School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 3 3051/3

Tuesday **3 JUNE 2008** 12.30 – 2.00 P.M.

Additional materials:
Lined paper
Graph paper

MINISTRY OF EDUCATION NATIONAL EXAMINATIONS

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 in the spaces provided at the top of this page as well as at the top of all lined paper submitted.

Answer **ALL** the questions in **Section A** (1–4) in the spaces provided on the question paper and any **TWO** questions from **Section B** on the lined paper provided.

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 of elements printed on page 2.

ADDITIONAL INFORMATION

s.t.p. (t = 0 °C, p = 760 mmHg)
The volume of one mole of gas at room temperature and pressure (r.p.t.) is 24 000 cm^3.

FOR EXAMINER'S USE	
Section A	
1	
2	
3	
4	
Section B	
5	
6	
7	
TOTAL	

This question paper consists of 12 printed pages and 4 blank pages.

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Sulphur 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	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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

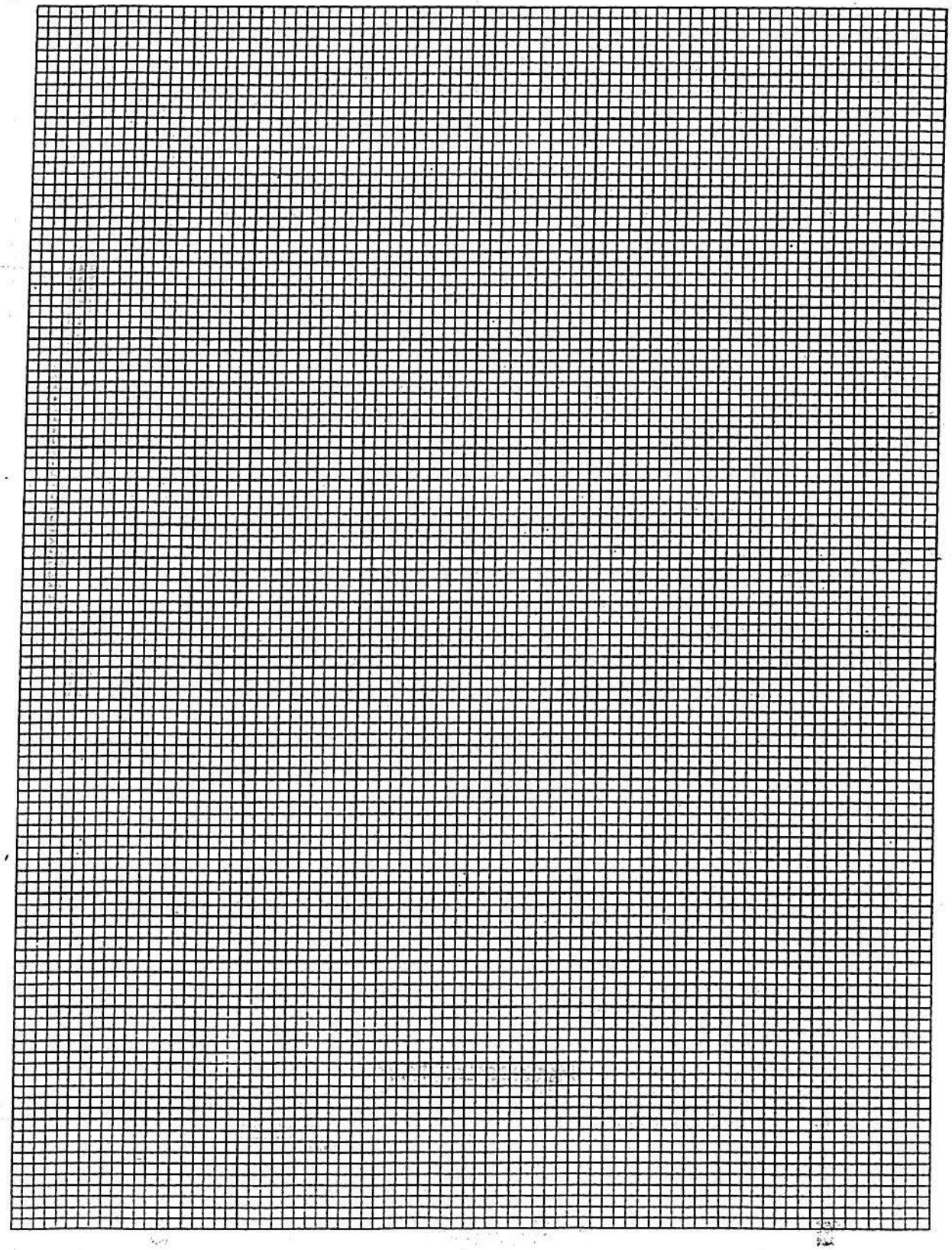
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium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

