Name: …… Index No. …… Class: ……

BUKIT BATOK SECONDARY SCHOOL

GCE O LEVEL PRELIMINARY EXAMINATION

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

SCIENCE **5076/03**

Paper 3 Chemistry

15 August 2018

1030 – 1145 h

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
Write in dark blue or black pen
You may use a 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.
Write your answers in the spaces provided on the Question Paper.

Section B

Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

Electronic calculators may be used.
A copy of the Data Sheet is printed on page 18.
A copy of the Periodic Table is given at the end of the paper.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

Section A [45 marks]
Answer **all** the questions.
Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows the composition of unpolluted, dry air.

(a) Write in the missing name of the gas which occupies 78% of air. [1]

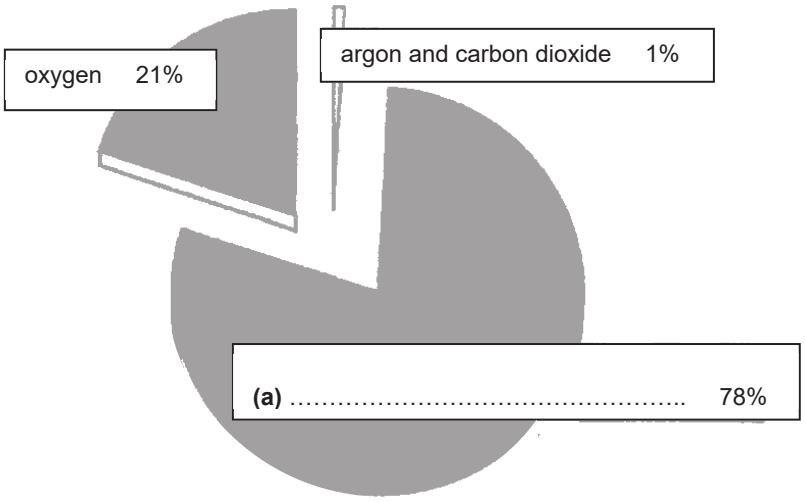


Fig. 1.1

(b) Name two gases that pollute the atmosphere and name the chemical source of each.

Gas 1 ……

Source ……

……

Gas 2 ……

Source ……

…… [4]

2 A student collected some water from a polluted river.
The water contains some soluble solids and insoluble clay.

(a) State a method that can separate the clay from the rest of the water.

…… [1]

(b) The student then boiled the river water to obtain the soluble solids.
Fig. 2.1 shows how she heated the water.

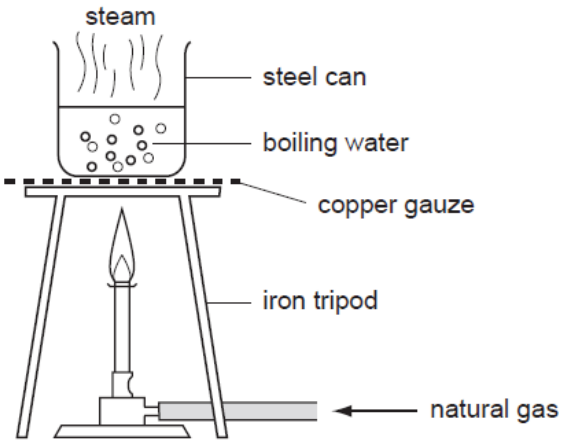


Fig. 2.1

The student wrote in her practical sheet that "*the boiled river water is pure because the universal indicator remains green when it is added to the boiled river water.*"

Do you agree with her statement? Explain.

……..

…….. [1]

(c) On cooling, steam will condense. Describe what happens to the spacing and movement of the particles of steam during condensation.

changes to spacing

……..

changes to movement

…….. [2]

3 Cold packs are used to reduce swelling, inflammation and pain by removing the heat. A list of chemicals from a science laboratory is shown below:

ammonium nitrate, dilute hydrochloric acid, water, anhydrous sodium carbonate, sodium hydroxide

(a) From the list of chemicals provided above, select a **pair** of chemicals that can be used for making a cold pack in a science laboratory.

…….. [1]

(b) Explain your answer in **(a)** and state the type of energy change.

……...

…….. [2]

4 A solution of nitric acid, HNO_3, has a concentration of 126 g/dm^3.

(a) **(i)** Calculate the relative molecular mass of nitric acid.
[Relative atomic masses, A_r : H, 1; N, 14; O, 16]

relative molecular mass = …….. [1]

(ii) Calculate the concentration of the solution in mol/dm^3.

concentration = …….. [1]

(b) Magnesium carbonate reacts with this solution of nitric acid as follows:

$$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$$

(i) What mass of magnesium carbonate react with 500 cm^3 of nitric acid?

Mass of magnesium carbonate = …….. [2]

(ii) Find the volume of carbon dioxide gas produced in this reaction.

Volume of carbon dioxide = …….. [1]

(c) Another nitric acid solution is made by diluting 1.0 mol to make 2.0 dm^3 of solution. What is the concentration of this solution in mol/dm^3?

concentration …….. [1]

5 Fig. 5.1 shows the properties of some elements in Group VII.

Properties	X	Y	Iodine
melting point / °C	- 7.2	- 101.0	114.0
boiling point / °C	58.8	- 35.0	184.0
reaction with aqueous potassium iodide	colourless solution turns brown	colourless solution turns brown	
reaction with cold aqueous sodium hydroxide	reacts quickly and less vigorously to form a colourless solution	reacts rapidly and vigorously to form a colourless solution	reacts slowly to form a colourless solution

Fig. 5.1

(a) State the physical state and colour of **Y** at room temperature and pressure.

