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Bukit Batok Secondary School
GCE O Level Preliminary Examination
Sec 4 Express

CHEMISTRY

Paper 1 Multiple Choice

5073/01

24 August 2017
0745hr to 0845hr

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

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.

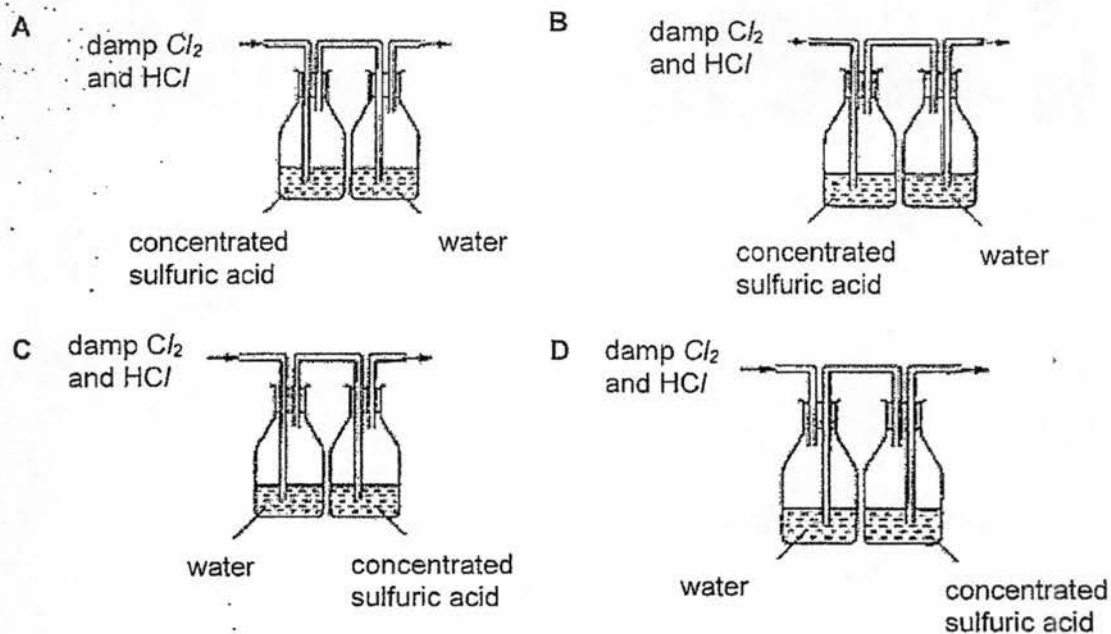
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed at the end of the question paper.

The use of an approved scientific calculator is expected, where appropriate.

- 1 Hydrogen chloride, HCl , is very soluble in water, whereas chlorine, Cl_2 , is only slightly soluble in water. Both gases can be dried using concentrated sulfuric acid.

Which diagram represents the correct method of obtaining dry chlorine from damp chlorine containing a small amount of hydrogen chloride?

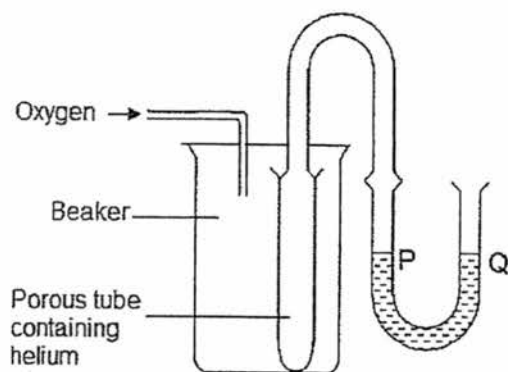


- 2 A liquid is required to dry a piece of wet copper foil. The liquid must have two properties.
- 1 able to evaporate quickly in air, and
 - 2 miscible in water

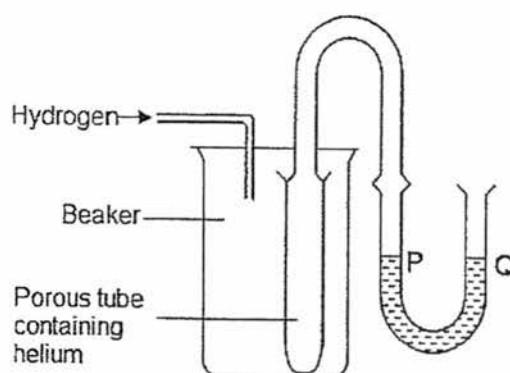
Which one of the liquids below would be most suitable for this purpose?

	boiling point / $^{\circ}\text{C}$	solubility in water
A	36	insoluble
B	56	very soluble
C	98	very soluble
D	290	insoluble

- 3 Two experiments, experiment 1 and 2, are set up to demonstrate the diffusion of gases. What would happen to the water levels at P and Q in both experiments?



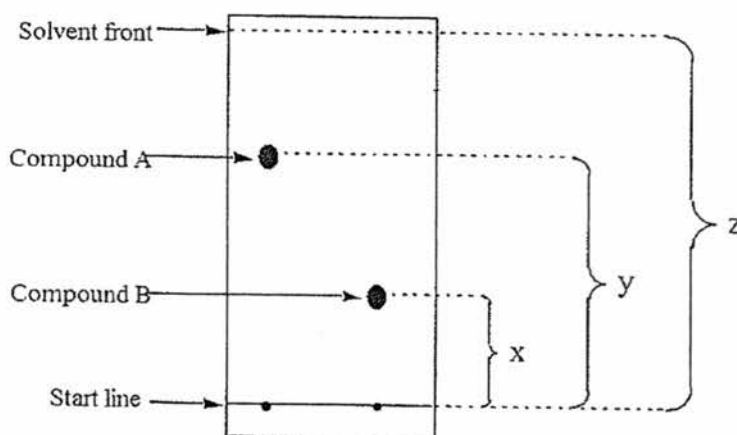
Experiment 1



Experiment 2

	Experiment 1	Experiment 2
A	P is higher than Q	P and Q remain the same
B	P is higher than Q	Q is higher than P
C	P and Q remain the same	P and Q remain the same
D	P and Q remain the same	P is higher than Q

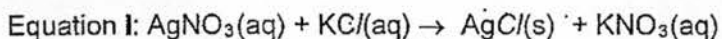
- 4 A paper chromatogram of two compounds A and B is shown in the diagram below:



Which statement regarding the paper chromatogram must be correct?

- A Compound A has a lower R_f value than compound B.
 B Compound A is less soluble in the solvent than compound B.
 C The R_f value of A is $\frac{y}{z}$.
 D The solvent level is placed above the starting line.

- 5 Two reactions were allowed to take place as shown by the equations below :

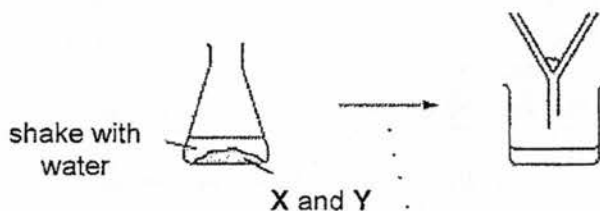


The products shown in both equations I and II were mixed together.

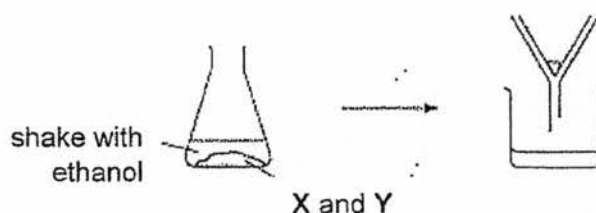
Which of the following method is the best separation to obtain a sample of silver chloride from the mixture?

- A Add aqueous ammonia to the mixture, filter to obtain the residue of silver chloride.
 - B Add excess dilute sulfuric acid to the mixture and filter the residue to obtain silver chloride.
 - C Decant off the aqueous layer and heat the residue to obtain the silver chloride.
 - D Filter the mixture and add excess dilute nitric acid to the residue. Filter to obtain the silver chloride.
- 6 A solid mixture contains an ionic salt, X, and a covalent organic compound, Y. Two students suggest methods of separating the mixture as shown.

method 1



method 2



Which methods of separation are likely to work?

	method 1	method 2
A	✓	✓
B	✓	X
C	X	✓
D	X	X

- 7 Cl-35 and Cl-37 are two isotopes of chlorine.

Which statements are correct?

- 1 Both isotopes have the same mass number.
- 2 Both isotopes have the same electronic configuration.
- 3 Both isotopes have the same physical properties.
- 4 Both isotopes have the same chemical properties.

- A 1 and 2 only
 B 1 and 3 only
 C 2 and 3 only
 D 2 and 4 only

- 8 Carbon disulfide is a simple covalent compound used in manufacturing polymers and fibres.

A student made the following statements:

- Carbon disulfide has a low boiling point.
- Carbon disulfide has good electrical conductivity when molten.
- Carbon disulfide is very soluble in water.
- Carbon disulfide is a crystalline solid at room temperature.

How many statement(s) is/are correct about the compound?

- A 1 B 2 C 3 D 4

- 9 What is the total number of shared pair electrons in a propene molecule?

- A 8 B 9 C 10 D 11

- 10 Which one of the following sets of solid elements includes a giant metallic structure, a macromolecular structure and a simple molecular structure?

