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Candidate Name _____

Class Register Number

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PEIRCE SECONDARY SCHOOL

Department of Science

Second Semestral Examination for Secondary Three Express

CHEMISTRY

5073

Tuesday

11 October 2016

0900 – 1100

Additional Material:

OTAS Answer Sheet

Time: 2 hours

INSTRUCTIONS TO CANDIDATES

Section A: Multiple Choice (30 marks)

There are thirty multiple choice questions in this section.

Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**. Choose the one you consider correct and record your answer in the OAS provided.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Section B: Structured Questions (40 marks)

Answer **all** questions. Write your answers in the spaces provided on the Question Paper.

Section C: Free Response Questions (30 marks)

Answer **all** questions. Write your answers in the spaces provided on the Question Paper.

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on page 23.

Parent's Signature

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For Examiner's Use

Section A	
Section B	
Section C	
Total	

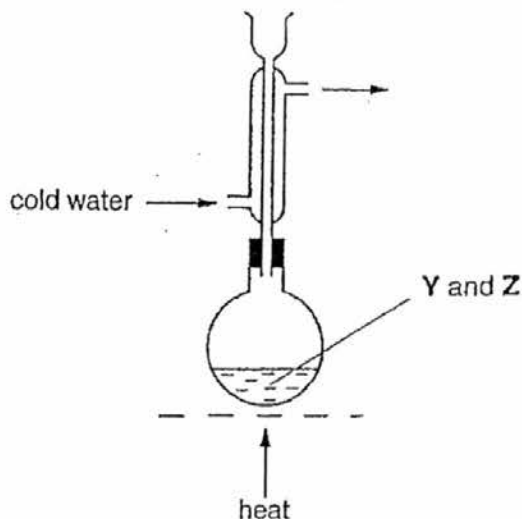
218

This paper consists of 23 printed pages.

Section A: [30 marks]

Answer all the questions in the OTAS Answer Sheet provided.

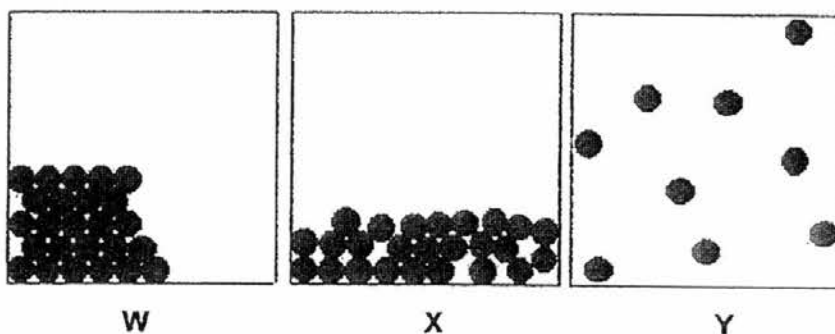
- 1 The following diagram shows the apparatus used for the slow reaction between liquid Y (boiling point 57°C) and liquid Z (boiling point 80°C).



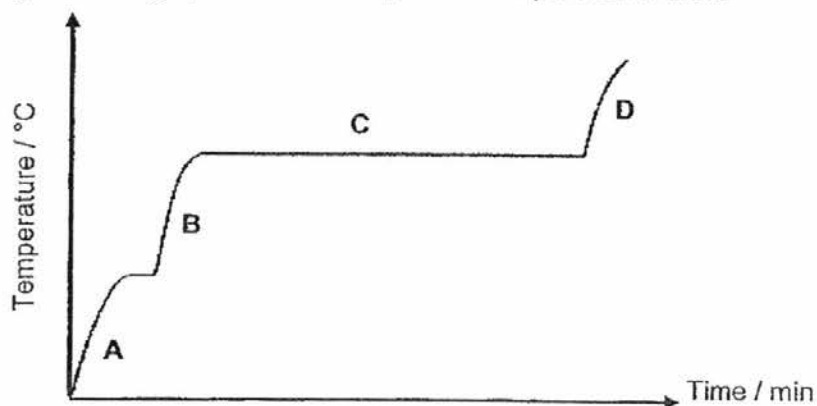
What is the purpose of the condenser?

- A to enable Y and Z to mix more efficiently
 - B to prevent the mixture from becoming too hot
 - C to allow the product to escape as fast as it is formed
 - D to prevent Y and Z from escaping before the reaction is complete
- 2 In a volumetric experiment involving the addition of hydrochloric acid to 25.0 cm^3 of aqueous sodium hydroxide it is necessary to determine the point when the reaction have just completed. Which piece of apparatus could be used to determine the end-point of reaction?
- A electronic balance
 - B gas syringe
 - C stop watch
 - D thermometer
- 3 Which property of a gas affects the rate at which it spreads through a laboratory?
- A boiling point
 - B viscosity
 - C molecular mass
 - D atomic radius

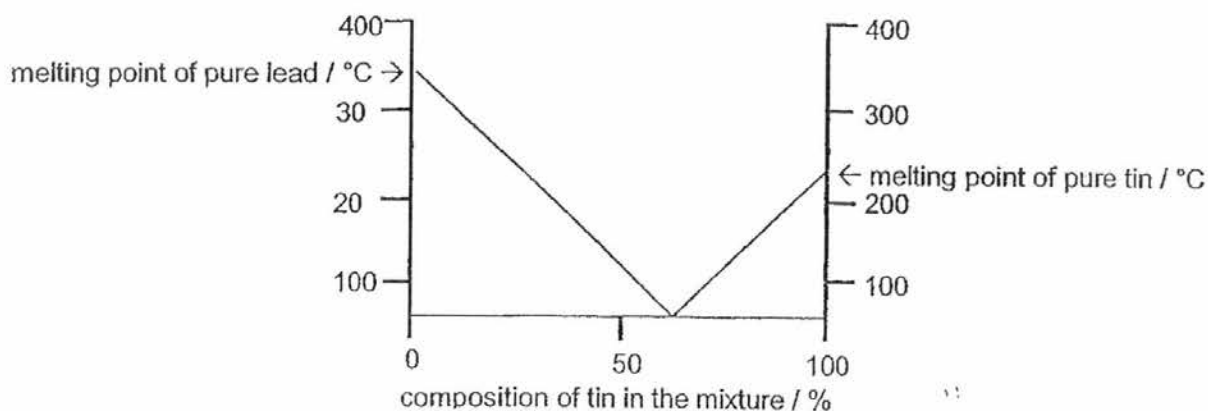
- 4 Diagrams W, X and Y show how the particles of a substance are packed at different temperatures.



The graph shows the temperatures changes which occur on warming the substance. In which region of the graph would all the particles be packed as in X?



- 5 The graph gives the melting points of lead and tin.



It is conclusive that **all** mixture of lead and tin must have a melting point

- A above that of tin.
- B below that of lead.
- C below that of tin.
- D between that of tin and lead.

6 Which mixture can be separated into its components by adding water, stirring and filtering?

- A copper (II) carbonate and copper (II) chloride
- B magnesium and iron
- C sugar and sodium chloride
- D naphthalene and sand

Use the table below to answer questions 7 and 8.

The following table contains the information about solids A, B, C, D and E.

A is white. It is formed by burning magnesium in oxygen.	B is red and has a constant composition. It decomposes into two elements when heated.	C is coloured grey and is attracted to a magnet. It cannot be decomposed into anything simpler.	D is speckled green and white. The green particles dissolve in water but the white particles do not.	E is blue and dissolves in water. Its solution can be separated into three dyes by chromatography.
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7 Which of the following solids is a mixture?

- A A, B, D and E only
- B A and B only
- C B, D and E only
- D D and E only

8 Which of the following substances is the correct identity of solid C?

- A mixture of iron and sulfur
- B sand
- C zinc
- D iron

- 9 On bubbling carbon dioxide into an aqueous solution **X**, a white precipitate **Y** is formed. This precipitate dissolves when more carbon dioxide is bubbled through, forming a colourless solution of **Z**. What are the formulae of **X**, **Y** and **Z**?

	X	Y	Z
A	CaCO_3	Ca(OH)_2	$\text{Ca(HCO}_3)_2$
B	Ca(OH)_2	CaCO_3	$\text{Ca(HCO}_3)_2$
C	Ca(OH)_2	$\text{Ca(HCO}_3)_2$	CaCO_3
D	CaCO_3	$\text{Ca(HCO}_3)_2$	CaCO_3

- 10 When testing for a chloride ion using silver nitrate, the solution must be acidified with nitric acid.

What is the purpose of nitric acid?

- A** to act as a catalyst
B to oxidise the chloride ion
C to prevent precipitation of silver carbonate
D to prevent decomposition of any silver chloride formed
- 11 Which pair of substances are isotopes?
- A** $^{12}_6\text{C}$ and $^{14}_6\text{C}$
B carbon dioxide and carbon monoxide
C diamond and graphite
D C_2H_4 and C_3H_6
- 12 Which ion has the most number of electron shells that contain electrons?
- A** Al^{3+}
B Be^{2+}
C N^{3-}
D S^{2-}

13 Which statement explains why sodium chloride, NaCl, has a lower melting point than magnesium oxide, MgO?

- A Sodium chloride is covalent while magnesium oxide is ionic.
- B Sodium chloride is less reactive than magnesium oxide
- C The attraction between Na^+ and Cl^- is weaker than that between Mg^{2+} and O^{2-} .
- D The melting point of sodium is less than magnesium.

14 A compound X contains chlorine and one other element.
Which property of X indicates that the bonds in X are covalent?

- A It can be synthesized from its elements.
- B It cannot conduct electricity in any state.
- C It is gaseous at room temperature.
- D It is insoluble in water.