…… [1]

(b) Using evidence from Figure 5.1, explain and deduce the identity of **X**.

……

……

……

……

……

…… [3]

(c) Iodine reacts with cold aqueous sodium hydroxide according to the equation:

$$2NaOH + I_2 \rightarrow NaI + NaOI + H_2O$$

(i) Explain why both element **X** and **Y** undergoes similar reaction with cold aqueous sodium hydroxide.

……

…… [1]

(ii) Hence, construct a chemical equation for the reaction between element **X** and cold aqueous sodium hydroxide.

…… [1]

6 Equal masses of lumps of lead (II) carbonate were reacted with three different acids of the same concentration in three separate experiments I, II and III. The acids were in excess and all other conditions were kept the same.

Experiment	Reagents	
I	Lead (II) carbonate	Nitric acid
II	Lead (II) carbonate	Sulfuric acid
III	Lead (II) carbonate	Ethanoic acid

The mass of the lead (II) carbonate was measured and calculated at regular time intervals and the results for experiments I and II are shown in Figure 6.1.

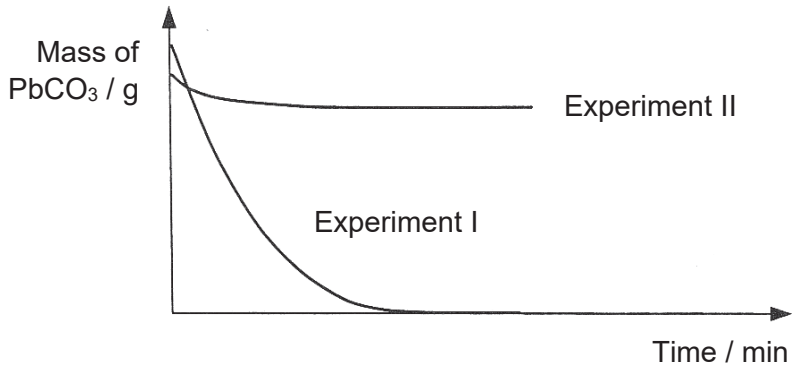


Fig. 6.1

(a) Using Fig. 6.1, determine if lead (II) carbonate react completely with sulfuric acid. Explain your answer.

…… [1]

(b) **(i)** In experiments I and III, would ethanoic acid react faster than nitric acid? Explain your answer in terms of hydrogen ions in the acids.

……..

……..

……..

…… [2]

(ii) Lead (II) ethanoate is a white, crystalline substance with a sweetish taste and is soluble in water.

Sketch on the same axes above, the result for experiment III. [1]

(c) Briefly outline how a pure and dry sample of lead (II) nitrate can be made from lead (II) carbonate.

……

……

……

……

……

……

…… [4]

7 Propane and propene are both organic compounds.

(a) Compare how they react, if at all, with
(i) oxygen,
(ii) hydrogen.

……

……

……

……

……

……

……

……

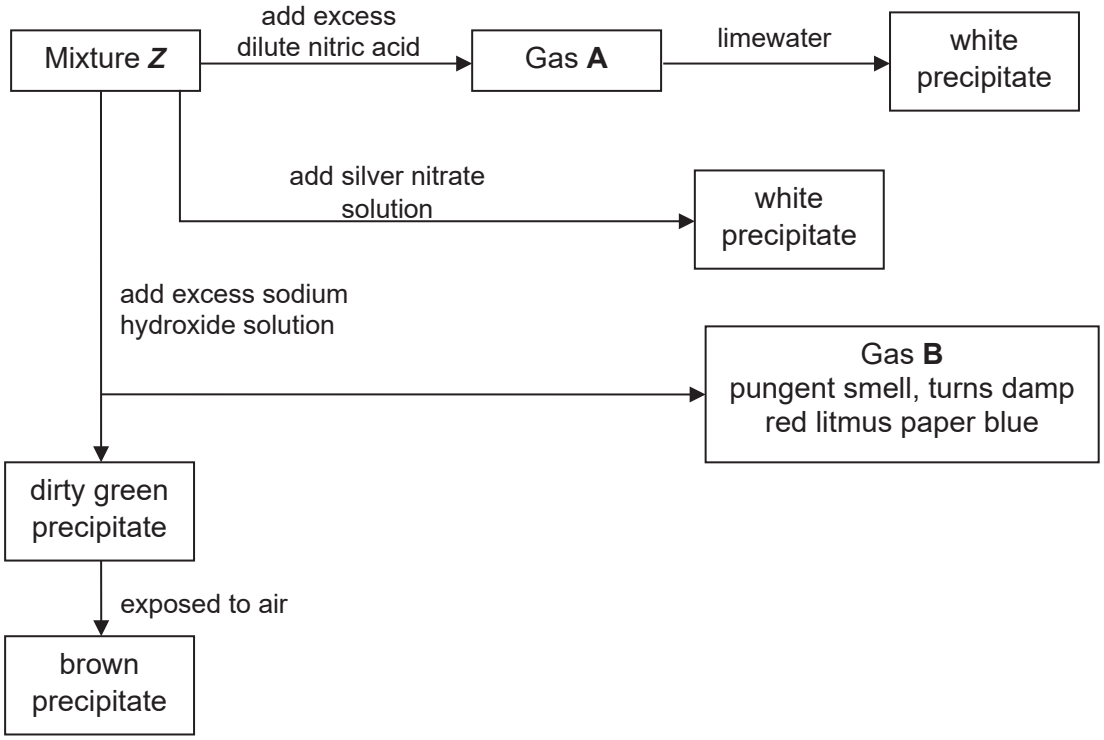
……

……... [5]

(b) Write a chemical equation for any one of these reactions.

