

Visit

FREETESTPAPER.com

for more papers



Website: [freetestpaper.com](http://www.freetestpaper.com)



[Facebook.com/freetestpaper](https://www.facebook.com/freetestpaper)



[Twitter.com/freetestpaper](https://www.twitter.com/freetestpaper)

Name: Index No. Class:



BUKIT BATOK SECONDARY SCHOOL
GCE O LEVEL PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

SCIENCE

Paper 3 Chemistry

5076/03

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]

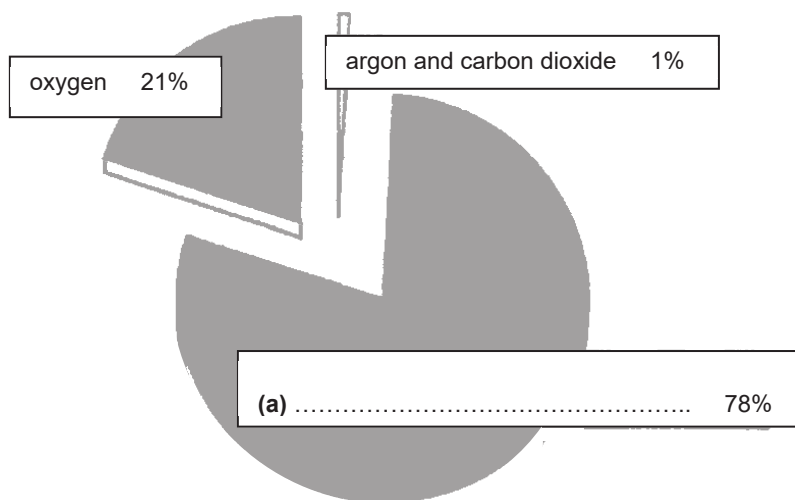


Fig. 1.1

- (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.

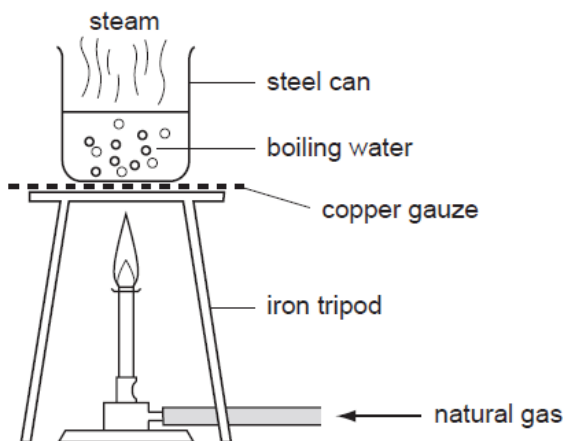


Fig. 2.1

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:



(i) What mass of magnesium carbonate react with 500 cm³ 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 dm³ of solution.
What is the concentration of this solution in mol/dm³?

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:



(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.

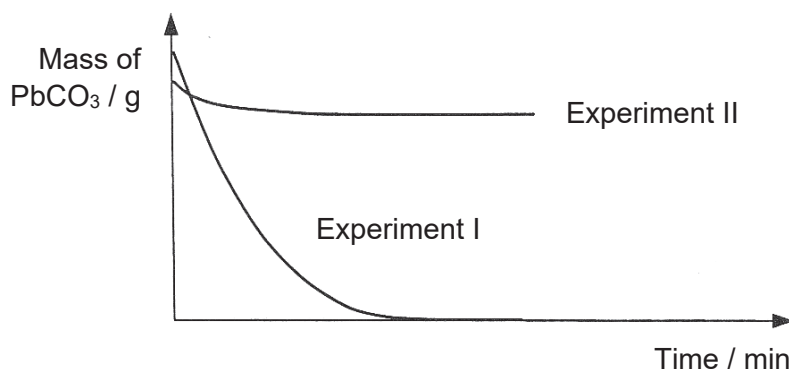


Fig. 6.1

- (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.