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

School No.	Candidate No.	Level:	For Examiner's Use
Subject Number & Title:		Paper:	
Surname & Initials:		Section:	
Signature:	Date:	Ques. No.	

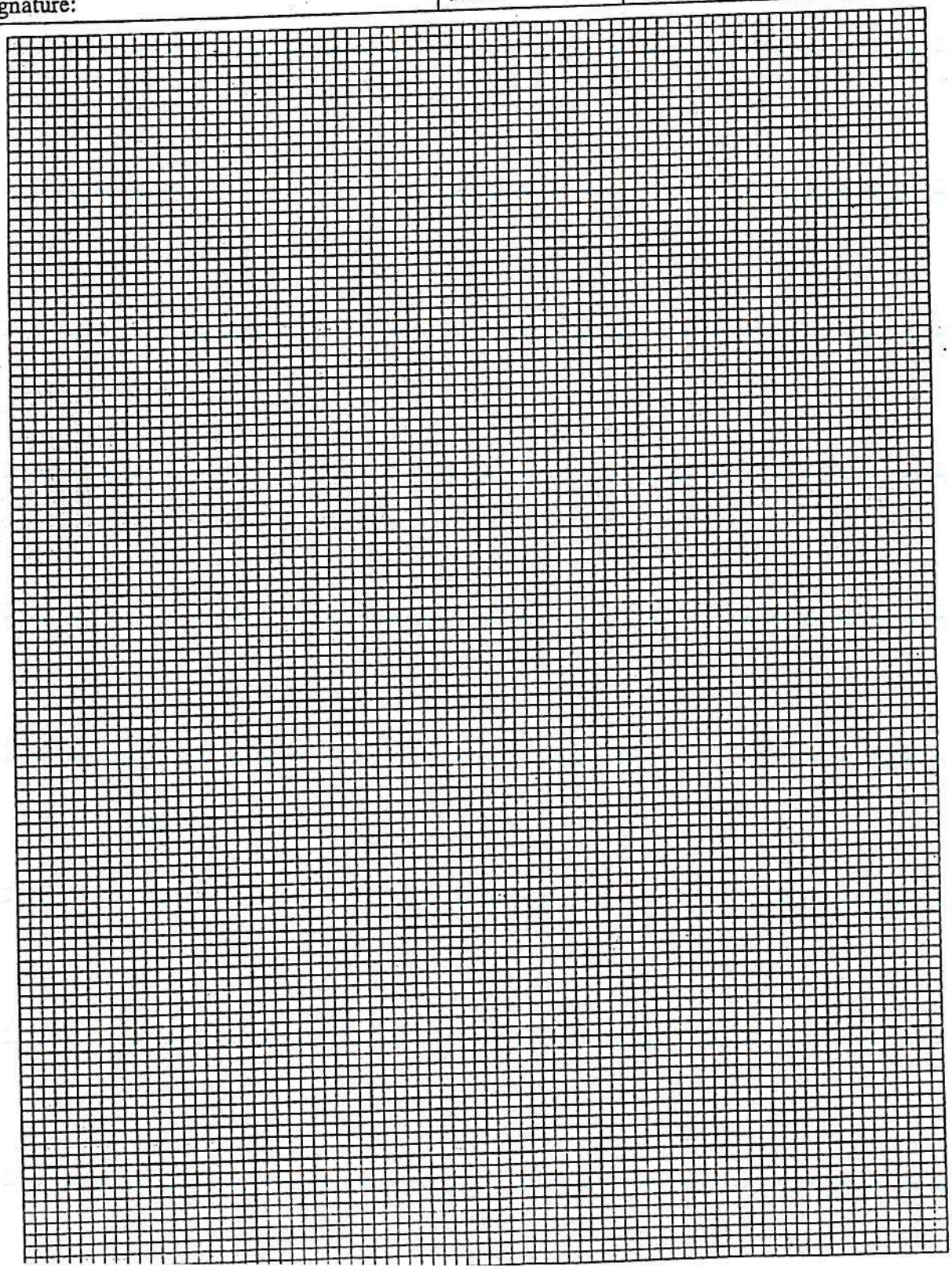


SCIENCE GRAPH PAPER

AB7

MINISTRY OF EDUCATION
BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION
EXAMINATION

School No.	Candidate No.	Level:	For Examiner's Use
Subject Number & Title:		Paper:	
Surname & Initials:		Section:	
Signature:	Date:	Ques. No.	



Section A

