



# MODULE JUJ

2008

SCORE A

SCORE A

CHEMISTRY



## Chapter 2: The Structure of the Atom

### A. Knowledge (Definition, meaning and facts)

- 1) State the kinetic theory of matter.  
State one example to support the kinetic theory of matter
- 2) What are atom, molecule and ion?
- 3) What is melting point?
- 4) Define proton number and nucleon number.
- 5) State the meaning of isotopes.
- 6) State the uses of isotopes such as carbon-14 and cobalt-60.

### B. Understanding / Application / Analysis

- 6) Explain why the temperature remains unchanged during the melting process.
- 7) Explain why the temperature remains unchanged during the freezing process.
- 8) A solid compound is heated until it converts into gas. Explain the changes in energy content, forces of attraction between the particles, and arrangement of particles.
- 9) State the main subatomic particles of an atom.
- 10) Compare and contrast the relative atomic mass and the relative charge of the subatomic particles of the atom.
- 11)  ${}_{13}^{27}\text{Al}$  is the symbol of aluminium.
  - (a) Determine the number of neutron of aluminium.
  - (b) Draw the electron arrangement of aluminium.

### C. Synthesis (Experiment)

- 12) Solid Z has a melting point of  $65^{\circ}\text{C}$ . Describe a laboratory experiment to determine the melting point of Z. Your answer should show how the melting point of Z is determined.
- 13) Compound W has a freezing point of  $82^{\circ}\text{C}$ . Describe a laboratory experiment to determine the freezing point of W.



### Chapter 3: Chemical Formulae and Equations

#### A. Knowledge (Definition, meaning and facts)

- 1) State the meaning of relative atomic mass based on carbon-12 scale.
- 2) Define a mole.
- 3) State the meaning of molar mass
- 4) State the meaning of molar volume of gas.
- 5) State the meaning of empirical formula.
- 6) State the meaning of molecular formula.

#### B. Understanding / Application / Analysis

- 7) Explain why we couldn't determine the empirical formula of copper(II) oxide by heating copper powder in a crucible.
- 8) Compare and contrast empirical formula with molecular formula using ethane as an example.
- 9) Vinegar is a dilute ethanoic acid with a molecular formula of  $\text{CH}_3\text{COOH}$ .
  - (a) Find the empirical formula of ethanoic acid.
  - (b) Find the percentage composition by mass of carbon in ethanoic acid.
- 10) 3.6 g of carbon reacted with 0.8 g of hydrogen to form a compound.
  - (a) Determine the empirical formula of the compound formed.
  - (b) Given that the relative molecular mass of the compound is 88 g, find its molecular formula.  
[Relative atomic mass: C, 12; H, 1]
- 11) Hydrogen Gas is reacted with 20 g of hot copper(II) oxide powders to produce solid copper and water.
  - (a) Write the chemical equation for the reaction.
  - (b) Calculate the maximum mass of solid copper formed.  
[Relative atomic mass: Cu, 64; O, 16; H, 1]

#### C. Synthesis (Experiment)

- 12) Describe a laboratory experiment to determine the empirical formula of magnesium oxide.  
Your answer should include all the precautions and calculations involved.  
[Relative atomic mass: Mg, 24; O, 16]



## Chapter 4: Periodic Table of Elements

### A. Knowledge (Definition, meaning and facts)

- 1) State the basic principle of arranging the elements in the Periodic Table from its proton number.
- 2) State the physical properties of Group 1.
- 3) State the physical properties of Group 17.
- 4) State the changes in the atomic size and electronegativity of elements across Period 3.
- 5) State three special properties of transition elements?

### B. Understanding / Application / Analysis

- 6) State the position of element  ${}_{20}^{39}\text{X}$  in Periodic Table. Explain your answer.
- 7) When across Period 3 from sodium to argon, the atomic size decreases. Explain why.
- 8) When across Period 3 from sodium to argon, the electronegativity increases. Explain why.
- 9) The reactivity of Group 1 increases when going down the group. Explain why.
- 10) The reactivity of Group 17 decreases when going down the group. Explain why.
- 11) Why helium gas is not reactive?
- 12) X is an element from Group 1. X is burnt in oxygen and the product is dissolved in water. What is the property of the solution formed? Explain Why.
- 13) Chlorine gas is dissolved in water. What can you observe if a piece of blue litmus paper is immersed into the solution formed? Explain why.
- 14) W is an element from Group 1. Predict the chemical reaction of W with:
  - a) water,
  - b) Oxygen,
 State the observation and write the chemical equation involve.

### C. Synthesis (Experiment)

- 15) Describe a laboratory experiment to compare the reactivity of elements in Group 1: lithium, sodium and potassium.
- 16) Describe a laboratory experiment to compare the reactivity of chlorine, bromine and iodine in the reaction with iron wool. State the observation and write the chemical equations involve in reactions.



## Chapter 5: Chemical Bonds

### A. Knowledge (Definition, meaning and facts)

- 1) What is anion?
- 2) What is cation?
- 3) State two physical properties of ionic compounds.
- 4) State two physical properties of covalent compounds.

### B. Understanding / Application / Analysis

- 5) Explain why sodium chloride can conduct electricity in aqueous state but cannot conduct electricity in solid state.
- 6) Magnesium chloride and hydrogen chloride are two compounds of chlorine. At room condition, magnesium chloride exists as a solid but hydrogen chloride exists as a gas. Explain why.
- 7) Describe the formation of ionic bond in sodium chloride, NaCl.
- 8) By using example, describe the formation of covalent bond between element from Group 14 and element from Group 17.

### C. Synthesis

- 9) Draw electron arrangement of the compound formed from the following elements.
  - a) Nitrogen and hydrogen,
  - b) Carbon and oxygen,
  - c) Magnesium and chlorine,
  - d) Carbon and hydrogen,
  - e) Hydrogen and chlorine,
  - f) Sodium and oxygen.



## Chapter 6: Electrochemistry

### A. Knowledge (Definition, meaning and facts)

- 1) State the meaning of electrolyte.
- 2) State the meaning of electrolysis.
- 3) State three factors affecting electrolysis of an aqueous solution.

### B. Understanding / Application / Analysis

- 4) Explain why solution of hydrogen chloride in water can conduct electricity but solution of hydrogen chloride in methylbenzene cannot conduct electricity?
- 5) By using example, explain how the following factors can determine the selective discharge of ions at the electrodes.
  - i. Types of electrodes,
  - ii. Concentration of the ions.
- 6) Describe the electrolysis of molten lead(II) bromide.
- 7) Describe the extraction of aluminium by electrolysis.
- 8) Draw the structure of Daniell cell and explain how it can produce electricity.
- 9) Draw the structure of a dry cell and explain how it can produce electricity.

### C. Synthesis

- 10) Describe a laboratory experiment to extract lead from lead(II) oxide by using electrolysis.
- 11) Describe a laboratory experiment to show that types of electrodes affecting the selective discharge of ions in electrolysis of copper(II) sulphate solution.
- 12) You are given magnesium ribbon, copper plate, magnesium nitrate solution, copper(II) sulphate solution, connecting wires with crocodile clips, 250 cm<sup>3</sup> beaker, voltmeter and porous pot.  
Construct a voltaic cell by using the above materials.  
Explain how the voltaic cell can produce electricity. Your answer must include observation and half equations for reaction at anode and cathode.
- 13) Describe a laboratory experiment to construct the electrochemical series of magnesium, copper, zinc and lead.



## Chapter 7&8: Acids ,Bases and Salts

### A. Knowledge (Definition, meaning and facts)

- 1) State the meaning of acid and alkali.
- 2) What is the meaning of strong acid and weak alkali?
- 3) What is neutralisation?
- 4) What is salt?
- 5) What is precipitate reaction?

