NAME: _____ ( ) CLASS: _____

PRELIMINARY EXAMINATION 2016
SECONDARY 4

CHEMISTRY

5073 / 01

Paper 1 Multiple Choice

22 August 2016

Tuesday

1 hour
1100 – 1200 h

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers - **A, B, C and D**.
Consider the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in the question paper.
Electronic calculators may be used in this paper.
A copy of the Periodic Table can be found on page 2.

This question paper consists of **19 printed pages** including the Cover Sheet.

DATA SHEET
The Periodic Table of the Elements

Group																
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †														

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

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

Key: a X b — 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.).

*There are **forty** questions in 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 provided.*

1 Which observation suggests that matter exists as very small moving particles?

A Gold can be beaten into sheets.

B Solids will melt when heated.

C Some gases are less dense than air, but others are denser.

D The smell of scent soon fills a room when the bottle is opened.

2 When solid Q was added to dilute hydrochloric acid, effervescence was observed and a colourless solution was obtained. When solid Q was added to an aqueous mixture of sodium hydroxide and sodium nitrate and warmed, a gas was evolved which turned moist red litmus blue.

What could Q be?

A ammonium nitrate

B aluminium

C copper

D zinc carbonate

3 A solution X formed a white precipitate both with dilute sulfuric acid and with aqueous silver nitrate.

What could solution X contain?

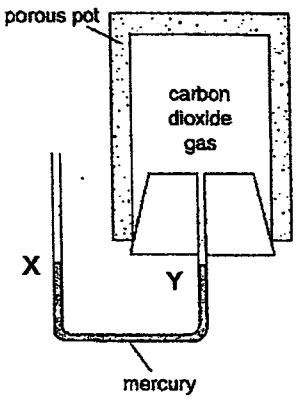
A barium chloride

B barium nitrate

C lead(II) chloride

D zinc sulfate

4 The diagram shows a porous pot filled with carbon dioxide gas and left in air.



After some time what would happen to the mercury levels at **X** and **Y**?

A level **X** drops, level **Y** rises

B level **X** rises, level **Y** drops

C both levels remain the same

D both levels rise as the mercury expands

5 Three atoms L, M and N have atomic masses of 235, 238 and 239 respectively. L has 92 electrons, M has 92 protons and N has 145 neutrons.

Which of these atoms are isotopes?

A L and M

B L and N

C M and N

D L, M and N

6 The proton number and nucleon number of elements **M** and **N** are as follows:

Element	Proton number	Nucleon number
M	13	27
N	8	16

When elements **M** and **N** combine together to form a compound, what will be the mass of one mole of the compound?

A 43

B 70

C 102

D 113

7 The metal radium (Ra) is in Group II of the Periodic Table. It will combine with chlorine to form radium chloride.

Which of the following statements about radium chloride is correct?

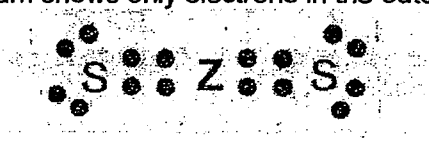
A It is soluble in tetrachloromethane.

B It is a covalent compound with the formula of $RaCl_2$.

C Its aqueous solution can conduct electricity by the movement of ions.

D It has a simple molecular structure.

8 A compound formed from element Z and sulfur has the following electronic structure. The diagram shows only electrons in the outermost shell.



To which group of the Periodic Table does element Z belong?

A Group II

B Group IV

C Group VI

D Group 0

9 Zinc oxide is produced by heating zinc carbonate.

$ZnCO_3 \rightarrow ZnO + CO_2$

What is the percentage yield of zinc oxide if 200 g of zinc carbonate produces 90 g of zinc oxide on heating?
(M_r of $ZnCO_3$ = 125; M_r of ZnO = 81)

A $\frac{90 \times 125 \times 100}{200 \times 81}$

B $\frac{90 \times 200 \times 81}{125}$

C $\frac{90 \times 200 \times 81 \times 100}{125}$

D $\frac{90 \times 125}{200 \times 81}$

10 18 g of magnesium required x cm^3 of 0.500 mol/dm^3 dilute hydrochloric acid to react completely. What is the value of x?

A 1.5

B 3

C 1500

D 3000

11 To identify an oxide of nitrogen, 0.10 mol of the oxide (NxOy) is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature.

$NxOy + zH_2(g) \rightarrow xNH_3 + yH_2O$

The water weighs 3.60 g. The ammonia produced occupied a volume of 2400 cm^3. What is the formula of the oxide of nitrogen?

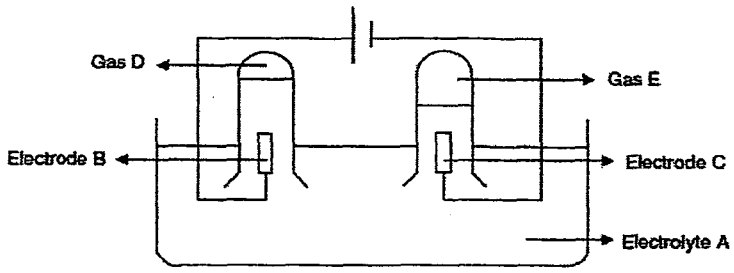
A N_2O

B NO_2

C NO

D N_2O_4

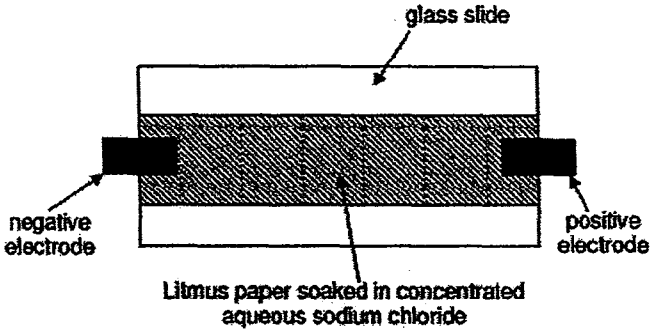
12 The diagram below show the electrolysis of electrolyte **A**.



The ratio of the volume of gas **D** to that of gas **E** is 1:2.
Which of the following correctly identifies electrolyte **A**, electrodes **B** and **C**?

	Electrolyte A	Electrode B	Electrode C
A	molten zinc chloride	platinum	platinum
B	aqueous silver nitrate	graphite	graphite
C	aqueous silver nitrate	silver	silver
D	aqueous sodium sulfate	graphite	graphite

13 A piece of litmus paper was soaked in concentrated aqueous sodium chloride and supported on a glass slide. The paper was connected to an electrical supply as shown in the diagram.