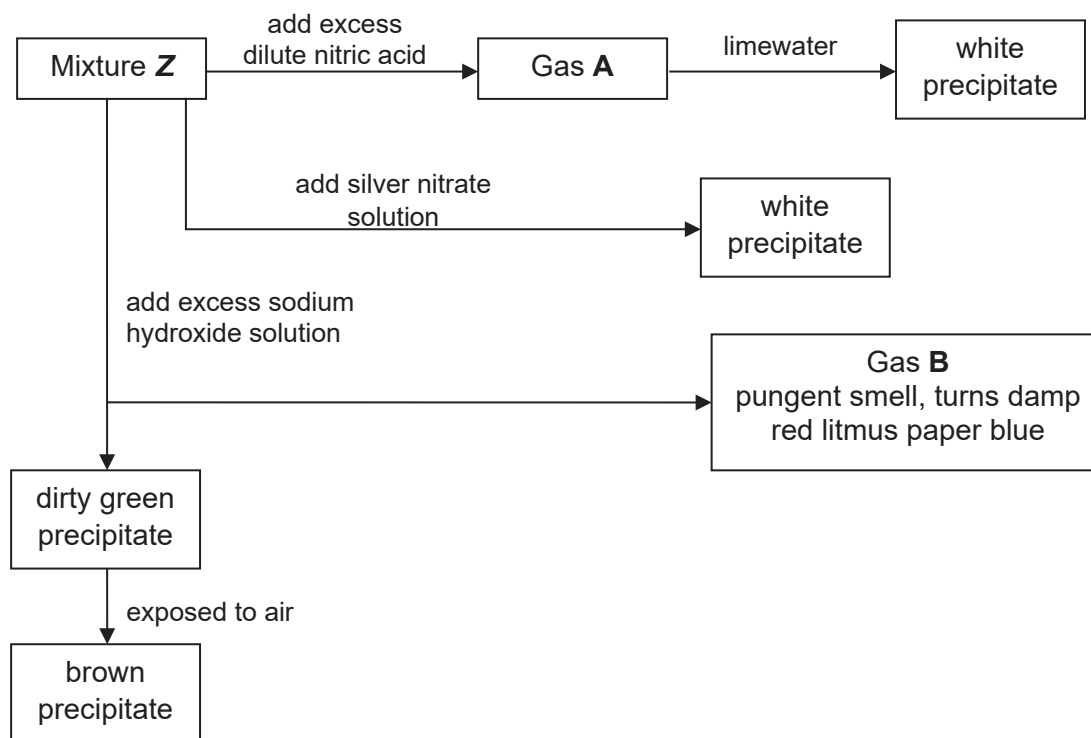
- (a) Compare how they react, if at all, with
(i) oxygen,
(ii) hydrogen.

.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [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:

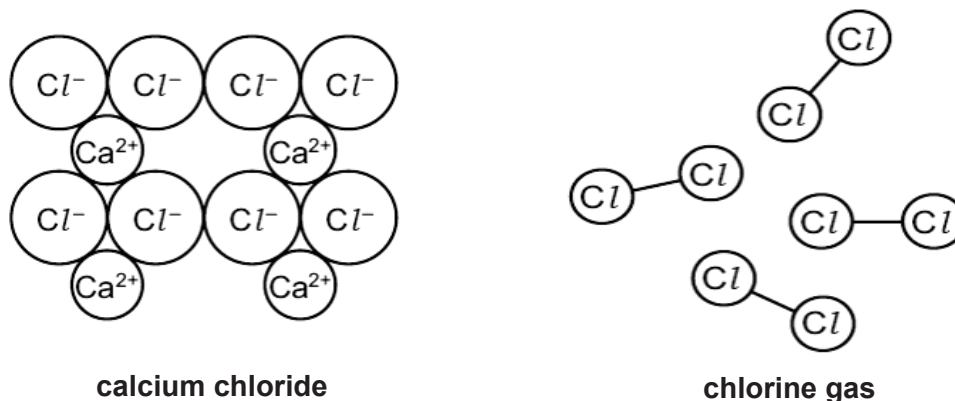
Y: [2]

- 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/ °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.