### B. Understanding / Application / Analysis

- 6) The pH value of solution ammonia in water is 9 but the pH value of solution of ammonia in trichloromethane is 7. Explain why the pH values of the two solutions are different.
- 7) 80 cm<sup>3</sup> of distilled water is added to 20 cm<sup>3</sup> of 2.0 moldm<sup>-3</sup> solution of HCl. Find the molarity of the dilute solution.
- 8) In a titration, 40 cm<sup>3</sup> of 0.25 moldm<sup>-3</sup> potassium hydroxide, KOH solution is needed to neutralise 20 cm<sup>3</sup> of nitric acid, HNO<sub>3</sub>. Calculate the molarity of the nitric acid, HNO<sub>3</sub>.
- 9) Given dilute nitric acid and dilute sulphuric acid have the same concentration of 0.5 moldm<sup>-3</sup>. In a neutralisation experiment, 20 cm<sup>3</sup> of nitric acid is required to neutralise 20 cm<sup>3</sup> of sodium hydroxide solution but only 10 cm<sup>3</sup> of sulphuric acid is required to neutralise 20 cm<sup>3</sup> of sodium hydroxide solution. Explain why.

### C. Synthesis

- 10) Describe a chemical test to determine a given solution is an acid solution.
- 11) Describe a laboratory experiment to determine the concentration of sodium hydroxide by using titration process. You are given 0.2 moldm<sup>-3</sup> of dilute sulphuric acid, phenolphthalein, burette, pipette and conical flask.
- 12) You are given solid sodium chloride. Describe how to prepare sodium chloride solution of 0.2 moldm<sup>-3</sup> in laboratory by using 250 cm<sup>3</sup> volumetric flask.
- 13) Describe the preparation of zinc sulphate .
- 14) Describe the preparation of lead(II) chloride.
- 15) Describe the preparation of potassium nitrate.
- 16) Solid W is a salt. Describe the tests you would carry out to confirm the presence of zinc ions and nitrate ions in the salt?
- 17) Solid X is a metal carbonate. Describe the tests you would carry out to confirm that X consists of carbonate ions besides heating.
- 18) You are given four test tubes filled with solution consist of zinc ions, lead(II) ions, aluminium ions and magnesium ions respectively. Describe the tests you would carry out to confirm the ion that present in each test tube.

- 19) You are given potassium chloride solution, lead(II) oxide powder and dilute nitric acid.  
Describe how you would prepare lead(II) chloride salt from the given materials.
- 20) You are given dilute sulphuric acid, copper(II) nitrate solution and sodium carbonate solution. Describe how you would prepare copper(II) sulphate salt from the given materials.

## Chapter 9: Manufactured Substance in Industry

### A. Knowledge (Definition, meaning and facts)

- 1) What is the meaning of alloy?
- 2) State the aims of making alloys.
- 3) What is the meaning of composite materials?
- 4) State the components of the following composite materials:
  - a. Reinforced concrete,
  - b. Superconductor,
  - c. Fibre optic,
  - d. Fibre glass,
  - e. Photochromic glass.
- 5) State the catalyst, temperature and pressure of the following process:
  - a. Contact process
  - b. Haber process
- 6) What is the meaning of polymers?
- 7) Name the monomer of polythene and polyvinyl chloride.
- 8) State four types of glass and their compositions. List the uses of each glass.
- 9) What is **ceramics**?
- 10) State the properties and list the uses of ceramics.

### B. Understanding / Application / Analysis

- 11) Bronze is an alloy consists of copper and tin. Explain why bronze is harder than copper.
- 12) Explain how acid rain is formed.  
Describe how acid rain causes environmental pollution.
- 13) Explain the industrial process involved in the manufacture of sulphuric acid.  
Write all the chemical equations involve.
- 14) Explain the industrial process involved in the manufacture of ammonia gas.
- 15) Write all the chemical equations involve.



**C. Synthesis**

- 16) Describe a laboratory experiment to prepare ammonium sulphate (ammonium fertiliser)
- 17) Describe a laboratory experiment to compare the hardness of brass and copper.

**Chapter 10: Rate of Reaction****A. Knowledge (Definition, meaning and facts)**

- 1) What is rate of reaction?
- 2) What is stated in the collision theory?
- 3) What is activation energy?
- 4) What is effective collision?

**B. Understanding / Application / Analysis**

- 5) Explain how surface area (size of reactant) can increase the rate of reaction based on collision theory.
- 6) Explain how temperature can increase the rate of reaction based on collision theory.
- 7) Explain how catalyst can increase the rate of reaction based on collision theory.
- 8) Explain why hydrochloric acid of  $2.0 \text{ mol dm}^{-3}$  is reacted faster with zinc compare to hydrochloric acid of  $0.5 \text{ mol dm}^{-3}$ .

**C. Synthesis**

- 9) Hypothesis: The smaller the size of reactant, the higher the rate of reaction. Describe a laboratory experiment to confirm the hypothesis by using the reaction between calcium carbonate and hydrochloric acid.
- 10) Describe a laboratory experiment to show that the presence of catalyst will increase the rate of decomposition of hydrogen peroxide.
- 11) Describe a laboratory experiment to show that an increase in temperature will increase the rate of reaction between sodium thiosulphate solution and sulphuric acid.



## Chapter 11: Carbon compounds

### A. Knowledge (Definition, meaning and facts)

- 1) What is homologous series?
- 2) What is saturated hydrocarbon and unsaturated hydrocarbon? State an example of each of them.
- 3) Explain what is isomers and isomerism by using butane as an example.
- 4) What is polymer? State an example of polymer and its monomer.
- 5) What are saturated and unsaturated fats?

### B. Understanding / Application / Analysis

- 7) Explain what is isomers and isomerism by using butane.
- 8) Explain why ethene gas can decolourise the acidified potassium manganate(II) solution but ethane can not decolourise acidified potassium manganate(II) solution.
- 9) Explain why both hexane and hexene have six carbon atoms but hexene burns with a more sooty flame.
- 10) Pentane and propane are members from alkane family. Explain why the melting point of pentane is higher than propane.
- 11) Propanol and propanoic acid are dissolved in water. It is found that propanol solution is a neutral but propanoic acid is an acid solution.
- 12) Explain the coagulation process of latex.
- 13) Explain how to prevent coagulation of latex.

### C. Synthesis

- 14) Describe a test to differentiate hexene and hexane.
- 15) Describe a laboratory experiment to prepare ethane gas from ethanol.
- 16) Describe a laboratory experiment to prepare ethanoic acid gas from ethanol.
- 17) Ethylpropanoate is a product from reaction between alcohol and carboxylic acid.
  - (a) State two physical properties of ethylpropanoate.
  - (b) Describe a laboratory experiment to prepare Ethylpropanoate.

Your answer must include the drawing of the setup-apparatus and the chemical equation involve.

- 18) Explain how to prepare propanoic acid from propene.



## Chapter 12: Oxidation and Reduction

### A. Knowledge (Definition, meaning and facts)

- 1) What is oxidation and deduction based on loss or gain of oxygen?
- 2) What is oxidation and deduction based on transfer of electrons?
- 3) What is oxidation and deduction based on changes in oxidation number?
- 4) What are redox reactions? State an example of redox reactions.
- 5) What is oxidising agent and reducing agent? State an example of oxidising agent and reducing agent.

### B. Understanding / Application / Analysis

- 6) Determine whether the reaction between hydrochloric acid and sodium hydroxide is a redox reaction. Explain your answer based on changes in oxidation number.
- 7) Determine whether the reaction between lead(II) nitrate and copper(II) is a redox reaction. Explain your answer based on changes in oxidation number.
- 8) The reaction between zinc and copper(II) sulphate solution is a redox reaction. Explain why.
- 9) When bromine water is added to the potassium iodide solution, the solution changes colour from colourless to brown. Explain the observation.
- 10) Describe the rusting of iron.
- 11) A mixture of copper(II) oxide and aluminium powder is heated strongly. The mixture burns brightly. Explain this observation based on oxidation and reduction.
- 12) Chlorine water is added to potassium iodide solution in a test tube. 2 cm<sup>3</sup> of 1,1,1-trichloroethene is added to the test tube and the mixture is shaken thoroughly. The colour of 1,1,1-trichloroethene changes from colourless to purple. Explain the observation.