……... [1]

8 A mixture ***Z*** was made by dissolving two salts, ***X*** and ***Y***, in water. A series of reactions was carried out on mixture ***Z*** as shown below.



(a) Identify the **four** ions that are present in mixture ***Z***. Justify your answers. [4]

Ions	Formula	Reasons
1		
2		
3		
4		

(b) Predict what would be observed if excess ammonia solution was added to a sample of mixture ***Z***.

……

……... [1]

(c) No reaction was observed when ammonia solution was added to aqueous solution of salt ***Y***.

Give the names of salts ***X*** and ***Y***.

X : ……...

Y : …… [2]

- End of Section A -

Section B [20 marks]
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

9 Fig. 9.1 shows the structures of calcium chloride and chlorine gas.

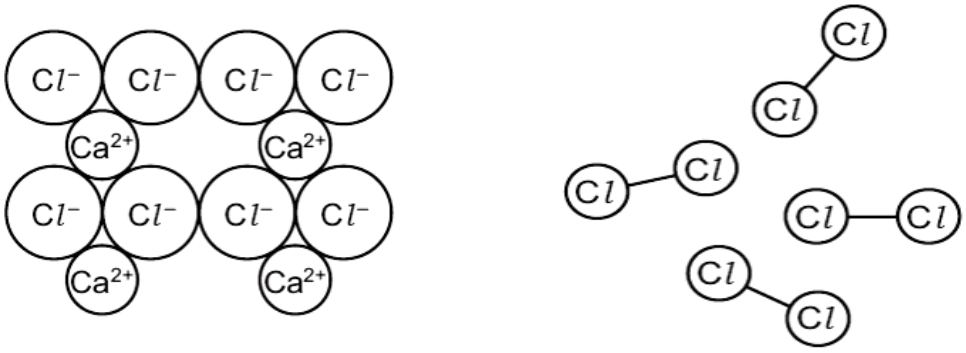


Fig. 9.1

(a) Chlorine exists as two isotopes, ^{35}Cl and ^{37}Cl.
Describe the similarities and differences between these two isotopes.

……

……

…….. [3]

(b) Calcium reacts with chlorine atoms to form calcium chloride.
Fig. 9.2 shows the physical properties of calcium chloride and chlorine.

	conductivity	boiling point/ ^{O}C
calcium chloride	conducts in molten state but not in solid state	1935
chlorine gas	does not conduct electricity	-34

Fig. 9.2

(i) Predict and explain the electrical conductivity of strontium chloride.

……

……

…….... [2]

(ii) Explain how a calcium atom combines with chlorine atoms to form calcium chloride. Your answer should include:

- electronic structures of atoms
- force of attraction in the compound

……

……

……

……... [3]

(iii) Give a reason why chlorine gas has such a low boiling point.

……

……

……... [2]

[Total : 10 marks]

10 (a) Duralumin is an alloy made up mainly of aluminium and copper atoms.

Fig. 10.1 shows how the strength of duralumin changes with the different percentage of copper added.

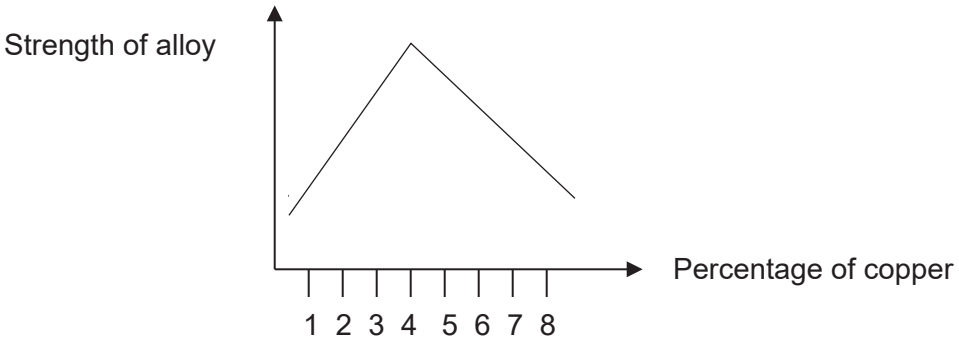


Fig. 10.1

(i) Using the information from Figure 10.1, estimate the percentage of copper that will produce the strongest duralumin mixture.

…… [1]

(ii) Explain, with the aid of a well-labelled diagram of duralumin, why it is stronger than pure aluminium.

……

……

…… [2]

(b) Fig. 10.2 shows the results of an experiment in which four metals are placed in solutions of other metal nitrates.

Solution		Metals added			
Metal nitrate	**Colour**	**Calcium**	**Chromium**	**Cobalt**	**Copper**
Calcium nitrate	Colourless	No reaction	No reaction	No reaction	No reaction
Chromium (III) nitrate	Green	Colourless solution and grey solid	No reaction	No reaction	No reaction
Cobalt (II) nitrate	Pink	Colourless solution and grey solid	Green solution and grey solid	No reaction	No reaction
Copper(II) nitrate	blue	Colourless solution and reddish-brown solid		Pink solution and reddish-brown solid	No reaction

Fig. 10.2

(i) Arrange the four metals in order of their reactivity starting with the most reactive.