Candidates are to answer all **four** questions in Section A.

1. (a) A student knows that a compound was potassium sulphate.

Write a procedure; include testing methods and their positive results; that would conclusively demonstrate that the salt is potassium sulphate.

procedure for potassium

_____

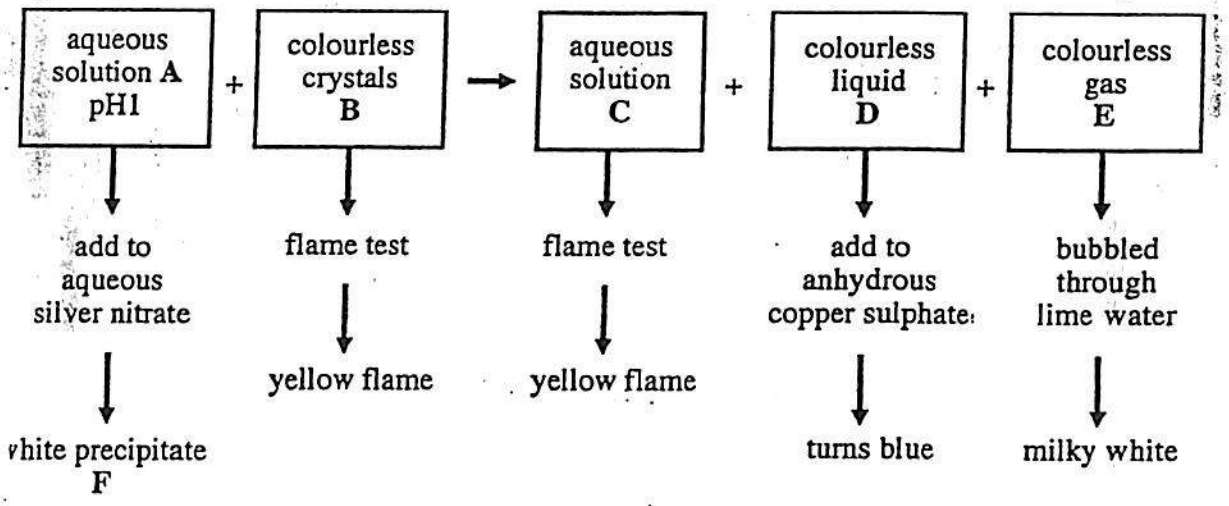
_____ [2]

procedure for sulphate

_____

_____ [2]

(b) A series of steps produces the data in the schematic reaction.



Use the data to identify the substances A through F.

