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Name: _____ Class: _____ Reg. No. : _____



ST JOSEPH'S INSTITUTION

SECONDARY 4 PRELIMINARY EXAMINATION

CHEMISTRY

5073 / 01

Paper 1 Multiple Choice

27 August 2014

1 hour

Additional Materials: Multiple Choice Answer Sheet

(08:00 – 09:00 h)

READ THESE INSTRUCTIONS FIRST

Write your answers in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and index number on the cover page of this Question Booklet and on the separate Answer Sheet.

There are **forty** questions on this paper. 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 choice in soft pencil on the separate Answer Sheet.

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

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 2.

At the end of the examination, hand in the Question Booklet and Answer Sheet.

This document consists of **20** printed pages.

[Turn over]

DATA SHEET
The Periodic Table of the Elements

Group																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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7 Li Lithium 3																	9 Be Beryllium 4																	11 Na Sodium 11																	12 Mg Magnesium 12																	13 Al Aluminum 13																	14 Si Silicon 14																	15 P Phosphorus 15																	16 S Sulfur 16																	17 Cl Chlorine 17																	18 Ar Argon 18																	19 K Potassium 19																	20 Ca Calcium 20																	21 Sc Scandium 21																	22 Ti Titanium 22																	23 V Vanadium 23																	24 Cr Chromium 24																	25 Mn Manganese 25																	26 Fe Iron 26																	27 Co Cobalt 27																	28 Ni Nickel 28																	29 Cu Copper 29																	30 Zn Zinc 30																	31 Ga Gallium 31																	32 Ge Germanium 32																	33 As Arsenic 33																	34 Se Selenium 34																	35 Br Bromine 35																	36 Kr Krypton 36																	37 Rb Rubidium 37																	38 Sr Strontium 38																	39 Y Yttrium 39																	40 Zr Zirconium 40																	41 Nb Niobium 41																	42 Mo Molybdenum 42																	43 Tc Technetium 43																	44 Ru Ruthenium 44																	45 Rh Rhodium 45																	46 Pd Palladium 46																	47 Ag Silver 47																	48 Cd Cadmium 48																	49 In Indium 49																	50 Sn Tin 50																	51 Sb Antimony 51																	52 Te Tellurium 52																	53 I Iodine 53																	54 Xe Xenon 54																	55 Cs Cesium 55																	56 Ba Barium 56																	57 La Lanthanum 57																	58-71 Lanthanoid series																	72 Hf Hafnium 72																	73 Ta Tantalum 73																	74 W Tungsten 74																	75 Re Rhenium 75																	76 Os Osmium 76																	77 Ir Iridium 77																	78 Pt Platinum 78																	79 Au Gold 79																	80 Hg Mercury 80																	81 Tl Thallium 81																	82 Pb Lead 82																	83 Bi Bismuth 83																	84 Po Polonium 84																	85 At Astatine 85																	86 Rn Radon 86																	87 Fr Francium 87																	88 Ra Radium 88																	89-103 Actinoid series																	104 Ce Cerium 58																	105 Pr Praseodymium 59																	106 Nd Neodymium 60																	107 Pm Promethium 61																	108 Sm Samarium 62																	109 Eu Europium 63																	110 Gd Gadolinium 64																	111 Tb Terbium 65																	112 Dy Dysprosium 66																	113 Ho Holmium 67																	114 Er Erbium 68																	115 Tm Thulium 69																	116 Yb Ytterbium 70																	117 Lu Lutetium 71																	118 Th Thorium 90																	119 Pa Protactinium 91																	120 U Uranium 92																	121 Np Neptunium 93																	122 Pu Plutonium 94																	123 Am Americium 95																	124 Cm Curium 96																	125 Bk Berkelium 97																	126 Cf Californium 98																	127 Es Einsteinium 99																	128 Fm Fermium 100																	129 Md Mendelevium 101																	130 No Nobelium 102																	131 Lr Lawrencium 103																

a

X

b

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

58-71 Lanthanoid series
90-103 Actinoid series

*58-71 Lanthanoid series
190-103 Actinoid series

Key

a	X
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.).

- 1 The melting point of lithium chloride is 605°C and the boiling point of water is 100°C . What is the most likely boiling point of a sample of water that contains a small quantity of lithium chloride?
- A 600°C B 456°C C 104°C D 90°C
- 2 Which of the following observations suggests that matter exists as very small, moving particles?
- A Solids will melt when heated.
B Some gases are less dense than air, but others are more dense.
C The smell of scent soon fills a room when the bottle is opened.
D Gold can be beaten into sheets.
- 3 Which one of the following substances
- (i) is an element;
(ii) also forms crystals composed of small molecules?
- A copper B graphite
C ice D Iodine
- 4 A flask contains the liquids trichloromethane and water. They are separated using a separating funnel. Which conclusion can be made from these observations?
- A Trichloromethane and water have different masses.
B Trichloromethane and water have different boiling points.
C Trichloromethane has a different density compared to water.
D Trichloromethane and water do not mix.

- 5 A mixture of solids is treated with excess dilute sulfuric acid. A colourless gas is evolved and some, but not all, of the mixture dissolves. What could the mixture contain?
- A Ammonium hydroxide and potassium oxide
 - B Copper(II) carbonate and lead(II) oxide
 - C Iron(II) carbonate and zinc oxide
 - D Magnesium carbonate and iron(II) chloride
- 6 Which of the following solutions can be used to distinguish between aqueous sodium hydroxide and aqueous ammonia?
- A Copper(II) sulfate solution
 - B Iron(II) chloride solution
 - C Potassium chloride solution
 - D Zinc nitrate solution
- 7 In which one of the following sets do all three particles have the same total number of electrons?
- | | | | |
|---|---------------|---------------|---------------|
| A | Cl^- | Br^- | I^- |
| B | F^- | Ne | Na^+ |
| C | H^- | H | H^+ |
| D | Li^+ | Na^+ | K^+ |
- 8 An element X forms compounds having the formulae Na_2X , XO_2 and XO_3 . What is X likely to be?
- | | |
|------------|------------|
| A carbon | B chlorine |
| C nitrogen | D sulfur |

- 9 Which one of the following atoms, A, B, C or D, would readily form an ion with a charge of +2?

	<i>Mass number</i>	<i>Atomic (proton) number</i>
A	12	6
B	16	8
C	24	12
D	31	15

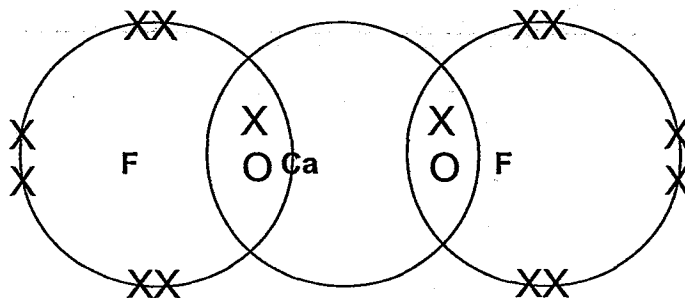
- 10 What particles are present in solid lead(II) bromide and in molten lead(II) bromide?

	<i>Solid lead(II) bromide</i>	<i>Molten lead(II) bromide</i>
A	ions	ions and electrons
B	ions	ions
C	molecules	ions
D	molecules	molecules

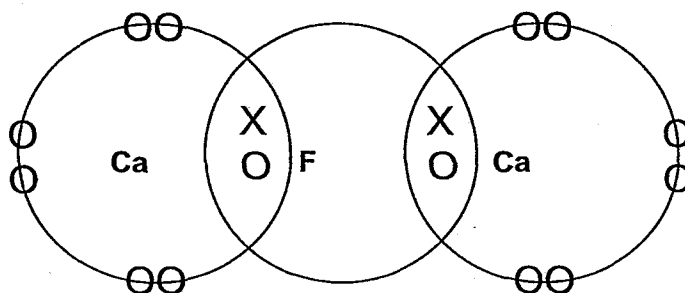
- 11 The formation of charged particles to produce an ionic compound is due to
- A the charging of the atoms by friction as they collide with each other.
 - B the sharing of electrons between metallic and non-metallic atoms.
 - C the passage of an electric current through the compound.
 - D the transfer of electrons from metallic to non-metallic atoms.
- 12 What is formed when an element X of proton (atomic) number 19 reacts with an element Y of proton (atomic) number 17?
- A A covalent compound of formula XY.
 - B A covalent compound of formula XY₂.
 - C An ionic compound of formula XY.
 - D An ionic compound of formula XY₂.