…… [1]

(ii) Predict two observations when chromium is added to copper(II) nitrate solution.

……

……

…… [2]

(c) One possible chemical reaction between metal **Y** and the solution of salt **X** is as follows:

$$\mathbf{Y} + \mathbf{X}(NO_3)_2 \rightarrow \mathbf{X} + \mathbf{Y}(NO_3)_2$$

(i) Complete the table below with the missing information.

formula	oxidation state of Y
Y	
$\mathbf{Y}(NO_3)_2$	

[2]

(ii) Using the data above, explain whether **Y** is an oxidizing or a reducing agent.

……

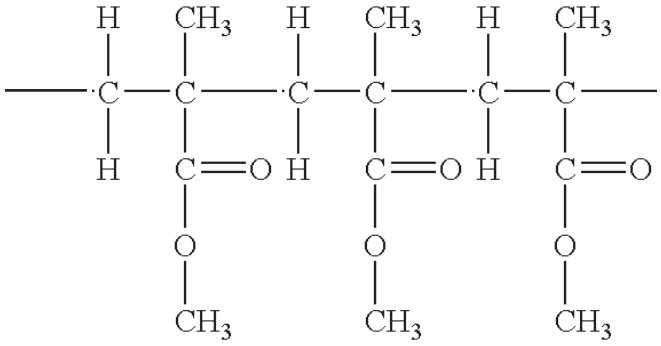
……

……

…… [2]

[Total : 10 marks]

11 Poly(methyl methacrylate) is formed by addition polymerisation.
Its structure is shown below.



(a) **(i)** Draw the structure of the monomer of poly(methyl methacrylate).

[1]

(ii) Explain why and how the monomer drawn in **(a)(i)** can undergo addition polymerisation to form poly(methyl methacrylate).

……

……

……

…… [2]

(b) Ethanol can be obtained from glucose through the process of fermentation. One of the conditions of this process is having an anaerobic environment. Otherwise, substance **X** will be produced instead.

(i) Write the chemical equation for fermentation of glucose.

…… [1]

(ii) Draw the structural formula of substance **X**.

[1]

(iii) Describe a laboratory experiment to differentiate ethanol and substance **X**.

……

……

……

……

…… [3]

(iv) A student carries out fermentation in a laboratory. To speed up the process, he heats up the mixture to 100 ºC. Explain why he will **not** obtain ethanol.

……

…… [1]

(v) State one use of ethanol.

…… [1]

[Total : 10 marks]

- End of Paper –

DATA SHEET

Colours of some common metal hydroxides

calcium hydroxide	white
copper(II) hydroxide	light blue
iron(II) hydroxide	green
iron(III) hydroxide	red-brown
lead(II) hydroxide	white
zinc hydroxide	white

DATA SHEET

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										2 **He** Helium 4
3 **Li** Lithium 7	4 **Be** Beryllium 9											5 **B** Boron 11	6 **C** Carbon 12	7 **N** Nitrogen 14	8 **O** Oxygen 16	9 **F** Fluorine 19	10 **Ne** Neon 20
11 **Na** Sodium 23	12 **Mg** Magnesium 24											13 **Al** Aluminium 27	14 **Si** Silicon 28	15 **P** Phosphorus 31	16 **S** Sulfur 32	17 **Cl** Chlorine 35.5	18 **Ar** Argon 40
19 **K** Potassium 39	20 **Ca** Calcium 40	21 **Sc** Scandium 45	22 **Ti** Titanium 48	23 **V** Vanadium 51	24 **Cr** Chromium 52	25 **Mn** Manganese 55	26 **Fe** Iron 56	27 **Co** Cobalt 59	28 **Ni** Nickel 59	29 **Cu** Copper 64	30 **Zn** Zinc 65	31 **Ga** Gallium 70	32 **Ge** Germanium 73	33 **As** Arsenic 75	34 **Se** Selenium 79	35 **Br** Bromine 80	36 **Kr** Krypton 84
37 **Rb** Rubidium 85	38 **Sr** Strontium 88	39 **Y** Yttrium 89	40 **Zr** Zirconium 91	41 **Nb** Niobium 93	42 **Mo** Molybdenum 96	43 **Tc** Technetium -	44 **Ru** Ruthenium 101	45 **Rh** Rhodium 103	46 **Pd** Palladium 106	47 **Ag** Silver 108	48 **Cd** Cadmium 112	49 **In** Indium 115	50 **Sn** Tin 119	51 **Sb** Antimony 122	52 **Te** Tellurium 128	53 **I** Iodine 127	54 **Xe** Xenon 131
55 **Cs** Caesium 133	56 **Ba** Barium 137	57 – 71 lanthanoids	72 **Hf** Hafnium 178	73 **Ta** Tantalum 181	74 **W** Tungsten 184	75 **Re** Rhenium 186	76 **Os** Osmium 190	77 **Ir** Iridium 192	78 **Pt** Platinum 195	79 **Au** Gold 197	80 **Hg** Mercury 201	81 **Tl** Thallium 204	82 **Pb** Lead 207	83 **Bi** Bismuth 209	84 **Po** Polonium –	85 **At** Astatine –	86 **Rn** Radon –
87 **Fr** Francium –	88 **Ra** Radium –	89 – 103 actinoids	104 **Rf** Rutherfordium –	105 **Db** Dubnium –	106 **Sg** Seaborgium –	107 **Bh** Bohrium –	108 **Hs** Hassium –	109 **Mt** Meitnerium –	110 **Ds** Darmstadtium –	111 **Rg** Roentgenium –	112 **Cn** Copernicium –		114 **Fl** Flerovium –		116 **Lv** Livermorium –		