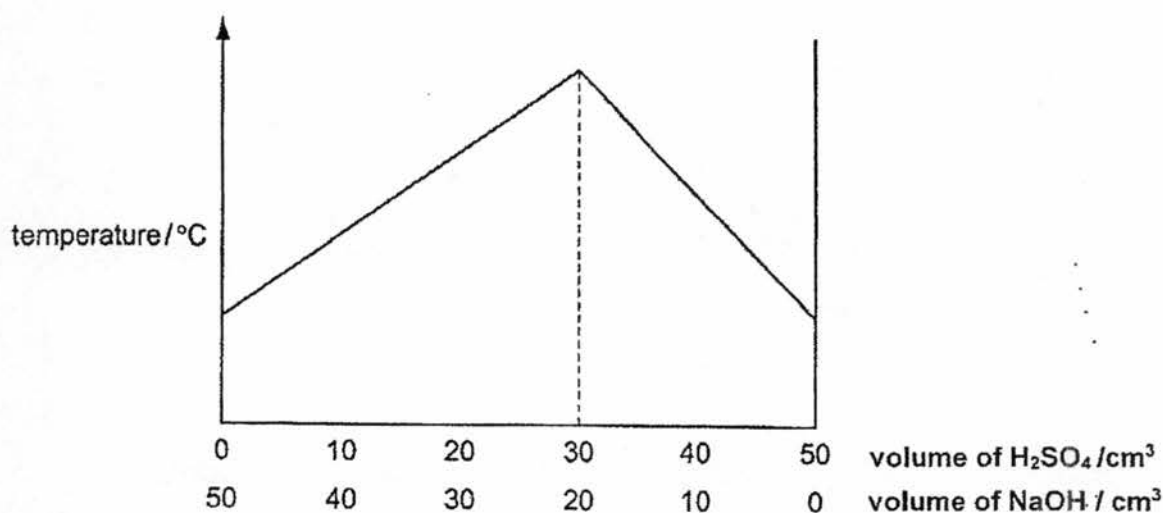
- | | | | |
|---|----|----|----|
| A | Al | Mg | Si |
| B | Al | Si | S |
| C | C | Si | Sn |
| D | Si | P | S |

- 11 Bones contain a complex mixture of calcium salts, proteins and other material. When a piece of bone is strongly heated in a current of air, the only residue is calcium oxide. From a sample of 50.0 g of bone, 14.0 g of calcium oxide was obtained.

What is the percentage by mass of calcium in the bone?

- A 10.0% B 14.0% C 20.0% D 28.0%

- 12 Which volume of 1.0 mol/dm^3 hydrochloric acid is required to react completely with 1.25 g of zinc carbonate?
- A 10 cm^3 B 20 cm^3 C 100 cm^3 D 200 cm^3
- 13 5.0 cm^3 of gaseous hydrocarbon reacted with excess oxygen to form 30.0 cm^3 of carbon dioxide and 15.0 cm^3 of water vapour.
- What is the formula of the hydrocarbon?
- A CH_4 B C_2H_4 C C_3H_6 D C_6H_6
- 14 An aqueous solution of sulfuric acid has a concentration of 1.0 mol/dm^3 . Different volumes of the acid are added to different volumes of aqueous sodium hydroxide.



- What is the concentration of the aqueous sodium hydroxide?
- A 0.6 mol/dm^3
 B 0.75 mol/dm^3
 C 1.5 mol/dm^3
 D 3.0 mol/dm^3
- 15 A student writes down four statements about two gases, hydrogen chloride and carbon monoxide.
- One mole of each gas has the same mass.
 - One mole of each gas occupies the same volume at room temperature and pressure.
 - One mole of each gas has the same number of atoms.
 - One mole of each gas has the same number of molecules.

How many of these statements is/are correct?

- A 1 B 2 C 3 D 4

16 Which substance has exactly the same number of atoms as 1 g of hydrogen gas?

- A 1 g of helium gas at r.t.p
- B 24 dm³ of oxygen gas at r.t.p
- C 127 g of solid iodine
- D 12000 cm³ of neon gas

17 Astatine is at the bottom of Group VII in the Periodic Table.

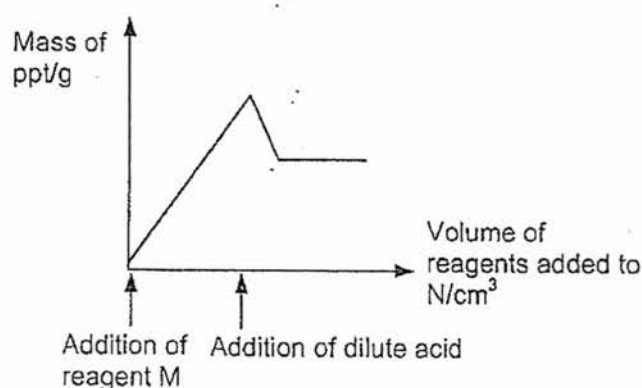
Which row describes the properties of astatine?

	colour	state	reaction with aqueous sodium iodide
A	black	liquid	iodine displaced
B	black	solid	no reaction
C	black	solid	iodine displaced
D	brown	liquid	no reaction

18 Which method is used to prepare copper(II) chloride?

- A adding copper to dilute hydrochloric acid at room temperature
- B precipitating the salt by adding copper(II) carbonate to aqueous ammonium chloride
- C titrating copper(II) hydroxide with dilute hydrochloric acid
- D warming copper(II) oxide with dilute hydrochloric acid

19 In a quantitative analysis, reagent M is gradually added to a salt solution N (that contains either 1 or 2 different anions), followed by the addition of a dilute acid. The graph below shows how the mass of precipitate formed changes with the reagents added.



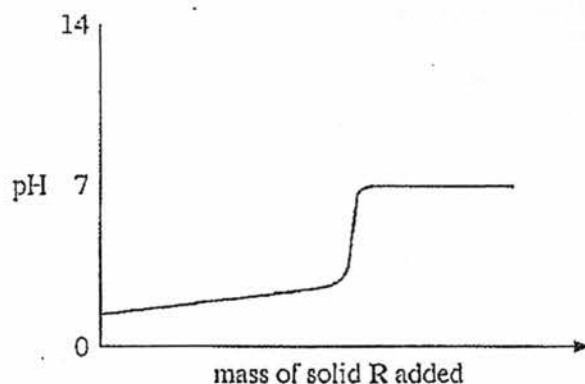
Which of the following combinations would produce the given results?

	anion(s) in N	reagents (M and acid) added
A	CO ₃ ²⁻	add aqueous silver nitrate, followed by dilute nitric acid
B	Cl ⁻ , CO ₃ ²⁻	add aqueous barium chloride, followed by dilute hydrochloric acid
C	SO ₄ ²⁻ , CO ₃ ²⁻	add aqueous silver nitrate, followed by dilute hydrochloric acid
D	SO ₄ ²⁻ , CO ₃ ²⁻	add aqueous barium chloride, followed by dilute hydrochloric acid

- 20 When sodium hydroxide solution is added to a solution containing potassium chloride and copper(II) nitrate, which of the following ions will decrease most in concentration?

A Cu^{2+} B K^+ C NO_3^- D Cl^-

- 21 Solid R is gradually added to aqueous solution S. The changes in pH are shown in the graph below.



What are R and S?

	R	S
A	insoluble metal oxide	hydrochloric acid
B	insoluble non-metal oxide	sodium hydroxide
C	soluble metal oxide	hydrochloric acid
D	soluble non-metal oxide	sodium hydroxide

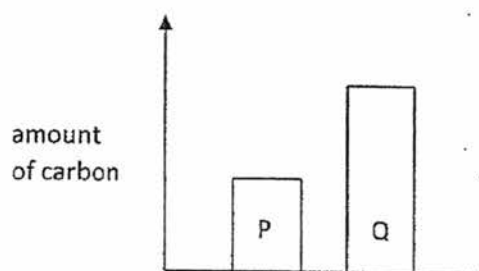
- 22 A new indicator has just been produced in the laboratory. It changes colour according to the table below:

pH	colour
0 - 3	red
3.5 - 5	green
5 - 14	purple

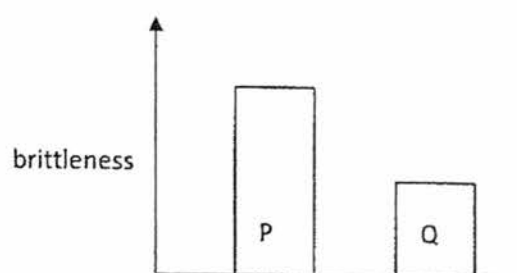
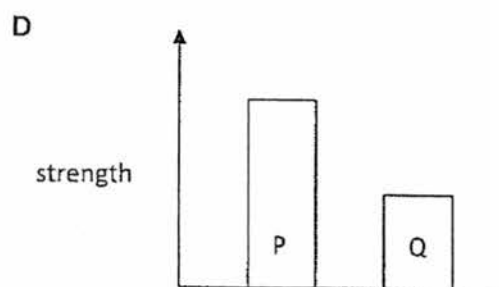
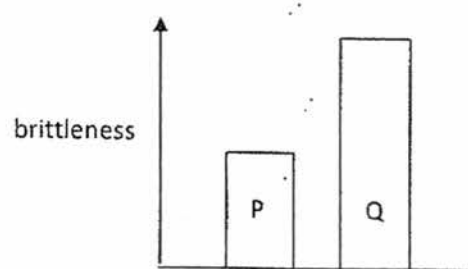
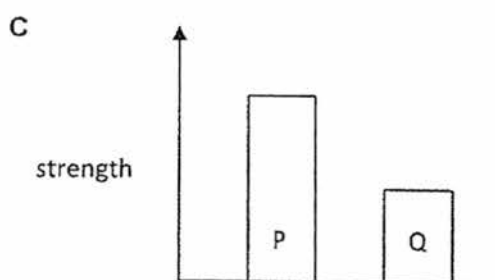
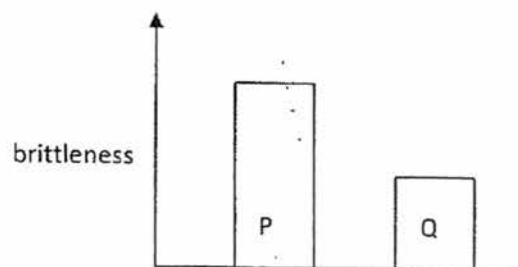
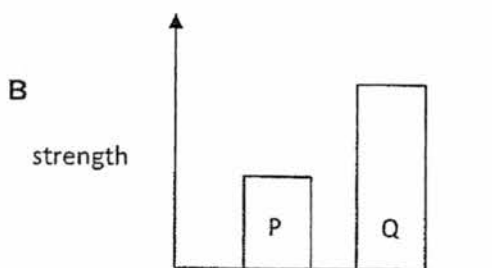
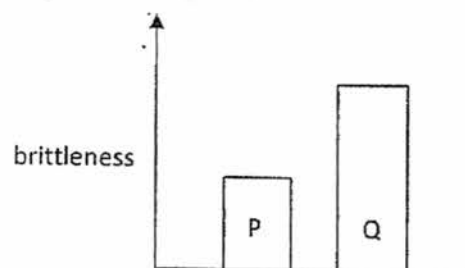
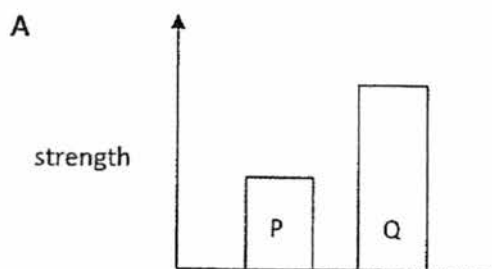
Which of the following substances can be distinguished using the new indicator?