- 13 Which of the following diagrams shows the electron arrangement in calcium fluoride? (NB Only the outermost electrons of each atom or ion are shown)

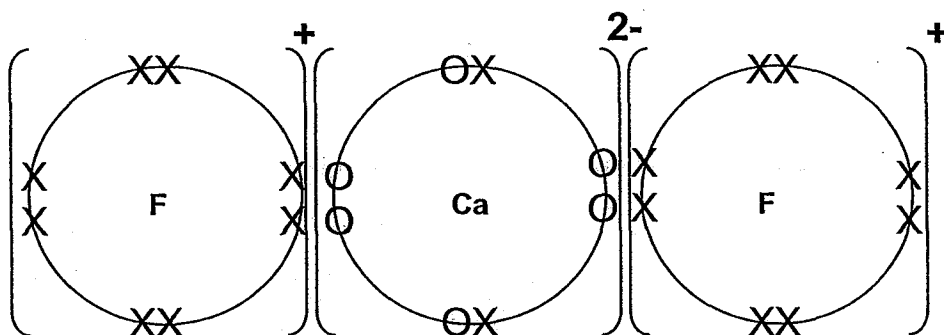
A



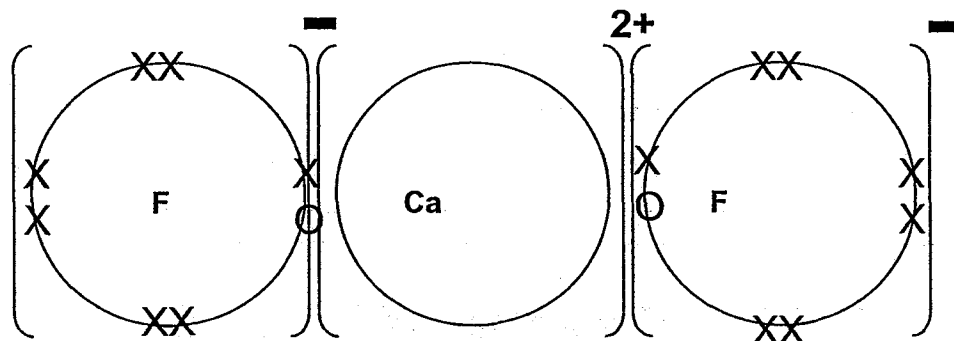
B



C



D



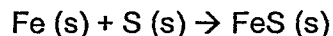
- 14 A 10g sample of metal oxide of chemical formula MO_2 was found to contain 4g of oxygen. What is the identity of the metal?

A Iron
B Lead
C Titanium
D Zinc

- 15 Which of the following compounds contains the highest percentage by mass of carbon?

A Carbon dioxide
B Sodium carbonate
C Ammonium carbonate
D Carbon monoxide

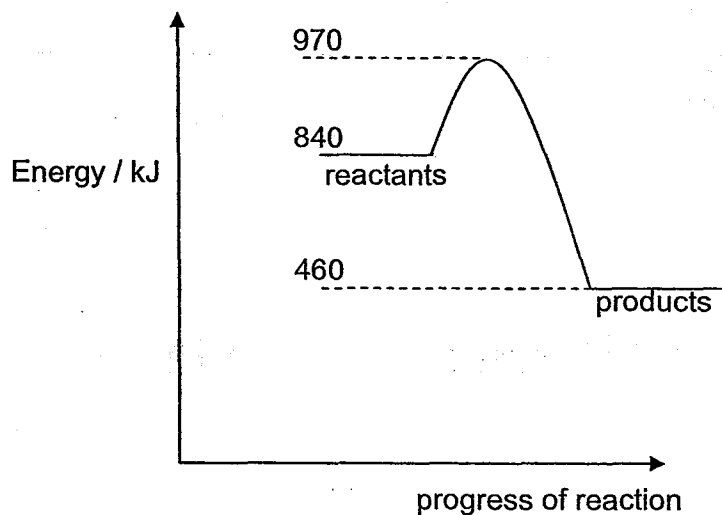
- 16 Steel pans sometimes blacken because of the sulfur coming from the proteins in the eggs reacting with iron to form iron(II) sulfide.



What mass of iron(II) sulfide is formed from using the pans to fry a hundred eggs each containing 0.032g of sulfur?

A 0.88g
B 8.8g
C 88g
D 5.6g

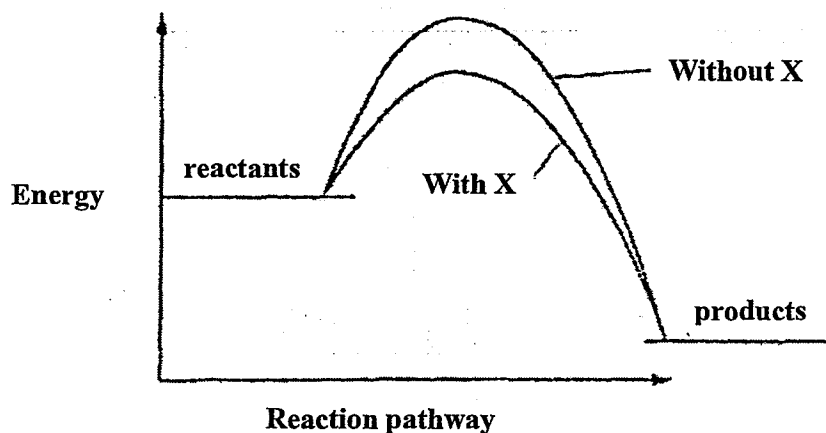
- 17 The diagram below shows the energy profile diagram for a chemical reaction.



Which of the following statements is true?

- A The reaction is endothermic with activation energy of 970 kJ.
- B The reaction is endothermic with 460 kJ of heat taken in.
- C The reaction is exothermic with activation energy of 510 kJ.
- D The reaction is exothermic and 380 kJ of heat energy is given out.

- 18 The energy profile diagram shows how adding substance X to a reaction mixture changes the reaction pathway.

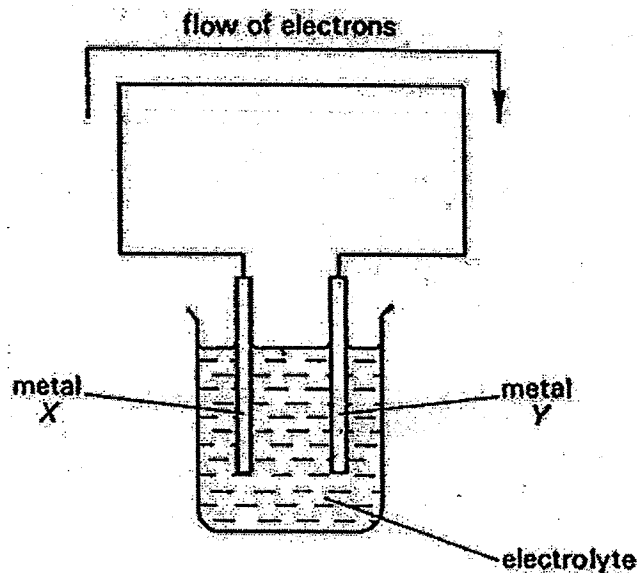


Which of the following changes is likely to be observed when X is added to the reaction mixture?

- A The reaction becomes less endothermic.
 - B The reaction becomes more exothermic.
 - C The activation energy decreases.
 - D The energy level of the reactants decreases.
- 19 What are the products of the electrolysis of concentrated aqueous sodium chloride using inert electrodes?