Key

proton (atomic) number

atomic symbol

lanthanoids	57 **La** Lanthanum 139	58 **Ce** Cerium 140	59 **Pr** Praseodymium 141	60 **Nd** Neodymium 144	61 **Pm** Promethium 147	62 **Sm** Samarium 150	63 **Eu** Europium 152	64 **Gd** Gadolinium 157	65 **Tb** Terbium 159	66 **Dy** Dysprosium 162	67 **Ho** Holmium 165	68 **Er** Erbium 167	69 **Tm** Thulium 169	70 **Yb** Ytterbium 173	71 **Lu** Lutetium 175
actinoids	89 **Ac** Actinium –	90 **Th** Thorium 232	91 **Pa** Protactinium 231	92 **U** Uranium 238	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 –

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

Bukit Batok Secondary School
Sec 4 Express, 5 Normal (Academic)
Science (Chemistry)

PRELIMINARY EXAMINATIONS 2018
ANSWERS

Paper 1 : Multiple Choice Questions (20 marks)

21	**D**	Sugar = $C_6H_{12}O_6$ where carbon, hydrogen and oxygen atoms are chemically bonded together
22	**C**	Conc sulfuric acid H_2SO_4 dries acidic gases (so they don't react). Upward delivery is used to collect gases which are less dense than air. NH_3 will react with conc H_2SO_4 though it can be collected via upward delivery. CO_2, H_2 and O_2 will not react with conc H_2SO_4 thus can be dried & collected. Only H_2 is less dense than air to be collected via upward delivery method.
23	**C**	Melting point of substance is to be <-150°C and boiling point <-100°C.
24	**C**	Different substances have different solubility in different solvents.
25	**D**	Y – from Group VI because it has 6 valence electrons Z – from Group VII because it gas 7 valence electrons
26	**B**	Hydroxide ion = OH^- There are 8 protons in oxygen and 1 proton in hydrogen atoms = 9 protons F- ion has 9 protons (each fluorine atom has 9 protons, it takes in 1 electron to form a fluoride ion, proton number is not affected thus remains the same).
27	**B**	Rubidium chloride is made up of Rb^+ and Cl^- ions thus RbCl. Group I metals have low melting point and are soluble in water.
28	**D**	Acidic oxide (CO_2) and amphoteric oxides (Al_2O_3 and ZnO) can react with NaOH which is a base.
29	**A**	R is a solid which can react with solution S in a neutralisation reaction. Thus R = insoluble metal oxide (ie a solid) and S = acid (solution)
30	**D**	$BaCl_2$ gives white precipitate = SO_4^{2-} present White precipitate soluble in excess aq NH_3 = Zn^{2+} ion present
31	**B**	No of moles of Mg = mass ÷ molar mass = 6g ÷ 24 = 0.250 mol 1mol Mg produces 1mol H_2 Volume of H_2 = no of moles x molar volume = 0.250 mol x 24 dm^3 = *6 dm^3*
32	**D**	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ Answer is **NOT** (B) because **LIME** is used to remove acidic impurities, not **limestone**. **LIME** is produced of heat limestone. $CaCO_3 \rightarrow CaO + CO_2$ $CaO + SiO_2 \rightarrow CaSiO_3$
33	**D**	30% of O_2 will be used up, 70% of air left.
34	**C**	(A) formation of bond = exothermic (B) rusting = exothermic (C) melting (ice absorb heat) = endothermic (D) H_2 combust in O_2 to form H_2O = exothermic
35	**D**	Na atom (2.8.1) loses 1 electron to form Na^+ ion (2.8). Loss of electrons = oxidation
36	**B**	½ volume of CO_2 produced , thus ½ mass of limiting reactant ($MgCO_3$) used.

37	**A**	Smallest molecules = lowest boiling point range
38	**C**	Complete combustion produce carbon dioxide and water.
39	**C**	Oxidation of ethanol to ethanoic acid produces water.
40	**B**	It has C=C and carboxyl group (COOH).

Paper 3 Section A : Short Answer Questions (45 marks)

1a. Nitrogen — 1m

1b. Gas : Sulfur dioxide (sulfur trioxide)
Source : Burning of coal in power stations / factories

Gas : Carbon monoxide
Source : Incomplete combustion of carbon-containing fuels in vehicles

Gas : Oxides of nitrogen
Source : Produce when oxygen and nitrogen react at high temperature — gas 1m
when fuel is burned/combusted in vehicle engines — source 1m

2a. filtration — 1m

2b. No. — no mark
The purity of the liquid is determined by the fixed boiling point.
OR
The universal indicator remains green can only prove that the liquid has a neutral pH (pH 7).
OR
The universal indicator can only prove whether the solution is acidic or alkaline, but cannot show whether the water is pure. — either 1m

2c. **Changes to spacing**
The spacing decreases, from moving far apart to closely packed. — 1m

Changes to movement
The movement slows down, from moving randomly at high speeds to sliding past one another in random motion. — 1m

3a. Ammonium nitrate and water — 1m

3b. Endothermic. — 1m
When ammonium salts react with water, the reaction take in / absorb energy from surrounding, causing surrounding temperature to drop / decrease. — 1m