### C. Synthesis

- 12) Describe a laboratory experiment to change the oxidation number of iron from +2 to +3.  
How would you confirm that iron(III) is formed?
- 13) Describe a laboratory experiment to change the oxidation number of iron from +3 to +2 by using zinc.
- 14) Describe the extraction of iron.
- 15) You are given lead, zinc, copper and their oxides. Describe a laboratory experiment to compare the reactivity of these metals toward oxygen.



## Chapter 12: Thermochemistry

### A. Knowledge (Definition, meaning and facts)

- 16) What is exothermic reaction and endothermic reaction?  
State an example for each reaction.
- 17) What is heat of precipitation?
- 18) What is heat of displacement?
- 19) What is heat of neutralisation?
- 20) What is heat of combustion?

### B. Understanding / Application / Analysis

- 21) Explain how exothermic reaction and endothermic are formed based on energy change during formation and breaking of chemical bonds.
- 22) Explain why the heat of combustion of butanol is higher than ethanol.
- 23) Explain why the heat of neutralisation between strong acids and strong alkalis is a constant,  
that is  $-57\text{kJmol}^{-1}$ ?
- 24) Explain why the heat of neutralisation between ethanoic acid and sodium hydroxide is less than  $-57\text{kJmol}^{-1}$ ?
- 25)  $50\text{ cm}^3$  of  $2\text{ mol dm}^{-3}$  sodium hydroxide solution is added to  $50\text{ cm}^3$  of  $2\text{ mol dm}^{-3}$  hydrochloric acid. The temperature increases  $t\text{ }^\circ\text{C}$ .
  - a. If  $100\text{ cm}^3$  of  $2\text{ mol dm}^{-3}$  sodium hydroxide solution is added to  $100\text{ cm}^3$  of  $2\text{ mol dm}^{-3}$  hydrochloric acid, predict the increase in temperature.
  - b. If  $50\text{ cm}^3$  of  $1\text{ mol dm}^{-3}$  sodium hydroxide solution is added to  $50\text{ cm}^3$  of  $1\text{ mol dm}^{-3}$  hydrochloric acid, predict the increase in temperature.
- 26) If  $50\text{ cm}^3$  of  $4\text{ mol dm}^{-3}$  sodium hydroxide solution is added to  $50\text{ cm}^3$  of  $4\text{ mol dm}^{-3}$  hydrochloric acid, predict the increase in temperature.

### C. Synthesis

- 27) Describe a laboratory experiment to determine the heat of displacement of copper by zinc.
- 28) Describe a laboratory experiment to determine the heat of neutralisation between strong acids and strong alkalis.
- 29) Describe a laboratory experiment to determine the heat of combustion of methanol.
- 30) "The higher the number of carbon atoms per molecule, the higher is the heat of combustion"  
Describe a laboratory experiment to prove that the above statement is true by using methanol, ethanol, propan-1-ol, butan-1-ol and pentan-1-ol.



## Chapter 13: Chemicals for Consumers

### A. Knowledge (Definition, meaning and facts)

- 1) What is soap?
- 2) What is saponification process?
- 3) What is detergent?
- 4) State the functions of each of the following additives in detergent.
  - a. Whitening agent(example: sodium perborate)
  - b. Optical whitener(fluorescent dyes)
  - c. Biological enzyme (Example: amylases, lipases, proteases and cellulases)
  - d. Fragrance
- 5) What is hard water?
- 6) State the function of each of the following food additives:
  - a. Preservatives ( Sodium nitrite, sodium benzoate)
  - b. Antioxidants (Ascorbic acid)
  - c. Flavourings (Monosodium glutamate (MSG), Aspartame)
  - d. Stabilisers
  - e. Thickeners
- 7) State the functions of the following modern medicines.
  - a. Analgesics ( Aspirin, Paracetamol, Codeine)
  - b. Antibiotics ( Penicilin, Streptomycin)
  - c. Psychotherapeutic medicine ( Stimulant, Antidepressant, Antipsychotic)
- 8) State the side effects of paracetamol and aspirin.

### B. Understanding / Application / Analysis

- 9) Describe the cleansing action of soap.
- 10) Explain why the cleansing action of a detergent is more effective than a soap in hard water.

### C. Synthesis

- 11) Describe a laboratory experiment to prepare soap from palm oil using the saponification process.
- 12) Describe a laboratory experiment to investigate the cleansing action of a soap and a detergent in hard water.

### Module 1: Ionic Formulae

Name of the Ion	Ionic formulae	Compound Name	Compound formulae
Sodium ion	$\text{Na}^+$	Sodium chloride	
potassium ion	$\text{K}^+$	Potassium bromide	
silver ion	$\text{Ag}^+$	Magnesium chloride	
hydrogen ion	$\text{H}^+$	Copper (II) oxide	
copper(I) ion	$\text{Cu}^+$	Potassium oxide	
copper(II) ion	$\text{Cu}^{2+}$	Iron(II) oxide	
magnesium ion	$\text{Mg}^{2+}$	Tin(II) oxide	
calcium ion	$\text{Ca}^{2+}$	Zink chloride	
zinc ion	$\text{Zn}^{2+}$	Copper(I) chloride	
barium ion	$\text{Ba}^{2+}$	Barium chloride	
iron(II) ion	$\text{Fe}^{2+}$	Silver oxide	
iron(III) ion	$\text{Fe}^{3+}$	Lead(II) chloride	
lead(II) ion	$\text{Pb}^{2+}$	Magnesium oxide	
lead(IV) ion	$\text{Pb}^{4+}$	Lead(II) iodide	
tin(II) ion	$\text{Sn}^{2+}$	Aluminum chloride	
tin(IV) ion	$\text{Sn}^{4+}$	Aluminum oxide	
Aluminum ion	$\text{Al}^{3+}$	Iron(III) oxide	
Lithium ion	$\text{Li}^+$	Calcium oxide	
fluoride ion	$\text{F}^-$	Tin(IV) oxide	
Chloride ion	$\text{Cl}^-$	Magnesium bromide	
bromide ion	$\text{Br}^-$	Lead(II) bromide	
iodide ion	$\text{I}^-$	Potassium chloride	
oxide ion	$\text{O}^{2-}$	Sodium iodide	
hydroxide ion	$\text{OH}^-$	Iron(III) chloride	
nitrate ion	$\text{NO}_3^-$	Lead(IV) oxide	
sulphate ion	$\text{SO}_4^{2-}$	Sodium oxide	
carbonate ion	$\text{CO}_3^{2-}$	Silver bromide	
ammonium ion	$\text{NH}_4^+$	Zink oxide	
phosphate ion	$\text{PO}_4^{3-}$	Calcium chloride	

**Module 2 : Write the correct formulae of each compound**

Name of compound	Formulae
Magnesium nitrate	
Potassium sulphate	
Iron(II) sulphate	
Copper(II) hydroxide	
Copper(II) carbonate	
Lead(II) sulphate	
Calcium carbonate	
Zink hydroxide	
Copper(II) nitrate	
Tin(II) hydroxide	
Potassium nitrate	
Sodium carbonate	
Zink nitrate	
Barium sulphate	
Iron(III) hydroxide	
Magnesium carbonate	
Silver sulphate	
Sodium hydroxide	
Zink sulphate	