	Anode (+)	Cathode (-)
A	chlorine	hydrogen
B	chlorine	sodium
C	oxygen	chlorine
D	oxygen	hydrogen

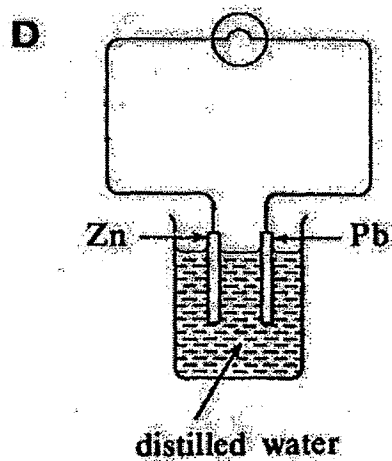
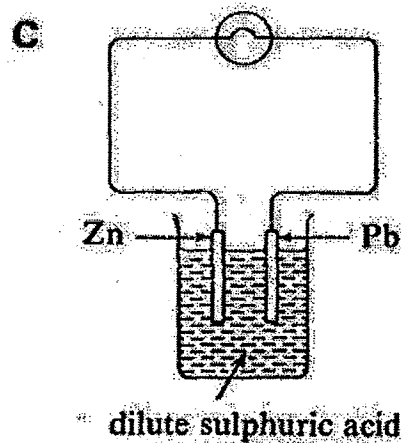
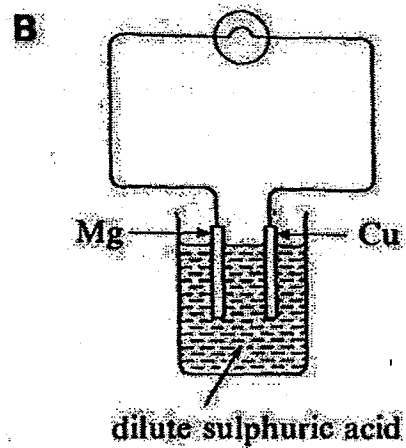
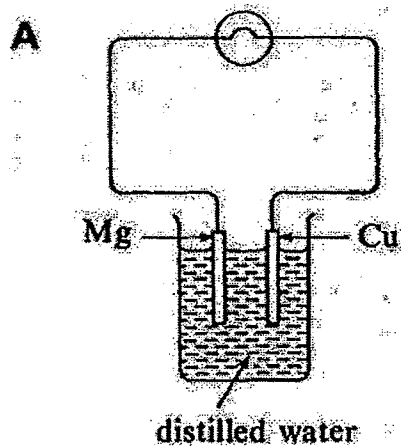
- 20 The apparatus shown in the diagram below is set up.



For which one of the following pairs of metals would electrons flow as shown in the diagram?

	<i>Metal X</i>	<i>Metal Y</i>
A	copper	zinc
B	iron	aluminium
C	lead	magnesium
D	zinc	lead

- 21 In which of the following cells would the bulb be expected to shine the brightest?



- 22 If the oxidation number of element X is +5, which of these formulae is correct?

- A K_2XO_4
- B $Ca(XO_3)_2$
- C KXO_5
- D PX_5

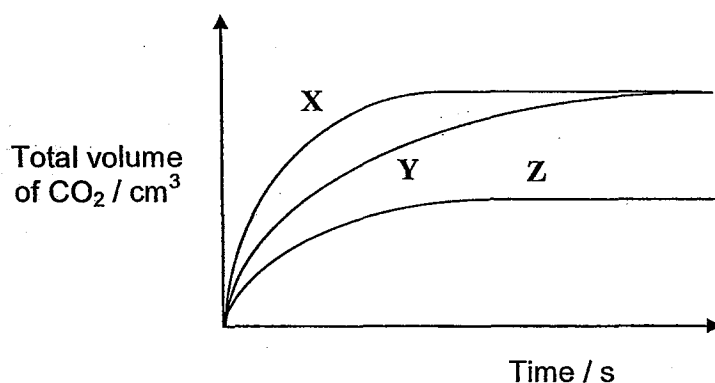
- 23 Two experiments were carried out under the same conditions of temperature and pressure, reacting marble with dilute hydrochloric acid.

In Experiment 1, an excess of powdered marble was added to 20 cm³ of dilute hydrochloric acid.

In Experiment 2, an excess of marble chips was added to 20 cm³ of dilute hydrochloric acid of the same concentration.

The total volumes of carbon dioxide given off were measured at intervals and plotted against time.

Which of the following pairs of curves would be obtained in the two experiments?

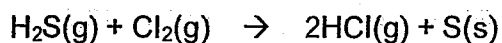


	Experiment 1 Powdered marble	Experiment 2 Marble chips
A	X	Y
B	X	Z
C	Y	X
D	Y	Z

24 Which of the following equations does not represent a redox reaction?

- A $2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$
- B $\text{Ca}^{2+}\text{(aq)} + \text{SO}_4^{2-}\text{(aq)} \rightarrow \text{CaSO}_4\text{(s)}$
- C $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$
- D $\text{Cl}_2\text{(g)} + 2\text{I}^-\text{(aq)} \rightarrow 2\text{Cl}^-\text{(aq)} + \text{I}_2\text{(aq)}$

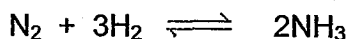
25 The reaction between hydrogen sulfide and chlorine is as follows



In this reaction,

- A chlorine is the reducing agent.
 - B chlorine is oxidised to hydrogen chloride.
 - C hydrogen sulfide is oxidised to sulfur.
 - D the oxidation number of hydrogen has increased.
- 26 Which of the following statements is correct about the chemical reactions of dilute ethanoic acid, dilute hydrochloric acid and dilute sulfuric acid?
- A They all dissociate fully to produce hydrogen ions in water.
 - B They all react with copper(II) oxide to release hydrogen gas.
 - C They all react with silver nitrate to form insoluble salts.
 - D They all react with aqueous potassium hydroxide to form soluble salts.
- 27 Which of the following salts is the most suitable to be prepared by titration method?
- A Ammonium nitrate
 - B Barium sulfate
 - C Copper(II) nitrate
 - D Magnesium chloride

- 28 Nitrogen and hydrogen react according to the equation:



A high yield of ammonia is favoured by conditions of high pressure and low temperature. However, in practice, a high temperature is employed because at low temperatures,

- A lower frequency of effective collisions occur.
 - B ammonia liquefies.
 - C the catalyst is inactive.
 - D the reacting gases do not have to be very pure.
- 29 The table shows the proton (atomic) number of four elements.

Element	W	X	Y	Z
Proton (atomic) number	9	11	17	19

Which statement is correct?

- A W is a metal
 - B X is more reactive than Z
 - C W is more reactive than Y
 - D Y and Z are in the same period
- 30 An element in the third period of the Periodic Table (sodium to argon) is a non-conductor of electricity and forms an acidic oxide that is very soluble in water. What is the element?
- A Aluminium
 - B Magnesium
 - C Silicon
 - D Sulfur

- 31 Iron filings are wrapped in a damp cloth and left to rust in the apparatus as shown in Fig. 31.1. Which letter in Fig. 31.2 indicates the water level when rusting has finished?

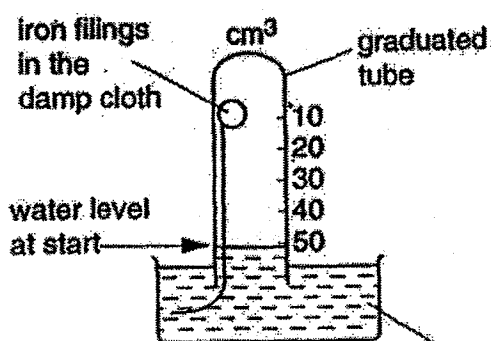


Fig. 31.1

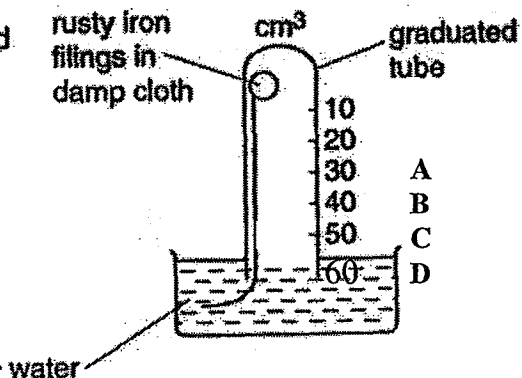
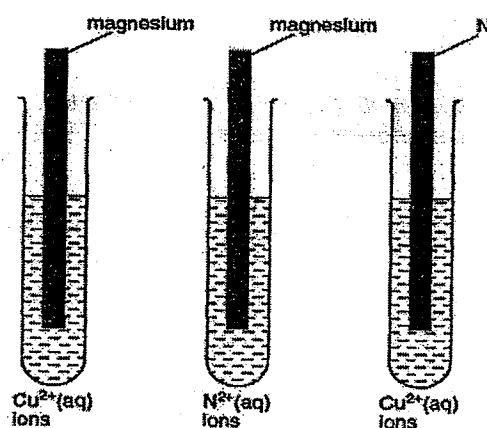


Fig. 31.2

- 32 Which statement about the production of iron from iron(III) oxide in a blast furnace is NOT correct?
- A The iron(III) oxide is reduced by carbon monoxide.
 - B Carbon dioxide reacts with coke to form carbon monoxide.
 - C Calcium silicate is formed by the reaction of limestone with sand.
 - D Molten iron formed is more dense than molten slag.