- A aqueous ammonia and potassium hydroxide
 B aqueous hydrogen chloride and carbon dioxide
 C aqueous sodium nitrate and sodium hydroxide
 D water and aqueous sodium chloride

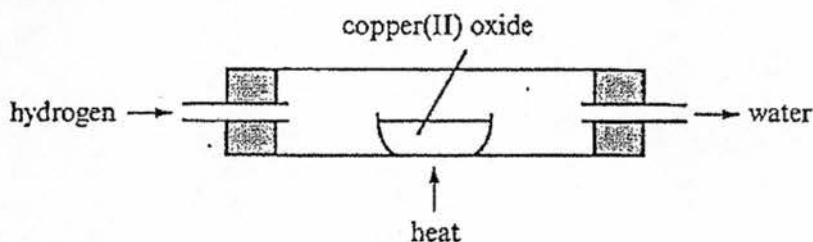
23 The diagram compares the amount of carbon in two steels, P and Q.



Which two diagrams correctly compare the strength and brittleness of P and Q?



- 24 An experiment is set up as shown.

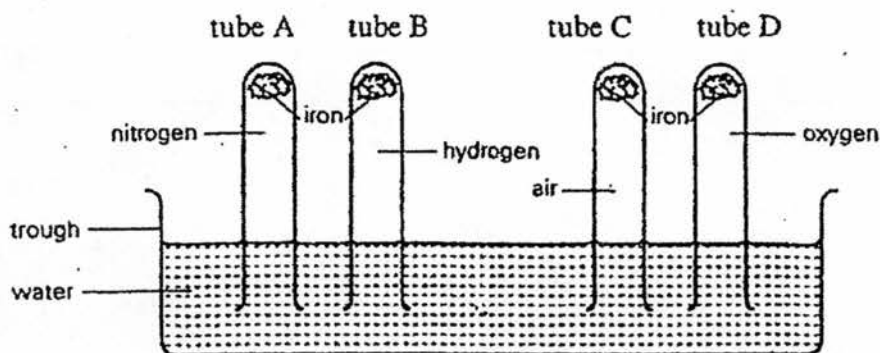


A student recorded these inferences.

- 1 Hydrogen is a reducing agent.
- 2 Hydrogen gains oxygen to form water.
- 3 Copper(II) oxide loses oxygen to form copper metal.
- 4 Copper(II) oxide gains hydrogen and is reduced.

Which of these inferences are correct?

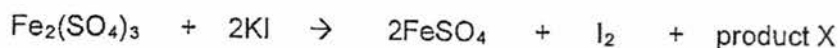
- A 1 and 3 only
 B 1, 2 and 3 only
 C 1, 2 and 4 only
 D 2 and 4 only
- 25 The experiment shown in the diagram was set up.
 Which tube shows the highest increase in water level after a month?



- 26 Which equation does **not** represent a redox reaction?

- A $\text{CuSO}_4 + \text{Zn} \rightarrow \text{Cu} + \text{ZnSO}_4$
 B $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 C $\text{H}_2\text{S} + \text{Cl}_2 \rightarrow 2\text{HCl} + \text{S}$
 D $\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$

- 27 The equation below shows the reaction of iron(III) sulfate with potassium iodide.



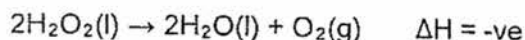
Which statement about the reaction is **not** correct?

- A At the end of the reaction, the solution appears brown.
 - B Formula of product X is K_2SO_4 .
 - C Iodine is reduced in the reaction.
 - D The oxidation state of iron decreases from +3 to +2.
- 28 In the Haber process, nitrogen and hydrogen react to form ammonia.

What is the source of hydrogen?

- A air
 - B limestone
 - C crude oil
 - D sulfuric acid
- 29 In which process is energy released?
- A dissolving ammonium nitrate in water
 - B electrolysis of water
 - C forming a chlorine molecule from two chlorine atoms
 - D photosynthesis

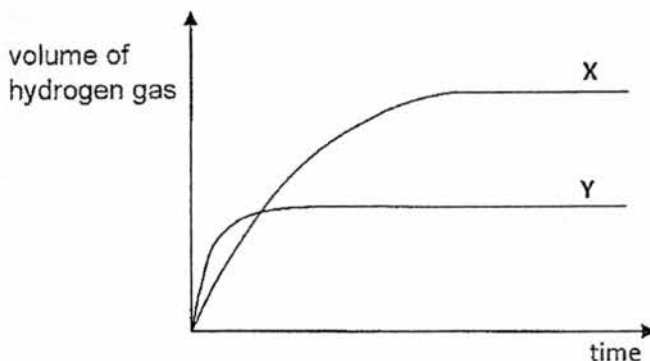
- 30 Which of the following can be deduced from the equation below?



- A Addition of a catalyst speeds up the reaction.
 - B Heat is taken in during the reaction.
 - C The volume of oxygen produced from 200 cm^3 of aqueous hydrogen peroxide is 100 cm^3 .
 - D When completely decomposed, 17g of hydrogen peroxide forms 9g of water and 8g of oxygen.
- 31 If the pressure on the reactants in a gaseous reaction is decreased, which of the following is **true**?

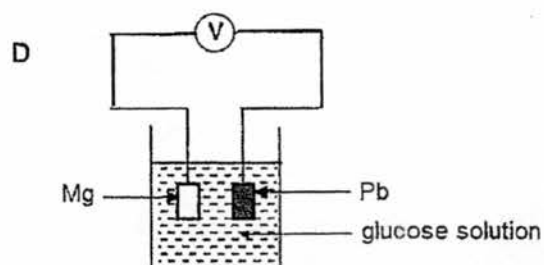
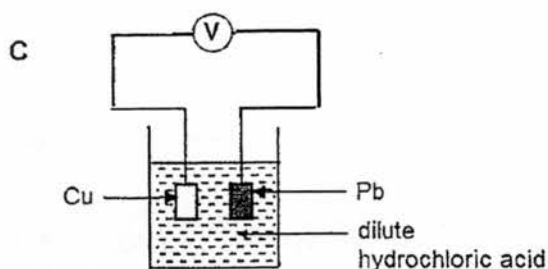
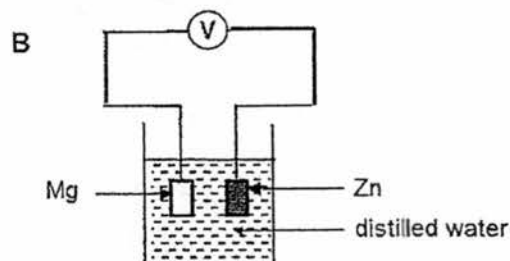
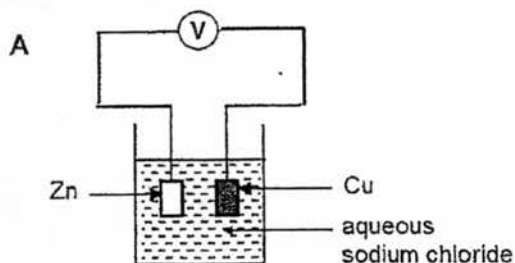
	concentration	rate of reaction
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	no effect	decreases

- 32 Two experiments on the reaction between zinc and sulfuric acid are carried out and their results are given in the graph below.



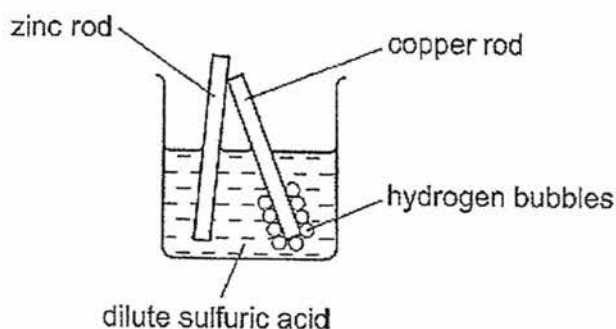
If 10 g of zinc granules reacts with 0.50 dm³ of 1 mol/dm³ sulfuric acid to produce graph X, which of the following could give rise to graph Y?