Name of compound	Formulae
Calcium carbonate	
Ammonium chloride	
Ammonium nitrate	
Ammonium carbonate	
Ammonium sulphate	
Ammonium phosphate	
Potassium hydroxide	
Aluminum sulphate	
Iron(III) sulphate	
Aluminum nitrate	
Magnesium hydroxide	
Potassium phosphate	
Calcium nitrate	
Iron(III) nitrate	
Iron(II) carbonate	
Sodium nitrate	
Barium hydroxide	
Potassium carbonate	
Silver hydroxide	

## Module 3: Recognize atom and ion

No	Compound / Molecule	Formulae	No. of particles	
			atom	ion
1	Copper (II) oxide			
2	Sodium oxide			
3	Potassium chloride			
4	Magnesium chloride			
5	Zinc oxide			
6	Lead(II) sulphate			
7	Silver sulphate			
8	Tin(II) nitrate			
9	Hydrochloric acid			
10	Sulfuric acid			
11	Nitric acid			
12	Magnesium nitrate			
13	Copper(II) sulphate			
14	Silver nitrate			
15	Iron(III) chloride			
16	Iron(II) nitrate			
17	Sodium sulphate			
18	Potassium manganase(VII)	$\text{KMnO}_4$		
19	Potassium dichromate(VI)	$\text{K}_2\text{Cr}_2\text{O}_7$		
20	Aluminium oxide			
21	Iron(III) chloride			
22	Aluminium chloride			
23	Aluminium sulphate			
24	Iron(III) sulphate			
25	Ammonium nitrate			
26	Acetic acid	$\text{CH}_3\text{COOH}$		
27	Ammonium sulphate			



## Module 4 : Calculating Relative Molecular Mass

No	Name of Compound	Formula of Compound	Relative Molecule Mass/ Relative Formula Mass	Ans
1	Copper(II) chloride	$\text{CuCl}_2$	$64 + 2(35.5) = 135$	135
2	Potassium chloride			74.5
3	Sodium sulphate			142
4	Magnesium sulphate			120
5	Zink carbonate			125
6	Potassium nitrate			101
7	Iron(II) oxide			72
8	Calcium nitrate			164
9	Barium sulphate			233
10	Tin(II) chloride			190
11	Lead(II) oxide			223
12	Aluminum chloride			133.5
13	Ammonium nitrate			80
14	Sodium nitrate			85
15	Silver oxide			232
16	Iron(III) chloride			162.5
17	Sodium bromide			103
18	Sodium oxide			62
19	Lead(II) sulphate			303
20	Lithium oxide			30
21	Magnesium nitrate			148
22	Potassium iodide			166
23	Potassium sulphate			174
24	Magnesium oxide			40
25	Iron(II) carbonate			116

No	Name of Compound	Formula of Compound	Relative Molecule Mass/ Relative Formula Mass	Ans
26	Carbon dioxide			44
27	Copper(II) carbonate			124
28	Sodium iodide			150
29	Ammonium nitrate			80
30	Copper(II) hydroxide			98
31	Calcium carbonate			100
32	Ammonium sulphate			132
33	Sodium carbonate			106
34	Silver sulphate			312
35	Aluminum oxide			102
36	Aluminum sulphate			342
37	Iron(III) oxide			160
38	Iron(III) sulphate			400
39	Potassium carbonate			138
40	Acetic acid			60
41	Sulfuric acid			98
42	Hydrochloric acid			36.5
43	Nitric acid			63
44	Magnesium hydroxide			58
45	Copper(II) nitrate			188
46	Magnesium etanoat	$(\text{CH}_3\text{COO})_2\text{Mg}$		142
47	Magnesium sulphate hydrate	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$		246
48	Copper(II) sulphate hydrate	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$		250
49	Butanoic acid	$\text{C}_3\text{H}_7\text{COOH}$		88
50	Potassium manganese(VII)	$\text{KMnO}_4$		158

**Module 5 : Writing A Balanced Chemical Equations**

**Write a balance chemical equations below:**

1. Copper(II) carbonate  $\rightarrow$  Copper(II) oxide + Carbon dioxide
2. Lead(II) nitrate + Sodium iodide  $\rightarrow$  Lead(II) iodide + Sodium nitrate
3. Aluminium + Zinc oxide  $\rightarrow$  Aluminium oxide + Zinc
4. Hydrogen + Oxygen  $\rightarrow$  Water
5. Potassium carbonate + Nitric acid  $\rightarrow$   
Potassium nitrate + Carbon dioxide + Water
6. Sodium hydroxide + Sulfuric acid  $\rightarrow$  Sodium sulphate + Water
7. Iron + Chlorine  $\rightarrow$  Iron(III) chloride
8. Lithium + Water  $\rightarrow$  Lithium hydroxide + Hydrogen
9. Bromine + Potassium iodide  $\rightarrow$  Potassium bromide + Iodine
10. Copper + Silver nitrate  $\rightarrow$  Copper(II) nitrate + Silver
11. Zinc + Iron(III) chloride  $\rightarrow$  Zinc chloride + Iron
12. Barium chloride + Sodium sulphate  $\rightarrow$   
Barium sulphate + Sodium chloride



13. Iron + Copper(II) oxide  $\rightarrow$  Iron(III) oxide + Copper
14. Sodium + Water  $\rightarrow$  Sodium hydroxide + hydrogen
15. Magnesium + carbon dioxide  $\rightarrow$  magnesium oxide + carbon
16. Potassium + Copper(II) oxide  $\rightarrow$  Potassium oxide + Copper
17. Magnesium + Chlorine  $\rightarrow$  Magnesium chloride
18. Aluminum + Oxygen  $\rightarrow$  Aluminum oxide
19. Sodium + Oxygen  $\rightarrow$  Sodium oxide
20. Magnesium + Oxygen  $\rightarrow$  Magnesium oxide
21. Potassium + Oxygen  $\rightarrow$  Potassium oxide
22. Aluminum + Oxygen  $\rightarrow$  Aluminum oxide
23. Zinc + Oxygen  $\rightarrow$  Zinc oxide
24. Lead(II) carbonate  $\rightarrow$  Lead(II) oxide + Carbon dioxide
25. Potassium + Chlorine  $\rightarrow$  Potassium chloride

## OBJECTIVE

In this module, we will discuss a few aspects including 'the needs of a question and finding the key words for answering this question'. You will also be given a simple way of memorizing certain topics. We hope that you will make use all the knowledge obtained in this seminar towards achieving excellence in chemistry consequently in your academic achievements that will make your family and school proud of you.

## EXAM FORMAT FOR SPM CHEMISTRY PAPERS

PAPER	PAPER 1 [ 4541/1]	PAPER 2 [ 4541/2]	PAPER 3 [4541/3]
Item	<b>Objective question</b> Multiple choice & Multiple combination	<b>Subjective question</b> <b>Section A</b> Structured questions <b>Section B</b> Limited response questions <b>Section C</b> Open response questions	Structured question & Open response question
Number of questions	50 (answer all)	<b>Section A</b> 6 questions (answer all) <b>Section B</b> 2 question ( choose one) <b>Section C</b> 2 question ( choose one)	<b>Structured questions</b> 1-2 questions (answer all) Design and planning the experiment 1 question (compulsory)
<b>Total marks</b>	50	100	50
<b>Ways to response</b>	Marked on OMR form	Written in the space provided in the question paper	Written in the space provided in the question paper
<b>Duration of time</b>	1 hour 15 minutes	2 hours 30 minutes	1 hour 30 minutes
<b>Construct</b>	Knowledge: 20 questions Understanding: 15 questions Application: 15 question	Knowledge: 14% Understanding:21% Application: 29% Analysing: 21% Synthesising: 15%	Sciences process skills: 13 sciences process skills
<b>Level of difficulty</b>	L: 25 questions M: 15 questions H: 10 questions	L:50% M:30% H:20%	