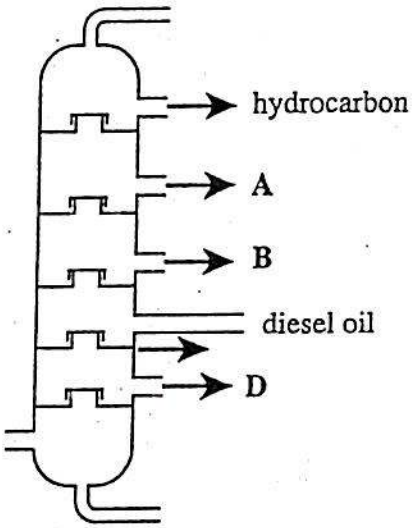
A _____ D _____

B _____ E _____

C _____ F _____ [6]

Total marks [10]

2. Crude oil is a mixture of many hydrocarbon molecules. The industrial fractional distillation of crude oil is shown in the diagram.



(a) Identify fractions **A** and **B**.

A _____

B _____ [2]

(b) Give one use of fraction **B**.

_____ [1]

(c) Give one use of fraction **D**.

_____ [1]

(d) The physical properties of fraction **B** and fraction **D** are different. State **TWO** of these properties and show how they are different.

1 _____

2 _____

_____ [2]

(e) The oil industry uses the process called cracking to obtain sufficient quantities of short-chained hydrocarbons.

(i) Name **TWO** hydrocarbons formed when pentane is cracked.

1 _____

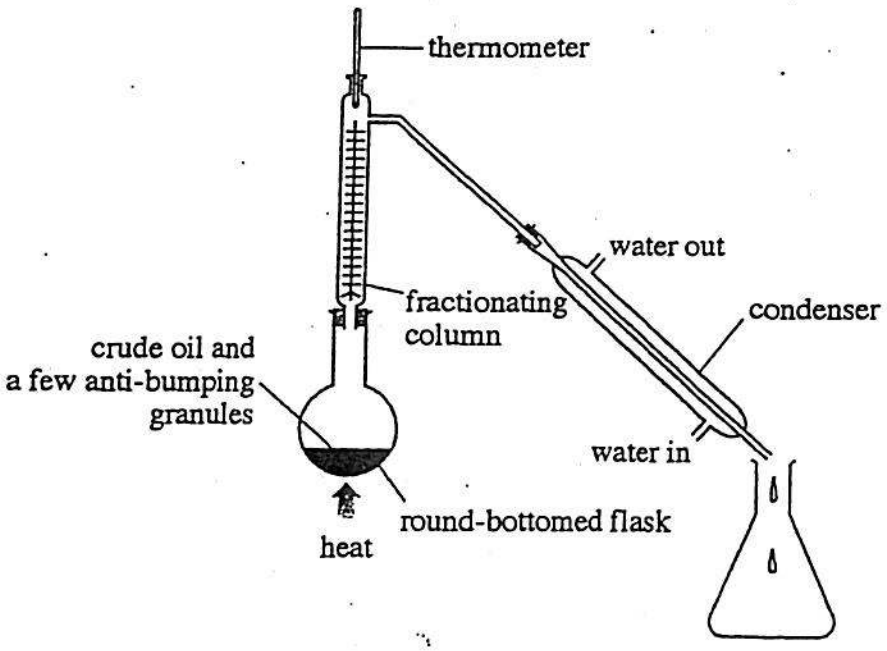
2 _____ [2]

(ii) Before the petroleum industry used the cracking method, long-chain hydrocarbons were discarded.

State the environmental problem which resulted from this waste.

_____ [1]

In an experiment to demonstrate the fractional distillation of crude oil in a lab, crude oil was placed in a round-bottomed flask and warmed with an electric heater as shown in the diagram.



(f) State **ONE** reason why this process, carried out in a laboratory, would not be as efficient as the process used in the industrial fractional distillation of crude oil.

_____

_____ [1]

Total marks [10]

3. Diagrams **A** and **B** show simple experiments that can be conducted in the laboratory.

(a) These diagrams show redox reactions.