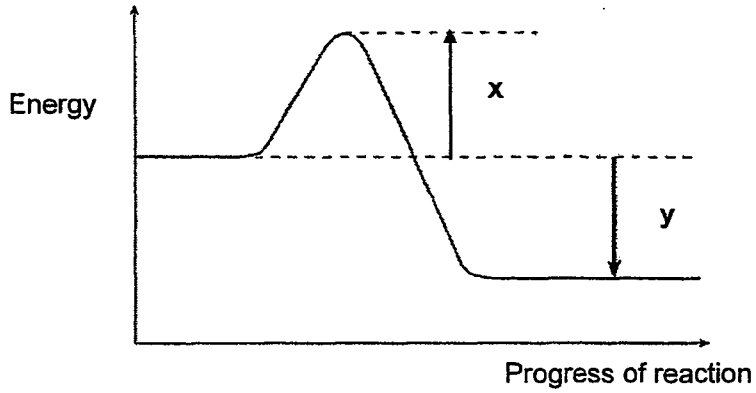
Which of the following shows the correct observations near each electrode after some time?

	Negative electrode	Positive electrode
A	blue	bleached
B	blue	no change
C	red	bleached
D	no change	red

14 In which equation is the sign of enthalpy, ΔH, correctly shown?

	Equation	ΔH
A	$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$	positive
B	$CH_4(g) \rightarrow C(g) + 4H(g)$	negative
C	$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$	positive
D	$H_2O(s) \rightarrow H_2O(l)$	negative

15 The energy profile diagram for a chemical reaction is shown.



Which statement is correct?

A The overall enthalpy change is equal to **y**.

B The reaction is endothermic.

C The value of **x** would increase in the presence of a catalyst.

D The value of **y** would decrease in the presence of a catalyst.

16 The rate of reaction, between zinc and dilute hydrochloric acid, can be found by measuring

I the rate of loss in mass as the gas escapes from the apparatus.
II the rate of rise of temperature.
III the volume of gas evolved at regular time interval.

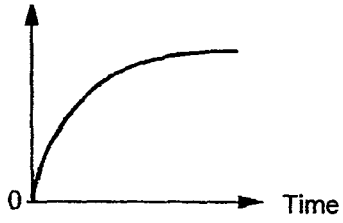
A I only
B I and III only
C II only
D I, II and III

17 0.5 g portions of baking soda are added to dilute hydrochloric acid until in excess.

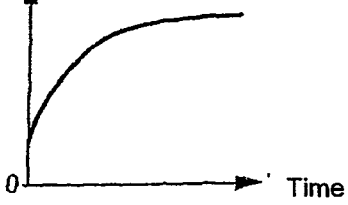
$$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$$

Which of the following graphs **cannot** be obtained from the above reaction?

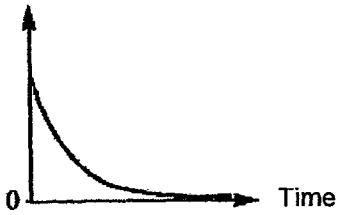
A



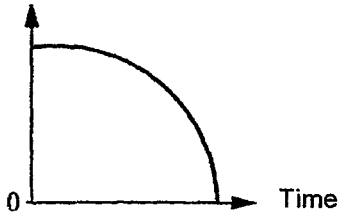
B



C



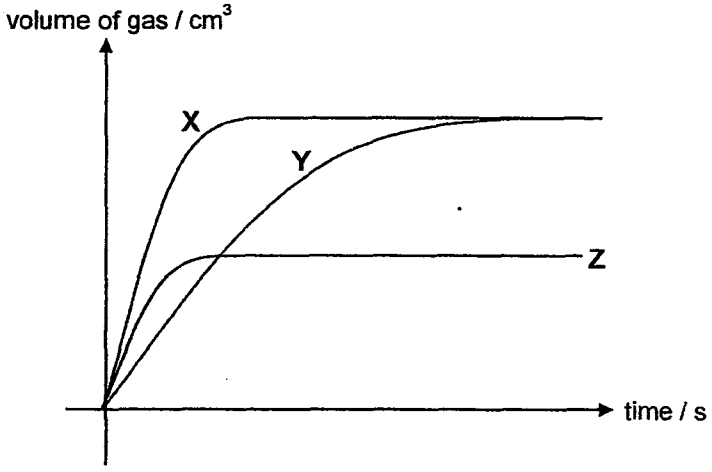
D



18 A student performed three experiments to produce hydrogen gas using excess zinc carbonate and dilute sulfuric acid at 30 °C.

experiment	zinc carbonate	dilute sulfuric acid	
	particle size	volume / cm^3	concentration / mol dm^{-3}
1	powdered	20	1.00
2	lumps	40	0.50
3	lumps	10	1.00

Three graphs were drawn for the volume of hydrogen produced against time.



Which graphs best represents each of the three experiments?

	experiment 1	experiment 2	experiment 3
A	**X**	**Y**	**Z**
B	**Y**	**X**	**Z**
C	**Y**	**Z**	**X**
D	**Z**	**X**	**Y**

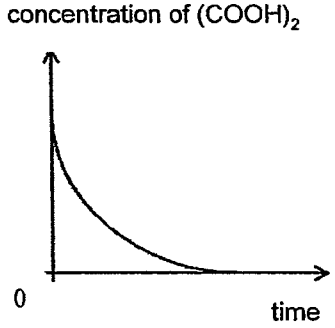
19 In autocatalysis, a chemical reaction is catalysed by one of its products. An example is the reaction between oxalic acid, $(COOH)_2$, and acidified potassium manganate(VII) as shown in the chemical reaction below.

$$5(COOH)_2 + 6H^+ + 2MnO_4^- \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

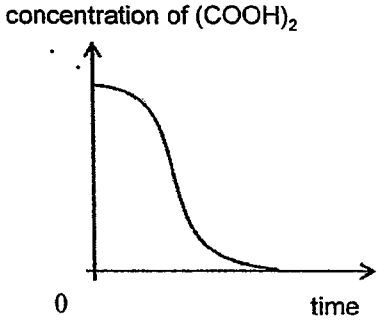
The reaction is very slow at room temperature, but it is catalysed by Mn^{2+} ions that are produced during the reaction.

Which graph shows the correct concentration of $(COOH)_2$ during the reaction?

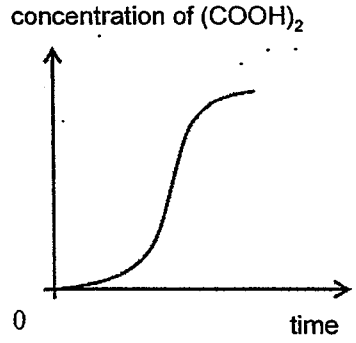
A



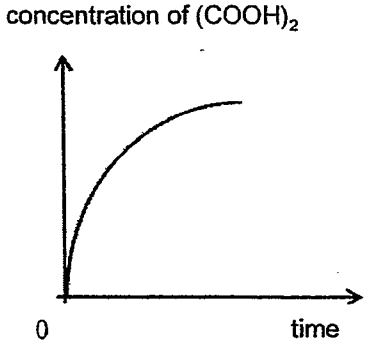
B



C



D



20 Which process shows magnesium being oxidised?

A adding magnesium to dilute hydrochloric acid

B adding zinc to aqueous magnesium nitrate

C heating magnesium carbonate strongly

D reduction of hydrogen sulfide using magnesium oxide as a catalyst

21 Disproportionation is a reaction in which the same element is both oxidised and reduced. Which reaction is an example of disproportionation?