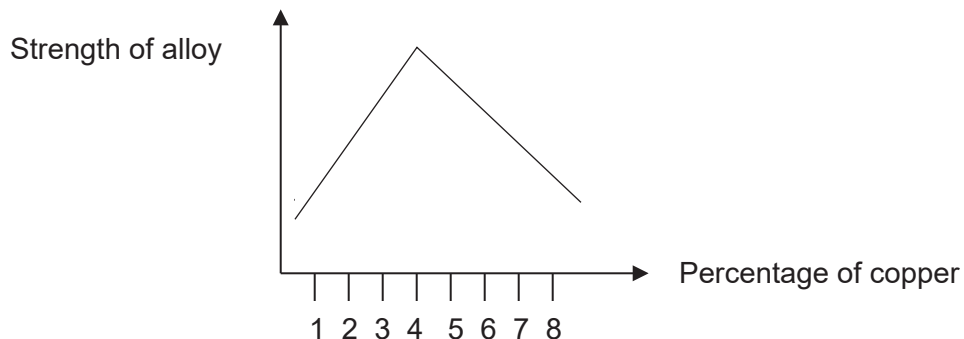


Fig. 10.1

(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:



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

formula	oxidation state of Y
Y	
Y(NO₃)₂	

[2]

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

.....

.....

.....

..... [2]

[Total : 10 marks]

(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 °C. 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															
		Key proton (atomic) number atomic symbol															
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Li Lithium 7	Be Beryllium 9	B Boron 11	C Carbon 12	N Nitrogen 14	O Oxygen 16	F Fluorine 19	Ne Neon 20	Na Sodium 23	Mg Magnesium 24	Al Aluminium 27	Si Silicon 28	P Phosphorus 31	S Sulfur 32	Cl Chlorine 35.5	Ar Argon 40		
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K Potassium 39	Ca Calcium 40	Sc Scandium 45	Ti Titanium 48	V Vanadium 51	Cr Chromium 52	Mn Manganese 55	Fe Iron 56	Co Cobalt 59	Ni Nickel 59	Cu Copper 64	Zn Zinc 65	Ga Gallium 70	Ge Germanium 73	As Arsenic 75	Se Selenium 79	Br Bromine 80	Kr Krypton 84
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb Rubidium 85	Sr Strontium 88	Y Yttrium 89	Zr Zirconium 91	Nb Niobium 93	Mo Molybdenum 96	Tc Technetium -	Ru Ruthenium 101	Rh Rhodium 103	Pd Palladium 106	Ag Silver 108	Cd Cadmium 112	In Indium 115	Sn Tin 119	Sb Antimony 122	Te Tellurium 128	I Iodine 127	Xe Xenon 131
55	56	57 – 71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs Caesium 133	Ba Barium 137	lanthanoids	Hf Hafnium 178	Ta Tantalum 181	W Tungsten 184	Re Rhenium 186	Os Osmium 190	Ir Iridium 192	Pt Platinum 195	Au Gold 197	Hg Mercury 201	Tl Thallium 204	Pb Lead 207	Bi Bismuth 209	Po Polonium -	At Astatine -	Rn Radon -
87	88	89 – 103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Fr Francium -	Ra Radium -	actinoids	Rf Rutherfordium -	Db Dubnium -	Sg Seaborgium -	Bh Bohrium -	Hs Hassium -	Mt Meitnerium -	Ds Darmstadtium -	Rg Roentgenium -	Cn Copernicium -	Fl Flerovium -	Lv Livermorium -	Uu Ununseptium -	Uub Ununbium -	Uut Ununtrium -	Uuq Ununquadium -
		lanthanoids															
		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	
		La Lanthanum 139	Ce Cerium 140	Pr Praseodymium 141	Nd Neodymium 144	Pm Promethium 147	Sm Samarium 150	Eu Europium 152	Gd Gadolinium 157	Tb Terbium 159	Dy Dysprosium 162	Ho Holmium 165	Er Erbium 167	Tm Thulium 169	Yb Ytterbium 173	Lu Lutetium 175	
		actinoids															
		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	
		Ac Actinium -	Th Thorium 232	Pa Protactinium 231	U Uranium 238	Np Neptunium -	Pu Plutonium -	Am Americium -	Cm Curium -	Bk Berkelium -	Cf Californium -	Es Einsteinium -	Fm Fermium -	Md Mendelevium -	No Nobelium -	Lr Lawrencium -	