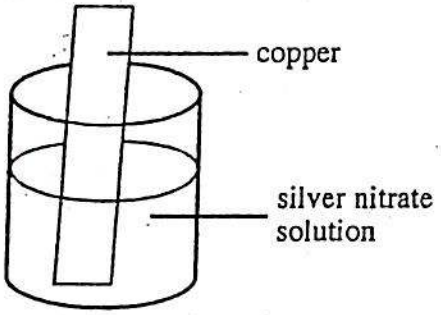


Diagram A

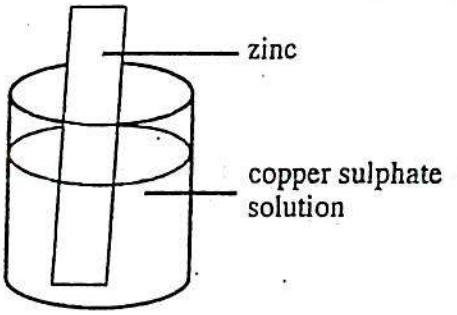


Diagram B

In **diagram A**, when copper is placed in a solution of silver nitrate, silver deposits on the copper strip.
In **diagram B** blue copper(II) sulphate gradually becomes colourless if a strip of zinc metal is placed in it.

(i) State why the solution in **diagram A** turns blue.

_____ [1]

(ii) From the diagrams, state the order of reactivity of the metals copper, silver and zinc.

_____ [1]

(iii) When copper reacts with silver nitrate, name the substance which is oxidized.

_____ [1]

(iv) Name the products of the reaction between zinc and copper sulphate.

_____ [1]

(v) Explain, in terms of electron exchange, why zinc metal reacts with copper sulphate.

_____ [2]

(b) The oxidation number of chromium can vary from compound to compound, resulting in chromium compounds with strikingly different colours.

State the oxidation number of chromium in the blue solution of $CrCl_2$.

_____ [1]

Zinc reacts with sulphuric acid producing hydrogen gas.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

(c) (i) Calculate the mass of zinc that must be dissolved to produce 4 800 cm^3 of hydrogen, at r.t.p.

[2]

(ii) Identify the reducing agent.

_____ [1]

Total marks [10]

4. The solubility of a salt is usually quoted in the grams of solute which will saturate 100 g of the solvent at a particular temperature.

(a) (i) State why it is necessary to use the phrase **"at a particular temperature"**.

_____

_____ [1]

(ii) Name the solute in brine. _____ [1]

(b) In an experiment to determine the solubility of potassium chloride, it was found that 27.40 g of the saturated solution at 30 °C contained 7.40 g.

(i) Calculate the mass of water in 27.40 g of the saturated solution at 30 °C of the salt.

[1]

(ii) Calculate the solubility of potassium chloride at 30 °C (mass of potassium chloride per 100 g of water).

[2]

The solubility of potassium chloride at 60 °C is 45.50 g in 100 g of water.

(c) In an experiment, 45.50 g of potassium chloride is added to 100 g of water at 60 °C.

(i) State the total mass of potassium chloride and water used.