- A 5 g zinc granules in 0.500 dm³ of 1 mol/dm³ sulfuric acid
 - B 5 g zinc granules in 0.500 dm³ of 2 mol/dm³ sulfuric acid
 - C 10 g zinc granules in 0.250 dm³ of 2 mol/dm³ sulfuric acid
 - D 10 g zinc granules in 0.125 dm³ of 2 mol/dm³ sulfuric acid
- 33 Which set-up would produce the greatest reading on the voltmeter?



- 34 In an experiment, rods of copper and zinc are dipped into dilute sulfuric acid with their top ends touching.

Hydrogen bubbles collect around the copper rod.



Which statement about the experiment is correct?

- A Copper reacts with the acid.
 - B Electrons flow from zinc to copper.
 - C The zinc becomes coated with copper.
 - D The copper becomes smaller.
- 35 The following three solutions were electrolyzed using inert electrodes.

solution 1	concentrated sodium chloride
solution 2	dilute sulfuric acid
solution 3	silver nitrate

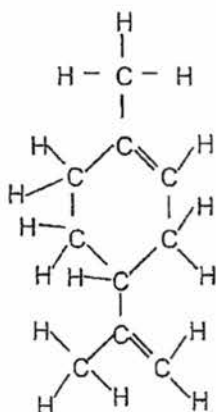
Which of the solution(s) produce oxygen gas at the anode?

- A 1 only
 - B 1 and 2 only
 - C 1, 2 and 3
 - D 2 and 3
- 36 Which statement applies to all three of the compounds ethane, ethene and ethanol?
- A One mole of each compound contains the same number of hydrogen atoms.
 - B One molecule of each compound contains the same number of carbon atoms.
 - C They are obtained from crude oil.
 - D They are all liquids at room temperature.

- 37 Which of these acids is polyunsaturated?

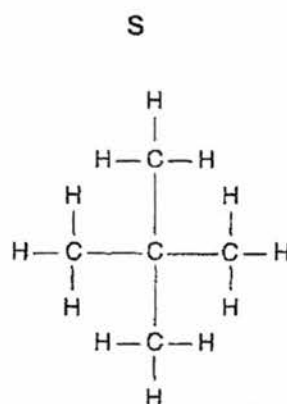
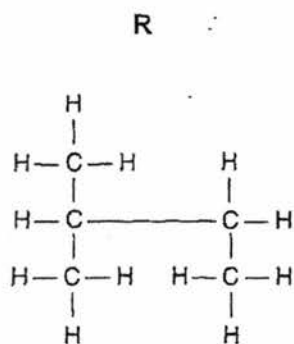
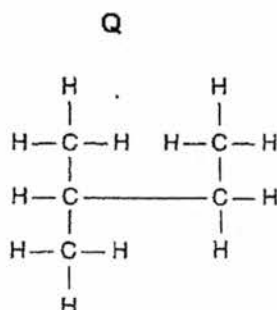
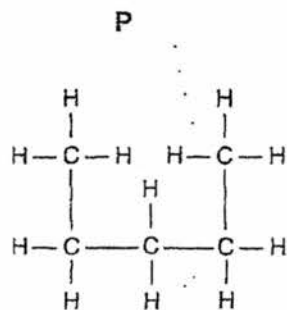
- A linolenic acid; $\text{CH}_3(\text{CH}_2\text{CH}=\text{CH})_3(\text{CH}_2)_7\text{CO}_2\text{H}$
- B oleic acid; $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}_2\text{H}$
- C palmitic acid; $\text{CH}_3(\text{CH}_2)_{14}\text{CO}_2\text{H}$
- D stearic acid; $\text{CH}_3(\text{CH}_2)_{16}\text{CO}_2\text{H}$

- 38 Liquid limonene may be extracted from oranges. The structure of limonene is shown below.



How many moles of hydrogen gas would react completely with one mole of limonene to make it saturated?

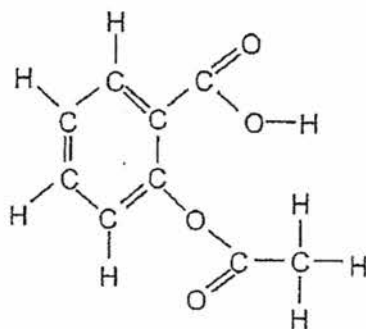
- A 1 B 2 C 3 D 4
- 39 Four structural formulae are shown below.



Which of the formulae represent the same compound?

- A P, Q and R
B P, Q and S
C Q and R
D Q and S

- 40 Aspirin is a drug which is used as a general pain killer. The structural formula of aspirin is shown below.



Which of the following statements about aspirin is **false**?

- A Its aqueous solution reacts with sodium carbonate.
- B It decolourised aqueous bromine.
- C It is formed from an alcohol and a carboxylic acid.
- D It turns purple acidified aqueous potassium manganate (VII) colourless.

End of Paper 1

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
1 H Hydrogen 1																	
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	101 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	108 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 Cesium 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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															
140 Ce Cerium 58																	
141 Pr Praseodymium 59																	
144 Nd Neodymium 60																	
147 Pm Promethium 61																	
150 Sm Samarium 62																	
152 Eu Europium 63																	
157 Gd Gadolinium 64																	
159 Tb Terbium 65																	
162 Dy Dysprosium 66																	
165 Ho Holmium 67																	
167 Er Erbium 68																	
169 Tm Thulium 69																	
173 Yb Ytterbium 70																	
175 Lu Lutetium 71																	
232 Th Thorium 90																	
238 U Uranium 92																	
251 Md Mendelevium 101																	
257 Fm Fermium 100																	
259 No Nobelium 102																	
260 Lr Lawrencium 103																	

a

X

b

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

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

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

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

Key

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

Name: Index no: Class:



Bukit Batok Secondary School
GCE O Level Preliminary Examination
Sec 4 Express

CHEMISTRY

Paper 2

5073/02

14 August 2017

1030hr to 1215hr

1 hour 45 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 an HB pencil for any diagrams or graphs.

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 of either/or.

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

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.

A copy of the Periodic Table is given at the end of the paper.

The use of an approved scientific calculator is expected, where appropriate

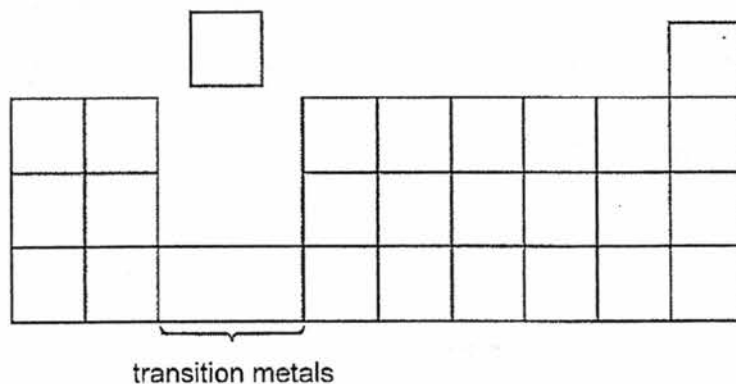
For Examiner's Use	
Section A	
Section B	
Total	

This document consists of 21 printed pages.

Section A [50 marks]

Answer all questions in this section in the spaces provided.

A1 The diagram below shows a simplified version of the Periodic Table.



Use the information below to place the elements in their correct position in the Periodic Table above. (The letters do **not** represent the chemical symbols of the elements.)

- (a) P has an electronic configuration of 2, 2.
- (b) Q has only two electrons.
- (c) R is a non-metal that forms a strong acid with Group VII elements.
- (d) S forms an ion, S^{3-} , with an electronic configuration of 2, 8, 8.

[Total: 4]

- A2** Elements W, X, Y and Z are all in the same period but in different groups of the Periodic Table.

W reacts with oxygen to form W_2O , a strongly basic oxide.

X reacts with oxygen to form XO_2 , an acidic oxide and a gas at room temperature.

The oxide of Y is Y_2O_3 , which can react with both an acid and a base.

Z produces an ion Z^{2+} .

Use the information given to answer the following questions:

- (a) Place X, Y, W and Z to their respective groups in the Periodic Table.

.....
[2]

- (b) Write the formulae for the sulfate and hydride of W.

.....[1]

- (c) What type of bonding is present in the oxide XO_2 ? Give a reason for your answer.

.....
[2]

- (d) Write the formula for the compound formed between Y and Z.

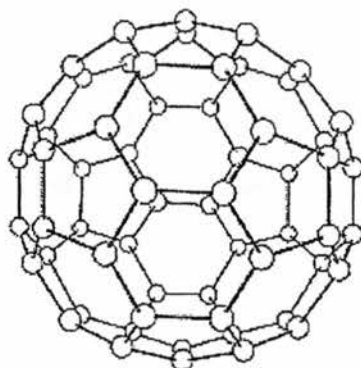
.....[1]

- (e) Write the equation for the reaction that occurs when element W reacts with oxygen. Include state symbols.

.....[2]

[Total: 8]

- A3** Until 1985 chemists believed that there were only two allotropes of carbon. In 1985 a third allotrope, buckminsterfullerene, was identified. The diagram shows the structure of a molecule of buckminsterfullerene. Each circle represents one carbon atom.



The molecule has 60 carbon atoms covalently bonded together, to give a structure with a shape similar to a modern football.

- (a) Name the other two allotropes of carbon.

.....[1]

- (b) (i) Suggest the formula of buckminsterfullerene.