15 Which particles are responsible for the conduction of electricity through metals and ionic compounds?

	metals	ionic compounds
A	electrons	electrons
B	electrons	positive ions and negative ions
C	positive ions	electrons
D	positive ions	positive ions and negative ions

16 In which reaction does the smallest percentage change in volume occur?

- A $\text{C}_3\text{H}_8 (\text{g}) + 5 \text{O}_2 (\text{g}) \rightarrow 3 \text{CO}_2 (\text{g}) + 4 \text{H}_2\text{O} (\text{l})$
- B $4 \text{NH}_3 (\text{g}) + 3 \text{O}_2 (\text{g}) \rightarrow 2 \text{N}_2 (\text{g}) + 6 \text{H}_2\text{O} (\text{l})$
- C $\text{CH}_3\text{CH}_2\text{OH} (\text{l}) + 3 \text{O}_2 (\text{g}) \rightarrow 2 \text{CO}_2 (\text{g}) + 3 \text{H}_2\text{O} (\text{l})$
- D $2 \text{H}_2\text{S} (\text{g}) + \text{SO}_2 (\text{g}) \rightarrow 3 \text{S} (\text{s}) + 2 \text{H}_2\text{O} (\text{l})$

- 17 The following set of statements describe the characteristics of dilute sulfuric acid.
- (i) A white precipitate is formed when aqueous barium chloride is added.
 - (ii) It turns anhydrous copper (II) sulfate from white to blue
 - (iii) Addition of universal indicator shows that the solution has a pH value of less than 7.0.
 - (iv) It reacts with copper (II) oxide, forming a blue solution.

Which two statements confirm the acidic nature of the solution?

- A (i) and (ii) only
 - B (i) and (iii) only
 - C (ii) and (iv) only
 - D (iii) and (iv) only
- 18 Which statement does **not** describe a property of a weak alkaline solution?
- A It has a pH between 8 and 9.
 - B It partially dissociates to form ions.
 - C It reacts with weak acid to form a salt.
 - D It reacts with aqueous salt solution to form ammonia gas.
- 19 Which reactants could be used to prepare potassium chloride safely?
- A potassium and dilute hydrochloric acid
 - B potassium and chlorine gas
 - C aqueous potassium hydroxide and dilute hydrochloric acid
 - D aqueous potassium sulfate and aqueous sodium chloride
- 20 Hydrazine has the formula H_2NNH_2 . It has similar properties to ammonia. Which property will hydrazine have?
- A It dissolves in water to give hydrogen ions.
 - B It is an ionic compound.
 - C It reacts with alkalis to form salts.
 - D It reacts with hydrogen chloride to form a compound with the formula $\text{C}/\text{H}_3\text{NNH}_3\text{Cl}/$.

21 Which process does **not** involve either oxidation or reduction?

- A formation of ammonium sulfate from ammonia and sulfuric acid
- B formation of nitrogen monoxide from ammonia
- C formation of sulfuric acid from sulfur
- D formation of zinc from zinc sulfide

22 Samples of hydrogen peroxide are added to aqueous potassium iodide and to acidified potassium dichromate (VII) respectively. The iodide ions are oxidised and dichromate (VI) ions are reduced. What colour changes are seen?

	potassium iodide	acidified potassium dichromate (VI)
A	colourless to brown	purple to colourless
B	brown to colourless	purple to colourless
C	colourless to brown	orange to green
D	brown to colourless	orange to green

23 The position of metal **M** in the reactivity series is shown.

K, Na, **M**, Al, Zn, Fe, Pb, Cu, Ag

Which method will be used to extract **M** from its ore?

- A electrolysis of its molten oxide
- B electrolysis of its aqueous sulfate
- C reduction of its oxide by heating with hydrogen
- D reduction of its oxide by heating with coke

- 24 High carbon steel is used in manufacturing processes.

Which physical properties does high carbon steel possess?

- (i) brittle
- (ii) malleable
- (iii) soft
- (iv) strong

- A (i) and (ii) only
- B (i) and (iv) only
- C (ii) and (iii) only
- D (iii) and (iv) only

- 25 Scrap iron is often recycled.

Which of the following is **not** a correct for recycling?

- A It reduces the amount of pollution at the site of the ore extraction.
- B It reduces the amount of waste taken to landfill sites.
- C It reduces the need to collect the scrap iron.
- D It saves natural resources.

- 26 Tellurium, Te, is in the same group of the Periodic Table as sulfur. What is the formula of potassium tellurate?

- A K_2Te
- B $KTeO_4$
- C K_2TeO_4
- D K_2TeO_3

- 27 X, Y and Z are elements in the same period of the Periodic Table. X forms a covalent chloride, Y forms an ionic chloride and Z can form both types of chloride.

If X, Y and Z are placed in ascending order of atomic number, which of the following is correct?

- A X, Y, Z
- B X, Z, Y
- C Y, X, Z
- D Y, Z, X

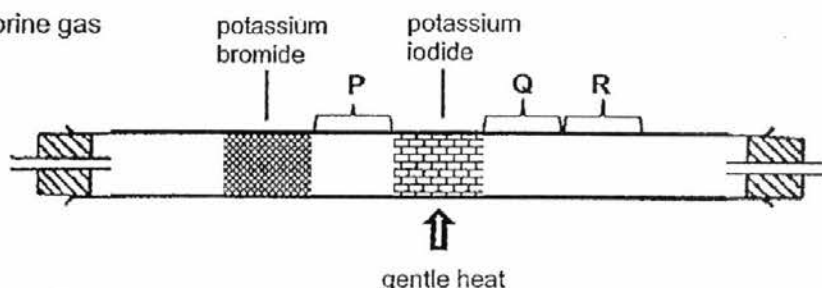
- 28 Element X is a solid at room temperature. It is able to lose one or two electrons per atom to achieve electronic structure of a noble gas. It does not react with water or steam.

What is element X?

- A K
B Ca
C Zn
D Cu

- 29 Using the apparatus shown, chlorine gas is passed through the tube.

After a while, coloured substances are seen at regions P, Q and R.



What are these coloured substances?

	P	Q	R
A	green gas	violet vapour	black solid
B	green gas	red brown vapour	violet vapour
C	red brown vapour	violet vapour	black solid
D	violet vapour	red brown vapour	red brown vapour

- 30 The scheme shows four stages, (i) to (iv), in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.

- (i) $C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$
(ii) $C_{30}H_{62}(l) \rightarrow C_{30}H_{62}(g)$
(iii) $C_{30}H_{62}(g) + 45.5 O_2(g) \rightarrow 30 CO_2(g) + 31 H_2O(g)$
(iv) $30 CO_2(g) + 31 H_2O(g) \rightarrow 30 CO_2(g) + 31 H_2O(l)$

Which stages are exothermic?

- A (i) and (ii) only
B (ii) and (iii) only
C (iii) and (iv) only
D (i) and (iv) only

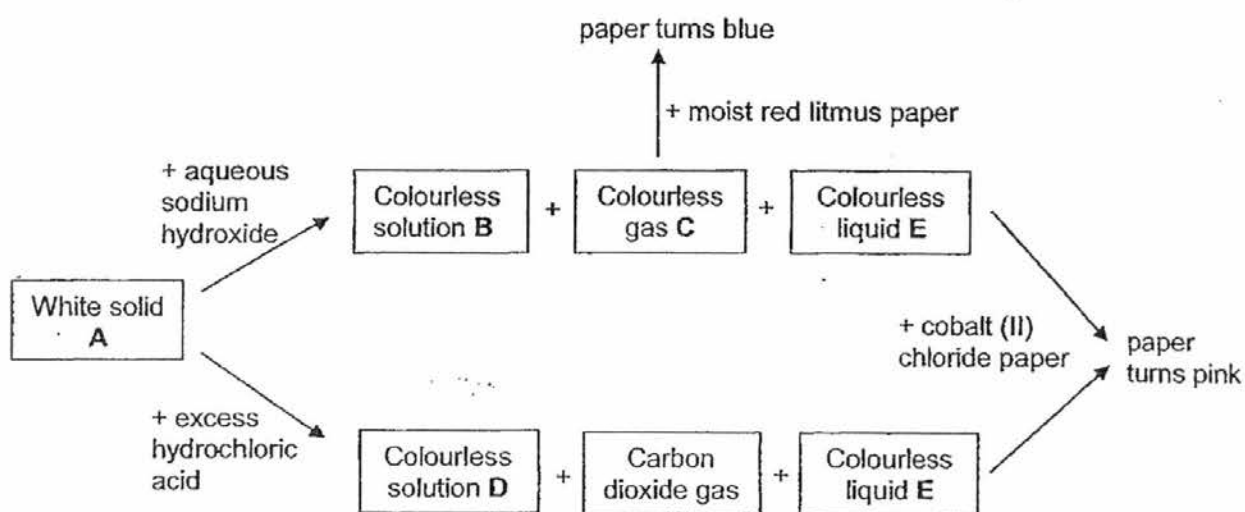
End of Section A

Candidate Name _____

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Section B [40 marks]Answer **all** the questions in the spaces provided.

- 1 The scheme below shows some reactions of substance **A**.



- (a) Identify substances **A**, **B**, **C** and **D**.

A _____

B _____

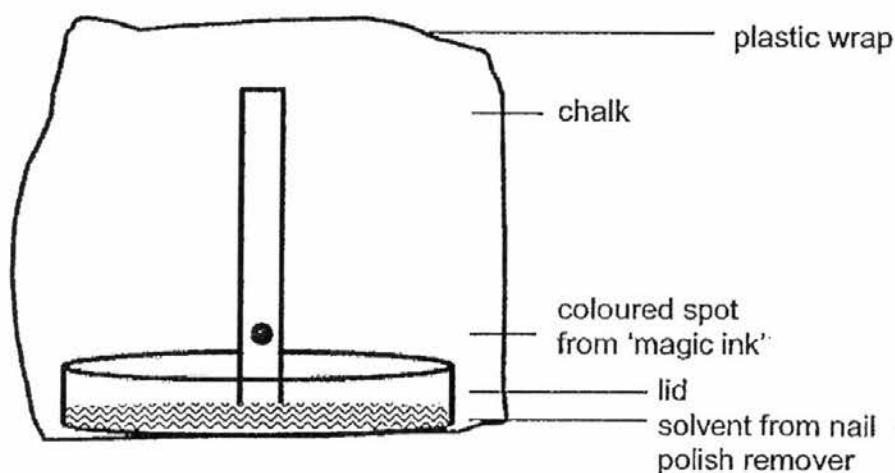
C _____

D _____ [4]

- (b) Both the reactions produced **E**. What is the compound responsible for the colour change observed in the cobalt (II) chloride paper?