A $Cl_2 + 2\ NaOH \rightarrow NaCl + NaOCl + H_2O$

B $3\ Cu + 8\ HNO_3 \rightarrow 3\ Cu(NO_3)_2 + 2NO + 4\ H_2O$

C $Fe_2(SO_4)_3 + 2\ KI \rightarrow 2\ FeSO_4 + K_2SO_4 + I_2$

D $2\ Pb(NO_3)_2 \rightarrow 2\ PbO + 4\ NO_2 + O_2$

22 Hydrogen peroxide, H_2O_2, reacts with silver oxide according to the following equation.

$$Ag_2O(s) + H_2O_2(l) \rightarrow 2Ag(s) + H_2O(l) + O_2(g)$$

In this reaction, hydrogen peroxide behaves as

A a dehydrating agent. **B** an acid.

C a reducing agent. **D** an oxidising agent.

23 Which of the following properties shows that a certain substance is alkaline?

A A solution of X attacks the skin.

B A solution of X decolourises acidified aqueous potassium manganate(VII).

C X when warmed with ammonium chloride produces ammonia gas.

D X reacts with dilute hydrochloric acid to produce hydrogen gas.

24 Which of the following reactants cannot be reacted with dilute nitric acid to prepare copper(II) nitrate?

A aqueous copper(II) sulfate

B copper(II) carbonate

C copper(II) hydroxide

D copper(II) oxide

25 In the Haber Process for the manufacture of ammonia, what are the usual operating conditions?

	Temperature /°C	Pressure / atm	Catalyst
A	200	450	iron
B	200	450	manganese(IV) oxide
C	450	200	iron
D	450	200	nickel

26 In the Haber process, ammonia is separated from hydrogen and nitrogen by

A absorbing ammonia with acid and treating the salt formed with a base.

B cooling the mixture until ammonia liquefies.

C dissolving ammonia in water and heating the solution.

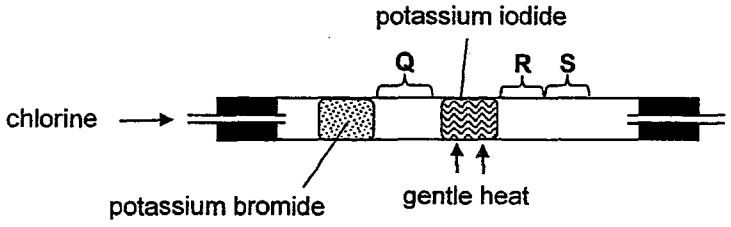
D fractional distillation.

27 Elements **X** and **Y** are in Group VII of the Periodic Table. **X** is a liquid at room temperature. **Y** is a solid at room temperature. Which statement(s) is/are correct?

I Atoms of **Y** have more protons than atoms of **X**.
II Molecules of **Y** have more atoms than molecules of **X**.
III **Y** displaces **X** from aqueous solution of X^- ions.

A I only
B III only
C II only
D I, II and III

28 Using the apparatus shown, chlorine was passed through the tube. After a short time, coloured substances were seen at **Q**, **R** and **S**.



What was seen at **Q**, **R** and **S**?

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

29 Some physical properties of elements **E**, **F** and **G** are given in the table below.

Element	E	F	G
Melting point/ °C	-7	63	-189
Boiling point/ °C	58	766	-186
Colour	Dark red	Silvery	colourless
Density/ gcm^{-3}	3.1	0.86	1.7×10^{-3}

Which group of the Periodic Table does **E**, **F** and **G** belong to?

	E	F	G
A	Group I	Group 0	Group VII
B	Group VII	Group I	Group 0
C	Group VII	Group 0	Group I
D	Group 0	Group I	Group VII

30 The table below shows the extraction of metals from their ores.

Metal	Method
X	Reduction using carbon
Y	Electrolysis
Z	Reduction by hydrogen

Which of the following shows the correct arrangement of the reactivity of metals in ascending order?

A Y,X,Z

B X,Y,Z

C Z,X,Y

D Z,Y,X

31 The metal, titanium is hard, strong, lighter than steel and relatively immune to corrosion. In the aircraft industry, it is likely to be used as a substitute for

A aluminium.

B copper.

C iron.

D zinc.

32 Chlorofluorocarbons breakdown in the presence of ultraviolet radiation to form chlorine radicals (atoms) which cause ozone depletion. An American scientist suggested that depletion of the ozone layer could be prevented by aluminium rods suspended below helium balloons. The rods would be electrically charged and would transfer electrons to the chlorine radicals which form particles X.

Which of the following statements is true?

A Particle X is a chlorine molecule.

B Particle X is stable as it has an octet structure.

C Particle X is more reactive than chlorine radicals.

D Particle X converts oxygen back to ozone.

33 One way of reducing the amount of pollutants released into the atmosphere is by using a new type of engine called the "lean burn" engine which operates at a lower temperature and with a higher percentage of air mixed with the fuel.

The following data shows the composition of exhaust gases emitted from cars when the two different engines were used.

	Percentage of gas in exhaust sample		
	Carbon dioxide	**Carbon monoxide**	**Oxides of nitrogen**
Normal engine with catalytic converter	10	4.5	0.2
"Lean burn" engine with catalytic converter	14	Less than 0.1	Less than 0.1

Which of the following statements is true of "lean burn" engines?

A The higher percentage of air leads to a higher production of oxides of nitrogen.

B The higher percentage of air leads to more complete combustion of fuel.

C The lower operating temperature of the engines causes less carbon monoxide to form.

D The lower operating temperature of the engines increases the chances of nitrogen gas reacting with oxygen gas.

34 Crude oil is a mixture of chemicals.

Which of the following statements indicates that crude oil is a mixture?

A It a thick, dark coloured liquid which is less dense than water.

B It is made from the remains of animals that lived long ago.

C It can be separated into useful materials for the chemical industry.

D It is found deep underground.

35 A margarine made from vegetable oil is described as "polyunsaturated"

What does this type of margarine contain?

A long chain alkane molecules

B alkene molecules joined by addition polymerization

C polymer molecules with C=C bonds

D polymer molecules with amide linkages

36 Which of the following about the homologous series of alcohol is **NOT** true?

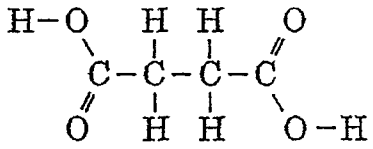
A They can be prepared by similar methods.

B They can be represented by a general formula.

C They exhibit a gradual change in physical properties.

D They have the same empirical formula.