.....[1]

- (ii) Calculate the number of moles of buckminsterfullerene in 3600 g of the substance.

[2]

- (iii) Suggest, in terms of structure and bonding, why buckminsterfullerene might be expected to vapourise at a much lower temperature than the other allotropes of carbon named in (a) (ii).

.....

[3]

[Total: 7]

- A4 An investigation was carried out into the energy changes that occur when different metals were added to copper(II) sulfate solution. 3 cm³ of copper(II) sulfate solution was added to each of six test tubes and the temperature of each solution was taken. An equal mass of metal was added to each test tube, the contents stirred and the temperature of the mixtures noted after one minute.

metal added	initial temperature of copper(II) sulfate solution / °C	temperature of mixture after 1 min / °C	temperature rise / °C
magnesium ribbon	20.0	29.0	
magnesium powder	20.5	56.0	
zinc granules	19.0	25.0	
zinc powder	21.0	41.0	
iron granules	18.5	20.0	
iron powder	19.5	34.5	

- (a) Complete the table by writing down the temperature rise for each metal added. [1]

- (b) What common observation, apart from temperature changes, would be made when each metal is added to copper(II) sulfate solution?

.....
[1]

- (c) State three conclusions that you can draw from all the results to these experiments. Explain how you arrived at each conclusion.

.....

[6]

- (d) (i) Draw an energy profile diagram for any of the reactions that occurred between each metal and copper(II) sulfate solution.

Your diagram should include

- the formulae of the reactants and products.
- a label for the reaction enthalpy change, ΔH and
- a label for the activation energy, E_a .

[3]

- (ii) Each of the reaction was repeated in the presence of a catalyst.
What effect does the catalyst have on the activation energy and the enthalpy change?

.....

.....[1]

[Total: 12]

- A5 A student buys and tests some tablets that contain aspirin, $\text{C}_6\text{H}_4(\text{COOH})_2$. He performs a titration experiment using a crushed tablet and 0.10 mol/dm^3 of aqueous sodium hydroxide to determine the mass of aspirin contains in one tablet.

His results show that the volume of aqueous sodium hydroxide needed for neutralisation is 16.70 cm^3 . The relative molecular mass of aspirin is 180.

- (a) With the help of an equation for the reaction between aspirin and aqueous sodium hydroxide, determine the mass of aspirin contains in one tablet. Show all working.

[3]

- (b) Some tablets that contain aspirin also contain citric acid. The student does another titration using one of these tablets.

Explain why the mass of aspirin you calculate from his titration results is incorrect.

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

[Total: 5]

- A6** Potassium chromate is soluble in water, forming a yellow solution. When aqueous silver nitrate is added to aqueous potassium chromate, a red precipitate of silver chromate is formed.

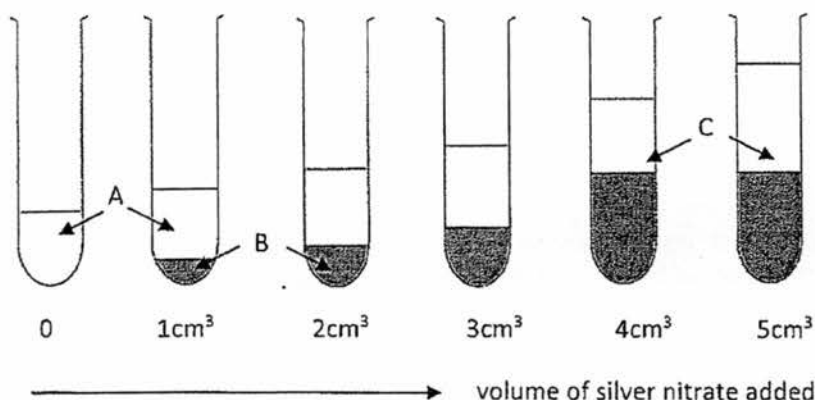
(a) (i) Name another compound that reacts with aqueous silver nitrate to form a yellow precipitate.

.....[1]

(ii) Write the ionic equation for the reaction in (a) (i).

.....[1]

(b) An experiment was carried out in which various volumes of aqueous silver nitrate were added to the same volume of aqueous potassium chromate. The mixtures were stirred and allowed to stand. The results are shown below.



Identify the appearance of A, B and C in the diagrams.

.....[3]

[Total: 5]

A7 When compound **A** ($\text{C}_2\text{H}_6\text{O}$), an alcohol, was heated with acidified potassium manganate (VII), an organic compound **B** was formed. When a mixture of **A** and **B** was heated in the presence of a catalyst, a sweet smelling liquid **C** ($\text{C}_4\text{H}_8\text{O}_2$) was obtained.

- (a) Describe the observation when compound **A** is heated with acidified potassium manganate (VII).

.....[1]

- (b) (i) Draw the structural equation for the reaction that occurs between **A** and **B**. Identify compound **A**, **B** and **C** and write their respective names next to their structural formula in the equation.

[3]

- (ii) State the conditions required for the reaction in (b) (i).

.....[1]

- (c) (i) Compound **A** can be used as a car fuel.

In some countries it is produced from the sugars in sugar cane.

- (i) Name the process used to produce compound **A** from sugar.

.....[1]

- (ii) Suggest why most of the compound **A** is not produced by the process named in (c) (i).

.....[1]

(iii) An environmentalist makes a comment about using compound **A** as a fuel.

Compound **A** as a fuel is 'carbon neutral' because using it does not add to the amount of carbon dioxide in the atmosphere.

Do you agree with the comment? Explain your reasoning.

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

[Total:9]

End of Section A

Section B [30 marks]

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

The last question is in the form of either/or and only one of the alternatives should be attempted.

- B8** There are a range of atmospheric pollution problems currently threatening the Earth's general environment. The increased use of fossil fuels has a negative effect on the health of the environment in terms of air and water pollution. Of all the fossil fuels, coal is the least expensive for its energy content. However, burning coal in electric power plants is a major source of carbon dioxide emissions. It also releases substantial amounts of methane. The U.S. Environmental Protection Agency's Clean Power Plan, as well as the low cost of natural gas, is leading older coal plants to close and reducing interest in new coal plants. Alternative sources of energy used as fuels are thus constantly sought after to meet the increasing demands of human activities.

Figure A below shows the changes in the type of fuel used between 1990 and 2002.

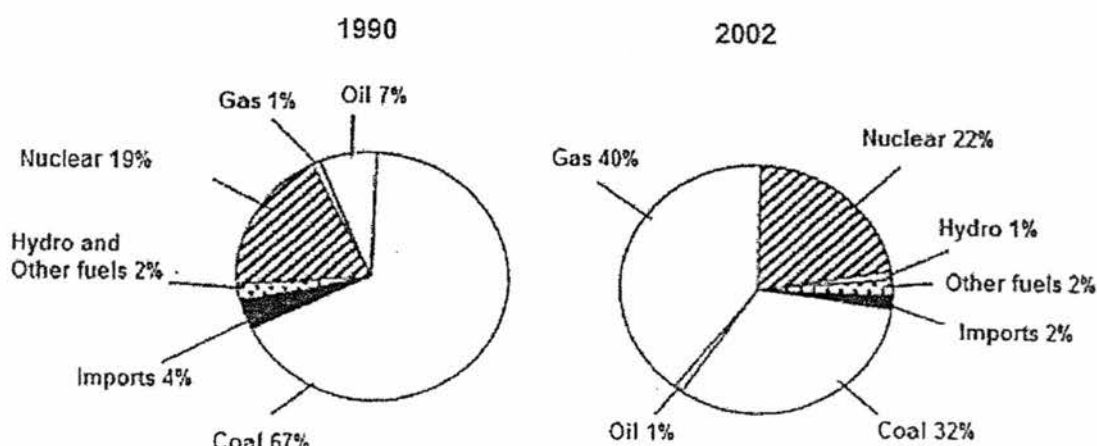


Figure A

Air pollution is caused by solid particles and poisonous gases in the air. These substances are called air pollutants, which include carbon monoxide and unburnt hydrocarbons.

Figure B shows the relationship between the air : fuel ratio and the production of air pollutants by the vehicle engines.

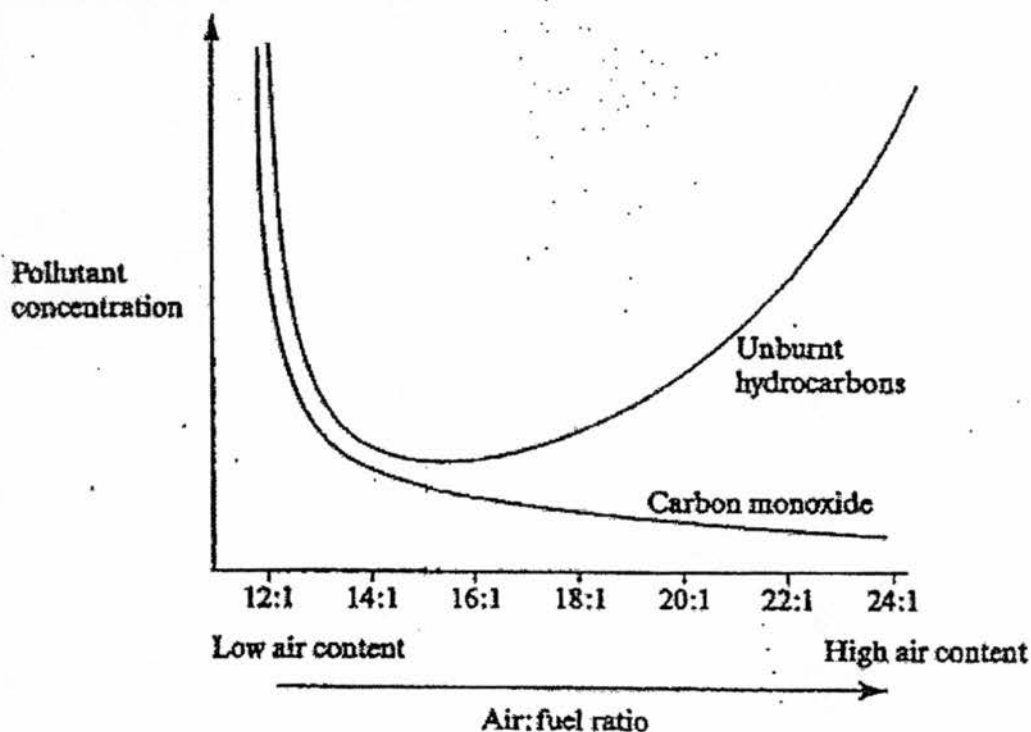


Figure B

- (a) Using information provided, give two main changes in the type of fuel used over 12 years from 1990 to 2002. Suggest an explanation for these changes.