_____ [1]

- 2 A teacher gave a project of using household materials to conduct experiments. The pupils prepared chalk, nail polish remover, 'magic pen', plastic wrap and a lid from a container. The pupils set up the experiment as shown and covered with a plastic wrap.



- (a) Name the process described above.

_____ [1]

- (b) Suggest why the pupils used nail polish remover as the solvent.

_____ [1]

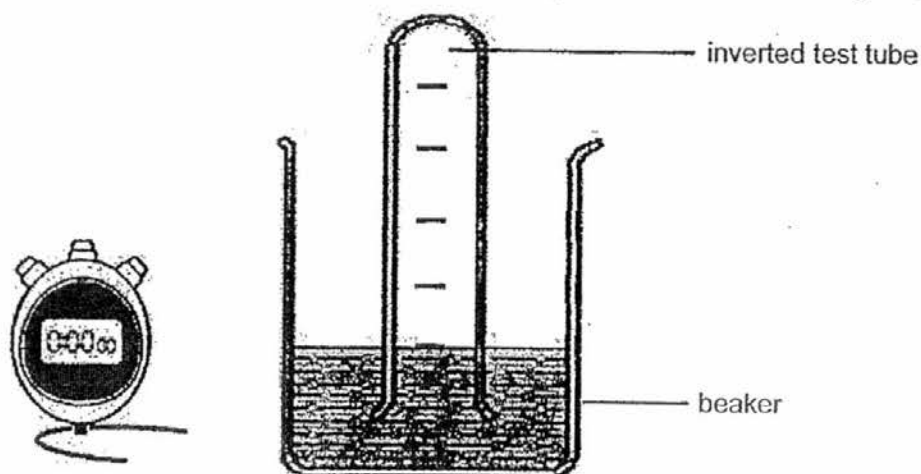
- (c) After 20 minutes, two coloured bands, namely band 1 and band 2 were formed on the chalk. Band 1 is more soluble than band 2.
Draw the coloured bands on the diagram.

[1]

- (d) Suggest a reason for covering the set-up with a plastic wrap?

_____ [1]

- 3 The diagram below shows an apparatus for measuring the rates of diffusion of gases...



The timings taken for 100 cm³ of some gases at r.t.p to diffuse from this apparatus set-up are shown in the table below. The melting and boiling points of the gases have also been included.

gas	time / s	melting points / °C	boiling points / °C
CO	132	-205	-192
CH ₄	100	-182	-162
N ₂		-210	-196
O ₂	141	-219	-183

- (a) Name the gas that diffuses the fastest?

_____ [1]

- (b) Suggest the time nitrogen (N₂) would take.

_____ [1]

- (c) Why is this set-up unsuitable for finding the rate of diffusion of ammonia.

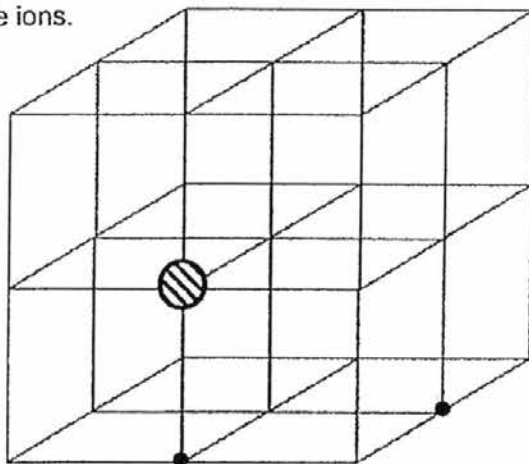
_____ [1]

- (d) At -200°C, which of the gases will exist in liquid state.

_____ [2]

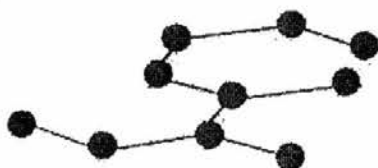
Complete each of the following diagrams as instructed.

- 4 (a) Complete the diagram of sodium chloride lattice by inserting ● for sodium ions and  for chloride ions.



[2]

- (b) Complete the diagram of one layer of graphite structure by adding more ● for carbon atoms and draw the bonds between the carbon atoms.

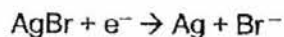


[1]

- (c) Using the structure given in (b), explain why graphite is soft and can conduct electricity.

[3]

- 5 In the basis of photography, the light sensitive silver bromide is used to make photographic film. Photographic paper coated in silver bromide is produced by bringing solutions of aqueous silver nitrate and aqueous potassium bromide into contact on the paper in the absence of light. A photographic image of an object can be obtained when the paper is exposed to strong light:



By rinsing the exposed film with sodium thiosulfate, light-sensitive silver bromide goes into solution. The black and white negatives of the image taken will be developed.

- (a) (i) Write an equation for the reaction between silver nitrate and potassium bromide.

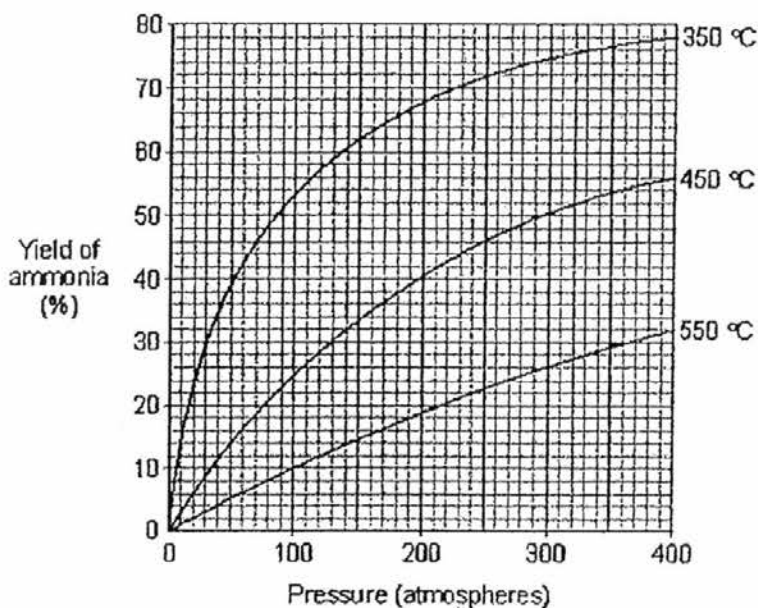
- (ii) Is the above reaction a redox reaction? Give a reason.

_____ [3]

- (b) Consider the equation given by the passage. Identify the substance that has been reduced and give a reason for your answer.

_____ [2]

- 6 Ammonia is manufactured by hydrogen and nitrogen respectively. The reaction is *reversible* which leads to a formation of an equilibrium mixture containing hydrogen, nitrogen and ammonia respectively. The graph shows the percentage of ammonia in the equilibrium mixture plotted against pressure for three different temperatures.

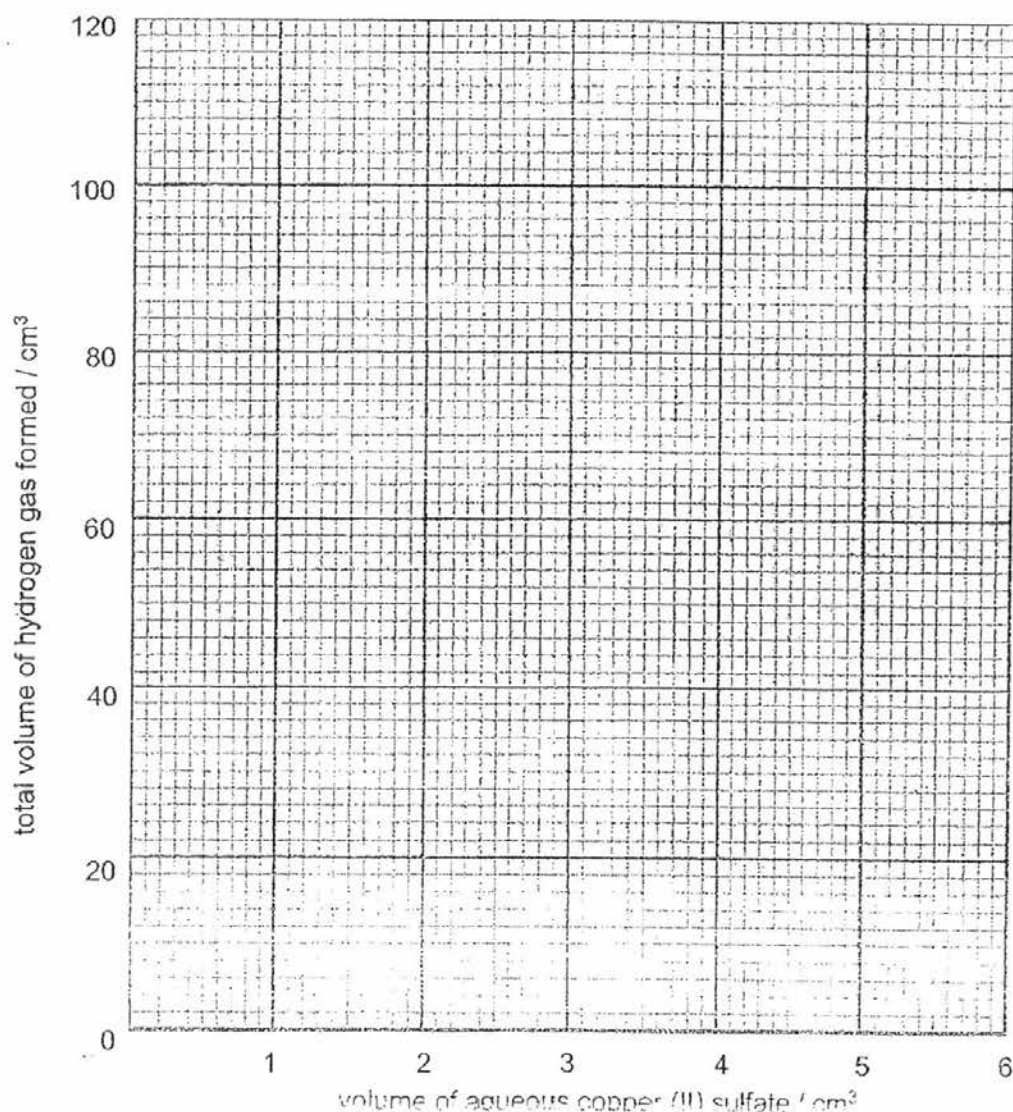


- (a) Write the equation for the above reaction for the manufacturing process of ammonia using hydrogen and nitrogen as the reagents.
- _____ [1]
- (b) What is meant by the term *reversible*?
- _____ [1]
- (c) With reference to the graph, explain the effect of increasing pressure on the percentage of ammonia in the equilibrium mixture.
- _____ [1]
- (d) With reference to the graph, suggest why the above process is normally carried out at 450 °C rather than 550 °C despite the fact that an increase in temperature should lead to an increase in the speed of reaction.
- _____ [1]

- 7 A chemist wanted to produce a salt zinc chloride by reacting zinc granules with dilute hydrochloric acid. In order to speed up the reaction, he added aqueous copper (II) sulfate solution as a catalyst.