**ANALYSIS OF THE SPM CHEMISTRY PAPERS  
[2003 – 2007]**

**PAPER 2**

YEAR CHAPTER		YEAR					
		2002	2003	2004	2005	2006	2007
FORM 4	1. Introduction to chemistry						
	2. The structure of the atom			2	½	1	1b
	3. Chemical formulae and questions		11			1	1a
	4. Periodic Table of elements	1	1		1		1a
	5. Chemical bonds					1	1a
	6. Electrochemistry		1	1	2		
	7. Acids and bases	1		1	2		1b
	8. Salts						
	9. Manufactured substances in industry	1	2	1		1	1a
FORM 5	10. Rate of reaction	1	1		1	1	1c
	11. Carbon compounds	1	1	2			1c
	12. Oxidation and reduction	1	1	1			1a
	13. Thermochemistry	1	1	1	2		
	14. Chemical for consumer	1	1	1	1	1	1a

**PAPER 3**

YEAR CHAPTER		YEAR					
		2002	2003	2004	2005	2006	2007
FORM 4	1. Introduction to chemistry						
	2. The structure of the atom				1		
	3. Chemical formulae and questions			1			
	4. Periodic Table of elements			1			
	5. Chemical bonds						
	6. Electrochemistry				½		1[sps]
	7. Acids and bases		1		½		
	8. Salts						
	9. Manufactured substances in industry		1		1		
FORM 5	10. Rate of reaction						
	11. Carbon compounds			1		1	
	12. Oxidation and reduction		1				
	13. Thermochemistry					1	1[de]
	14. Chemical for consumer						

**Note:** *sps* – sciences process skills, *de* – design the experiment

**ACTIVITY 1 : ANSWERS WITH IN CORRECT TERMS, WORDS OR INCORRECT KEY WORDS.**

BIL.	INCORRECT TERMS [TIDAK TEPAT]	CORRECT TERMS [TEPAT]
1.	Chocolate precipitate <i>[Mendakan coklat]</i>	
2.	A stable atom <i>[Atom yang stabil]</i>	
3.	Melting point is the point where solid changes to liquid. <i>[Takat lebur ialah takat dimana pepejal berubah menjadi cecair]</i>	
4.	Clear solution <i>[Larutan jernih]</i>	
5.	The rate of reaction for Experiment II is faster/slower than Experiment I <i>[kadar tindakbalas Eksperimen II lebih cepat/perlahan daripada Experiment I]</i>	
6.	Nucleus contains 1 proton number and 1 neutron number <i>[nucleus mengandungi 1 nombor proton dan 1 nombor neutron]</i>	
7.	Sodium donates electron <i>[Natrium menderma electron]</i>	
8.	Magnesium <b>is more active</b> than zinc <i>[Magnesium lebih aktif daripada zink]</i>	
9.	ECS	
10.	In the electrochemical series, magnesium <b>is more reactive</b> than zinc <i>[Untuk siri elektrokimia, magnesium lebih reaktif daripada zink]</i>	
11.	In the reactivity series, magnesium <b>is more electropositive</b> than zinc <i>[Untuk siri kereaktifan, magnesium lebih elektropositif daripada zink]</i>	

**ACTIVITY 2:**

Matching the definition with a correct terminology.  
 [Padankan definisi dengan istilah yang betul.]

Oxidizing agent [Agen pengoksidaan]	Empirical Formula [Formula empiric]	Isomers [Isomer]	
Electrolysis [Elektrolisis]	Strong alkali [Bes kuat]	Strong acid [Asid kuat]	Salts [Garam]
Exothermic reactions [Tindak balas eksotermik]	Endothermic reactions [Tindak balas endotermik]	Reducing agent [Agen penurunan]	
Weak alkali [Bes lemah]	Weak acid [Asid lemah]	Melting point [Takat lebur]	Heat of neutralization [Haba peneutralan]
Rate of reaction [Kadar tindak balas]	Hydrocarbon [Hidrokarbon]	Polymers [Polimer]	Polymerisation [Pempolimeran]
Vulcanization [Pemvulkanan]	Redox [Redoks]	Saponification [Saponifikasi]	Activation energy [Tenaga pengaktifan]
Unsaturated hydrocarbons [Hidrokarbon tak tepu]	The Heat of Displacement [Haba penyesaran]		
Double dissociation reactions/ precipitation reactions [Penguraian ganda dua/ pemendakan]			



NO	DEFINATION	TERMINOLOGY
1	Organic compound that contain only carbon and hydrogen. <i>[Sebatian yang mengandungi karbon dan hydrogen sahaja]</i>	
2	Compounds with the same molecular formulae but different structural formulae <i>[sebatian yang mempunyai formula molekul yang sama tetapi formula struktur yang berlainan]</i>	
3	The formula that gives the simplest whole number ratio of atoms of each element in the compound <i>[Formula yang menunjukkan nisbah paling ringkas bilangan atom setiap jenis unsur dalam suatu sebatian.]</i>	
4	A process whereby compounds in molten or aqueous state are broken down into their constituent elements by passing electricity through them <i>[Proses dimana suatu sebatian diurai oleh arus elektrik dalam keadaan lebur atau larutan berair]</i>	
5	It is reduced in the redox reduction <i>[Bahan yang mengalami penurunan]</i>	
6	It is oxidized in the redox reduction <i>[Bahan yang mengalami pengoksidaan]</i>	
7	A chemical reaction that releases heat <i>[Tindak balas yang membebaskan haba]</i>	
8	A chemical reaction that absorbs heat <i>[Tindak balas yang menyerap haba]</i>	
9	The energy changes when 1 mole of water formed from the neutralization between 1 mole of hydrogen ions, $H^+$ from an acid and 1 mole of hydroxide ions, $OH^-$ from an alkali <i>[Haba yang dibebaskan apabila 1 mol ion hydrogen meneutralkan 1 mol ion hidoksida .]</i>	
10	The temperature at which a solid changes into liquid at a particular pressure <i>[Suhu dimana pepejal berubah menjadi cecair pada tekanan piawai]</i>	

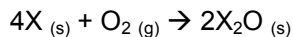
NO	DEFINITION	TERMINOLOGY
11	Chemical substance which ionise completely in water and produce high concentration of hydroxide ions. <i>[Bahan yang terurai lengkap menghasilkan kepekatan ion hidroksida yang tinggi dalam air.]</i>	
12	Chemical substance which ionise completely in water and produce high concentration of hydrogen ions. <i>[Bahan yang terurai lengkap menghasilkan kepekatan ion hidrogen yang tinggi dalam air.]</i>	
13	Chemical substance which ionises partially in water and produce hydroxide ions <i>[Bahan yang terurai separa untuk menghasilkan ion hidroksida dalam air]</i>	
14	Chemical substance which ionises partially in water and produce hydrogen ions <i>[Bahan yang terurai separa untuk menghasilkan ion hidrogen dalam air.]</i>	
15	The changes in quantity of reactants and reaction products with time <i>[Perubahan kuantiti bahan atau hasil terhadap masa]</i>	
16	An ionic compound formed from replacing hydrogen ions in an acid with metal or ammonium ions. <i>[Sebatian yang terhasil daripada menggantikan ion hydrogen dalam sesuatu asid oleh ion logam atau ion ammonium]</i>	
17	The minimum energy the colliding reactant particles must have before collision between them can result in chemical reaction. <i>[Tenaga minimum yang diperlukan bagi bahan tindak balas untuk bertindak balas.]</i>	
18	The hydrolysis of an ester when the catalyst is an alkali. <i>[Proses membuat sabun daripada hidrolisis ester]</i>	
19	Reaction that involves in transferring electron or involves in changing oxidation number <i>[Tindak balas yang melibatkan pemindahan elektron atau tindak balas yang melibatkan perubahan nombor pengoksidaan.]</i>	
20	Organic compound that contain only carbon and hydrogen and contain double or triple bonds between carbon atoms. <i>[Sebatian yang mengandungi karbon dan hidrogen sahaja dan terdapat ikatan ganda dua antara atom karbon]</i>	