- 33 Three test tubes were arranged as in the diagrams below. The tests were conducted to determine the reactivity of three metals (Mg, Cu and an unknown metal N). Each test tube contained a piece of one metal, half-immersed in an aqueous solution containing the ions of one of the other two metals. A deposit was formed in all three test tubes.



Metal N could be

- A Aluminium
 - B Calcium
 - C Silver
 - D Zinc
- 34 In which pair do both pollutants cause damage to buildings?
- A Carbon monoxide and chlorofluorocarbons
 - B Carbon monoxide and sulfur dioxide
 - C Ozone and nitrogen dioxide
 - D Nitrogen dioxide and sulfur dioxide

35 Water can be formed by a number of reactions involving organic substances. Which reaction does not produce water?

- A Fermentation of glucose.
- B Incomplete combustion of ethane.
- C Oxidation of propanol.
- D Reaction of methanol with methanoic acid.

36 A carboxylic acid has two carbon-carbon double covalent bonds. What could its molecular formula be?

- A $C_{16}H_{33}CO_2H$
- B $C_{16}H_{29}CO_2H$
- C $C_{17}H_{39}CO_2H$
- D $C_{17}H_{35}CO_2H$

37 Compound X has the molecular formula C_2H_6O .

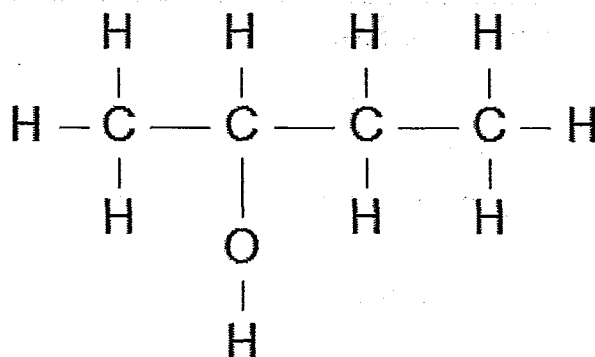
It was found that

- X can be made via fermentation process.
- X can be oxidised to Y.
- X can react with Y to form Z and water.

Which of the following show the correct identity of X, Y and Z?

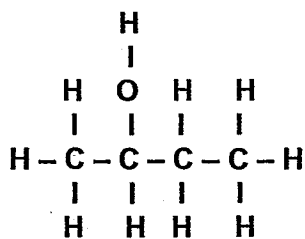
	X	Y	Z
A	propane	propanol	propyl propanoate
B	methane	ethanoic acid	ethyl methanoate
C	ethanol	ethanoic acid	ethyl ethanoate
D	ethanoic acid	ethanol	ethyl ethanoate

38 The structure of butan-2-ol is shown below.

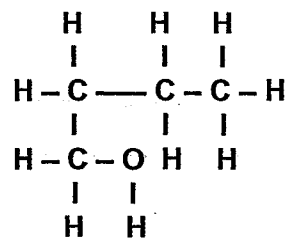


Which structure is an isomer of the structure shown above?

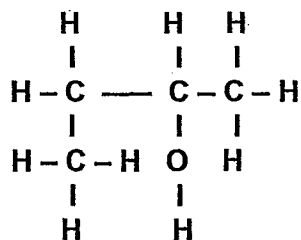
A



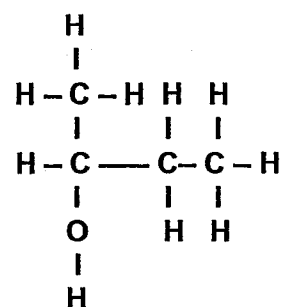
C



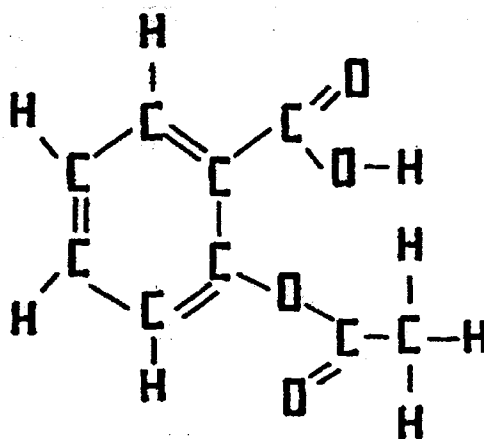
B



D

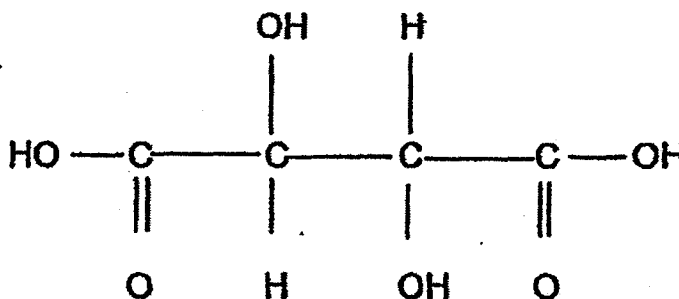


- 39 Aspirin is a drug which is used as a general painkiller. The full structural formula of aspirin is shown below.



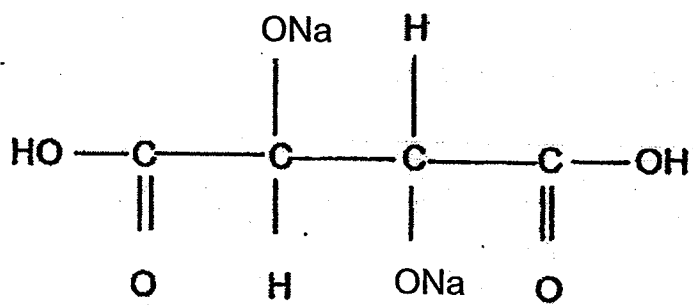
Which statement about aspirin is incorrect?

- A It can undergo substitution reaction with chlorine.
 - B Its aqueous solution reacts with sodium hydroxide.
 - C It turns acidified potassium manganate(VII) from purple to colourless.
 - D It is formed from an organic acid and an alcohol.
- 40 Tartaric acid is a white crystalline organic acid. It occurs naturally in many plants, particularly grapes, bananas and tamarinds, and is one of the main acids found in wine.

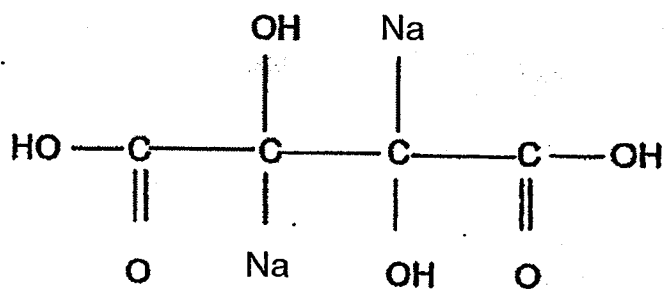


What is the formula of the salt formed when tartaric acid reacts with sodium carbonate?

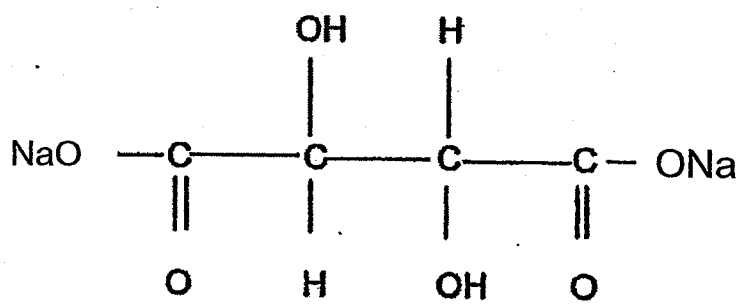
A



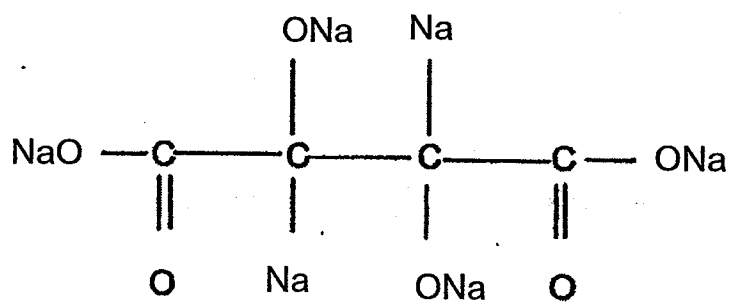
B



C



D



SJI Preliminary Examinations 2014

Chemistry 5073/1

1	C	11	D	21	B	31	B
2	C	12	C	22	B	32	C
3	D	13	D	23	A	33	D
4	D	14	C	24	B	34	D
5	B	15	D	25	C	35	A
6	A	16	B	26	D	36	B
7	B	17	D	27	A	37	C
8	D	18	C	28	A	38	C
9	C	19	A	29	C	39	C
10	B	20	D	30	D	40	C

Name: _____ Class: _____ Reg. No. : _____



ST JOSEPH'S INSTITUTION

SECONDARY 4 PRELIMINARY EXAMINATION

CHEMISTRY

5073 / 02

Paper 2 Theory

18 August 2014

Candidates answer on the Question paper.