_____ [1]

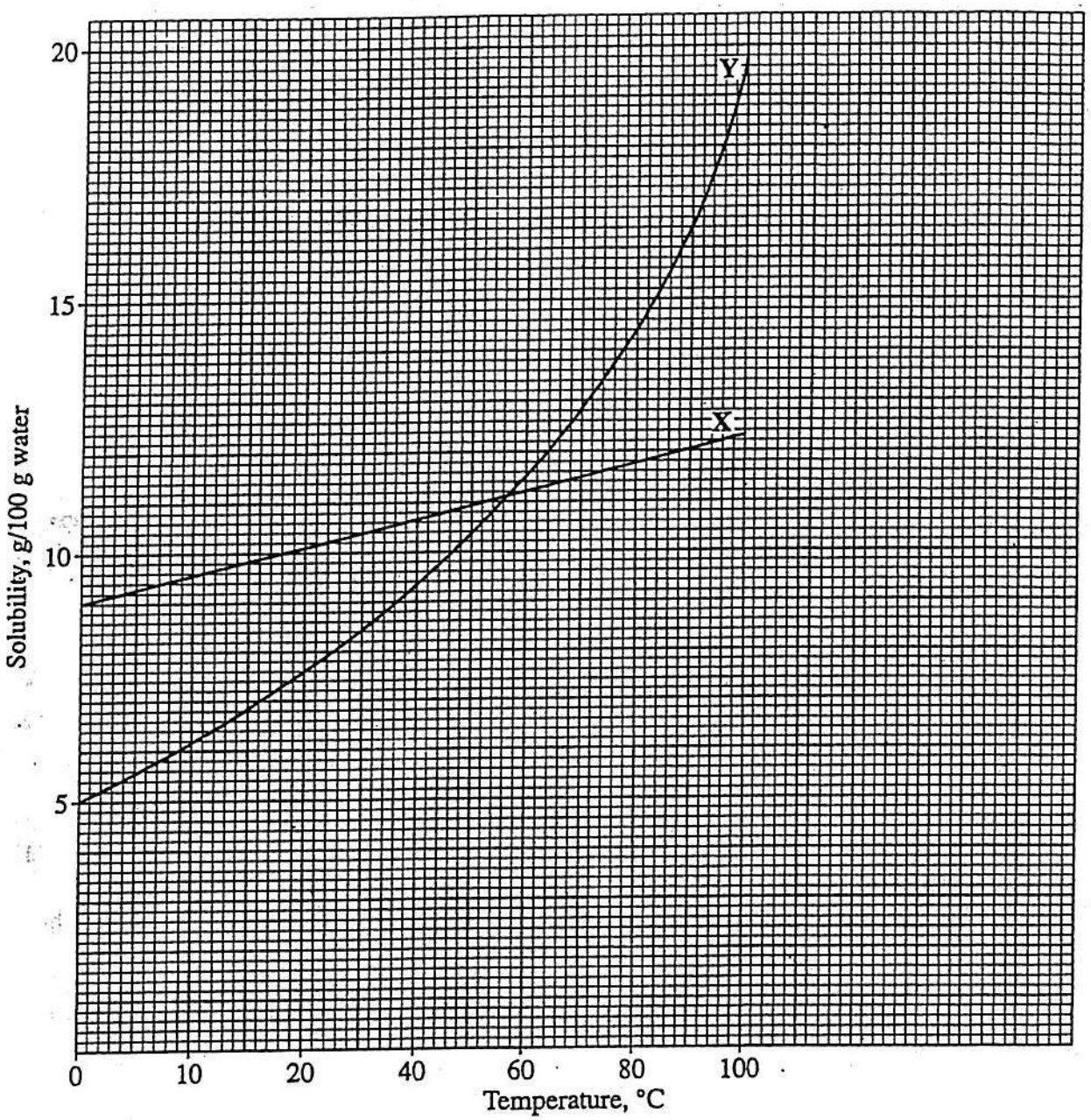
(ii) Use your answer to (b)(ii) to calculate the mass of potassium chloride that will precipitate from this solution when it is cooled to 30 °C.

[1]

(iii) State the mass of potassium chloride which will be contained in 100 g of the saturated solution at 60 °C.

_____ [1]

The graph shows solubility curves of **X** and **Y**.



Solubility curves of **X** and **Y**

(d) Use the graph to determine which of the two substances, **X** or **Y**, has a greater solubility at 10 °C and the difference in their solubility.

_____

_____ [2]

Total marks [10]

Section B

Answer **any two** of the three questions in this section.

5. Air contains many gaseous pollutants containing sulphur and carbon. Nitrogen gas can be liquefied from the mixture of air and used in the Haber process to produce ammonia. The ammonia in turn can be converted into fertilizer.

(a) (i) Name two gaseous molecules containing sulphur which contribute to air pollution. Only one of your answers can be an oxide of sulphur.