NO	DEFINITION	TERMINOLOGY
21	A reaction that involves the exchange of ions to produce insoluble salts. <i>[Tindak balas yang melibatkan pertukaran ion untuk menghasilkan garam yang tidak larut.]</i>	
22	Natural rubber becomes more elastic and stronger after treat it with sulphur <i>[Proses menukarkan getah kepada bahan yang kuat dengan menambahkan sulfur.]</i>	
23	The energy change when 1 mole of metal is displaced from salt solution by a more electropositive metal <i>[Haba yang dibebaskan apabila 1 mol logam disesarkan garamnya oleh logam yang lebih elektropositif]</i>	
24	A process of combining monomers to form a long chain of molecules <i>[Proses penggabungan beberapa monomer menjadi molekul besa]</i>	
25	Long chains of molecules from combination of two or more small molecules known as monomers <i>[Molekul berantai panjang yang terbentuk daripada penggabungan dua atau lebih molekul kecil dipanggil monomer]</i>	



### ACTIVITY 3: MOLE CONCEPT

1. 2.3g of element X reacted completely with oxygen. The following equation represent the reaction.



[Relative atomic mass: X=23, O=16]

- (i) Calculate the number of moles of element X. [1 mark]  
 (ii) Calculate the maximum mass of X<sub>2</sub>O formed. [3 marks]

**[Answer: (i) 0.1 mol, (ii) 3.1g]**



7.282 g of lead nitrate was heated strongly to produce products as above at s.t.p. Calculate:

- (i) Mass of lead (II) oxide  
 (ii) Volume of nitrogen dioxide released  
 (iii) Volume of oxygen produced in the experiment.

[Relative atomic mass: Pb, 207; N, 14; O, 16; Molar Volume is 22.4 dm<sup>3</sup> at standard temperature and pressure]

**[ answer: (i) 4.906 g , (ii) 0.9856 dm<sup>3</sup> ,(iii) 0.2464 dm<sup>3</sup> ]**

## ACTIVITY 4 : ANSWER TECHNIQUE

### QUESTION 1

When  $10 \text{ cm}^3$ ,  $0.5 \text{ mol dm}^{-3}$  sodium sulphate is added to excess lead(II) nitrate solution, a white precipitate is formed

[Apabila  $10 \text{ cm}^3$   $0.5 \text{ mol dm}^{-3}$  Natrium sulfat ditambah kepada larutan Plumbum(II) nitrat secara berlebihan, mendakan putih terbentuk]

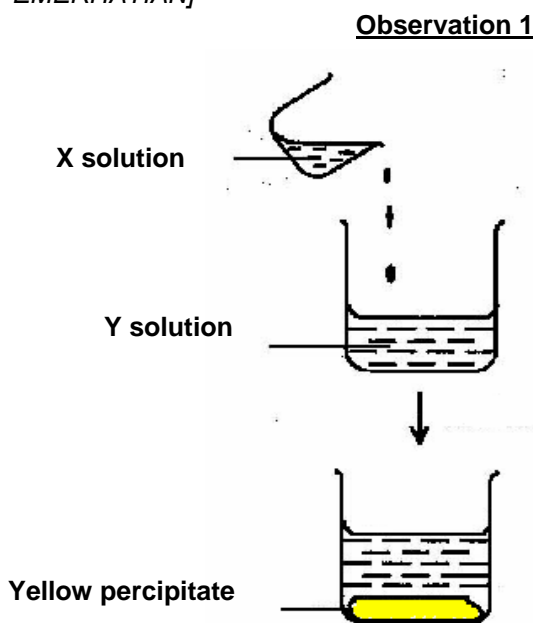
[Given that the relative atomic mass of Pb,207;O,16;S,32]

- Write the chemical equation for the reaction. [3 marks]  
[Tulis persamaan kimia bagi tindakbalas yang berlaku]
- Describe the chemical equation in (i). [1 mark]  
[Perihalkan persamaan kimia di(i).]
- Name the white precipitate.[1 mark]  
[Namakan mendakan putih yang terbentuk]
- Calculate the number of mole of sodium sulphate in the solution.[1 mark]  
[hitung bilangan mol bagi larutan Natrium sulfat ]
- Calculate the mass of precipitate formed.[3 marks]  
[Hitung jisim mendakan putih yang terbentuk]

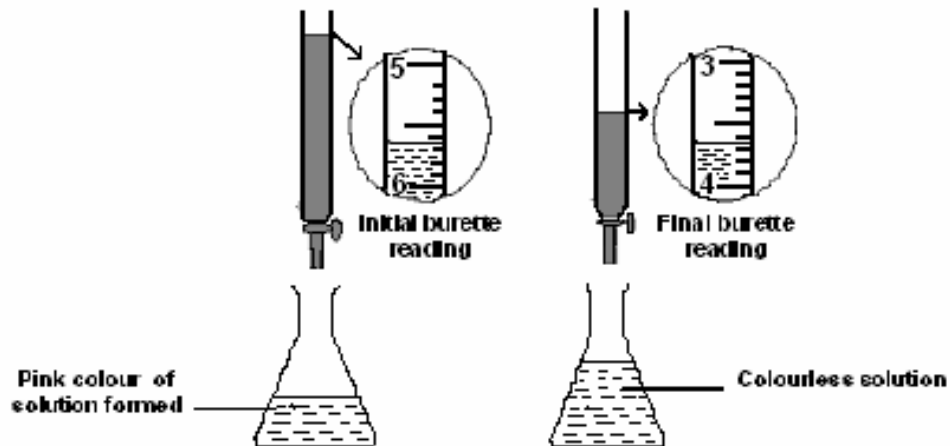
### QUESTION 2

CONCEPT OF OBSERVATION

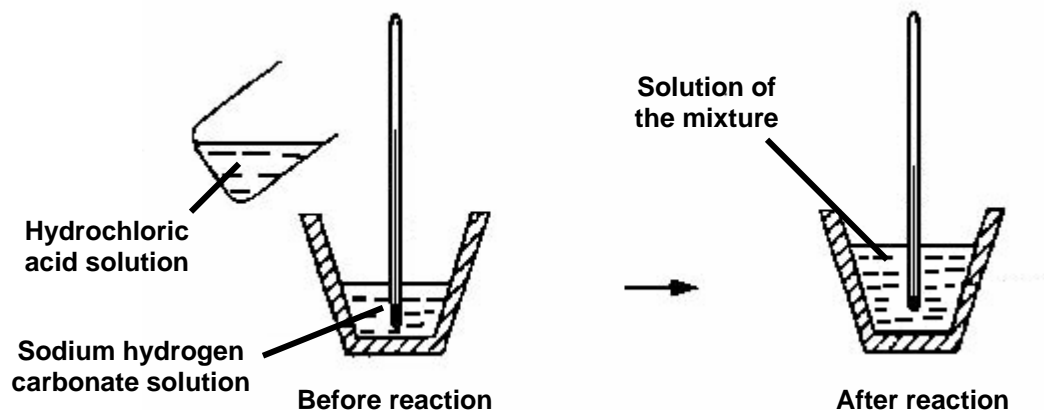
[KONSEP PEMERHATIAN]



Observation 2



Observation 3





### QUESTION 3

Table shows the positive and negative ions in three solutions  
 [Jadual menunjukkan ion positif dan ion negative bagi tiga jenis larutan]

Name of solution	Positive ion	Negative ion
Copper(II) sulphate	$\text{Cu}^{2+}$	$\text{SO}_4^{2-}$
Sodium chloride	$\text{Na}^+$	$\text{Cl}^-$
Lead(II) nitrate	$\text{Pb}^{2+}$	$\text{NO}_3^-$