1 hour 45 minutes
(11:00 – 12:45 h)

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions in the spaces provided.

Section B

Answer **all three** questions, the last question is in the form either/or.
Write your answers on the lined paper provided.

At the end of the examination, fasten all your work securely together for each section.

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 2.

Hand in Section A and B separately.

For Examiner's use	
Section A	
B10	
B11	
B12	
Total	

This document consists of **21** printed pages.

[Turn over]

The Periodic Table of the Elements																				
Group																				
I	II							III	IV	V	VI	VII	0							
		1 H Hydrogen																		
7 Li Lithium	8 Be Beryllium												11 B Boron	12 C Carbon	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton			
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon			
55 Cs Cesium	56 Ba Barium	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	72 Hf Hafnium			
87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium	104 Rf Rutherfordium			

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

Key

a	X
---	---

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 50.

A1 Iodine is the least reactive element in Group VII of the Periodic Table. Its compounds are used in medicine and photography and in dyes.

- (a) Solid iodine sublimes upon heating. State the change in the **arrangement** and **movement** of the particles in this process.

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[2]

- (b) (i) Silver iodide compound decomposes upon heating to produce silver and iodine gas.

Write a balanced chemical equation for the reaction.

.....

[1]

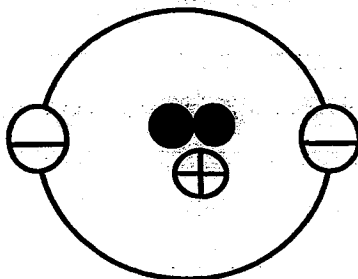
- (ii) 28g of silver iodide was decomposed and 1dm^3 of iodine gas was collected. Calculate the percentage yield of the reaction.

[3]

[Total : 6]

A2 Tritium is an isotope of hydrogen.

An ion of tritium has the following structure.



- (a) Complete the following table to show the names and the charges of the particles in this tritium ion.

Symbol	Name	Charge
●	neutron	
⊕		+1
⊖		-1

[2]

- (b) Using the symbol T to represent tritium, give the formula of

(i) the ion shown above

(ii) the compound formed between tritium and sodium. [2]

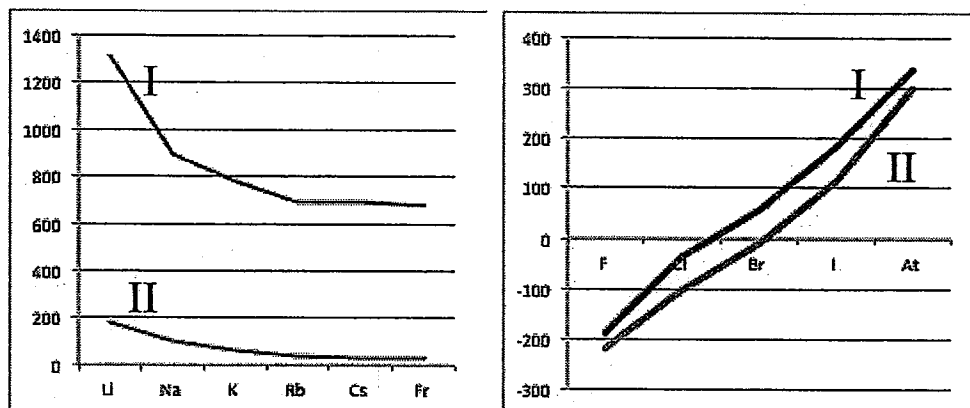
- (c) Would you expect the oxide of tritium to be a solid, a liquid or a gas at room temperature and pressure? Explain your reasoning.

.....

..... [1]

[Total : 5]

- A3** The graphs below show the melting and boiling points for elements in Group I and Group VII.



I - boiling point

II - melting point

- (a) State the trends of melting point for Group I and Group VII elements down their respective groups.

.....

[2]

- (b) Explain, using bonding and structures, the trend of melting points for Group I and Group VII elements.

.....

.....

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.....

.....

[4]

[Total : 6]

A4 The following information was found on a milk carton.

	<i>Per 100ml</i>
Proteins	3.3g
Fats	3.7g
Carbohydrates	4.7g
Calcium	120mg

- (a)** Based on the information provided, would you expect the milk to boil at a fixed temperature? Explain your answer.

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[2]

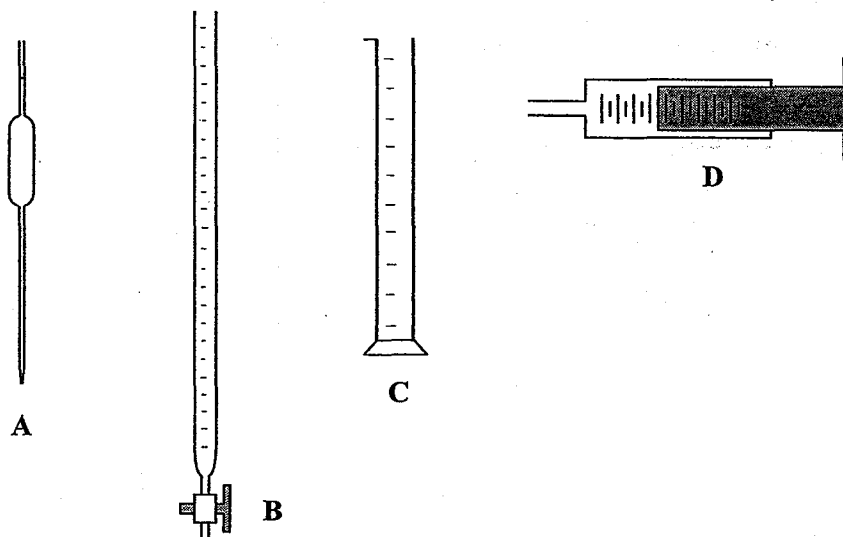
- (b) (i) Identify an element found on the milk label.

..... [1]

- (ii) State the electron arrangement of the ion of the element identified in (i).

..... [1]

- (c) Several pieces of laboratory apparatus are shown in the diagram.



Give the **letter** and **name** of the piece of apparatus best used for the following:

- (i) Delivering 25 cm^3 of milk into a carton.

..... [1]

- (ii) Delivering exactly 20.8 cm^3 of milk into a carton.

..... [1]

[Total : 6]

A5 Chlorofluorocarbons (CFCs) have been used in large quantities as solvents and aerosol propellants. CFCs are chemically inert and do not react with air or water.

When CFC molecules diffuse high up into the atmosphere they destroy the ozone layer in the stratosphere, which is about 30 kilometres from the Earth surface.

To prevent the damage of ozone, the use of CFCs is being greatly reduced and they are being replaced with other organic compounds that cause little or no harm to the ozone layer.

(a) One of the most widely used CFCs was CCl_2F_2 which can be made from methane in a series of reactions.

(i) Name the type of reaction that is used to make CCl_2F_2 from methane.

..... [1]

(ii) Explain how the destruction of ozone layer by CFCs in the stratosphere affects mankind.

.....
.....
..... [2]

- (b) A list of some CFCs in current use and their possible replacements is given in the following table.

Formula	Code Number	Potential for destroying the ozone layer (on a scale 0.0 – 1.0)
<i>Compounds in current use:</i>		
CCl_2F_2	11	1.0
$\text{CCl}_2\text{FCCl}_2\text{F}$	113	0.8
<i>Possible replacement compounds:</i>		
CH_2ClF	22	0.05
$\text{CF}_3\text{CH}_2\text{F}$	134a	0.0
$\text{CF}_3\text{CCl}_2\text{H}$	123	0.02
$\text{CH}_3\text{CCl}_2\text{F}$	141b	0.12
CH_3CHF_2	152a	0.0

- (i) Both compounds 134a and 152a do not harm the ozone layer. Suggest a reason for this.

.....

.....

[1]

- (ii) What do the formulae of compounds 22, 123 and 141b have in common that differs from the formulae of the compounds in 'current use'?

.....

..... [1]

[Total : 5]

- A6** A student conducted two experiments to find out the relative reactivity of copper and three other solid metals, X, Y and Z.