4ai. M_r of HNO_3 = 1 + 14 + 3(16) = 63 — 1m

4aii. Concentration of HNO_3 = concentration in g/mol ÷ molar mass
= 126 g/mol ÷ 63
= ***2.00 mol/dm^3*** — 1m

4bi. No of moles of HNO_3 = concentration x volume
= 2.00 mol/dm^3 x (500/1000) dm^3
= 1.00 mol 1m

2 mol of HNO_3 reacts with 1 mol of $MgCO_3$
1.00 mol of HNO_3 reacts with 0.500 mol of $MgCO_3$

Mass of $MgCO_3$ = no of moles x molar mass 1m
= 0.500 mol x [24 + 12 + 3(16)] *ecf if 1st 1m*
= ***42 g*** *wrong*
overall -1 if any answer not in 3sf

4bii. 2 mol of HNO_3 produces 1 mol of CO_2
1.00 mol of HNO_3 produces 0.500 mol of CO_2

Volume of CO_2 = no of moles x molar volume
= 0.500 mol x 24 dm^3
= ***12 dm^3*** 1m

4c. Concentration = no of moles ÷ volume
= 1.0 mol ÷ 2 dm^3
= ***0.500 mol/dm^3*** 1m

5a. Pale yellow / yellowish-green gas 1m

5b. X could be bromine since it is a liquid. 1m

It is more reactive than iodine since it is able to displace iodine. 1m

But it is less reactive than Y since it reacts less vigorously with sodium hydroxide. 1m

5ci. All of them have seven valence electrons. 1m

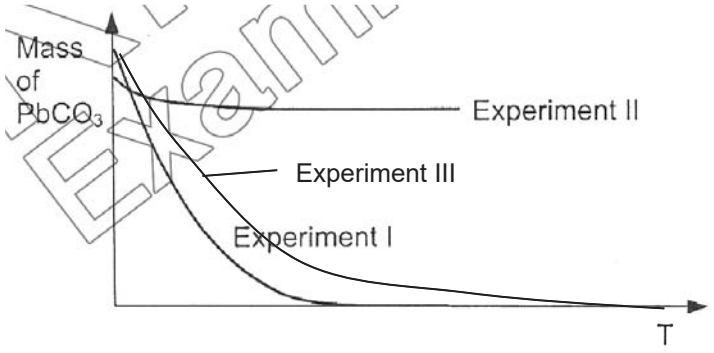
5cii. $2NaOH + X_2 \rightarrow NaX + NaOX + H_2O$ (or use Br for X) 1m

6a. No. Lead (II) sulfate produced is an insoluble salt / there is mass of lead (II) sulfate left. 1m

6bi. No. Ethanoic acid is weak acid but nitric acid is a strong acid. 1m

It has / produces lesser H+ ions per unit volume compared to nitric acid. 1m
(Frequency of collisions is lesser thus reaction is slower)

6bii.



1m

6c. (1) Add excess lead (II) carbonate to nitric acid. 1m
(2) Filter to remove excess lead (II) carbonate.
Obtain the filtrate, lead (II) nitrate. (not necessary) 1m
(3) Heat lead (II) nitrate solution till saturation.
Leave to cool for crystals to form. 1m
(4) Filter out the crystals.
Pat dry between filter papers 1m

7a. Both propane and propene reacts with excess oxygen to produce carbon dioxide and water. 1m

Both undergoes incomplete combustion to produce carbon monoxide and water. 1m

Propane does not react with hydrogen. 1m

Propene reacts with hydrogen at (200 °C with nickel catalyst) to produce propane. 1m
have ( ) 1m

7b. $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$
$2C_3H_8 + 10O_2 \rightarrow 6CO_2 + 8H_2O$
$2C_3H_6 + 6O_2 \rightarrow 6CO + 6H_2O$
$2C_3H_8 + 7O_2 \rightarrow 6CO + 8H_2O$
$C_3H_6 + H_2 \rightarrow C_3H_8$ either eqn 1m

8a.

Ions	Formula	Reasons
1	Fe^{2+}	*green precipitate formed after adding sodium hydroxide which turned brown over time*
2	NH_4^+	*ammonia gas produced when sodium hydroxide is added*
3	CO_3^{2-}	*carbon dioxide produced after adding nitric acid*
4	Cl^-	*white precipitate formed after adding silver nitrate*

each formula + reason 1m

total 4m

8b. Dirty green precipitate formed which is insoluble in excess aqueous ammonia. 1m
Turns brown on standing / when exposed to air bonus 1m

8c. X = iron (II) chloride 1m
Y = ammonium carbonate 1m

Explanation:
Possible answers are
(a) iron (II) chloride and ammonium carbonate
(b) iron (II) carbonate and ammonium chloride
However, iron (II) carbonate is an insoluble salt (both X and Y dissolve).
Also, no reaction when aq NH_3 added to Y so Y is an ammonium salt.