.....

.....

.....

.....

..... [3]

- (b) Using the information from **Figure B**, describe and explain the trend for the carbon monoxide curve.

.....

.....

.....

.....

.....

[3]

- (c) Estimate the optimum air : fuel ratio to minimise pollution by carbon monoxide and unburnt hydrocarbons.

.....[1]

- (d) (i) Name another air pollutant not mentioned in the graphs which is also produced by the vehicle engines.

.....[1]

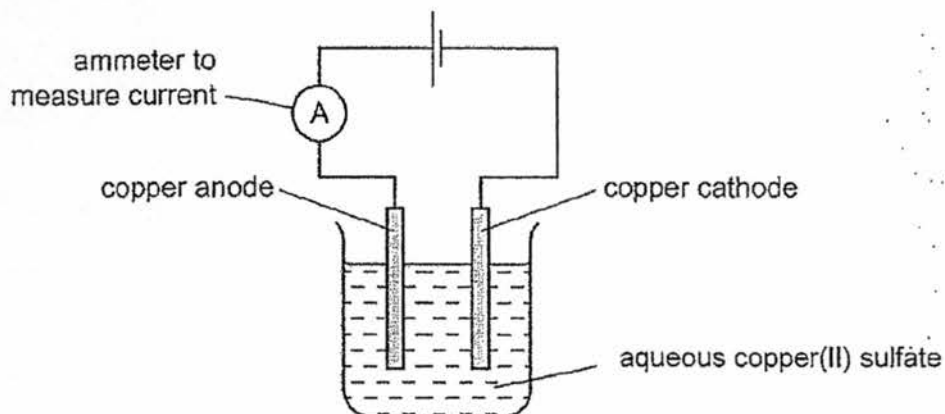
- (ii) Name the device fitted in cars which is used to remove both the emissions of carbon monoxide and the pollutant you named in (d) (i) from the car engine. Write an equation for this reaction.

.....

.....[2]

[Total: 10]

- B9** A student carries out a series of experiments. In each experiment, he electrolyses aqueous copper(II) sulfate solution using the apparatus shown.

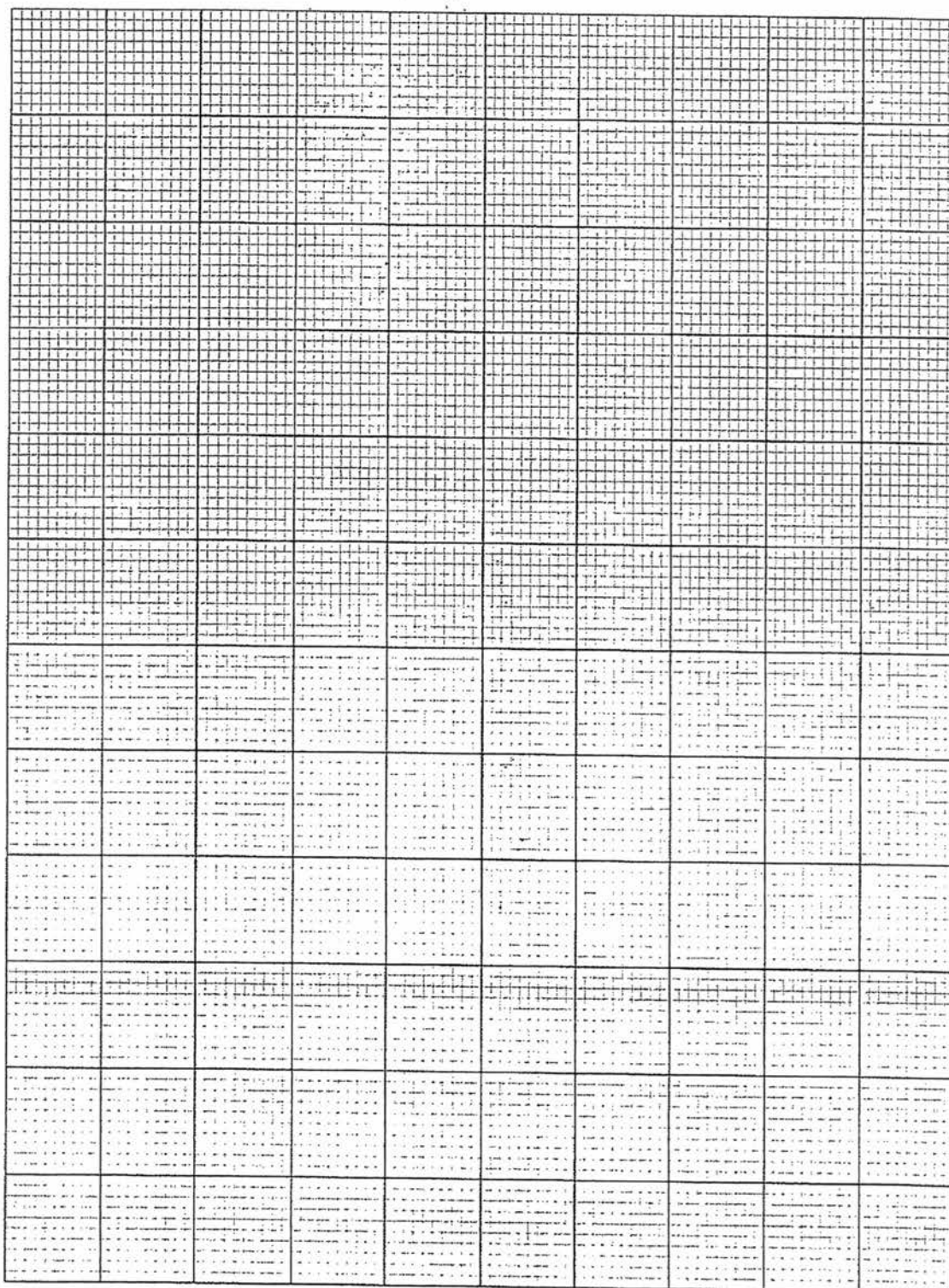


He uses the same concentration of aqueous copper(II) sulfate each time, but changes the current he passes through the solution. He runs each electrolysis for 10 minutes. The student weighs the negative electrode before and after each experiment and works out the mass of copper deposited.

The table shows the results of his experiments.

experiment	time / mins	current / Amps	mass of copper deposited / g
1	10	1.0	0.21
2	10	2.0	0.40
3	10	3.0	0.58
4	10	4.0	0.81

- (a) Use data from the table to plot a graph to show the relationship between current and mass of copper deposited.
Draw a straight line of best fit, taking into account all of your plotted points. [3]



- (b) Describe the relationship that your graph shows.

.....
[1]

- (c) The student carries out another experiment. He passes an electric current of 6.0 A through a solution of copper(II) sulfate for 5 minutes.

Use your graph and the information above to predict the mass of copper that would form in the experiment.

.....
[1]

- (d) At the end of the electrolysis, the student removes a sample of the electrolyte and puts it in a test tube. He then adds aqueous ammonia dropwise to the sample until there is no more further change. Describe and explain what the student sees.

.....
[2]

- (e) The student carries out another electrolysis using aqueous silver nitrate and silver electrodes. His results are shown in the table.

electrolyte	time / mins	current / Amps	mass of silver deposited / g
aqueous silver nitrate	10	4.0	2.7

- (i) Write an ionic half equation for the reaction that happens at the cathode.

.....[1]

- (ii) Carry out calculations to compare the difference in the number of moles of copper and the number of moles of silver that are formed when a current of 4.0 A is used for 10 minutes. Suggest an explanation for the difference in the number of moles of each metal formed.

[2]

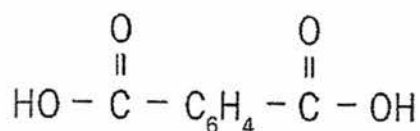
[Total: 10]

EITHER

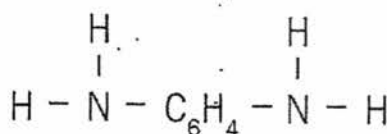
- B10** In the early 1970s, a polymer known as Kevlar was invented by Stephanie Kwolek, an American chemist. Kevlar fibre is used for making bulletproof vests, army helmets and 'puncture-proof' tyres. Kevlar fibre is also used in the protective clothing worn by firefighters.

Kevlar is made by condensation polymerisation from two different monomers – 1,4-benzenedicarboxylic acid and 1,4-diaminobenzene.

The structural formulae of these monomers are shown below.



1,4-benzenedicarboxylic acid



1,4-diaminobenzene

- (a) (i) Draw the structural formula of the organic compound formed when 1,4 benzenedicarboxylic acid is reacted with an excess of sodium carbonate.