The volume of one mole of any gas is 24 dm³ 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 ₆ H ₁₂ O ₆ where carbon, hydrogen and oxygen atoms are chemically bonded together
22	C	Conc sulfuric acid H ₂ SO 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 ₂ SO ₄ though it can be collected via upward delivery. CO ₂ , H ₂ and O ₂ will not react with conc H ₂ SO 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 has 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 ₂ O 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 ₂ O ₃ + 3CO → 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 → CaO + CO ₂ CaO + SiO ₂ → 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 ₂ O = 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 when fuel is burned/combusted in vehicle engines gas 1m
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 $\text{HNO}_3 = 1 + 14 + 3(16) = 63$ 1m
- 4aii. Concentration of $\text{HNO}_3 = \text{concentration in g/mol} \div \text{molar mass}$
 $= 126 \text{ g/mol} \div 63$
 $= \underline{\underline{2.00 \text{ mol/dm}^3}}$ 1m

4bi. No of moles of HNO_3 = concentration x volume
 = $2.00 \text{ mol/dm}^3 \times (500/1000) \text{ dm}^3$
 = 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
 = $0.500 \text{ mol} \times [24 + 12 + 3(16)]$ *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
 = $0.500 \text{ mol} \times 24 \text{ dm}^3$
 = **12 dm³** 1m

4c. Concentration = no of moles ÷ volume
 = $1.0 \text{ mol} \div 2 \text{ dm}^3$
 = **0.500 mol/dm³** 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

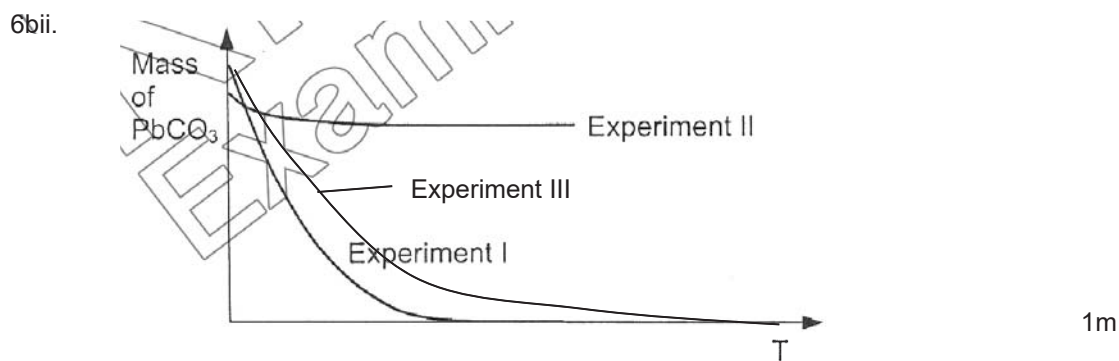
5ci. All of them have seven valence electrons. 1m

5cii. $2\text{NaOH} + \text{X}_2 \rightarrow \text{NaX} + \text{NaOX} + \text{H}_2\text{O}$ (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



- 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+}	<i>green precipitate formed after adding sodium hydroxide which turned brown over time</i>
2	NH_4^+	<i>ammonia gas produced when sodium hydroxide is added</i>
3	CO_3^{2-}	<i>carbon dioxide produced after adding nitric acid</i>
4	Cl^-	<i>white precipitate formed after adding silver nitrate</i>

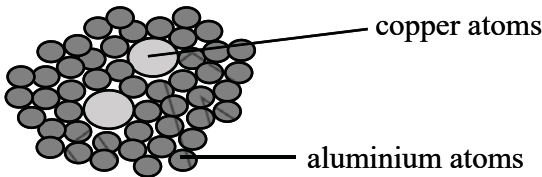
each formula + reason 1m
 total 4m

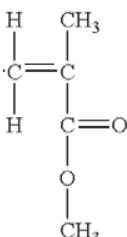
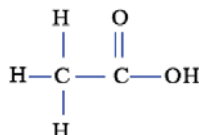
8b. Dirty green precipitate formed which is insoluble in excess aqueous ammonia. 1m
Turns brown on standing / when exposed to air bonus 1m

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 little amount of energy to overcome. 1m
 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
 $\text{Y}(\text{NO}_3)_2$: +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 $\text{Y}(\text{NO}_3)_2$. 1m
 Y reduces $\text{X}(\text{NO}_3)_2$ by decreasing the oxidation state of X from +2 to 0 in X. 1m

- 11ai. 
- 1m
- 11a.ii. 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 substance 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