The data showed volumes of gas evolved and volume of aqueous copper (II) sulfate used.

volume of gas evolved / cm^3	volume of aqueous copper (II) sulfate used / cm^3
120	0
40	1
17	2
4	3
0	4
0	5
0	6



(a) Plot a graph of volume of gas evolved against volume of aqueous copper (II) sulfate. [2]

(b) Describe a test used to identify the gas evolved in this experiment.

_____ [2]

(c) The chemist used aqueous copper (II) sulfate as a catalyst. With the aid of an equation, explain why it is not a desirable choice.

_____ [2]

(d) Outline the steps taken to produce zinc chloride salt using zinc and hydrochloric acid.

_____ [5]

End of Section B

Section C [30 marks]Answer all **three** questions in the spaces provided.

- 8 The table gives the estimated percentages by mass of the substances found in the Universe, the Earth's core and the Earth's crust.

other planets		Earth's core		Earth's crust	
substance	%	substance	%	substance	%
Hydrogen	90.0	Iron	35.0	Oxygen	52.5
Helium	8.9	Oxygen	28.0	Silicon	31.0
Carbon	1.0	Magnesium	17.0	Aluminium	6.0
Oxygen		Silicon	13.0	Iron	5.0
Manganese		Nickel	2.7	Calcium	4.0
Iron		Aluminium	0.1	Titanium	0.5
Sulfur		Sodium	0.1	Hydrogen	0.15
Silicon		Hydrogen	0.05	Nickel	0.05

- (a) (i) Calculate the combined percentage of oxygen, manganese, iron, sulfur and silicon found in other planets.

- (ii) Suggest two reasons why other planets are not suitable for mankind to live in.

 [3]

- (b) Which element is more common in the other planets than it is in either the Earth's crust or the Earth's core?

 [1]

- (c) Which of the metals is more abundant in the Earth's crust than it is in Earth's core?

 [1]

- (d) Which two metals are more abundant in the Earth's core than it is in Earth's crust?

 [2]

- (e) The conditions of the Earth's core is 5000 °C with extreme pressure while of the Earth's crust is less than 600 °C. Suggest why the figures for the percentages of the substances in the Earth's core may not be reliable.

[1]

- 9 Use the information in the table to answer the questions.

element	density of element at r.t.p in g / cm ³	formula of oxide(s)
J	0.003214	J ₂ O
L	3.10	L ₂ O
M	0.0899	None
Q	0.53	Q ₂ O
R	0.97	R ₂ O
T	2.07	TO ₂ ; TO ₃
X	3.00	X ₂ O ₃
Z	7.86	ZO ; Z ₂ O ₃

- (a) Which element is a noble gas? Give a reason for your choice.

_____ [2]

- (b) Suggest the identity of T. Give a reason for your choice.

_____ [2]

- (c) Both Q and R are from the same Group of the periodic table. Suggest the Group number. Write an equation of Q/R with water.

_____ [2]

- (d) Both J and L are elements from Group VII.

- (i) Suggest the colour and state of J.

- (ii) Outline an experiment to investigate which element, J or L, is more reactive. Write an equation for the above experiment.

[6]

10 Most of the reactions in chemistry involve water.

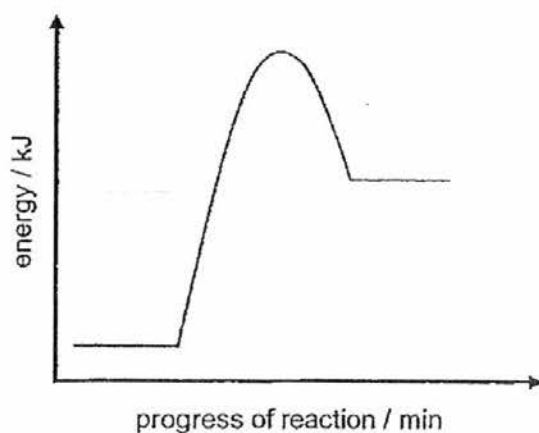
(a) Draw a 'dot and cross' diagram to show the bonding in water.

[2]

Water is either used as a solvent for dissolving solutes or in reactions to produce useful compounds. Part (b) and (c) shows 2 different interactions of substances with water.

(b) Water can be used to dissolve ammonium nitrate to make a cold pack. Cold pack is useful in remote areas where an ice pack is unavailable. When the inner bag of water is broken by squeezing the cold pack, it will dissolve the solid. This reaction absorbs heat from the surroundings, quickly lowering the pack's temperature.

The energy profile diagram shows the reaction between ammonium nitrate and water.



(i) Is the above reaction exothermic or endothermic? Explain your answer using the energy profile diagram given.

(ii) Label the energy profile diagram with the phrases "reactants", "products", "enthalpy change, ΔH " and "activation energy, E_a ".

[4]

- (c) Metal **G** reacts with water readily to form hydroxides; metal **H** reacts with both water and steam to produce basic oxides ; metal **I** reacts with steam to form an amphoteric oxide ; metal **J** reacts slowly with steam and it also reacts with water and oxygen to form reddish brown oxides.

- (i) Rank the reactivity of metals **G**, **H**, **I** and **J** in ascending order of reactivity.

- (ii) Name the reaction between metal **J** with water and oxygen. Suggest a way to prevent metal **J** from reacting with water and oxygen.

- (iii) **J** can be extracted from its oxide by reacting with coke (C). Write a balanced equation for the reaction between the oxide of **J** and coke.

 [4]

End of Paper

DATA SHEET The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
		1 H Hydrogen																
7 Li Lithium	9 Be Beryllium											11 B Boron	12 C Carbon	14 N Nitrogen	16 O Oxygen	19 F Fluorine	20 Ne Neon	
23 Na Sodium	24 Mg Magnesium											27 Al Aluminium	28 Si Silicon	31 P Phosphorus	32 S Sulfur	35.5 Cl Chlorine	36 Ar Argon	
39 K Potassium	40 Ca Calcium	45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	59 Ni Nickel	64 Cu Copper	65 Zn Zinc	70 Ga Gallium	73 Ge Germanium	75 As Arsenic	76 Se Selenium	84 Kr Krypton		
85 Rb Rubidium	88 Sr Strontium	89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	101 Ru Ruthenium	106 Pd Palladium	106 Rh Rhodium	108 Ag Silver	112 Cd Cadmium	115 In Indium	119 Sn Tin	122 Sb Antimony	127 I Iodine	128 Te Tellurium	131 Xe Xenon		
133 Cs Cesium	137 Ba Barium	139 La Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	190 Os Osmium	195 Pt Platinum	195 Ir Iridium	197 Au Gold	201 Hg Mercury	204 Tl Thallium	207 Pb Lead	208 Bi Bismuth	210.8 Po Polonium	210.8 At Astatine	210.8 Rn Radon		
Fr Francium	Ra Radium	Ac Actinium																

140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	159 Tb Terbium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium	
232 Th Thorium	232 Pa Protactinium	238 U Uranium	238 Np Neptunium	238 Pu Plutonium	238 Am Americium	238 Cm Curium	238 Bk Berkelium	238 Cf Californium	238 Es Einsteinium	238 Fm Fermium	238 Md Mendelevium	238 No Nobelium	238 Lr Lawrencium

a

X

b

Key

a = relative atomic mass
X = element symbol
b = proton (atomic) number

58 – 71 Lanthanoid series
90 – 103 Actinoid series

* 58 - 71 Lanthanoid series
90 - 103 Actinoid series

Key

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Candidate Name _____

Class Register Number

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PEIRCE SECONDARY SCHOOL

Department of Science

Second Semestral Examination for Secondary Three Express

CHEMISTRY

5073

Monday

_____ 2016

0800 – 1000

**Additional Material:
OTAS Answer Sheet**

Time: 2 hours

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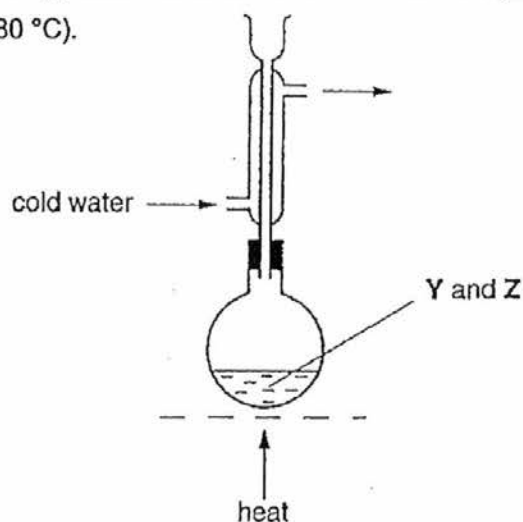
Answer **all** questions. Write your answers in the spaces provided on the Question Paper.

The number of marks is given in brackets [] at the end of each question or part question.

Section A: [30 marks]

Answer **all** the questions in the OTAS Answer Sheet provided.