37 The diagram shows an organic compound.



Which of the following correctly describes the above compound?

A It forms an aqueous solution with a pH less than 7.

B It can be neutralized by a salt.

C It can be reduced by acidified potassium manganate(VII) solution.

D It reacts with an acid to form an ester.

38 Which pair of organic compounds can be distinguished in a chemical test by using aqueous bromine?

A C_2H_6, C_3H_8

B C_3H_8, C_4H_8

C C_4H_{10}, C_5H_{12}

D C_8H_{18}, $C_{10}H_{22}$

39 In which reaction does the relative molecular mass of the organic compound increase?

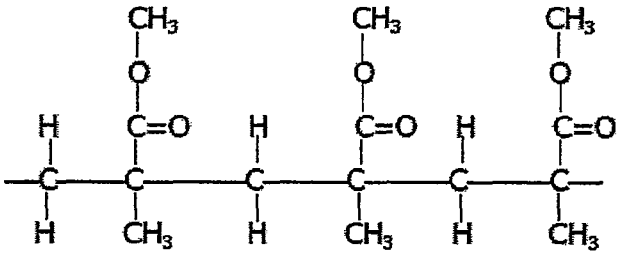
A conversion of an ester into an alcohol and an acid by hydrolysis

B conversion of an alcohol into an alkene by dehydration

C fermentation of sugar

D oxidation of an alcohol to an acid

40 Poly (methyl methacrylate) is used to make hard contact lenses. Part of its polymer chain is shown below.



Which statement about poly(methyl methacrylate) is correct?

A It is a condensation polymer.

B Its monomer is $CH_2=C(CH_3)CO_2CH_3$.

C It is a carboxylic acid.

D It decolourises bromine water.

NAME: _____ ( ) CLASS: _____

PRELIMINARY EXAMINATION 2016
SECONDARY 4 ('O' Level Programme)

CHEMISTRY

5073 / 02

Paper 2

15 Aug 2016

Candidates answer on the Question Paper.

1 hour 45 minutes
1115 – 1300 h

Additional materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class 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.
Answer **all** questions in the spaces provided.

At the end of the examination, hand in
Sections A and B SEPARATELY.

The number of marks is given in brackets [ ] at the end of each question or part question.
Electronic calculators may be used in this paper.
A copy of the Periodic Table is found on page 2.

Section	Marks
A	
B9	
B10	
B11 (Either /Or)	
Total marks (80M)	

This question paper consists of **21 printed pages** including the Cover Sheet.

[Turn over]

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	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
689	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
	85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
	Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

*58-71 Lanthanoid series
190-103 Actinoid series

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92

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
Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

Key

a X b	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 (50 marks)

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

A1 **(a)** Cotton wool soaked in concentrated ammonia solution and concentrated hydrochloric acid are placed at each end of a sealed tube. The cotton wool with ammonia solution gives off gaseous ammonia. The cotton wool with hydrochloric acid gives off gaseous hydrogen chloride. These gases meet to form solid ammonium chloride.

(i) Mark on the diagram, with a 'X' where you would expect solid ammonium chloride to be formed along the tube. [1]

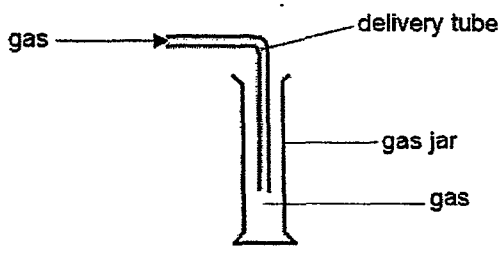
(ii) Explain why the white powder is formed in the position which you have drawn in **(a)**.

.....

.....

.....[2]

(iii) The experimental setup below is used for collecting a sample of HCl in the laboratory.



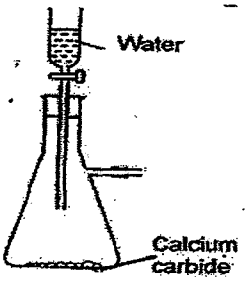
From the list given below, circle the other gases which can be collected using this method.

NH_3 CO_2 H_2 SO_2

[1]

(iv) The first lamps invented were not electric. A gas called acetylene (C_2H_2) was burned to produce the light. Adding water to a solid called calcium carbide made the acetylene gas. Acetylene gas is insoluble in water.

Based on the information given, complete the diagram below to illustrate how you would collect acetylene in the laboratory. Label all the parts drawn.



[2]
[Total: 6]

A2 Chlorine exists as two isotopes, $^{35}_{17}Cl$ (Chlorine-35) and $^{37}_{17}Cl$ (Chlorine-37), and can form useful compounds such as magnesium chloride and carbon tetrachloride, CCl_4.

(a) Complete the table below to show the number of subatomic particles in the ion of each isotope.

Ion	Number of protons	Number of neutrons
$^{35}_{17}Cl^-$		
$^{37}_{17}Cl^-$		

[1]

(b) A compound of magnesium chloride was formed between the two different type of chlorine isotopes

(i) Draw a 'dot-and-cross' diagram to show the bonding between magnesium and chlorine-37.

[2]

(ii) A student proposes that that the melting point will be higher for the magnesium chloride compared to carbon tetrachloride.

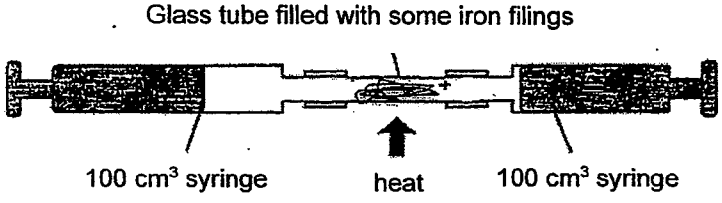
Do you agree with the statement? Give a reason for your answer.

.....

.....

.....[2]
[Total: 5]

A3 (a) The percentage of oxygen in air can be determined by using the apparatus shown below. The glass tube was filled with some iron filings (in excess) and the total volume of air in the syringes was 80 cm^3.



(i) Calculate the expected total volume of gas left remaining at the end of the experiment.

[1]

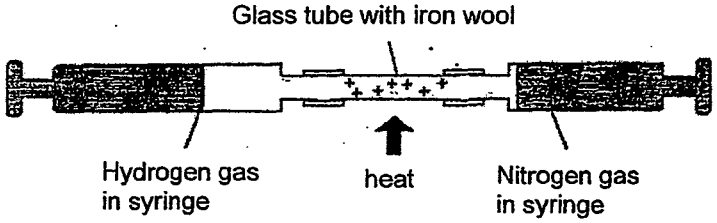
(ii) A student commented that the glass tube should be fully packed with iron to ensure accurate results. Explain why the results obtained would be less accurate if the glass tube were only partially filled with iron filings.

.....

.....

.....[1]

(b) The Haber Process which is used to manufacture ammonia can be demonstrated in the laboratory by the method shown below.



