 cm³ of hydrogen peroxide and 5g of manganese(IV) oxide, a catalyst, was used in the reaction. The chemical equation for the reaction is:



- (a) Define the rate of a chemical reaction. [2]
- (b) A small round flat-bottomed flask, a gas syringe, delivery tube and a stopper were used in this experiment.

Draw the part of the apparatus that is used to collect the oxygen gas in this experiment. [1]

- (c) (i) The table of results shows what happens when a student investigates the decomposition of hydrogen peroxide.

Time in minutes	1	2	3	4	5	6	7	8
Volume of O ₂ in cm ³	30.0	51.5	66.5	78.0	84.5	89.0	90.0	90.0

Plot a graph of the volume of gas against time in minutes.

Draw a smooth curve and label the curve. [4]

- (ii) The experiment was repeated using 30 cm³ of hydrogen peroxide that was half the concentration of the hydrogen peroxide used in the first experiment. The other conditions remained the same.

On the same axes, sketch a second graph to show how the volume of gas collected would vary with time in the second experiment. [2]

- (d) Calculate the number of moles of hydrogen peroxide decomposed to produce 90 cm³ of oxygen at r.t.p. [2]

- (e) (i) In this experiment, manganese(IV) oxide acts as a catalyst.

Outline a method to show that the manganese(IV) oxide is a catalyst and not a reactant. [2]

- (ii) The rate of reaction is different when manganese(IV) oxide is used as a fine powder rather than coarse lumps.

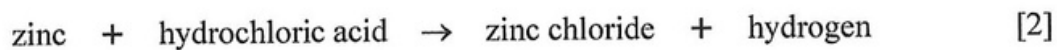
Explain why. [2]



- (f) Zinc and dilute hydrochloric acid are reacted together to produce zinc chloride, a soluble salt.

The rate of this reaction can be increased by heating the reaction mixture.

- (i) Explain in terms of the collision theory the effect of increasing the temperature of the reaction mixture. [3]
- (ii) Write a balanced symbol equation for the word equation:



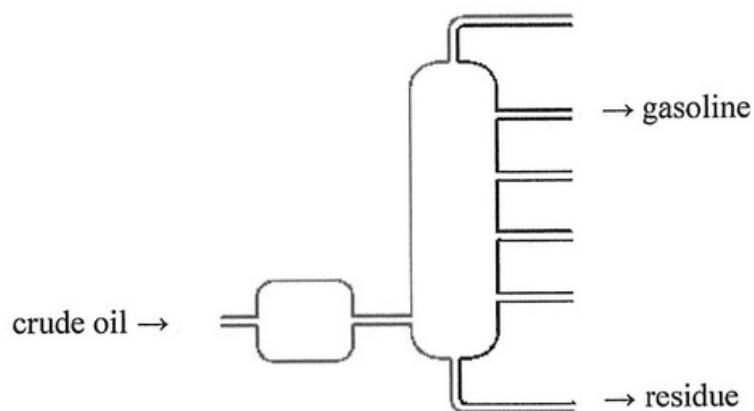
TOTAL MARKS [20]



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7. The diagram shows a fractionating column used to separate saturated hydrocarbons from crude oil.



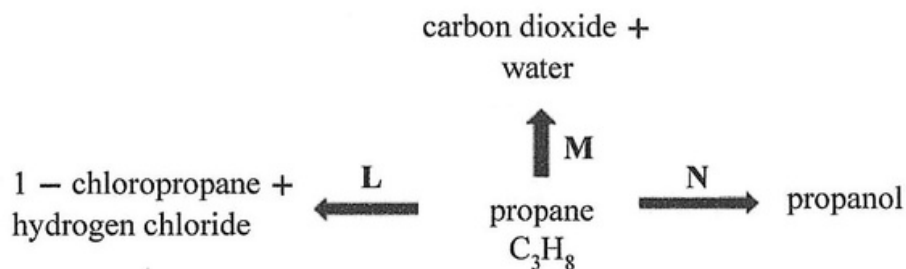
- (a) State **two** physical properties that are affected as the length of hydrocarbon chains are increased. [2]
- (b) Name the residue formed from the distillation of crude oil and state **one** use. [2]
- (c) Long chain hydrocarbon molecules can be broken down into smaller more useful molecules.

Name the process used to produce these smaller molecules.

[1]



- (d) The flow chart shows reactions that occur with propane (C_3H_8).



- (i) Write the name of the reactions **L**, **M** and **N**. [3]
 - (ii) State the general formula of propane. [1]
 - (iii) Write the chemical formula of propanol and correctly draw its structural formula. [3]
 - (iv) Write the balanced chemical equation for 'Reaction **M**' from the flow chart. [2]
 - (v) Calculate the volume (dm^3) of carbon dioxide produced at r.t.p., if 0.14 moles of propane (C_3H_8) was used in the reaction. [2]
- (e) Compound **W** contains 85.71% carbon and 14.29% hydrogen.
- (i) Calculate the empirical formula of Compound **W**. [3]
 - (ii) Compound **W** has a relative molecular mass of 56.
Find its molecular formula. [1]

TOTAL MARKS [20]

Question
Write on both sides of the paper

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