In experiment I, he heated each of the oxides of the metals in a test-tube.

In experiment II, he tested the action of metals X, Y and Z on aqueous copper(II) sulfate.

He then tabulated the results of both experiments as follows.

Experiment I	Copper(II) oxide	Oxide of X	Oxide of Y	Oxide of Z
Action of heat	No reaction	No reaction	No reaction	Metal Z is formed

Experiment II	X	Y	Z
Action on aqueous copper(II) sulfate	Copper is deposited	A gas is evolved	No reaction

- (a) Based on the experimental results, arrange the four metals, Cu, X, Y and Z in **descending** order of reactivity.

..... [1]

- (b) (i) Suggest from the reactivity series, the possible identity of metals X and Z.

..... [2]

- (ii) Based on the identity of X in (i), describe two observations that would be obtained in the reaction between X and aqueous copper(II) sulfate.

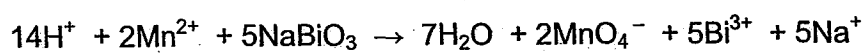
.....
.....
..... [2]

- (c) Sketch a graph of temperature of the reaction mixture versus time from the time metal X is added to the aqueous copper(II) sulfate solution until there is no further change.

[1]

[Total : 6]

A7 In acidic media, manganese(II) ions react with sodium bismuthate, NaBiO_3 , as shown below:



(a) Determine the oxidation number of bismuth in sodium bismuthate.

[1]

(b) Does sodium bismuthate undergo oxidation or reduction in this reaction? Explain your answer with reference to oxidation numbers.

.....
.....

[1]

(c) Underline the substance that acts as a reducing agent. Explain your choice in terms of oxidation numbers.

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.....
.....

[2]

[Total : 4]

A8 In parts of Africa, salts are traditionally obtained from papyrus plant ash. Plant ash is a mixture of large insoluble particles and salts which are soluble in water.

The composition and solubility of some salts found in the ash from the papyrus plant are shown in the table below

Salt	M_r	Mass of salt per 100g of ash / g	Solubility of salt in g / dm ³
Magnesium sulfate	120	5	220
Potassium carbonate	138	10	1120
Potassium chloride	64.5	18	359
Potassium sulfate	174	4	122
Sodium carbonate	106	12	70
Sodium chloride	58.5	40	359

(a) (i) Which salt in the table has the lowest solubility in mol/dm³?

..... [1]

(ii) Which negatively-charged ion is present in the highest mass in 100g of ash?

..... [1]

- (b) Describe briefly how a student may determine through experimental procedure, the mass of sulfate ions present in 100g of the ash mixture that has been dissolved in water.

.....

.....

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[4]

- (c) Another student suggested that the identity of the magnesium ion could be confirmed by adding aqueous sodium hydroxide in excess to a sample of the aqueous ash mixture.

He observed a white precipitate forming which dissolved in excess aqueous sodium hydroxide to form a colourless solution.

Do you agree with his observation? Explain.

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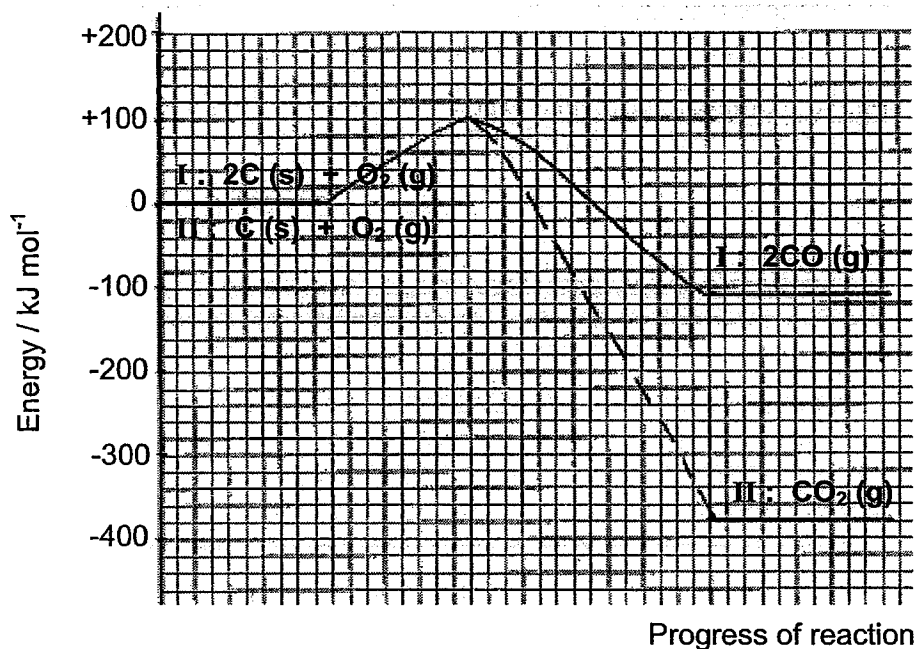
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[2]

[Total : 8]

A9 The following graphs show the energy changes which occur during the incomplete and complete combustion of one mole of carbon.



- (a) Explain, using bond breaking and bond formation, whether the reactions are exothermic or endothermic.

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.....

.....

[2]

- (b) Use the graphs to estimate the enthalpy change, ΔH , for each reaction.

For complete combustion, $\Delta H = \dots\dots\dots$ kJ / mol

For incomplete combustion, $\Delta H = \dots\dots\dots$ kJ / mol

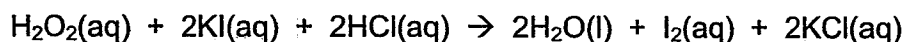
[2]

[Total : 4]

Section B

Answer all **three** questions in this section.

- B10** The speed of reaction between three compounds – hydrogen peroxide, hydrochloric acid and potassium iodide – was studied in a series of experiments.



The speed of reaction was measured as a function of the concentration of each reactant. The table below shows the results obtained.

Experiment	Concentration of H_2O_2 (mol/dm^3)	Concentration of HCl (mol/dm^3)	Concentration of KI (mol/dm^3)	Speed of reaction ($\text{mol/dm}^3/\text{s}$)
1	0.1	0.1	0.1	0.0001
2	0.2	0.1	0.1	0.0002
3	0.1	0.2	0.1	0.0001
4	0.2	0.1	0.2	0.0004

- (a) (i) Using the information given, state how the concentration of hydrogen peroxide affects the speed of reaction. [2]
- (ii) Besides hydrogen peroxide, identify another reactant whose concentration affects the speed of reaction and suggest how the speed is affected. Explain your answer using the data provided above. [2]
- (b) Sketch the graph of the concentration of hydrogen peroxide against the speed of reaction. [2]

- (c) Other than the concentration factor, state and explain using collision theory one factor that increases the speed of reaction. [2]
- (d) Explain, in terms of oxidation number, why this reaction is a redox reaction. [2]

[Total : 10]

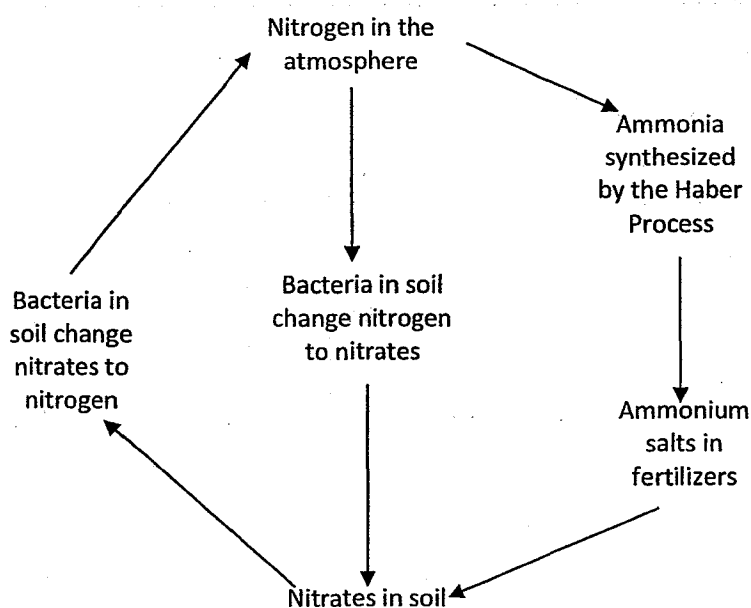
B11 A student carried out an electrolysis of dilute sulfuric acid and collected the gases formed.