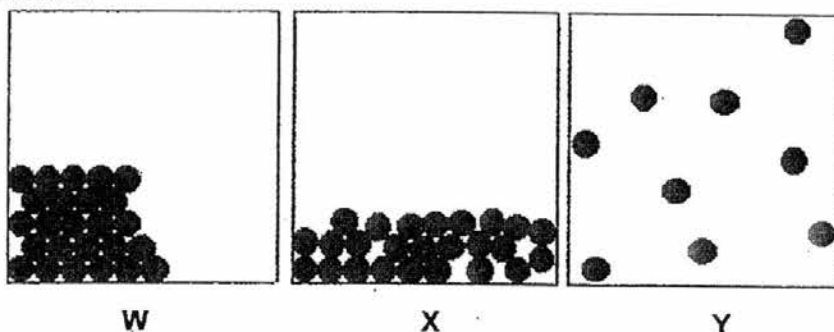
- 1 The diagram shows the apparatus used for the slow reaction liquid **Y** (boiling point 57 °C) and liquid **Z** (boiling point 80 °C).



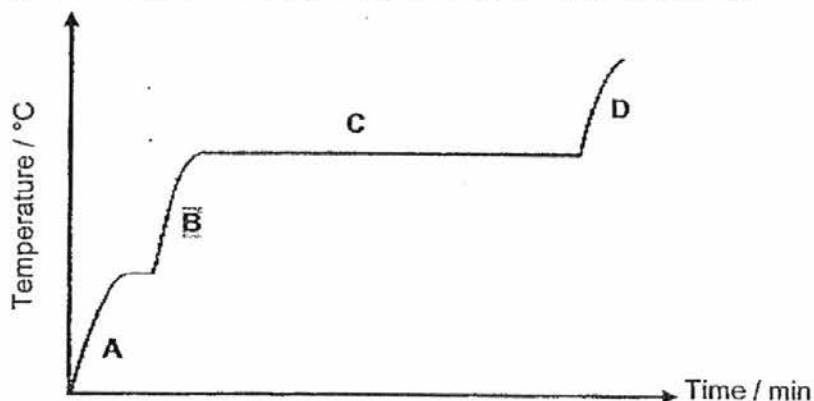
What is the purpose of the condenser?

- A to enable **Y** and **Z** to mix more efficiently
B to prevent the mixture from becoming too hot
C to allow the product to escape as fast as it is formed
D to prevent **Y and **Z** from escaping before the reaction is complete**
- 2 In a volumetric experiment involving the addition of hydrochloric acid to 25.0 cm³ of aqueous sodium hydroxide it is necessary to determine when the reaction is just complete. Which piece of apparatus could be used to determine the end-point of reaction?
- A electronic balance
B gas syringe
C stop watch
D thermometer
- 3 Which of the property of a gas affects the rate at which it spreads through a laboratory?
- A boiling point
B viscosity
C molecular mass
D atomic radius

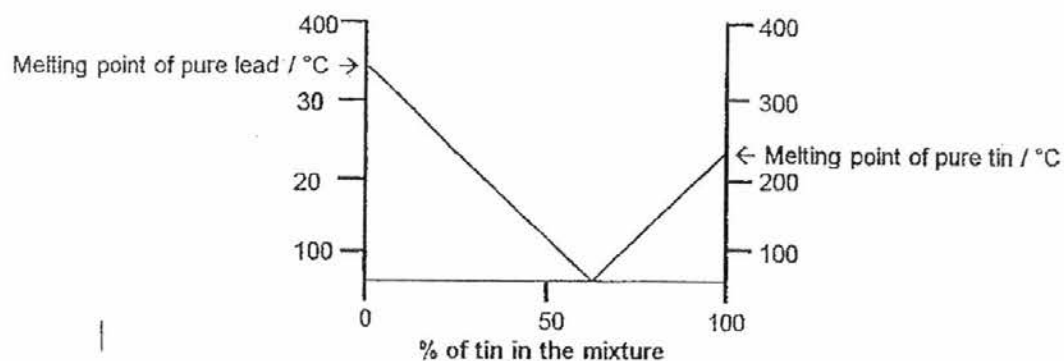
- 4 Diagrams W, X and Y show how the particles of a substance are packed at different temperatures.



The graph shows the temperatures changes which occur on warming the substance. In which region of the graph would all the particles to be packed as in X?



- 5 The graph gives the melting points of lead and tin.



It is conclusive that **any** mixture of lead and tin must have a melting point

- A above that of tin.
- B below that of lead.
- C below that of both tin and lead.
- D between that of tin and lead.

- 6 Which mixture can be separated into its components by adding water, stirring and filtering?

A copper(II) carbonate and copper(II) chloride

B magnesium and iron

C sugar and sodium chloride

D naphthalene and sand

Use the table below to answer question 7 and 8.

The following table contains the information about solids **A**, **B**, **C**, **D** and **E**.

A is white. It is formed by burning magnesium in oxygen.	B is red and has a constant composition. It decomposes into two elements when heated.	C is coloured grey and is attracted to a magnet. It cannot be decomposed into anything simpler.	D is speckled green and white. The green particles dissolve in water but the white particles do not.	E is blue and dissolves in water. Its solution can be separated into three dyes by chromatography.
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- 7 Which of the following solids is a mixture?

A A, B, D and E

B A and B

C B, D and E

D D and E

- 8 Which of the following substances is the correct identity of solid **C**?

A mixture of iron and sulfur

B sand

C zinc

D iron

- 9 On bubbling carbon dioxide into an aqueous solution of **X**, a white precipitate **Y**, is formed. This precipitate dissolves when more carbon dioxide is bubbled through, forming a colourless solution of **Z**. What are the formulae of **X**, **Y** and **Z**?

	X	Y	Z
A	CaCO_3	Ca(OH)_2	$\text{Ca(HCO}_3)_2$
B	Ca(OH)_2	CaCO_3	$\text{Ca(HCO}_3)_2$
C	Ca(OH)_2	$\text{Ca(HCO}_3)_2$	CaCO_3
D	CaCO_3	$\text{Ca(HCO}_3)_2$	CaCO_3

- 10 When testing for a chloride ion using silver nitrate, the solution must be acidified with nitric acid.

What is the purpose of nitric acid?

- A** to act as a catalyst
B to oxidise the chloride ion
C to prevent precipitation of silver carbonate
D to prevent decomposition of any silver chloride formed

- 11 Which pair of substances are isotopes?

- A** $^{12}_6\text{C}$ and $^{13}_6\text{C}$
B carbon dioxide and carbon monoxide
C diamond and graphite
D C_2H_4 and C_3H_6

- 12 Which ion has the most number of electron shells that contain electrons?

- A** Al^{3+}
B Be^{2+}
C N^{3-}
D S^{2-}

- 13 Which statement explains why sodium chloride, NaCl, has a lower melting point than magnesium oxide, MgO?

A Sodium chloride is covalent while magnesium oxide is ionic.
 B Sodium chloride is less reactive than magnesium oxide
 C The attraction between Na⁺ and Cl⁻ is weaker than that between Mg²⁺ and O²⁻
 D The melting point of sodium is less than magnesium.

- 14 A compound X contains chlorine and one other element.
 Which property of X indicates that the bond in X are covalent?

A It can be synthesized from its elements.
 B It cannot conduct electricity in any state.
 C It is gaseous at room temperature.
 D It is insoluble in water.

- 15 Which particles are responsible for the conduction of electricity through metals and ionic compounds?

	metals	ionic compounds
A	electrons	electrons
B	electrons	positive ions and negative ions
C	positive ions	electrons
D	positive ions	positive ions and negative ions

- 16 In which reaction does the smallest percentage change in volume occur?

A $\text{C}_3\text{H}_8 (\text{g}) + 5 \text{O}_2 (\text{g}) \rightarrow 3 \text{CO}_2 (\text{g}) + 4 \text{H}_2\text{O} (\text{l})$
 B $4 \text{NH}_3 (\text{g}) + 3 \text{O}_2 (\text{g}) \rightarrow 2 \text{N}_2 (\text{g}) + 6 \text{H}_2\text{O} (\text{l})$
 C $\text{CH}_3\text{CH}_2\text{OH} (\text{l}) + 3 \text{O}_2 (\text{g}) \rightarrow 2 \text{CO}_2 (\text{g}) + 3 \text{H}_2\text{O} (\text{l})$
 D $2 \text{H}_2\text{S} (\text{g}) + \text{SO}_2 (\text{g}) \rightarrow 3 \text{S} (\text{s}) + 2 \text{H}_2\text{O} (\text{l})$

- 17 The following set of statements describes the characteristics of dilute sulfuric acid.
- (i) A white precipitate is formed when aqueous barium chloride is added.
 - (ii) It turns anhydrous copper (II) sulfate from white to blue
 - (iii) Addition of universal indicator shows that the solution has a pH value of less than 7.0.
 - (iv) It reacts with copper (II) oxide, forming a blue solution.

Which two statements confirm the acidic nature of the solution?

- A (i) and (ii)
- B (i) and (iii)
- C (ii) and (iv)
- D (iii) and (iv)

- 18 Which statement does not describe a property of a weak alkaline solution?

- A it has a pH between 8 and 9.
- B It partially dissociate to form ions.
- C It reacts with weak acid to form a salt.
- D it reacts with aqueous salt solution to form ammonia gas.

- 19 Which reactants could be used to prepare potassium chloride safely?

- A potassium and dilute hydrochloric acid
- B potassium and chlorine gas
- C aqueous potassium hydroxide and dilute hydrochloric acid
- D aqueous potassium sulfate and aqueous sodium chloride

- 20 Hydrazine has the formula H_2NNH_2 . It has similar properties to ammonia. Which property will hydrazine have?

- A It dissolves in water to give hydrogen ions.
- B It is an ionic compound.
- C It reacts with alkalis to form salts.
- D It reacts with hydrogen chloride to form a compound with the formula $\text{C}_2\text{H}_5\text{NNH}_3\text{Cl}$.