The mixture of nitrogen and hydrogen is passed back and forth over the hot iron wool until there is no further reaction.

(i) Suggest why it is important to ensure that no air is present in the apparatus shown above.

.....

.....[1]

(ii) Write a balanced chemical equation for the reaction between nitrogen and hydrogen.

.....[1]

(c) Aqueous ammonia is formed when ammonia gas is dissolved in water. When aqueous ammonia is added dropwise until excess to a sample of contaminated water, a mixture of white and blue precipitate was formed initially. The resulting mixture was a dark blue solution.

(i) Write the formula(e) of the possible cations present in the water sample.

.....[2]

(ii) Write the ionic equation with state symbols for the reaction forming the blue precipitate.

.....[1]

[Total: 7]

A4 The cells in the lining of our stomach produce gastric juice. This is a liquid mixture containing hydrochloric acid. Production of too much gastric juice will cause stomach pain. Tablets containing magnesium hydroxide or calcium carbonate are used for the relief of gastric pain. Below are labels from two brands of tablets.

ACTIQUICK Each tablet contains 250 mg of calcium carbonate	**PAIN-AWAY** Each tablet contains 250 mg of magnesium hydroxide

(a) Write separate balanced chemical equations for the reactions between the two tablets and the acid in the stomach.

.....

.....[2]

(b) Tablets containing calcium carbonate are rarely used nowadays to relieve gastric pain. Suggest a reason for this.

.....

.....[1]

(c) Assuming that the acid present in our stomach has a concentration of 1.00 mol/dm^3 and that 10 cm^3 of acid is released into the stomach during a gastric attack, determine:

(i) the number of moles of acid present during a gastric attack.

[1]

(ii) the number of ACTIQUICK tablets a person would have to consume to overcome the gastric pain.

[2]
[Total:6]

A5 Metal cans are usually made from either steel or aluminium. Metal cans are easy to collect and recycle.

(a) Give two reasons why it is important to recycle metal cans.

.....

.....[2]

(b) Before the cans are melted down, they have to be first separated into steel cans and aluminium cans. Suggest how these cans may be separated and relate this method to the properties of steel and aluminium.

.....[1]

(c) Steel used to make cans of food are usually covered by a thin coating of tin. Explain the function of this thin coating of tin.

.....[1]

(d) In the industrial production of aluminium, electrolysis method is used. During the electrolysis process, aluminium fluoride is often added to lower the melting point of the electrolyte.

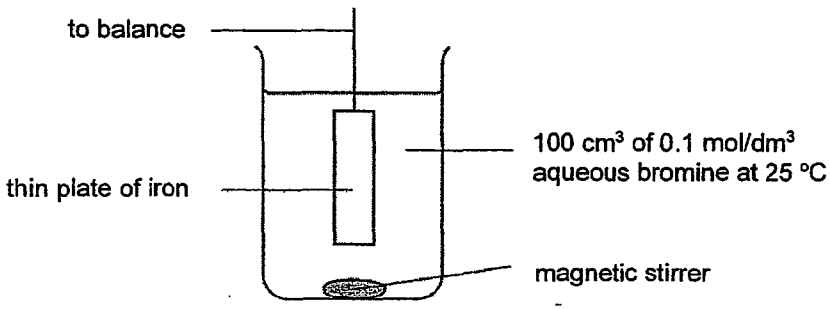
(i) Is electrolysis an endothermic or exothermic reaction?

.....[1]

(ii) When one mole of aluminium fluoride is formed, 216 kJ of heat is evolved. Calculate the heat energy given off when 2.8 g of aluminium fluoride is formed.

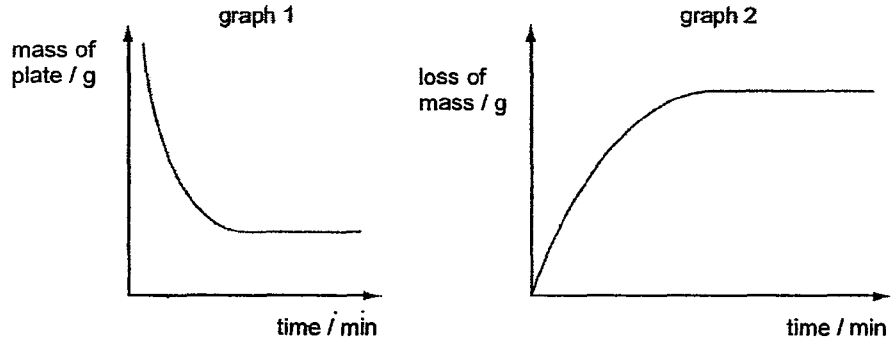
[2]
[Total: 7]

A6 A student carried out the following experiment to investigate the rate of the reaction between iron and aqueous bromine using the apparatus shown below.



The iron was removed at regular intervals and the stopwatch was paused. The iron was then washed, dried and weighed. After weighing, the iron was immersed in the solution again and the stopwatch was restarted.

From the results of this experiment, two graphs were plotted as shown below



(a) Is iron or aqueous bromine in excess?
Use graph 1 to explain your answer.

.....

.....[1]

(b) There are two possible equations for the reaction between iron and bromine.

Equation 1: $Fe + Br_2 \rightarrow Fe^{2+} + 2Br^-$

Equation 2: $2Fe + 3Br_2 \rightarrow 2Fe^{3+} + 6Br^-$

(i) Is iron oxidised or reduced in this reaction?
Use ideas about **electron transfer** to explain your answer.

.....

.....[1]

(ii) Describe a test on the resulting solution to find out which equation shows the reaction that had taken place.

.....

.....

.....[2]

(c) The experiment was repeated using aqueous iodine solution under the same initial conditions. Predict and explain how the rate of the reaction would change.

.....

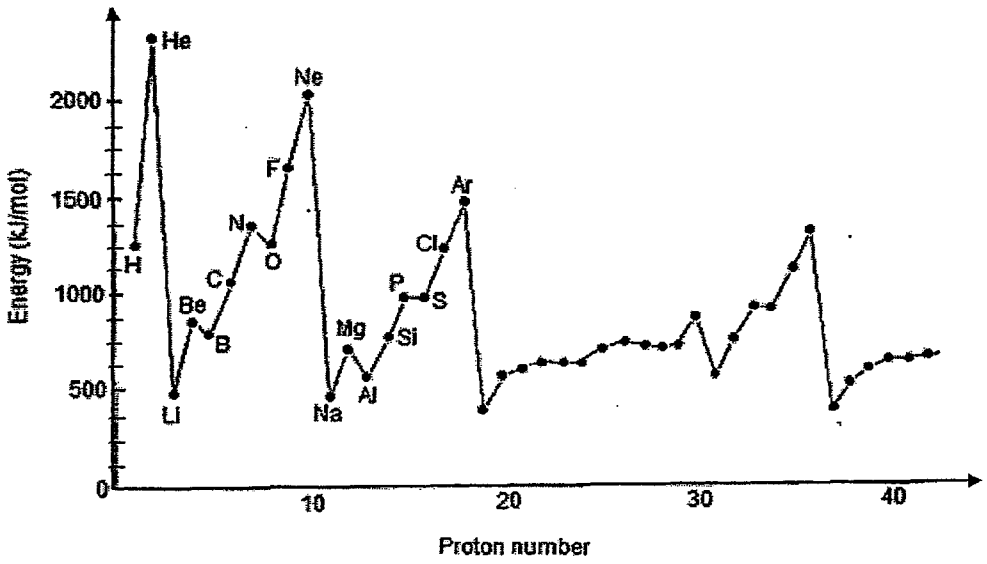
.....[1]
[Total: 5]

A7 The graph below shows the first ionisation energy of the atoms of elements in the Periodic Table. The first ionisation energy is the amount of energy needed to remove the most loosely held electron in the atom to form a positive ion.