Paper 3 Section B : 3 Questions choose 2 (20 marks)

9a. Both have 17 protons. 1m

They have different number of neutron / atomic mass. 1m

^{35}Cl has 18 neutrons/ mass number of 35.
^{37}Cl has 20 neutrons/mass number of 37. 1m

9bi. Strontium chloride conducts in molten state but not in solid state. no marks
The ions (Sr^{2+} and Cl^{-}) are mobile in molten state. 1m
But they cannot move (and are fixed in positions) when in solid state. 1m

9bii. Calcium atom has an electronic configuration of 2.8.8.2.
Chlorine has an electronic configuration of 2.8.7. 1m

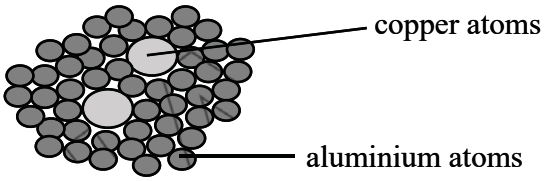
Each calcium atom transfers two valence electrons to 2 chlorine atoms. 1m

Ca^{2+} and Cl^{-} ions are formed which are attracted by electrostatic forces of attraction. 1m

9biii. Weak intermolecular force between chlorine molecules required 1m
little amount of energy to overcome. 1m

10ai. 4% 1m

10aii.



1m

Copper atoms is bigger than aluminium atoms thus they disrupt the orderly arrangement of aluminium atoms and prevent them from sliding. 1m

10bi. Calcium > chromium > cobalt > copper 1m

10bii. Blue solution turns green. 1m
Brown solids formed. 1m

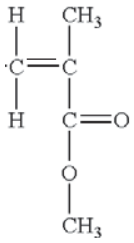
10ci. Y: 0 1m
$Y(NO_3)_2$: +2 1m

10cii. It is a reducing agent. no marks

Y is oxidised as the oxidation state of Y increases from 0 in Y to +2 in $Y(NO_3)_2$. 1m

Y reduces $X(NO_3)_2$ by decreasing the oxidation state of X from +2 to 0 in X. 1m

11ai.



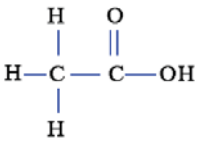
1m

11aii. At **high temperature and pressure (**and in the presence of a catalyst), the **carbon-carbon double bonds** of the monomer **break** / the monomer has C=C bonds which break. 1m

Each monomer forms single bonds and joins with two other monomers. form the polymer, poly(methyl methacrylate). 1m

11bi. $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2CO_2$ 1m

11bii.



1m

11biii. Add potassium manganate(VII) to both substances. 1m
If it turns from purple to colourless, it is substance is ethanol. 1m
If it remains purple, it is substance X. 1m

Also accept –
Use of blue litmus paper
X turns blue litmus paper red
Blue litmus paper remains blue if its ethanol.

Add suitable metal / metal carbonate
If susbstance X, effervescence seen.
H_2 produced with caused lighted splint to extinguish with pop sound (if use metal)
CO_2 produced which formed white precipitate in limewater (if use metal carbonate)

11biv. When the mixture is heated, the yeast denatures and stops the reaction. 1m

11bv. Solvent in paints and varnishes
Manufacture of perfumes, detergent, deodorants etc.
Found in alcoholic drinks like beer, wines and spirits
Used in preparation of ethanoic acid
(Any one) 1m

Bukit Batok Secondary School
Sec 4 Express, 5 Normal (Academic)
Science (Chemistry)

PRELIMINARY EXAMINATIONS 2018
ANSWERS

Paper 3 Section A : Short Answer Questions (45 marks)

1a. Nitrogen — 1m

1b. Gas : Sulfur dioxide (sulfur trioxide)
Source : Burning of coal in power stations / factories

Gas : Carbon monoxide
Source : Incomplete combustion of carbon-containing fuels in vehicles

Gas : Oxides of nitrogen
Source : Produce when oxygen and nitrogen react at high temperature — gas 1m
when fuel is burned/combusted in vehicle engines — source 1m

2a. filtration — 1m

2b. No. — no mark
The purity of the liquid is determined by the fixed boiling point.
OR
The universal indicator remains green can only prove that the liquid has a neutral pH (pH 7).
OR
The universal indicator can only prove whether the solution is acidic or alkaline, but cannot show whether the water is pure. — either 1m

2c. **Changes to spacing**
The spacing decreases, from moving far apart to closely packed. — 1m

Changes to movement
The movement slows down, from moving randomly at high speeds to sliding past one another in random motion. — 1m

3a. Ammonium nitrate and water — 1m

3b. Endothermic. — 1m
When ammonium salts react with water, the reaction take in / absorb energy from surrounding, causing surrounding temperature to drop / decrease. — 1m

4ai. M_r of HNO_3 = 1 + 14 + 3(16) = 63 — 1m

4aii. Concentration of HNO_3 = concentration in g/mol ÷ molar mass
= 126 g/mol ÷ 63
= ***2.00 mol/dm^3*** — 1m

4bi. No of moles of HNO_3 = concentration x volume
= 2.00 mol/dm^3 x (500/1000) dm^3
= 1.00 mol — 1m

2 mol of HNO_3 reacts with 1 mol of $MgCO_3$
1.00 mol of HNO_3 reacts with 0.500 mol of $MgCO_3$

Mass of $MgCO_3$ = no of moles x molar mass — 1m
= 0.500 mol x [24 + 12 + 3(16)] — *ecf if 1st 1m wrong*
= ***42 g*** — *overall -1 if any answer not in 3sf*

4bii. 2 mol of HNO_3 produces 1 mol of CO_2
1.00 mol of HNO_3 produces 0.500 mol of CO_2

Volume of CO_2 = no of moles x molar volume
= 0.500 mol x 24 dm^3
= ***12 dm^3*** — 1m