21 Which process does **not** involve either oxidation or reduction?

A formation of ammonium sulfate from ammonia and sulfuric acid

B formation of nitrogen monoxide from ammonia

C formation of sulfuric acid from sulfur

D formation of zinc from zinc sulfide

22 Samples of hydrogen peroxide are added to aqueous potassium iodide and to acidified potassium dichromate (VII) respectively. The iodide ions are oxidised and dichromate (VI) ions are reduced. What colour changes are seen?

	potassium iodide	acidified potassium dichromate (VI)
A	colourless to brown	purple to colourless
B	brown to colourless	purple to colourless
C	colourless to brown	orange to green
D	brown to colourless	orange to green

23 The position of metal **M** in the reactivity series is shown.

K, Na, **M**, Al, Zn, Fe, Pb, Cu, Ag

Which method will be used to extract **M** from its ore?

A electrolysis of its molten oxide

B electrolysis of its aqueous sulfate

C reduction of its oxide by heating with hydrogen

D reduction of its oxide by heating with coke

- 24 High carbon steel is used in manufacturing processes.

Which physical properties does high carbon steel possess?

- (i) brittle
- (ii) malleable
- (iii) soft
- (iv) strong

- A (i) and (ii) only
- ~~B (i) and (iv) only~~
- C (ii) and (iii) only
- D (iii) and (iv) only

- 25 Scrap iron is often recycled.

Which of the following is **not** a correct reason for recycling?

- A It reduces the amount of pollution at the site of the ore extraction.
- B It reduces the amount of waste taken to landfill sites.
- ~~C It reduces the need to collect the scrap iron.~~
- D It saves natural resources.

- 26 Tellurium, Te, is in the same group of the Periodic Table as sulfur. What is the formula of potassium tellurate?

- A K_2Te
- B $KTeO_4$
- ~~C K_2TeO_4~~
- D K_2TeO_3

- 27 X, Y and Z are elements in the same period of the Periodic Table. X forms a covalent chloride, Y forms an ionic chloride and Z can form both types of chloride.

If X, Y and Z are placed in ascending order of atomic number, which of the following is correct?

- A X, Y, Z
- B X, Z, Y
- C Y, X, Z
- D Y, Z, X

- 28 Element X is a solid at room temperature.

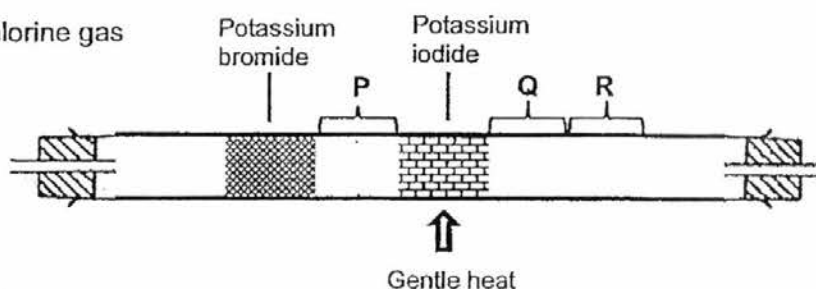
It is able to lose one or two electrons per atom to achieve electronic structure of a noble gas. It does not react with water or steam.

What is element X?

- A K
B Ca
C Zn
D Cu

- 29 Using the apparatus shown, chlorine gas is passed through the tube.

After a while, coloured substances are seen at regions P, Q and R.



What are these coloured substances?

	at P	at Q	at R
A	green gas	violet vapour	black solid
B	green gas	red brown vapour	violet vapour
C	red brown vapour	violet vapour	black solid
D	violet vapour	red brown vapour	red brown vapour

- 30 The scheme shows four stages, (i) to (iv), in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.

- (i) $C_{30}H_{62}(s) \rightarrow C_{30}H_{62}(l)$
 (ii) $C_{30}H_{62}(l) \rightarrow C_{30}H_{62}(g)$
 (iii) $C_{30}H_{62}(g) + 45.5 O_2(g) \rightarrow 30 CO_2(g) + 31 H_2O(g)$
 (iv) $30 CO_2(g) + 31 H_2O(g) \rightarrow 30 CO_2(g) + 31 H_2O(l)$

Which stages are exothermic?

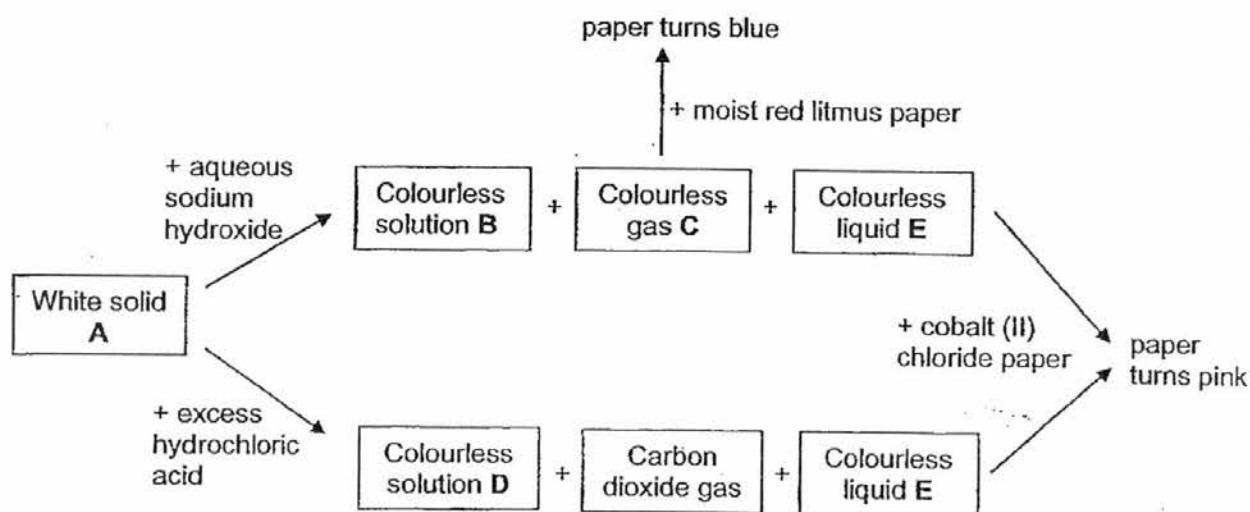
- A (i) and (ii)
B (ii) and (iii)
C (iii) and (iv)
D (i) and (iv)

End of Section A

Candidate Name _____

Section B [40 MARKS]Answer **all** the questions in the spaces provided.

- 1 The scheme below shows some reactions of substance **A**.



- (a) Identify substances **A**, **B**, **C**, **D** and **E**.

A ammonium carbonate or $(\text{NH}_4)_2\text{CO}_3$ [1]

B sodium carbonate or Na_2CO_3 [1]

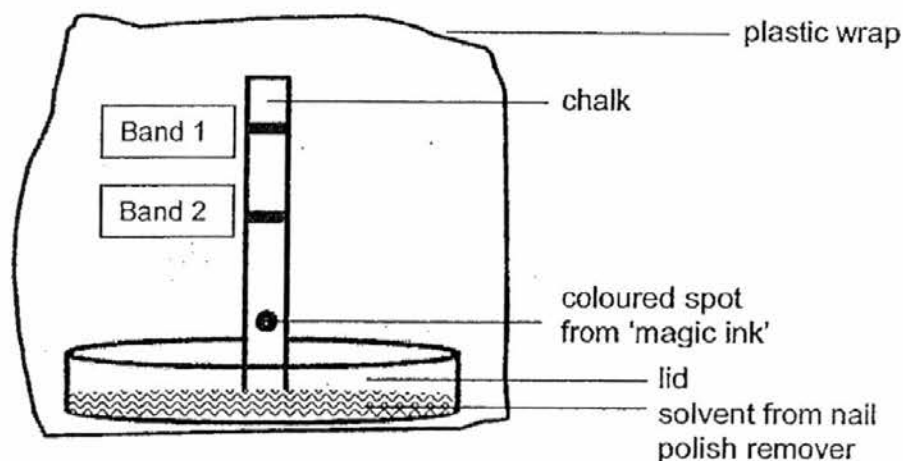
C ammonia gas / NH_3 [1]

D ammonium chloride / NH_4Cl [1]

- (a) Both the reactions produced **E**. What is the compound responsible for the colour change observed in the cobalt (II) chloride paper?

Water / H_2O [1]

- 2 A teacher gave a project of using household materials to conduct experiments. The pupils prepared chalk, nail polish remover, 'magic pen', plastic wrap and a lid from a container. The pupils set up the experiment as shown before covering with a plastic wrap.



- (a) Name the process described above.

Chromatography [1]

- (b) Suggest why the pupils used nail polish remover as the solvent.

coloured spot from the 'magic ink' is soluble in nail polish remover [1]

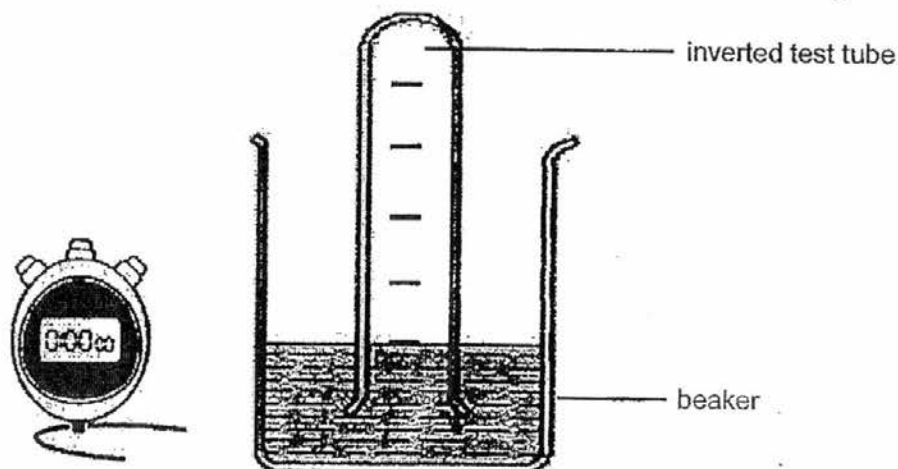
- (c) After 20 minutes, two coloured bands, namely band 1 and band 2 were formed on the chalk. Band 1 is more soluble than band 2.
Draw the coloured bands on the diagram.