Example of the first two elements is given as follow:

$H \rightarrow H^+ + e$ First ionisation energy = 1250 kJ/mol

$He \rightarrow He^+ + e$ First ionisation energy = 2300 kJ/mol



(a) Using the graph,

(i) estimate the first ionisation energy for Krypton.

.....[1]

(ii) state the least reactive element.

.....[1]

(b) Suggest an explanation for the difference in first ionisation energy between beryllium and magnesium.

.....

.....

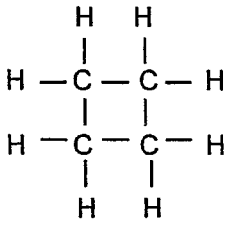
.....

.....

.....[3]

[Total: 5]

A8 Cyclobutane is a colourless gas. Its structure is given below.



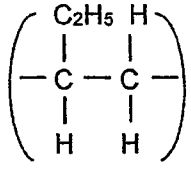
(a) **(i)** Write the empirical formula of cyclobutane.

..... [1]

(ii) Write a balanced chemical equation for the complete combustion of cyclobutane.

.....[1]

(b) Compound **U** is an isomer of cyclobutane.
It can be made into polymer **V.** The repeating unit of polymer **V** is shown below.



(i) Explain the term "isomer".

.....[1]

(ii) Draw the full structural formula of compound **U**.

[1]

(iii) Name the polymer **V** and state the type of polymerisation that produces polymer **V**.

.....

..... [2]

(iv) Compound **U** reacts with bromine gas to give compound **W**.
Write the balanced chemical equation for this reaction.

[1]

(v) Compound **U** reacts with steam to give compound **X.**
Name this compound **X** and give the conditions needed for this reaction.

.....

.....[2]
[Total: 9]

NAME: _____ ( ) CLASS: _____

Section B (30m)

Answer all **three** questions from this section. The last question is in the form of an either / or and only **one** of the alternatives should be attempted.
Write your answers in the space provided.

B9 Below is a table of data corresponding to the following chemical equation:

$$2ClO_2\,(aq) + 2OH^-\,(aq) \rightarrow ClO_3^-\,(aq) + ClO_2^-\,(aq) + H_2O\,(l)$$

Six experiments were carried out with different concentrations of ClO_2 and OH^-.
ClO_2 is a yellow liquid and its colour will 'disappear' during the reaction.
The initial rate of disappearance of ClO_2 is given in the table for each experiment.
The higher the rate of disappearance, the faster the speed of reaction.

Experiment	concentration of ClO_2 (mol/dm^3)	concentration of OH^- (mol/dm^3)	initial rate of disappearance of ClO_2 (mol/dm^3s)
1	0.020	0.030	0.00276
2	0.040	0.030	0.01104
3	0.020	0.060	0.00552
4	0.040	0.060	0.02208
5	0.040	0.090	0.03312
6	0.120	0.030	0.09936

(a) Explain in terms of **oxidation states**, why the reaction is redox.

.....

.....

.....

.....[2]

(b) Does the increase in concentration of each reactant have an *equal* effect on the rate of reaction? Explain your answer using results from the table, stating clearly which experimental data you are using.

.....

.....

.....

.....

.....[3]

(c) Predict the initial rate of disappearance of ClO_2 if the experiment was conducted using 0.040 mol/dm^3 of ClO_2 and 0.120 mol/dm^3 of OH^-.

.....[1]

(d) Using collision theory, explain the effect of concentration on the rate of reaction.

.....

.....

.....[2]

(e) Calculate the mass of H_2O produced in **experiment 2** if 50 cm^3 of each solution was used.

[4]
[Total: 12]

B10 The table below gives the standard reduction potential ($E^{\ominus}$) of some metals.
The more negative the value, the more easily the metal will ionise by losing electrons.

Metal	Standard reduction potential ($E^{\ominus}$)/volts
A	-1.66
B	-0.13
C	-2.37
D	-0.44
E	+0.34
F	-0.76

(a) What is the relationship between the standard reduction potential of these metals and their reactivity?

.....[1]

(b) **(i)** Nickel has a reduction potential of -0.25 V.
Draw a labeled diagram to show the set-up of a simple cell involving nickel and metal **B** in a beaker of green dilute nickel(II) nitrate solution.
Your diagram should include a voltmeter and indicate the direction of electron flow in the circuit.

[1]

(ii) Write the ionic half equations for the reactions that occur at the nickel and metal **B** electrodes.

.....

.....[2]

(iii) Describe and explain how the pH of the electrolyte changes during the experiment.

.....

.....

.....[2]

(c) If a piece of metal **F** is placed in a beaker of dilute nickel(II) nitrate solution, what type of chemical reaction occurs here?
Write down one observation you would make.

.....

.....[2]
[Total: 8]

B11 Either The pH levels of water bodies like ponds and rivers close to industrial areas can be in the **detrimental** ranges of between pH 3 to pH 4. During winter in the same region, the pH of melted ice or snow was found to be lower than other periods of the year.

(a) State one effect that the detrimental pH ranges of water bodies could cause.

.....[1]

(b) Suggest, with reference to reactions that occur, how the pH of water bodies could get to such detrimental ranges.

.....

.....

.....

.....

.....

.....

.....