(ii) Name the pollutant oxide that does not contribute to acid rain.

(iii) Name the third most abundant gas found in the mixture of air. [4]

The Haber process involves an exothermic, reversible reaction.

(b) (i) Write a balanced equation to show the Haber process. [3]

(ii) Write a suitable statement of Le Chatelier's Principle. [2]

(iii) The synthesis of ammonia is an exothermic process and heat is given out when the gases hydrogen and nitrogen react. Despite this, a high temperature is used in the process. Explain why this is so. [1]

(iv) Use the equation that you have written in part (i) to show why a high pressure is maintained in the reaction chamber. [2]

(v) Define a *catalyst* and state, with a reason, how a catalyst would affect the composition of the equilibrium mixture of reactants and products. [2]

(vi) State how the energy of this reaction might be used by the plant using the Haber process. [1]

(vii) Find the maximum volume of ammonia produced from 150 dm^3 of nitrogen, all volumes measured at r.t.p. [2]

(c) Name a fertilizer that contains nitrogen and write an equation to show how it can be made from ammonia. [3]

Total marks [20]

6. An average person drinks 2 L of water each day, yet eliminates about 2.5 L of water. The extra water is produced when food is metabolized in the body. In one series of metabolic reactions glucose ($C_6H_{12}O_6$) is burned to produce carbon dioxide and water.

(a) According to the chemical equation

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

(i) State the mass of water produced from 90 g of glucose. [3]

(ii) Assuming that 1 g of water is 1 mL of water; calculate the volume of water produced from 90 g of glucose and the mass of carbon dioxide which would be produced at the same time. [1]

(b) The empirical formula of glucose is CH_2O. Ethanoic acid, lactic acid, ribose and share the same empirical formula as glucose.

(i) Write the molecular formula of lactic acid if it is three times the empirical formula.

(ii) Write the molecular formula of ribose, which has a molecular mass of 150.

(iii) Name a household substance that contains ethanoic acid. [5]

(c) Succinic, an organic acid, present in fungi and lichens, is extracted to make perfumes and dyes. The percentage composition of this acid is 40.68% carbon, 5.08% hydrogen and 54.24% oxygen.

Determine its empirical formula. [3]

(d) Methane and candle wax (paraffin wax) belong to the same homologous series of organic compounds.

(i) Name the homologous series to which they belong. [1]

(ii) Use the equation to calculate the volume of carbon dioxide produced by burning 7.04 g of candle wax ($C_{25}H_{52}$) in oxygen at r.p.t.

$$C_{25}H_{52} + 38O_2 \rightarrow 25CO_2 + 26H_2O$$ [3]

(iii) Draw the structural formula of methane. [1]

(iv) Write a balanced chemical equation for the complete combustion of methane. [3]

Total marks [20]

7. A certain mass of a Group II metal was added to excess hydrochloric acid and the volume of hydrogen gas recorded at r.t.p. at regular intervals. The data collected is shown in the table.

time/s	0	20	40	60	80	100	120	140	160	180
H_2/cm^3	0	50	85	115	140	160	177.5	190	200	200

(a) Describe a test for hydrogen and state the results you would expect. [2]

(b) (i) Plot a suitable graph of the data. [6]

Use your graph to

(ii) find the volume of gas produced in 90 s; [1]

(iii) find the time it takes to 74.0 cm^3 of H_2 (g); [1]

(iv) draw and label a curve for the same reaction if it were catalysed; [1]

(v) draw and label a curve that used only half the amount of metal. [1]

(c) (i) State the final volume of gas produced in dm^3. [1]

(ii) Write a balanced equation for the reaction using magnesium as the metal. [2]

(iii) Calculate (to two decimal places) the mass of magnesium required to produce this volume of gas at r.t.p. [2]

(d) (i) Study the equation you have written in part (c)(ii). Which substance has been oxidized during the reaction? [1]

(ii) Write a half-reaction for the oxidation reaction. [2]

Total marks [20]

End]