[1]

- (d) Why do you think the pupils cover the set-up with a plastic wrap?

The solvent in the nail polish removal has a low boiling point and the solvent will evaporate [1]

- 3 The diagram below shows an apparatus for measuring the rates of diffusion of gases.



The timings taken for 100cm^3 of some gases at r.t.p to diffuse from this apparatus set-up are shown in the table below. The melting and boiling points of the gases have also been included.

gas	time/s	Melting points/ $^{\circ}\text{C}$	Boiling points/ $^{\circ}\text{C}$
CO	132	-205	-192
CH ₄	100	-182	-162
N ₂		-210	-196
O ₂	141	-219	-183

- (a) Name the gas that diffuses the fastest?

methane [1] reject writing formula

- (b) Suggest the time nitrogen (N₂) would take.

132 s [1]

- (c) Why is this set-up unsuitable for finding the rate of diffusion of ammonia?

Ammonia is soluble in water [1]

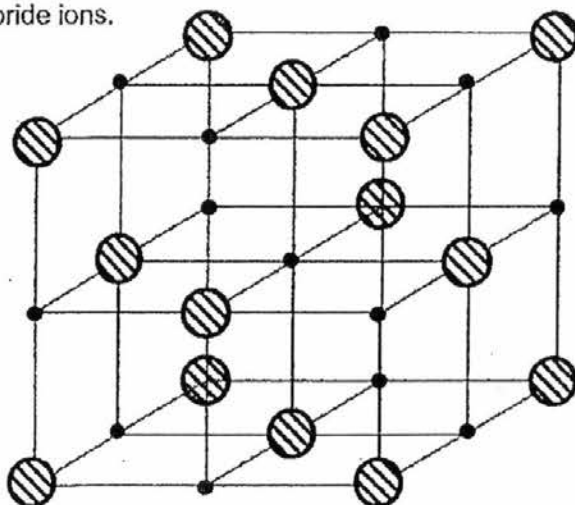
- (d) At -200°C , which of the gases will exist in liquid state.

CO, N₂, O₂ [2]
 3 correct 2 mks
 2 correct 1 mk
 1 correct 0 mk

236

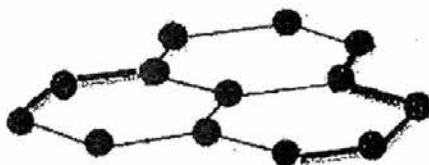
Complete each of the following diagrams as instructed.

- 4 (a) Complete the diagram of sodium chloride lattice by inserting ● for sodium ions and for  chloride ions.



[2]

- (b) Complete the diagram of one layer of graphite structure by adding more ● for carbon atoms and drawing the bonds between the carbon atoms.



[1]

- (c) Using the structure given in (b), explain why graphite is soft and can conduct electricity.

In graphite, there are weak intermolecular forces of attraction in between the layers, causing the layers to be able to slide, hence graphite is soft.

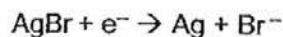
Each carbon atom has one unbonded electron, this electron is delocalized and can carry electric charges and conduct electricity.

4 points – [3]

3 points – [2]

2 points – [1]

- 5 In the basis of photography, the light sensitive silver bromide is used to make photographic film. Photographic paper coated in silver bromide is produced by bringing solutions of aqueous silver nitrate and aqueous potassium bromide into contact on the paper in the absence of light. A photographic image of an object can be obtained when the paper is exposed to strong light:



By rinsing the exposed film with sodium thiosulfate, light-sensitive silver bromide goes into solution. The black and white negatives of the image taken will be developed.

- (a) (i) Write an equation for the reaction between silver nitrate and potassium bromide.
 $\text{AgNO}_3 + \text{KBr} \rightarrow \text{AgBr} + \text{KNO}_3$ [1]

- (ii) Is the above reaction a redox reaction? Give a reason.

It is not a redox reaction [1].

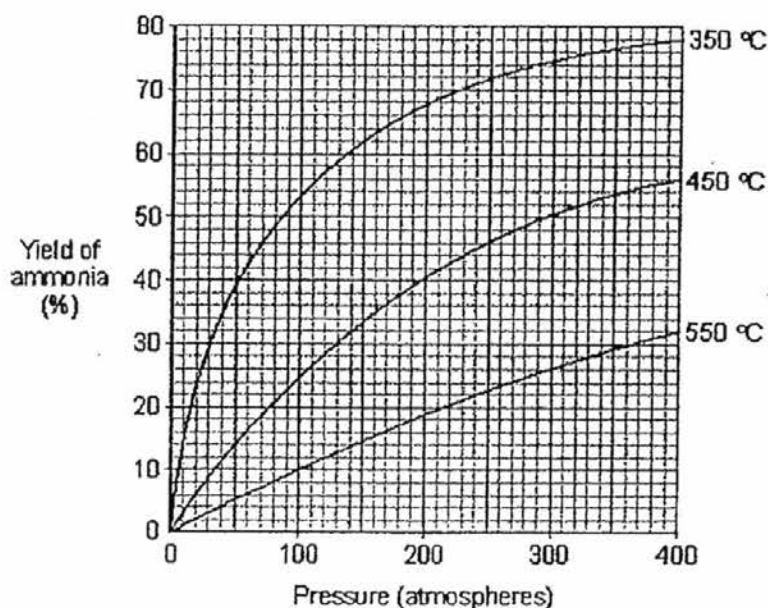
Both the o.s of silver in AgNO_3 and AgBr is +1 while the o.s of bromine in KBr and AgBr is -1. [1]

- (b) Consider the equation given by the passage. Identify the substance that has been reduced and give a reason for your answer.

Silver ion in silver bromide [1]

o.s of silver decreases from +1 in AgBr to 0 in Ag [1]

- 6 Ammonia is manufactured by hydrogen and nitrogen respectively. The reaction is *reversible* which leads to a formation of an equilibrium mixture containing hydrogen, nitrogen and ammonia respectively. The graph shows the percentage of ammonia in the equilibrium mixture plotted against pressure for three different temperatures.



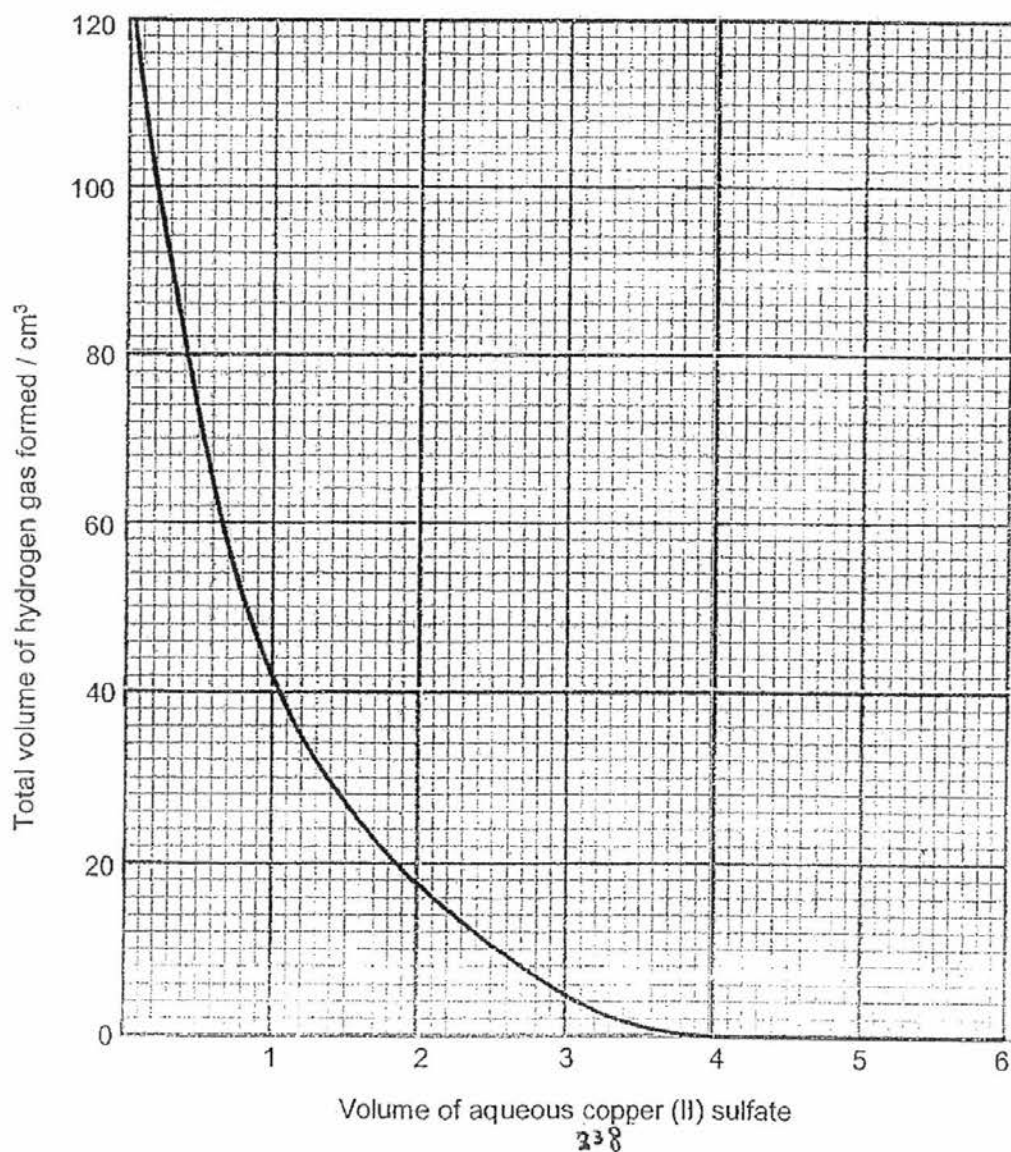
- (a) Write the equation for the above reaction for the manufacturing process of ammonia using hydrogen and nitrogen as the reagents.
- $$\text{N}_2 + 3 \text{H}_2 \rightleftharpoons 2 \text{NH}_3$$
 [1]
- (b) What is meant by the term *reversible*?
- The reaction occurs in both forward and backward directions [1]
- (c) With reference to the graph, explain the effect of increasing pressure on the percentage of ammonia in the equilibrium mixture.
- Increase pressure increase the yield of reaction [1]
- (d) With reference to the graph, suggest why the above process is normally carried out at 450°C rather than 550°C despite the fact that an increase in temperature should lead to an increase in the speed of reaction.

from the graph, the maximum yield at 550°C is less than the maximum yield at 450°C.
[1]

- 7 A chemist wanted produce a salt zinc chloride by reacting zinc granules with dilute hydrochloric acid. In order to speed up the reaction, he added aqueous copper (II) sulfate solution as a catalyst.