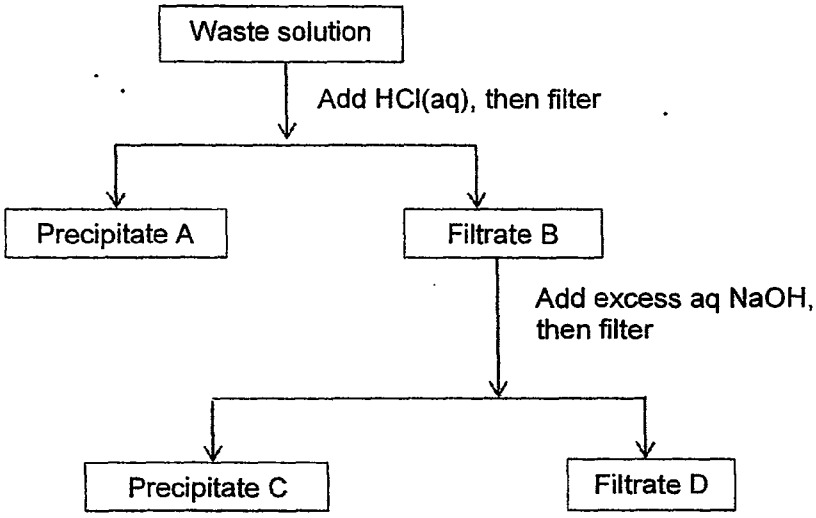
.....[3]

(c) Suggest a reason why the pH of melted ice or snow is lower in winter compared to the other seasons.

.....

.....[1]

(d) Water bodies are also affected by the chemical wastes released from factories. These wastes often contain harmful cations. The waste solution from a factory was analysed and was found to contain silver(I) ions, iron(III) ions, copper(II) ions and aluminium ions. The flow diagram below was designed by a student to remove all these harmful cations from the waste solution.



(d) (i) Write the formula of precipitate A.

.....[1]

(ii) Name the substance(s) present in precipitate C.

.....[2]

(iii) The filtrate D was still found to be contaminated with one of the cations. Write the formula of this cation.

.....[1]

(iv) Filtrate D was also found to contain nitrate ions which are harmful if present in drinking water. Explain why it is difficult to remove nitrate ions from waste solutions.

.....[1]
[Total: 10]

B11 Or This question is about the chemistry of the Group II elements in the Periodic Table.

(a) Explain why Group II elements are able to conduct electricity in terms of their structure.

.....[1]

(b) Compare the reactions of magnesium and calcium with cold water. In each case identify the products formed. Hence predict how barium would react with cold water.

.....

.....

.....

.....

.....[4]

(c) Magnesium oxide is used to line the walls of hot furnaces.

(i) What property of magnesium oxide allows it to be used for this purpose?

.....[1]

(ii) How does the bonding in magnesium oxide explain this property?

.....

.....

.....[2]

(d) Slaked lime is calcium hydroxide, which is made by reacting calcium oxide with water.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$$

Slaked lime is used to remove acidic gases from the waste fumes that are emitted from power stations such as sulfur dioxide.

$$Ca(OH)_2(s) + SO_2(g) \rightarrow CaSO_3(s) + H_2O(l)$$

Explain why slaked lime can be used to remove sulfur dioxide.

.....

.....

.....[2]

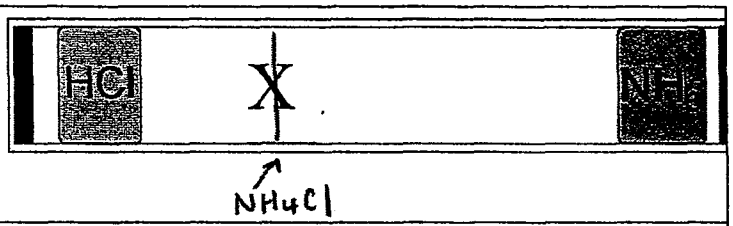
[Total: 10]

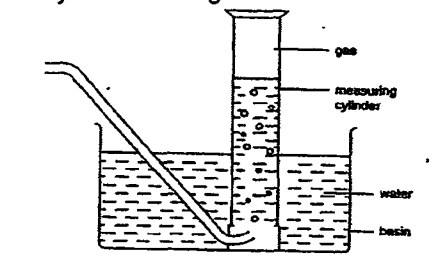
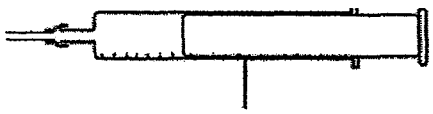
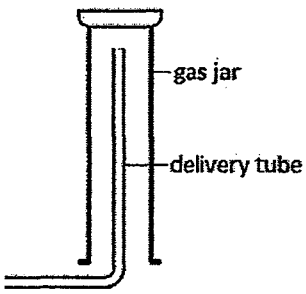
Sec.4 Chemistry Prelim Examination 2016 Marking Scheme:

Paper 1:

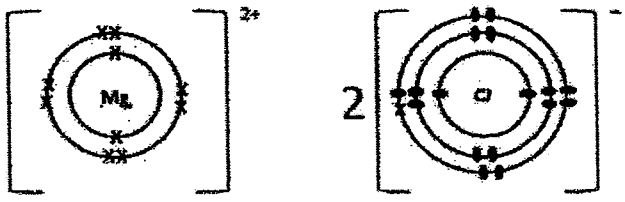
1	D	21	A
2	B	22	C
3	A	23	C
4	B	24	A
5	A	25	C
6	C	26	B
7	C	27	A
8	B	28	C
9	A	29	B
10	D	30	C
11	B	31	A
12	D	32	B
13	A	33	B
14	A	34	C
15	A	35	C
16	D	36	D
17	D	37	A
18	A	38	B
19	B	39	D
20	A	40	B

Paper 2:
Section A

A1	**(a)**	**(i)**	
		(ii)	Ammonium chloride is formed closer to HCl as HCl has a higher relative molecular mass/is denser than NH_3, HCl diffuses slower than NH_3 (vice versa).
		(iii)	NH_3 CO_2 H_2 SO_2

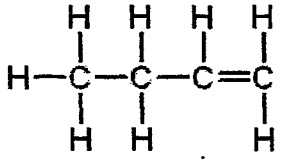
		(iv)	correct method clearly labelled diagram   gas syringe  - 1m wrong proportion/incomplete diagram - 0m if wrong method
. .			. .
A2	**(a)**		

Number of protons	Number of neutrons	
17	18	
17	20	

	(b)	(i)	 Symbol X : electron of Mg ● : electron of Cl
		(ii)	Yes, the magnesium chloride will have a higher melting point than carbon tetrachloride For carbon tetrachloride, it has a simple molecular structure that has weak intermolecular forces of attraction, which are easily overcome with little energy. For magnesium chloride, it has a giant ionic structure with strong electrostatic forces of attraction between oppositely charged ions, which takes a lot of energy to overcome
A3	(a)	(i)	Total volume of gas left = $\frac{79 \times 80}{100}$ = 63.2 cm^3
		(ii)	The total volume of air in the apparatus is more than 80 cm^3 due to the air in the glass tube. Thus the change in volume will be greater, leading to a higher percentage of oxygen.
	(b)	(i)	There is a high risk of explosion as hydrogen can react explosively with oxygen in air.
		(ii)	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
	(c)	(i)	Al^{3+}, Pb^{2+} and Cu^{2+}.
		(ii)	$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$
A4	(a)		$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$
	(b)		Calcium carbonate reacts with the acid to produce carbon dioxide which fills the stomach causing discomfort.