- (a) Write the formula for copper(II) sulphate, sodium chloride and lead(II) nitrate.  
 [Tulis formula bagi kuprum(II) sulfat, Natrium klorida dan Plumbum(II) nitrat ]

### QUESTION 4

Balance each of the following equations:  
 [Seimbangkan persamaan berikut]

- i.  $\text{Mg} + \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
- ii.  $\text{O}^{2-} + \text{H}^+ \rightarrow \text{H}_2\text{O}$
- iii.  $\text{Na} + \text{H}^+ \rightarrow \text{Na}^+ + \text{H}_2$
- iv.  $\text{MnO}_4^- + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{H}_2\text{O}$
- v.  $\text{Fe}^{2+} + \text{MnO}_4^- + \text{H}^+ \rightarrow \text{Fe}^{3+} + \text{Mn}^{2+} + \text{H}_2\text{O}$
- vi.  $\text{Cr}_2\text{O}_7^{2-} + \text{H}^+ \rightarrow \text{Cr}^{3+} + \text{H}_2\text{O}$

**QUESTION 5**

Draw an energy profile diagram for the reaction between zinc with sulphuric acid. On the energy profile diagram show the:

*[Lukis satu gambarajah profil tenaga untuk tindakbalas antara zink dengan asid sulfuric . Pada gambar rajah profil tenaga itu tunjukkan]*

- Heat of reaction,  $\Delta H$   
*[Haba tindak balas,  $\Delta H$ ]*
- Activation energy without a catalyst,  $E_a$   
*[Tenaga pengaktifan tanpa mangkin,  $E_a$ ]*
- Activation energy with a catalyst,  $E'_a$   
*[Tenaga pengaktifan dengan mangkin,  $E'_a$ ]*

**QUESTION 6**

**CHEMICAL TESTS**  
**[UJIAN KIMIA]**

Type of gases	Method	Observation
Hydrogen		
Oxygen		
Chlorine		





**Question 7**

The table gives some information about some polymers and the monomers used to make them. Complete the table above.

*[Jadual menunjukkan beberapa maklumat tentang beberapa polimer dan monomer yang digunakan untuk membuatnya.*

*Lengkapkan rajah dibawah]*

Monomer	Polymer	Structure of monomer	Structure of polymer
Ethene	Polyethene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$	
Chloroethene / vinyl chloride			
Phenylethene / styrene			$\left[ \begin{array}{cc} \text{C}_6\text{H}_5 & \text{H} \\   &   \\ -\text{C} & -\text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_n$
	polypropene		

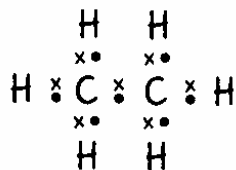
**QUESTION 8**

Sodium metal reacts with oxygen to form a metal oxide compound.  
 Draw the electrons arrangement of the metal oxide compound formed.  
 [Logam natrium bertindakbalas dengan oksigen membentuk satu oksida.  
 Lukiskan susunan electron bagi oksida logam yang terbentuk? ]

[ 2 marks ]

**QUESTION 9**

The diagram shows the arrangement of outer electrons in a molecules of ethane, C<sub>2</sub>H<sub>6</sub>.  
 [Rajah menunjukkan susunan elektron terluar bagi molekul ethana]



Draw similar diagrams to show the arrangement of outer electrons in:  
 [Lukis rajah yang sama bagi menunjukkan susunan bagi elektron terluar bagi:]

- i. Oxygen, O<sub>2</sub>
- ii. Nitrogen, N<sub>2</sub>
- iii. Ammonia, NH<sub>3</sub>
- iv. Tetrachlorometane, CCl<sub>4</sub>

## QUESTION 10

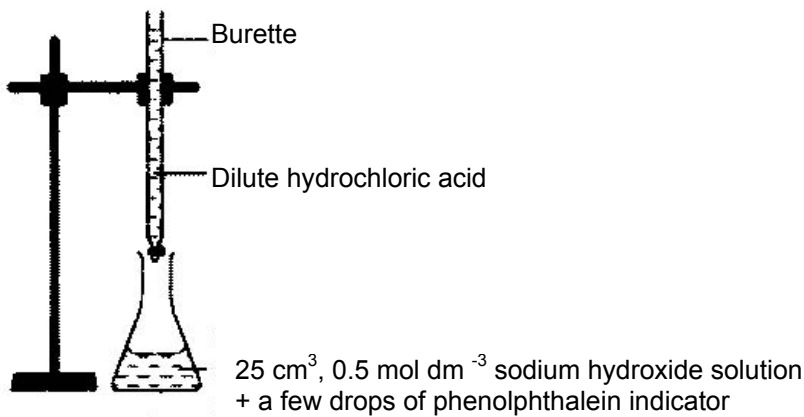


Diagram 2

Diagram 2 shows the apparatus setup to determine the concentration of hydrochloric acid.  
[Rajah 2 menunjukkan susunan radas yang digunakan untuk menentukan kepekatan asid hidroklorik cair.]

- (a) State the colour change occurred in the conical flask when the end point is reached.  
[Nyatakan perubahan warna larutan dalam kelalang kon sebaik sahaja takat akhir tercapai]

[ 1 mark ]

- (b) Name the analysis technique used and the type of reaction involved in this experiment.  
[Nyatakan kaedah analisis yang digunakan dan tindakbalas yang terlibat dalam eksperimen itu.]

[ 2 marks ]



- (c) The average volume of hydrochloric acid used in this experiment is  $12.50 \text{ cm}^3$ . Calculate the molarity of hydrochloric acid used.

*[Didapati purata isipadu asid hidroklorik cair yang digunakan dalam eksperimen itu ialah  $12.50 \text{ cm}^3$ . Hitung kemolaran asid hidroklorik yang digunakan]*

[ 3 marks ]

- (d) Distilled water is added to  $25 \text{ cm}^3$  sodium hydroxide solution  $0.5 \text{ mol dm}^{-3}$  until  $100 \text{ cm}^3$  solution is obtained.

Determine the new concentration of sodium hydroxide solution.

*[Air suling ditambahkan kepada  $25 \text{ cm}^3$  larutan natrium hidroksida  $0.5 \text{ mol dm}^{-3}$  sehingga memperolehi  $100 \text{ cm}^3$  larutan.*

*Berapakah kepekatan larutan baru yang dihasilkan.]*

[ 2 marks ]

- (e) You were given with copper(II) nitrate solution.

*[Anda dibekalkan dengan larutan kuprum(II) nitrat.]*

- (i) Describe briefly how you would test for the presence of nitrate ion in the solution.  
*[Huraikan dengan ringkas bagaimana anda mengesahkan kehadiran ion nitrat dalam larutan itu ? ]*

[ 3 marks ]

## QUESTION 11

Diagram 3 shows the apparatus set-up to study the electrolysis of copper(II) sulphate solution.  
 [Rajah 3 menunjukkan susunan radas bagi mengkaji elektrolisis larutan kuprum(II) sulfat.]