- (a) Draw a labelled diagram to show the apparatus used and the products formed. [2]
- (b)
 - (i) Write half equations for the reactions at the anode and cathode. Use the half equations to construct an overall equation for the reaction and give tests for any gases evolved.
 - (ii) Use your equations to explain how the composition of the solution changes after the electrolysis has been running for some time. [5]
- (c) Electrolysis is used to coat a layer of silver onto a spoon. Starting with a metallic spoon, suggest suitable materials that can be used as the electrolyte, the anode and cathode needed to silver-plate the spoon. [3]

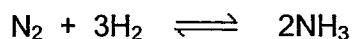
[Total : 10]

EITHER

B12 A simplified diagram of the nitrogen cycle is shown below.



- (a) Nitrogen from the atmosphere reacts with hydrogen gas to form ammonia in the Haber Process. The equation for this reaction is as follows:



The reversible reaction requires the use of a catalyst, which operates most efficiently within a temperature range of 280 °C to 450°C. The hydrogen gas required is obtained from cracking of oil.

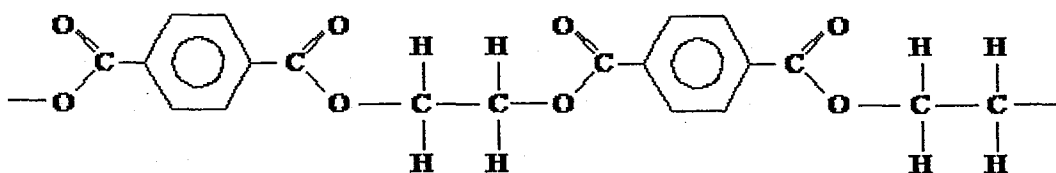
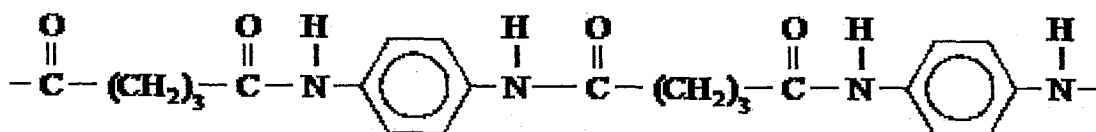
- (i) Explain the meaning of the term 'reversible'. [1]
- (ii) Hydrogen gas can also be produced by electrolysis of water. Suggest an advantage of this method compared to cracking of oil. [1]
- (iii) Draw a dot-and-cross diagram (showing valence electrons only) to show the structure of nitrogen gas. With reference to the structure, suggest why nitrogen gas is unreactive. [2]

- (iv) Name the catalyst used in the Haber Process and explain how it speeds up the rate of production of ammonia. [2]
- (v) As nitrogen gas reacts with hydrogen gas to form ammonia, there is a decrease in pressure. Explain why this happens. [2]
- (b) (i) Although certain bacteria in the soil convert nitrogen gas into nitrates, other bacteria convert nitrogen into ammonium salts. The ionic equation for this second reaction is:
- $$\text{N}_2 + 8\text{H}^+ + 6\text{e}^- \rightarrow 2\text{NH}_4^+$$
- Explain why this is a reduction reaction. [1]
- (ii) In the presence of hydrogen ions, a different type of bacterium converts nitrate ions into nitrogen gas and water. Write the ionic equation for this reaction. [1]

[Total : 10]

OR

- B12 (a) The diagrams below show the structures of two synthetic polymers.

Polymer APolymer B

- (i) Construct a table to show the following information about these two polymers
- The formula and name of the type of linkages present in each type of polymer.
 - The structures of the monomers that react to form each polymer. [3]
- (ii) From the monomers that form polymers **A** and **B**, draw the structure of another polymer that may possibly formed. [1]
- (iii) A student bought a sports bag which is made using polymer **B**. The bag had a warning label which stated:
- “Non-biodegradable. Harmful when disposed”***
- Explain what the label means. [2]
- (b) This question concerns the chemistry of ethene and compounds derived from it.
- Consider the following statements and then answer the questions below.
- Ethene may be polymerised to form poly(ethene).
 - Treatment of ethene with aqueous bromine gives a compound **C**.
 - Compound **C** may be converted in the laboratory into a compound **D**, which has a percentage composition by mass of: C 38.71%; H 9.68%; O 51.61%. The relative molecular mass, M_r , of **D** is 62.
- (i) Explain the meaning of the term ‘polymerisation’. [1]
- (ii) Write the chemical equation to represent the treatment of ethene with aqueous bromine. [1]
- (iii) Use the analytical data provided above to calculate and deduce the molecular formula of compound **D**. [2]

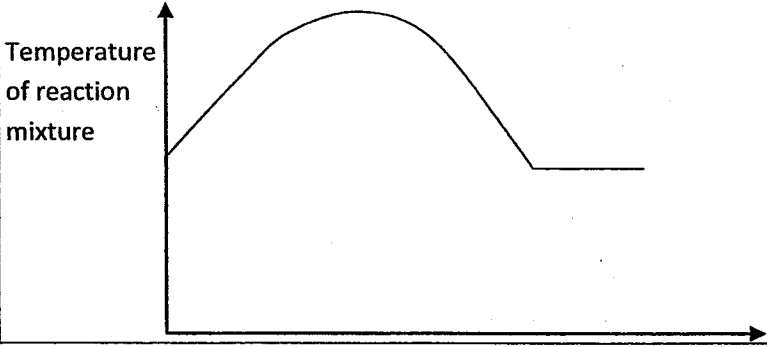
[Total : 10]

SJI Preliminary Examinations 2014

Chemistry 5073/2

A1	(a)	Close together to far apart Orderly arranged to disorderly arranged Vibrate about fixed position to moving randomly at high speeds
	(b)(i)	$2\text{AgI} \rightarrow 2\text{Ag} + \text{I}_2$
	(b)(ii)	mol AgI = $28/235 = 0.1191\text{mol}$ mol $\text{I}_2 = 0.1191/2 = 0.05955\text{mol}$ volume of $\text{I}_2 = 0.05955 \times 24\text{dm}^3 = 1.43\text{dm}^3$ % yield = $1/1.43 \times 100 = 69.9\%$

A2	(a)	Symbol	Name	Charge	
			neutron	0	
			proton	+1	
			electron	-1	
	(b)(i)	T^-			
	(b)(ii)	NaT			
	(c)	Liquid. This is because it combines with oxygen to form T_2O which is similar to H_2O , which is a liquid			

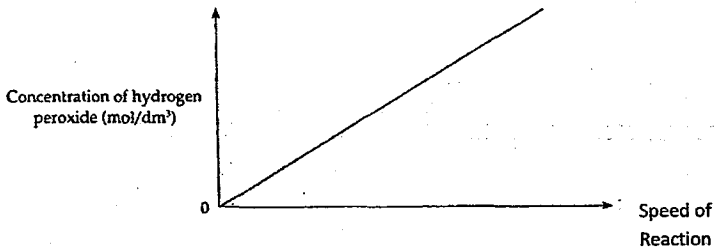
A3	(a)	the melting point decreases down Group I and increases down Group VII
	(b)	The <u>atomic size increases</u> down Group I, leading to <u>greater size of their respective positive ions</u>. Down group I, lesser energy required to overcome the <u>electrostatic forces of attraction between the positive ions</u>. (to overcome the attractive forces holding the positive ions in fixed arrangement) Down Group VII, the <u>atomic size increases</u>, leading to an <u>increase in the molecular sizes</u> of the elements. There will be <u>stronger intermolecular forces of attraction</u>, resulting in <u>more energy required to overcome these forces</u>.
A4	(a)	Milk will not boil at a fixed temperature as it is a mixture
	(b)(i)	Calcium
	(b)(ii)	2.8.8
	(c)(i)	C – measuring cylinder
	(c)(ii)	B – Burette
A5	(a)(i)	Substitution reaction
	(a)(ii)	More ultraviolet radiation enters the Earth's atmosphere, Causing higher instances of skin cancer and eye cataract .
	(b)(i)	Both compounds do not contain the element chlorine and cannot generate chlorine radicals, which cause ozone depletion.
	(b)(ii)	The formulae of the compounds contain an additional element hydrogen while those in current use contains only C, Cl and F .
A6	(a)	Y, X, Cu, Z
	(b)(i)	X could be (Magnesium), (Aluminium), Zinc, Iron, Lead Z could be Silver, Gold, Platinum
	(b)(ii)	Reddish brown solid is deposited. Blue solution turns colourless (or green with iron)
	(c)	 Temperature of reaction mixture Time

A7	(a)	Let x be the oxidation state of bismuth in sodium bismuthate. $(+1) + x + 3(-2) = 0$ $x = +5$
	(b)	Sodium bismuthate undergoes reduction. The oxidation state of bismuth decreases from +5 in sodium bismuthate to +3 in bismuth(III) ions.
	(c)	Underline : <u>Mn²⁺</u> Manganese(II) ions reduces sodium bismuthate as the oxidation state of bismuth decreases from +5 in sodium bismuthate to +3 in bismuth(III) ions. Manganese(II) ions are oxidised as the oxidation state of manganese increases from +2 in manganese(II) ions to +7 in the manganate(VII) ions.