	(c)	(i)	Number of moles of acid = $\frac{10 \times 1.00}{1000}$ = 0.0100 mol

		(ii)	Number of moles of calcium carbonate required to react with acid = 0.01 ÷ 2 = 0.005 mol Mass of calcium carbonate required = 0.005x100 = 0.5g Number of tablets required = 0.5 ÷ $\frac{250}{1000}$ ( ) = 2 tablets
A5	**(a)**		Saves/conserves finite metal resources. Saves energy involved in metal extraction as extraction requires more chemical processes. Metal extraction process causes air pollution as carbon monoxide maybe produced. Land used for mining of metal ores to produce new metal to make cans cannot be used for other purposes such as agriculture and housing. (Any 2)
	(b)		They can be separated by big electro-magnets because only steel is magnetic.
	(c)		Tin forms a non-porous/protective layer that prevents steel from contact with atmospheric oxygen and moisture, thus prevents rusting.
	(d)	**(i)**	Endothermic
		(ii)	M_r of AlF_3 = 84 Moles of AlF_3 = 2.8/84 = 0.0333 Heat energy given off = 0.0333x216= 7.2 kJ
A6	**(a)**		Iron is in excess. The balance is connected to the iron plate and the balance reading shows that there are still unreacted iron at the end of the reaction /Final mass of iron did not reach zero.
	(b)	**(i)**	Oxidised. Iron atom loses either 2 or 3 electrons to form Fe^{2+} or Fe^{3+} respectively.
		(ii)	Add aqueous sodium hydroxide / aqueous ammonia to the solution. If dirty green precipitate is obtained, the reaction illustrated by equation 1 occurred. If reddish-brown precipitate is obtained, the reaction illustrated by equation 2 occurred.

	(c)		Slower reaction Iodine is less reactive than bromine / Iodine is a weaker oxidising agent than bromine
A7	(a)	(i)	1375 kJ / mol
		(ii)	helium
	(b)		The first ionisation energy of beryllium is higher than magnesium. Beryllium atoms have a smaller atomic radius / smaller atomic size / less electron shells / than magnesium atoms.
			As a result, the attractive forces between the positively charged nucleus and the valence electrons are stronger for beryllium than magnesium. Thus, more energy is required to overcome the attractive force for beryllium than magnesium.
A8	(a)	(i)	CH_2
		(ii)	$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$
	(b)	(i)	Isomer is a compound that has same molecular formula but different structural formula to another organic compound.
		(ii)	Compound U 
		(iii)	Polybutene. Addition polymerisation
		(iv)	$C_4H_8 + Br_2 \rightarrow C_4H_8Br_2$
		(v)	Butanol. Conditions : phosphoric(V) acid as catalyst, 300^0C & 60atm

Section B

B9	(a)		ClO_2 is oxidised. The oxidation state of chlorine increases from +4 in ClO_2 to +5 in ClO_3^-. ClO_2 is reduced. The oxidation state of chlorine decreases from +4 in ClO_2 to +3 in ClO_2^-. Since oxidation and reduction occurs simultaneously, the reaction is redox.

	(b)		With reference to experiment 1 and 2, when the concentration of ClO_2 doubles, the rate of reaction increases by 4 times. With reference to experiment 1 and 3, when the concentration of OH^- doubles, the rate of reaction also doubles. The increase in the concentration of each reactant does not have an equal effect on the rate of reaction. Hence, the concentration of ClO_2 has a greater effect on the rate of reaction than the concentration of OH^-
	(c)		0.04416 mol/dm^{3}s or 0.0442 mol/dm^{3}s (to 3sf)
	(d)		When concentration is increased, there are more reactant particles per unit volume. This leads to higher frequency of effective collisions between particles. This leads to a faster rate of reaction.
	(e)		Mol ratio of ClO_2 : OH^- = 1 : 1 Since 50 cm^3 of ClO_2 and OH^- was used and ClO_2 had a higher concentration of 0.040 mol/dm^3 compared to OH^- of concentration 0.030 mol/dm^3. Thus OH^- is the limiting reagent. (or show calculation to find limiting reactant) No. of mol of OH^- = 50/1000 x 0.030 = 0.00150 mol Mol ratio of H_2O : OH^- = 1 : 2 No. of mol of H_2O produced = ½ x 0.00150 = 0.000750 mol Mass of H_2O produced = 0.000750 x (1x2+16) = 0.0135 g
B10	(a)		The more reactive the metal, the more negative will be the standard reduction potential value.
	(b)	(i)	Electron flow from Ni to metal B Anode (-) : Ni Cathode(+): Metal B Electrolyte :dilute aqueous nickel(II) nitrate

			Voltmeter to be included.

		(ii)	Anode: $Ni\ (s) \rightarrow Ni^{2+}\ (aq) + 2\ e^-$ Cathode: $2H^+(aq) + 2e^- \rightarrow H_2\ (g)$:
		(iii)	pH increases. Concentration of OH^- is greater than H^+ since H^+ ions are discharged.
	(c)		This is a metal displacement reaction. Nickel(II) nitrate solution becomes less green/fades to colourless solution OR Grey/silvery deposit (of nickel) on metal F
B11 either	(a)		Death of aquatic life (plants & animals)
	(b)		Either: • Coal is burnt in power stations. This leads to sulfur in coal reacting with oxygen in air to form sulfur dioxide. • Sulfur dioxide reacts with moisture and oxygen to form sulfuric acid. • Sulfuric acid dissolves in rain to form acid rain which lowers the pH of water bodies. Or: • Nitrogen in air reacts with oxygen in air at high temperatures in power stations to form oxides of nitrogen. • Oxides of nitrogen react with moisture and oxygen to form nitric acid. • Nitric acid dissolves in rain to form acid rain which lowers the pH of water bodies.
	(c)		**More coal is burnt in winter** to generate electricity or heat for keeping warm. Therefore more sulfur dioxide and oxides of nitrogen are produced causing **more acid rain / snow** to form.
	(d)	(i)	AgCl
		(ii)	Iron(III) hydroxide & Copper(II) hydroxide
		(iii)	Al_{3+}
		(iv)	**All nitrates are soluble in water** and cannot be removed by precipitation.
B11 or	(a)		Group II elements have a giant metallic structure that is made up of positive ions in a sea of electrons Since the electrons are able to move freely across the metal structure, they are able to conduct electricity

	(b)		Calcium would react more vigorously with cold water as compared to magnesium. In both cases, hydrogen is produced. Calcium would produce calcium hydroxide and magnesium will produce magnesium hydroxide. Barium will react very vigorously with cold water.
	(c)	(i)	Magnesium oxide has a high melting.
		(ii)	The magnesium and oxide ions are held together in a giant lattice structure by strong electrostatic forces of attraction between ions / ionic bonds. A lot of heat energy is required to break the bonds / overcome forces of attraction.
	(d)		Slaked lime is basic while sulfur dioxide is acidic. They can undergo a neutralization reaction