[1]

- (ii) Write the formula of the gas produced in reaction (a) (i) and describe a simple laboratory test to confirm the identity of the gas produced.

.....

.....[2]

- (b) Explain what is meant by condensation polymerisation.

.....

.....[1]

(c) (i) Draw the structural formula of one repeat unit of Kevlar.

[1]

(ii) Suggest two possible gases produced on the combustion of Kevlar.

[1]

(d) Suggest the name of a synthetic polymer that has the same functional group as Kevlar. Give a reason for your choice.

[2]

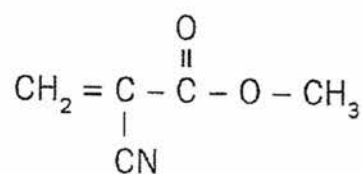
(e) Sea fishing nets used to be made from natural fibres. Many nets are now made from synthetic fibres. Suggest one **advantage**, other than strength, and one **disadvantage** of using synthetic fibres named in (d) rather than natural fibres to make sea fishing nets.

[2]

[Total: 10]

OR

- B10** Superglue is a very strong adhesive used to fasten materials, such as wood, together. The active ingredient in superglue is methyl cyanopropenoate, commonly known as methyl cyanoacrylate. The structure of methyl cyanopropenoate is shown below.



methyl cyanopropenoate

Superglue polymerises when exposed to moisture in the air. This causes the glue to set.

- (a) Draw the structural formulae of the two functional groups present in methyl cyanopropenoate. Name the two functional groups.

[2]

- (b) What type of polymerisation does methyl cyanopropenoate undergo when it forms superglue?

.....[1]

- (c) Draw the structural formula of the polymer formed, showing two repeat units.

[1]

- (d) Other than superglue, suggest another name for the polymer formed in (c).

.....[1]

- (e) Name two possible gases that are produced when the polymer formed in (c) is burnt in excess oxygen.

.....[1]

- (f) (i) A sample of methyl cyanopropenoate is shaken with bromine water.
Describe what you would observe.

.....
.....[1]

- (ii) What type of reaction has occurred in (f) (i)?

.....[1]

- (iii) Write the formula of the organic product formed in (f) (i).
Hence calculate the mass of one mole of the organic product formed

[2]

[Total: 10]

- End of Paper 2 -

The Periodic Table of Elements

Group

I	II											III	IV	V	VI	VII	0
1 H Hydrogen																	2
7 Li Lithium 3	9 Be Beryllium 4																
23 Na Sodium 11	24 Mg Magnesium 12																
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	101 Ru Ruthenium 44	101 Rh Rhodium 45	103 Pd Palladium 46	106 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	127 Te Tellurium 52	128 I Iodine 53	131 Xe Xenon 54	131 Kr Krypton 36
133 Cs Cesium 55	137 Ba Barium 56	138 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	210 Po Polonium 84	222 Rn Radon 86	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	257 No Nobelium 102	259 Md Mendelevium 101	260 Lr Lawrencium 103
---------------------------	---------------------------------	------------------------------	-------------------------------	-----------------------------	-----------------------------	-------------------------------	----------------------------	-------------------------------	----------------------------	---------------------------	----------------------------	------------------------------	-----------------------------	------------------------------	---------------------------------	--------------------------------

a = relative atomic mass

X = atomic symbol

b = atomic (proton) number

Key

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

Bukit Batok Secondary School
Sec 4 Express 2017
Chemistry 5073

PRELIMINARY EXAMINATIONS – ANSWERS

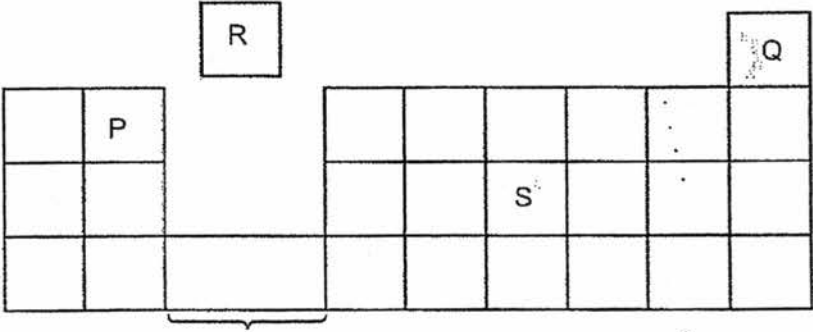
Paper 1 : Multiple Choice Questions

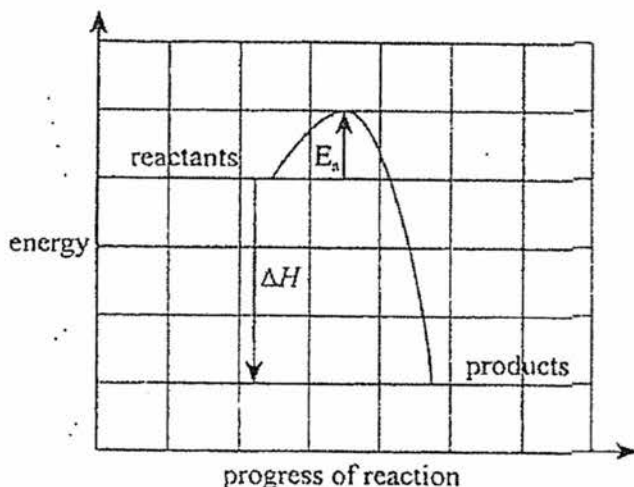
1 C	2 B	3 B	4 C	5 D	6 A	7 D	8 A	9 B	10 B
11 C	12 B	13 D	14 D	15 C	16 C	17 B	18 D	19 D	20 A
21 A	22 B	23 A	24 B	25 D	26 D	27 C	28 C	29 C	30 D
31 B	32 B	33 A	34 B	35 D	36 B	37 A	38 B	39 C	40 D

5	D	By filtration, lead(II) hydroxide and silver chloride are obtained as residue. To remove lead(II) hydroxide, add excess nitric acid. Neutralisation takes place between lead(II) hydroxide and nitric acid to form lead(II) nitrate solution. Silver chloride remains as precipitate. By filtration, silver chloride is obtained as residue.
11	C	Mass of Ca in CaO = (Ar of Ca / Mr of CaO) x mass of CaO = $(40 / 56) \times 14 = 10\text{g}$ % by mass of Ca = $(10/50) \times 100 = 20.0\%$.
12	C	No of moles of $\text{ZnCO}_3 = 1.25/125 = 0.01\text{ mol}$ $2\text{HCl} + \text{ZnCO}_3 \rightarrow \text{ZnCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$ No of moles of HCl = $2 \times \text{no of moles of ZnCO}_3 = 2 \times 0.01 = 0.02$ Vol of HCl = mol / conc = $0.02 / 1.0 = 0.02\text{ dm}^3 = 20\text{ cm}^3$
13	D	$\text{C}_x\text{H}_y + \text{O}_2 \rightarrow 6\text{CO}_2 + 3\text{H}_2\text{O}$ $5\text{ cm}^3 \quad \quad \quad 30\text{ cm}^3 \quad \quad 15\text{ cm}^3$ From the equation, the hydrocarbon has 6 carbon atoms and 6 hydrogen atoms.
15	C	Only statement 1 is wrong as mass of one mole of HCl is 36.5 g and one mole of CO is 28 g.
16	C	No of moles of $\text{H}_2 = \frac{1}{2} = 0.5\text{ mol}$ One molecule of H_2 has 2 atoms. No of moles of $\text{I}_2 = 127/254 = 0.5\text{ mol}$. = no. of moles of hydrogen gas. Each molecule of I_2 also has 2 atoms. Hence iodine has the same no. of atoms as hydrogen.
19	D	Barium chloride reacts with sulfate ions and carbonate ions to form insoluble barium sulfate and insoluble barium carbonate. This causes the mass of ppt to increase. When an acid is added, it reacts with barium carbonate but not barium sulfate. Hence the mass of ppt decreases with the removal of insoluble barium carbonate.
20	A	Copper(II) nitrate reacts with sodium hydroxide to form insoluble copper(II) hydroxide, thus decreasing the concentration of copper(II) ions.
21	A	S is an acid as it has a pH less than 7. The metal oxide is insoluble as it does not increase the pH after neutralisation has taken place. If it is soluble, by adding excess of it, pH should show > 7 .
24	B	$\text{H}_2 + \text{CuO} \rightarrow \text{Cu} + \text{H}_2\text{O}$
25	D	Rusting of iron uses up oxygen in the test tube. Water enters the tube to occupy the space left vacant by O_2 .
26	D	Neutralisation is not a redox reaction as there is no change in oxidation state of all the elements in the reactants.
28	C	One source of H_2 is from the cracking of alkane which is obtained from the fractional distillation of crude oil.
31	B	A decrease in pressure causes a decrease in the no of particles per unit volume which corresponds to a decrease in conc. This reduces the frequency of effective collision between the reactants, hence the decrease in rate of rxn.

32	B	No. of moles of zinc = $10/65 = 0.154$ mol. No. of moles of sulfuric acid = 0.5 mol. $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2 + \text{ZnSO}_4$ Mole ratio of Zn : $\text{H}_2\text{SO}_4 = 1:1$ Hence zinc is the limiting reactant. To produce half the volume of gas, mass of zinc is reduced by half. As Y is faster than X, concentration of acid in Y is higher than X
33	A	The further apart the metals in the reactivity series, the greater the voltmeter reading. As glucose solution is not an electrolyte, D is not an option.
34	B	In a simple cell, electrons flow from a more reactive metal (Zn) to a less reactive metal (Cu). As zinc loses electrons to form zinc ions, it becomes smaller.
37	A	Polyunsaturated means the cpd consists of many C=C bonds. Oleic acid consists of only one C=C bond. Stearic acid & palmitic acid do not have any C=C bond.