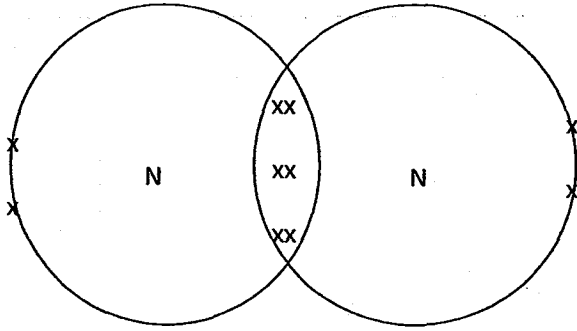
A8	(a)(i)	Sodium carbonate (70/106 mol/dm ³)
	(a)(ii)	Chloride ion
	(b)	Add excess nitric acid to remove all carbonate ions. Add aqueous barium salt to precipitate out the sulfate. Filter the mixture to collect the residue. Wash with distilled water, dry residue and weigh. Use stoichiometry to find mass of sulphate ions $\text{BaSO}_4 \rightarrow \text{Ba}^{2+} + \text{SO}_4^{2-}$
	(c)	No. Magnesium hydroxide has no amphoteric properties / does not behave as an acid and does not react with more alkali to form a soluble salt.

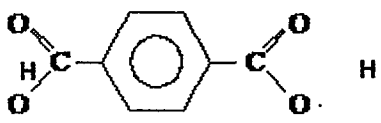
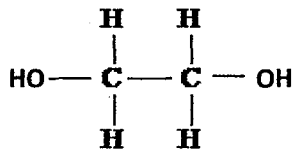
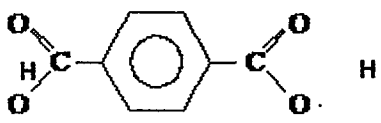
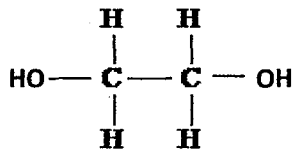
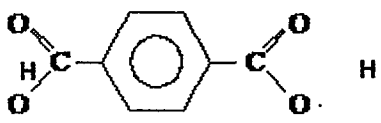
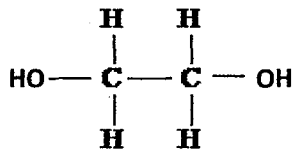
A9	(a)	Energy <u>absorbed to break bonds in reactants</u> (in carbon and O=O bonds); is <u>less than</u> energy <u>released in the formation of bonds in products</u> (in CO and C=O bonds). The reactions are exothermic.
	(b)	-380 kJ/mol (complete combustion) -110 kJ / mol (incomplete combustion)

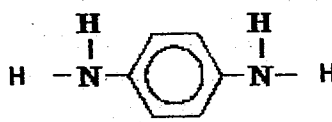
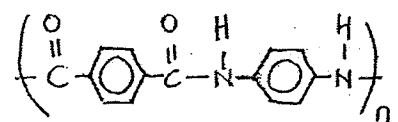
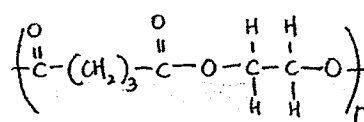
B10	(a)(i)	Using <u>Expt 1 and 2</u> , when the concentration of hydrogen peroxide <u>doubles</u> from <u>0.1 to 0.2 mol/dm³</u> and with the concentrations of HCl and KI constant at 0.1mol/dm ³ , the <u>speed of reaction doubles</u> from 0.0001 to 0.0002 mol/dm ³ /s.
	(a)(ii)	Using <u>Expt 2 and 4</u> , when the concentration of hydrogen peroxide and hydrochloric acid is <u>constant</u> at 0.2 and 0.1 mol/dm ³ respectively,

		<u>doubling the concentration of KI from 0.1 to 0.2 mol/dm³ doubles the speed of reaction from 0.0002 to 0.0004 mol/dm³/s.</u>
	(b)	
	(c)	<u>increase temperature, particles gain energy and move faster</u> more particles with energy equivalent to or greater than the activation energy <u>increase frequency of effective collisions between particles.</u>
	(d)	hydrogen peroxide is reduced as the oxidation number of oxygen decreases from -1 in H ₂ O ₂ to -2 in H ₂ O KI is oxidised as the oxidation number of I decreases from -1 in KI to 0 in I ₂ Since oxidation and reduction occur simultaneously, the reaction is a redox reaction.

B11	(a)	Correct labelling of anode and cathode Correct ratio of gases in tubes and must be collected.
	(b) (i)	Anode : $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$ Cathode : $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ Overall : $4\text{H}^+ + 4\text{OH}^- \rightarrow 2\text{H}_2 + \text{O}_2 + 2\text{H}_2\text{O}$ $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$ Test for gases: Oxygen – rekindles a glowing splint Hydrogen – gives a ‘pop’ sound when tested with a lighted splint
	(ii)	After some time, the sulfuric acid becomes more concentrated as water has been removed during electrolysis
	(c)	Electrolyte : any solution containing silver ions (e.g. silver nitrate solution) Anode : pure silver metal Cathode : spoon

B12	Either (a)(i)	The term 'reversible' refers to a reaction that has both a forward and reverse reaction occurring simultaneously. The reactants form the products in the forward reaction, while the products are converted to the reactants in the reverse reaction.
	(a)(ii)	Water is more abundant compared to oil, which is a limited resource.
	(a)(iii)	 Nitrogen gas is unreactive as a lot of energy is required to break the strong triple covalent bonds between nitrogen atoms.
	(a)(iv)	Catalyst is finely divided iron The iron provides an alternative pathway for the reaction , which has a lower activation energy .
	(a)(v)	One mole of nitrogen gas reacts with three moles of hydrogen gas to form two moles of ammonia gas. There are fewer molecules per unit volume formed compared to the reactants, causing fewer collisions on the walls of the vessel.
	(b)(i)	Nitrogen gains electrons to form ammonium ions. Or Oxidation number of N decreases from 0 in N_2 to -3 in NH_4^+
	(b)(ii)	$2NO_3^- + 12H^+ + 10e^- \rightarrow N_2 + 6H_2O$

B12	OR (a)(i)	<table border="1"> <tr> <td>Polymer A</td><td> $\begin{array}{c} O \\ \\ -O-C- \end{array}$ Ester linkage </td><td>   </td></tr> <tr> <td>Polymer B</td><td> $\begin{array}{c} O \quad H \\ \quad \end{array}$ </td><td> $HO - \overset{\overset{O}{ }}{C} - (CH_2)_3 - \overset{\overset{O}{ }}{C} - OH$ </td></tr> </table>	Polymer A	$\begin{array}{c} O \\ \\ -O-C- \end{array}$ Ester linkage	 	Polymer B	$\begin{array}{c} O \quad H \\ \quad \end{array}$	$HO - \overset{\overset{O}{ }}{C} - (CH_2)_3 - \overset{\overset{O}{ }}{C} - OH$
Polymer A	$\begin{array}{c} O \\ \\ -O-C- \end{array}$ Ester linkage	 						
Polymer B	$\begin{array}{c} O \quad H \\ \quad \end{array}$	$HO - \overset{\overset{O}{ }}{C} - (CH_2)_3 - \overset{\overset{O}{ }}{C} - OH$						

			-C - N - Amide linkage		
	(ii)	 OR 			
	(iii)	Cannot be decomposed by bacteria in the soil. Land pollution – takes up land space to dispose which deprive the land for other uses/land pollution Air pollution – releases toxic fumes like CO when burned away			
	b(i)	the joining together of monomers / small molecules to form long chains / large molecules			
	(ii)	$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$			
	(iii)	C $38.71/12 = 3.23$; H $9.68/1 = 9.68$; O $51.61/16 = 3.23$ ratio C:H:O = 1:3:1 /empirical formula = CH_3O empirical mass = 31 so molecular formula = $2 \times CH_3O = C_2H_6O_2$			