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
 when fuel is burned/combusted in vehicle engines gas 1m
 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 $\text{HNO}_3 = 1 + 14 + 3(16) = 63$ 1m
- 4aii. Concentration of $\text{HNO}_3 = \text{concentration in g/mol} \div \text{molar mass}$
 $= 126 \text{ g/mol} \div 63$
 $= \underline{2.00 \text{ mol/dm}^3}$ 1m
- 4bi. No of moles of $\text{HNO}_3 = \text{concentration} \times \text{volume}$
 $= 2.00 \text{ mol/dm}^3 \times (500/1000) \text{ dm}^3$
 $= 1.00 \text{ mol}$ 1m

2 mol of HNO₃ reacts with 1 mol of MgCO₃
 1.00 mol of HNO₃ reacts with 0.500 mol of MgCO₃

$$\begin{aligned} \text{Mass of MgCO}_3 &= \text{no of moles} \times \text{molar mass} \\ &= 0.500 \text{ mol} \times [24 + 12 + 3(16)] \\ &= \underline{42 \text{ g}} \end{aligned}$$

1m
 ecf if 1st 1m
 wrong
 overall -1 if any answer not in 3sf

4bii. 2 mol of HNO₃ produces 1 mol of CO₂
 1.00 mol of HNO₃ produces 0.500 mol of CO₂

$$\begin{aligned} \text{Volume of CO}_2 &= \text{no of moles} \times \text{molar volume} \\ &= 0.500 \text{ mol} \times 24 \text{ dm}^3 \\ &= \underline{12 \text{ dm}^3} \end{aligned}$$

1m

4c. Concentration = no of moles ÷ volume
 = 1.0 mol ÷ 2 dm³
 = 0.500 mol/dm³

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 + X₂ → NaX + NaOX + H₂O (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

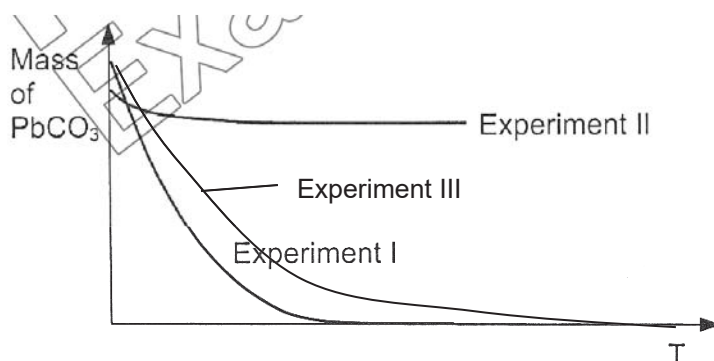
6bi. No. Ethanoic acid is weak acid but nitric acid is a strong acid.

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 °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+}	<i>green precipitate formed after adding sodium hydroxide which turned brown over time</i>
2	NH_4^+	<i>ammonia gas produced when sodium hydroxide is added</i>
3	CO_3^{2-}	<i>carbon dioxide produced after adding nitric acid</i>
4	Cl^-	<i>white precipitate formed after adding silver nitrate</i>

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

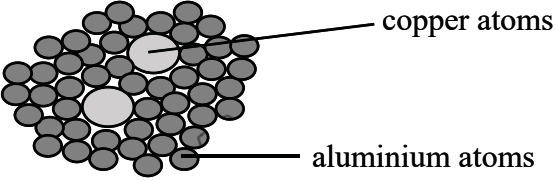
(a) iron (II) chloride and ammonium carbonate

(b) iron (II) carbonate and ammonium chloride

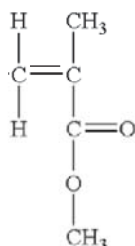
However, iron (II) carbonate is an insoluble salt (both X and Y dissolve).

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
 $\text{Y}(\text{NO}_3)_2$: +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 $\text{Y}(\text{NO}_3)_2$. 1m
 Y reduces $\text{X}(\text{NO}_3)_2$ 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

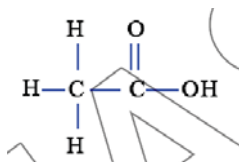
Each monomer forms single bonds and joins with **two other monomers**. form the polymer, poly(methyl methacrylate).

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.
If it turns from purple to colourless, it is substance is ethanol.
If it remains purple, it is substance X.

1m

1m

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 substance 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