Paper 2

Section A (50 marks)		
A1		4
	Total	4
A2a	X – Group VI, Y – Group III, W – Group I, Z – Group VII [$4\sqrt{-2m}$, $3\sqrt{-2\sqrt{-1m}}$, $1\sqrt{-0m}$] [reject X – Gp IV as carbon is in different period from Y, W and Z]	2
b	W_2SO_4 and WH [reject HW] [both answer must be correct to score 1m]	1
c	covalent bonding [1] As XO_2 forms an acidic oxide, X must be a non-metal. Covalent bond is formed between non-metallic elements. Or Covalent compound has a low boiling point as it exists as a gas at room temperature. [1]	2
d	YZ_3	1
e	$4\text{W}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{W}_2\text{O}(\text{s})$ [1m for balanced equation; 1m for correct state symbols]	2
	Total	8
A3a	diamond and graphite [both answers must be correct to score 1 m]	1
b i	C_{60}	1
ii	$\text{Mr} = 12 \times 60 = 720$ [1] no. of moles of buckminsterfullerene = mass/Mr $= 3600/720$ $= 5 \text{ mol}$ [1] [allow e.c.f. from b i]	2
iii	Diamond and graphite are both giant molecular structure whereas buckminsterfullerene has a simple molecular structure. [1]	3

	More energy is required to break the strong covalent bonds between the carbon atoms throughout the giant structure [1] than overcoming the weak intermolecular forces of attraction between the simple buckminsterfullerene molecules. [1]	
	Total	7
A4 a	9.0, 35.5, 6.0, 20.0, 1.5, 15.0 [1] [All answers must be to 1 d.p.]	1
b	A pinkish brown solid would be seen / would form on each metal. [Reject: Blue solution turns colourless as iron(II) sulfate solution is pale green]	1
c	Any three of the following: (i) All the three metals are more reactive than copper, [1]. They all displace copper from copper(II) sulfate solution as shown by the temperature rise in each reaction. [1] (ii) The reactions are exothermic [1] as there is an increase in temperature for each reaction. [1] (iii) Powdering the metals produces a faster reaction. [1] The temperature increases during the first minute is greater for each powdered metal. [1] (iv) The reactivity of the metals in order of increasing reactivity is : iron < zinc < magnesium. [1] The temperature rise is greatest for magnesium and least for iron? [1]	6
d i	 • 1m for correct E_a • 1m for correct ΔH • 1m for correct shape of graph and labelling of formulae of reactants and products. Note: Formulae of reactants and products depend on the reaction of metal used.	3
d ii	Activation energy decreases and enthalpy change is unchanged. [both answers must be correct to score 1 m]	1
	Total	12
A5 a	equation : $\text{C}_6\text{H}_5\text{COOH} + \text{NaOH} \rightarrow \text{C}_6\text{H}_5\text{COONa} + \text{H}_2\text{O}$ [1] No. of mole of NaOH = conc x vol = 0.10×0.0167 = 0.00167 mol From the equation, 1 mole of sodium hydroxide reacts with 1 mole of aspirin. No. of mole of aspirin = 0.00167 mol [1]	3

	Mass of aspirin = mol x Mr = 0.00167 x 180 = 0.3006 g = 0.301 g (3 s.f.) [1] [accept 301 mg]	
b	Citric acid also reacts with aqueous sodium hydroxide. The volume of aqueous sodium hydroxide used is higher than expected. [1] Hence the calculated mass of aspirin would be higher than the actual mass. [1]	2
	Total	5
A6ai	Potassium iodide / sodium iodide	1
aii	$\text{Ag}^+(\text{aq}) + \text{I}^-(\text{aq}) \rightarrow \text{AgI}(\text{s})$	1
b	A – yellow solution [potassium chromate solution] B – red precipitate [silver chromate precipitate] C – colourless solution [silver nitrate colourless]	3
	Total	5
A7a	Purple potassium manganate(VII) is decolourised / turns colourless.	1
bi	Compound A is ethanol, B is ethanoic acid and C is ethyl ethanoate. [2] [3√ – 2m; 2√ – 1m; 1√ – 0m] ethanoic acid ethanol ethyl ethanoate + H-O-H Structural equation -1m [minus 1m if no label of A, B or C for each compound but correct naming of each structural compound]	3
bii	Add concentrated sulfuric acid as a catalyst and heat the mixture.	1
ci	Fermentation	1
cii	The process is very slow. / The yield is very low.	1
ciii	The amount of carbon dioxide emitted during the combustion of ethanol [1] is balanced by the taking in of carbon dioxide by sugar cane during photosynthesis [1]. As there is no net gain in carbon dioxide, the environmentalist is correct.	2
	Total	9
Section B (30 marks)		
B8a	In 1990, solid fuel like coal was the most common type of fuel used because usage of coal dropped by 2 times (67% in 1990 to 32% in 2002) [1] In 2002, usage of gaseous fuel increased because usage increased by 39% (1% in 1990 and 40% in 2002) [1] Reason: Burning of coal produces more carbon dioxide and methane than gas fuels. These are greenhouse gases which can contribute to global warming.	3
b	- High concentration of carbon monoxide at air : fuel ratio of 12:1 due to low level of oxygen present, leading to higher tendency of incomplete combustion.[1] - Concentration of carbon monoxide decreased sharply from air : fuel ratio of 12:1 to 14:1 and decreased gradually after air fuel ratio of 14.1. [1]	3

	As air content increased to 24:1, greater amount of oxygen is available for complete combustion, thus decreasing the concentration of carbon monoxide. [1]	
c	15:1 (accept range between 14: 1 to 16: 1)	1
di	Oxides of nitrogen / nitrogen dioxide / nitrogen monoxide [1]	1
dii	Use of catalytic converter [1] $2\text{NO} + 2\text{CO} \rightarrow \text{N}_2 + 2\text{CO}_2$ [1]	2
	Total	10
B9a	Correct axes labelled with units [1] Correct plotting of all points [1] Draw best-fit line through origin [1]	3
b	Mass of copper formed increases proportionally to the increase in current.	1
c	Student extrapolates the graph to show a mass of 1.2g obtained when a current of 6.0 A is used. In 10 mins, 1.2 g of copper is produced. In 5 mins, 0.6 g of copper is produced. [1]	1
d	A blue precipitate is formed which dissolves in excess aqueous ammonia to form a dark blue solution. [1] There is no change in the electrolyte. / There is copper(II) ions present in the solution. [1]	2
ei	$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	1
eii	no. of moles of copper = $0.81 / 64 = 0.0127 \text{ mol}$ (3 s.f.) no. of moles of silver = $2.7 / 108 = 0.0250 \text{ mol}$ [1 m for both correct moles of copper and silver] $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$ From the calculation, no. of moles of copper is about half that of the no. of moles of silver. Each copper(II) ion needs two electrons to form a copper atom whereas each silver ion needs one electron to form a silver atom. [1] [explanation – 1m]	2
	Total	10
EITHER B10ai	$\text{NaO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{C}_6\text{H}_4-\overset{\text{O}}{\parallel}{\text{C}}-\text{ONa}$	1
aii	CO_2 [1] Bubble the gas through limewater. White precipitate formed indicates the presence of carbon dioxide gas. [1]	2
b	Condensation polymerisation is a process whereby monomers with different functional groups are joined together to form a large molecule with the removal of small molecules such as water.	1
ci	$\begin{array}{c} \text{O} \quad \quad \quad \text{O} \\ \parallel \quad \quad \parallel \\ -\text{N}-\text{C}_6\text{H}_4-\text{N}-\text{C}-\text{C}_6\text{H}_4-\text{C}- \\ \quad \quad \quad \\ \text{H} \quad \quad \quad \text{H} \end{array}$	1
cii	Any two of the following: [both gases must be correct to score 1m] carbon dioxide, carbon monoxide, nitrogen dioxide, water vapour	1
d	Nylon. [1]	2

	Both nylon and Kevlar contains amide linkages. [1]	
e	Advantage: It is durable / light / waterproof [1] Disadvantage: Any one of the following [1] It is non-biodegradable as It cannot be decomposed naturally by the bacteria in the soil. / It can remain buried in landfills for a long period of time which means more lands are needed for landfill sites. / It can cause water pollution as it may clog up rivers and drains which might become breeding ground for mosquitoes / when thrown into sea, it can endanger marine animals. / It can cause air pollution when burnt as it produces toxic gas like carbon monoxide.	2
	Total	10
OR B10a	$\begin{array}{c} \quad \\ -C = C - \end{array}$ carbon-carbon double bond $\begin{array}{c} O \\ \\ -C - O - \end{array}$ ester	2
b	Addition polymerisation	1
c	$\begin{array}{ccccccc} & H & & OCOCH_3 & H & & OCOCH_3 \\ & & & & & & \\ - & C & - & C & - & C & - & C & - \\ & & & & & & \\ & H & & CN & H & & CN \end{array}$	1
d	Poly(methyl cyanopropenoate)	1
e	Any two of the following gases: Carbon dioxide, water vapour, nitrogen dioxide [both gases must be correct to score 1m]	1
f i	Reddish brown aqueous bromine turns colourless.	1
f ii	Addition reaction / addition of bromine / bromination	1
f iii	CH₂BrCBrCNCOOCH₃ [1] Mass of one mole = (12 x 5) + 5 + (80 x 2) + 14 + (16 x 2) = 271 g [1]	2
	Total	10

The End