The data showed volume of gas evolved and volume of aqueous copper (II) sulfate used.

Volume of gas evolved / cm^3	Volume of aqueous copper (II) sulfate used / cm^3
120	0
40	1
17	2
4	3
0	4
0	5
0	6



- (a) Plot a graph of volume of gas evolved against volume of aqueous copper (II) sulfate. [2]
- (b) Describe a test used to identify the gas evolved in this experiment.
Place a lighted splint at the mouth of the test tube containing the gas. [1]
If the gas extinguished the splint with a 'pop' sound, then the gas is hydrogen [1]
- (c) The chemist used aqueous copper (II) sulfate as a catalyst. With the aid of an equation, explain why it is not a desirable choice.
Zinc is more reactive than copper, there will be a displacement reaction. [1]
$$\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$$
 [1]
- (d) Outline the steps taken to produce zinc chloride salt using zinc and hydrochloric acid.
Add excess zinc powder to the warm hydrochloric acid and stir well [1]
Filter the unreacted zinc powder [1]
Evaporate the filtrate till saturation [1]
Allow the solution to cool [1]
Rinse the crystals with distilled water and dry between sheets of filter paper [1]

End of Section B

Section C [30 MARKS]

Answer all three questions in the spaces provided.

- 8 The table gives the estimated percentages by mass of the substances found in the Universe, the Earth's core and the Earth's crust.

Other planets	%	Earth's core	%	Earth's crust	%
Hydrogen	90.0	Iron	35.0	Oxygen	52.5
Helium	8.9	Oxygen	28.0	Silicon	31.0
Carbon	1.0	Magnesium	17.0	Aluminium	6.0
Oxygen		Silicon	13.0	Iron	5.0
Manganese		Nickel	2.7	Calcium	4.0
Iron		Aluminium	0.1	Titanium	0.5
Sulfur		Sodium	0.1	Hydrogen	0.15
Silicon		Hydrogen	0.05	Nickel	0.05

- (a) (i) Calculate the combined percentage of oxygen, manganese, iron, sulfur and silicon found in other planets.

0.1 % [1]

- (ii) Suggest two reasons why other planets are not suitable for mankind to live in.

There is large percentage of hydrogen gas which is explosive when there is flame source [1] There is too little percentage of oxygen gas which is needed to support lives (living) / respiration etc. [1]

- (b) Which element is more common in the other planets than it is in either the Earth's crust or the Earth's core?

Hydrogen [1]

- (c) Which metal is more abundant in the Earth's crust than it is in Earth's core?

Aluminium [1]

- (d) Which two metals are more abundant in the Earth's core than it is in Earth's crust?

Iron and Nickel [2] accept Magnesium

- (e) The conditions of the Earth's core is 5000 °C with extreme pressure while of the Earth's crust is less than 600 °C. Suggest why the figures for the percentages of the substances in the Earth's core may not be reliable.

The substance might changed into vapour/liquid states which is in constant motion.

Hence the exact composition cannot be obtained [1]

- 9 Use the information in the table to answer the questions.

element	density of element at r.t.p in g/cm ³	formula of oxide(s)
J	0.003214	J ₂ O
L	3.10	L ₂ O
M	0.0899	None
Q	0.53	Q ₂ O
R	0.97	R ₂ O
T	2.07	TO ₂ ; TO ₃
X	3.00	X ₂ O ₃
Z	7.86	ZO ; Z ₂ O ₃

- (a) Which element is a noble gas? Give a reason for your choice.

M [1] it did not form any oxides. [1]

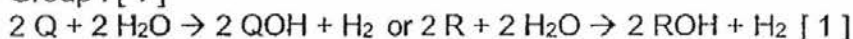
- (b) Suggest the identity of T. Give a reason for your choice.

chromium / manganese [1]

chromium / manganese can form ions of charge +4 and +6 [1]

- (c) Both Q and R are from the same Group of the periodic table. Suggest the Group number. Write an equation of Q/R with water.

Group I [1]



- (d) Both J and L are elements from Group VII.

- (i) Suggest the colour and state of J.

Pale yellow + gas or yellow green and gas [1]

- (ii) Outline an experiment to investigate which element, J or L is more reactive. Write an equation for the above experiment.

(1) Bubble aqueous J into a salt solution of L. [1]

(2) Observe if there is a colour change and record in a table. [1]

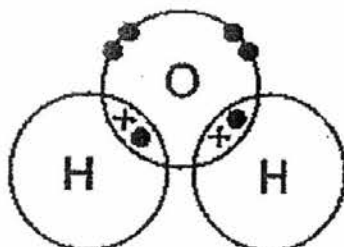
(3) Repeat step 1 but use aqueous L into a salt solution of J. [1]

(4) The reaction that produces the colour change is the more reactive element. [1]



10 Most of the reactions in chemistry involved water.

(a) Draw a 'dot and cross' diagram to show the bonding in water.

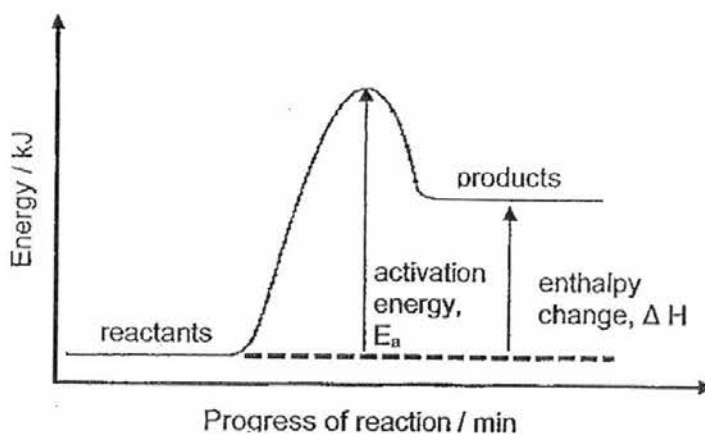


[2]

Water is either used as a solvent for dissolving solutes or in reactions to produce useful compounds. Part (b) and (c) shows 2 different interactions of substances with water.

(b) Water can be used to dissolve ammonium nitrate to make a cold pack. Cold pack is useful in remote areas where an ice pack is unavailable. When the inner bag of water is broken by squeezing the cold pack, it will dissolve the solid. This reaction absorbs heat from the surroundings, quickly lowering the pack's temperature.

The energy profile diagram shows the reaction between ammonium nitrate and water.



(i) Is the above reaction exothermic or endothermic? Explain your answer using the energy profile diagram given.

Endothermic. [1] energy level at the end of reaction is greater than at the start of reaction. [1] Accept : Enthalpy change is positive.

(ii) Label the energy profile diagram with the phrases " reactants ", " products ", " enthalpy change, ΔH " and " activation energy, E_a ".

[all 4 correctly labelled sections -2 mk ; any 2 correctly labelled sections- 1 mk]

- (c) Metal **G** reacts with water readily to form hydroxides; metal **H** reacts with both water and steam to produce basic oxides ; metal **I** reacts with steam to form an amphoteric oxide ; metal **J** reacts slowly with steam and it also reacts with water and oxygen to form reddish brown oxides.

- (i) Rank the reactivity of metals **G, H, I** and **J** in ascending order of reactivity.

J, I, H, G [1]

- (ii) Name the reaction between metal **J** with water and oxygen. Suggest a way to prevent metal **J** from reacting with water and oxygen.

Rusting [1]. Accept oxidation, corrosion

Oil/painting/greasing/coat with plastic/galvanizing/ electro-plating [1]

- (iii) **J** can be extracted from its oxide by reacting with coke (C). Write a balanced equation for the reaction between the oxide of **J** and coke.



End of Section C

The Periodic Table of the Elements

Group

I	II											III	IV	V	VI	VII	0		
7 Li lithium 3	9 Be beryllium 4											1 H hydrogen 1	11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10	4 He helium 2
23 Na sodium 11	24 Mg magnesium 12											13 Al aluminium 13	27 Si silicon 14	28 P phosphorus 15	31 S sulfur 16	32 Cl chlorine 17	35.5 Ar argon 18	40 K potassium 19	40 Ca calcium 20
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	86 Rn radon 86	
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	101 Ru ruthenium 44	101 Rh rhodium 45	103 Pd palladium 46	106 Ag silver 47	108 Cd cadmium 48	112 In indium 49	115 Sn tin 50	119 Sb antimony 51	122 Te tellurium 52	127 I iodine 53	131 Xe xenon 54	136 Kr krypton 36	136 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	187 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	210 Po polonium 84	210 At astatine 85	222 Rn radon 86	222 Rn radon 86	
87 Fr francium 87	88 Ra radium 88	89 Ac actinium 89																86 Rn radon 86	

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	147 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	238 Pa protactinium 91	238 U uranium 92	238 Np neptunium 93	244 Pu plutonium 94	244 Am americium 95	244 Cm curium 96	244 Bk berkelium 97	244 Cf californium 98	244 Es einsteinium 99	244 Fm fermium 100	244 Md mendelevium 101	244 No nobelium 102	244 Lr lawrencium 103

Key

a

X

b

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

*58-71 Lanthanoid series

†90-103 Actinoid series

The volume of one mole of any gas is 24dm³ at room temperature and pressure