4c. Concentration = no of moles ÷ volume
= 1.0 mol ÷ 2 dm^3
= ***0.500 mol/dm^3*** — 1m

5a. Pale yellow / yellowish-green gas — 1m

5b. X could be bromine since it is a liquid. — 1m

It is more reactive than iodine since it is able to displace iodine. — 1m

But it is less reactive than Y since it reacts less vigorously with sodium hydroxide. — 1m

5ci. All of them have seven valence electrons. — 1m

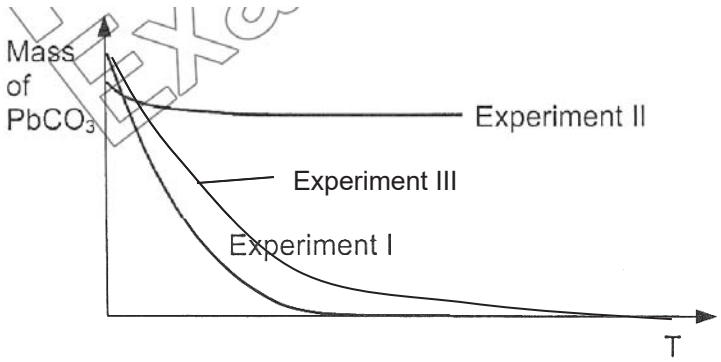
5cii. $2NaOH + X_2 \rightarrow NaX + NaOX + H_2O$ (or use Br for X) — 1m

6a. No. Lead (II) sulfate produced is an insoluble salt / there is mass of lead (II) sulfate left. — 1m

6bi. No. Ethanoic acid is weak acid but nitric acid is a strong acid. — 1m

It has / produces lesser H+ ions per unit volume compared to nitric acid. (Frequency of collisions is lesser thus reaction is slower) — 1m

6bii.



— 1m

6c. (1) Add excess lead (II) carbonate to nitric acid. — 1m
(2) Filter to remove excess lead (II) carbonate.
Obtain the filtrate, lead (II) nitrate. (not necessary) — 1m
(3) Heat lead (II) nitrate solution till saturation.
Leave to cool for crystals to form. — 1m
(4) Filter out the crystals.
Pat dry between filter papers — 1m

7a. Both propane and propene reacts with excess oxygen to produce carbon dioxide and water. 1m

Both undergoes incomplete combustion to produce carbon monoxide and water. 1m

Propane does not react with hydrogen. 1m

Propene reacts with hydrogen at (200 ^{o}C with nickel catalyst) to produce propane. 1m
have ( ) 1m

7b. $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$
$2C_3H_8 + 10O_2 \rightarrow 6CO_2 + 8H_2O$
$2C_3H_6 + 6O_2 \rightarrow 6CO + 6H_2O$
$2C_3H_8 + 7O_2 \rightarrow 6CO + 8H_2O$
$C_3H_6 + H_2 \rightarrow C_3H_8$ either eqn 1m

8a.

Ions	Formula	Reasons
1	Fe^{2+}	*green precipitate formed after adding sodium hydroxide which turned brown over time*
2	NH_4^+	*ammonia gas produced when sodium hydroxide is added*
3	CO_3^{2-}	*carbon dioxide produced after adding nitric acid*
4	Cl^-	*white precipitate formed after adding silver nitrate*

each formula + reason 1m

total 4m

8b. Dirty green precipitate formed which is insoluble in excess aqueous ammonia. 1m
Turns brown on standing / when exposed to air bonus 1m

8c. X = iron (II) chloride 1m
Y = ammonium carbonate 1m

Explanation:
Possible answers are
(a) iron (II) chloride and ammonium carbonate
(b) iron (II) carbonate and ammonium chloride
However, iron (II) carbonate is an insoluble salt (both X and Y dissolve).
Also, no reaction when aq NH_3 added to Y so Y is an ammonium salt.

Paper 3 Section B : 3 Questions choose 2 (20 marks)

9a. Both have 17 protons. 1m

They have different number of neutron / atomic mass. 1m

^{35}Cl has 18 neutrons/ mass number of 35.
^{37}Cl has 20 neutrons/mass number of 37. 1m

9bi. Strontium chloride conducts in molten state but not in solid state. no marks
The ions (Sr^{2+} and Cl^-) are mobile in molten state. 1m
But they cannot move (and are fixed in positions) when in solid state. 1m

9bii. Calcium atom has an electronic configuration of 2.8.8.2.
Chlorine has an electronic configuration of 2.8.7. 1m

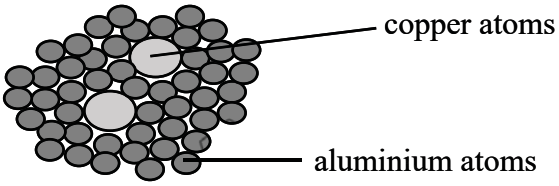
Each calcium atom transfers two valence electrons to 2 chlorine atoms. 1m

Ca^{2+} and Cl^- ions are formed which are attracted by electrostatic forces of attraction. 1m

9biii. Weak intermolecular force between chlorine molecules required 1m
little amount of energy to overcome. 1m

10ai. 4% 1m

10aii.



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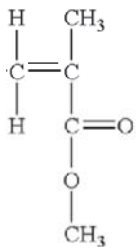

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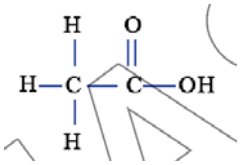

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