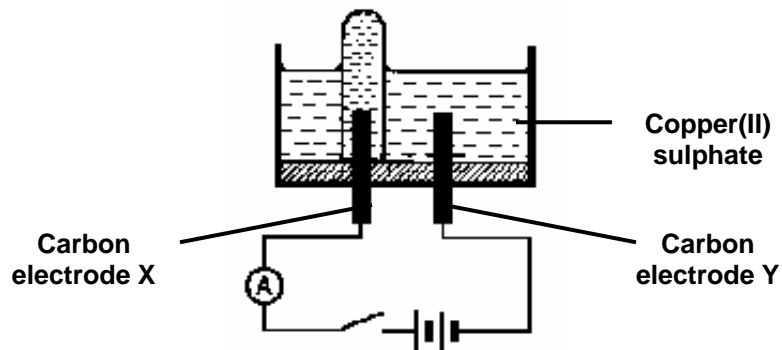


Diagram 3

- (a) What is meant by anion?  
 [Apakah yang dimaksudkan dengan anion ?]
- [1 mark]
- (b) Identify the cathode and anode on the diagram above by writing the word 'cathode' and 'anode' in the diagram  
 [Kenalpasti katod dan anod pada rajah diatas dengan menulis perkataan 'katod' dan 'anod' pada rajah. ]
- [1 mark]
- (c) State the energy changes that occur in the process.  
 [Nyatakan perubahan tenaga yang berlaku dalam proses berkenaan].
- [1 mark]
- (d) (i) Write the formulae of ions present in the copper(II) sulphate solution.  
 [Tuliskan formula bagi ion-ion yang hadir dalam larutan kuprum(II) sulfat.]
- [1 mark]
- (ii) State the ions in (d)(i) which move towards the carbon electrodes X and Y.  
 [Nyatakan ion-ion di(d)(i) yang bergerak ke elektrod karbon X dan Y.]
- [1 mark]



- (e) What observations can be made at  
 [Apakah pemerhatian yang boleh dibuat pada]
- (i) X:
- (ii) Y:

[2 marks]

**QUESTION 12**

Test	Observation
Sodium hydroxide solution is slowly added until excess. [Larutan natrium hidroksida dicampurkan perlahan-lahan sehingga berlebihan]	White precipitate formed. The white precipitate dissolves in excess sodium hydroxide solution. [Mendakan putih terbentuk. Mendakan putih larut dalam larutan natrium hidroksida berlebihan]
A few drops of sulphuric acid is added [sedikit asid sulfuric cair dicampurkan]	White precipitate formed. [mendakan putih terbentuk]

The table above shows the observations made for a test conducted on a colorless solution. Among the ions below, which ion will probably exist in the solution?  
 [Jadual diatas menunjukkan keputusan bagi ujian yang dijalankan ke atas satu larutan akueus yang tidak berwarna. Antara ion berikut, yang manakah mungkin hadir dalam larutan itu?]

- A  $Al^{3+}$                       B  $Mg^{2+}$                       C  $Pb^{2+}$                       D  $Zn^{2+}$

**QUESTION 13**

The following are three examples of sulphate salts.  
 [Berikut adalah tiga contoh garam sulfat.]

- Potassium sulphate,  $K_2SO_4$   
 [Kalium sulfat,  $K_2SO_4$ ]
- Lead(II) sulphate,  $PbSO_4$   
 [Plumbum(II) sulfat,  $PbSO_4$ ]
- Zinc sulphate,  $ZnSO_4$   
 [Zink sulfat,  $ZnSO_4$ ]
- Barium sulphate,  $BaSO_4$   
 [Barium sulfat,  $BaSO_4$ ]

From these examples, identify the soluble and insoluble salts.  
 [Daripada contoh ini, kenal pasti garam terlarutkan dan garam tak terlarutkan.]

## QUESTION 14

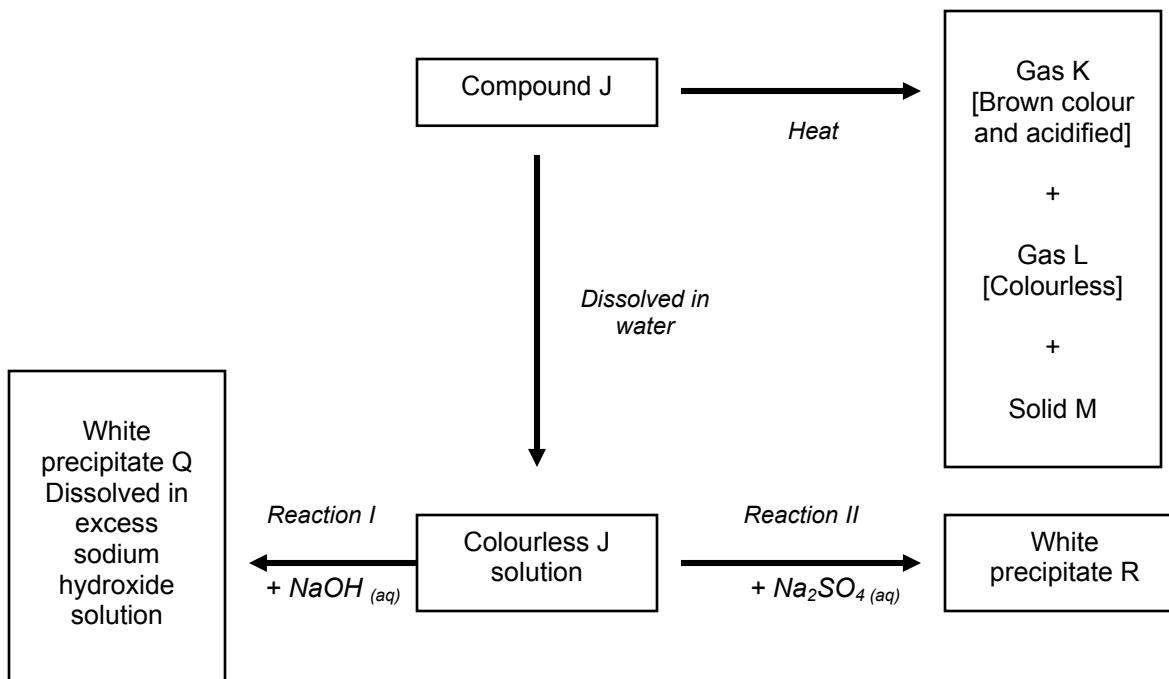


Diagram 4

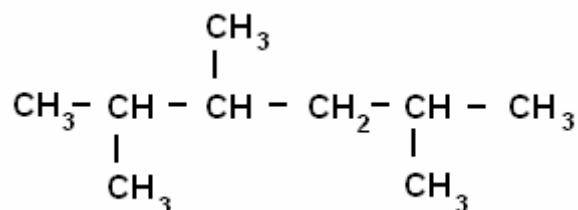
Diagram 4 shows a series of process done by a student to identify a compound J.

[Rajah 4 menunjukkan beberapa siri tindakbalas yang telah dilakukan oleh seorang pelajar untuk mengenali sebatian J ]

- (a) With refer to reaction I, white precipitate Q is formed which is soluble in excess sodium hydroxide solution. Name all the ions which are probably presence in solution J.  
 [Berdasarkan tindakbalas I, larutan J menghasilkan mendakan putih Q yang larut dalam larutan natrium hidroksida berlebihan. Namakan semua kation yang dijangka hadir dalam larutan J tersebut. ]
- (b) Referring to reaction I and II, name the cation presence in solution J.  
 [Berdasarkan tindakbalas I dan II, namakan kation yang hadir dalam larutan J itu.]
- (c) Write down the ionic equation for the reaction forming the white precipitate, R.  
 [Tuliskan persamaan ion bagi tindakbalas pembentuk mendakan putih R.]

- (d) (i) Name two cations which produced white precipitate that will not dissolve in excess sodium hydroxide solution.  
 [Namakan dua kation yang menghasilkan mendakan putih yang tidak larut apabila ditambahkan dengan larutan natrium hidroksida berlebihan]
- (ii) State one confirmatory test for one cations presence in (d)(i).  
 [Nyatakan satu ujian kimia untuk mengesahkan kehadiran satu kation dalam d(ii).]

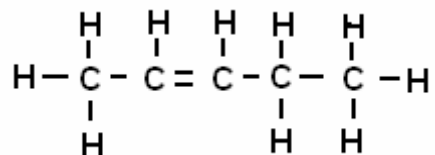
**QUESTION 15**



What is the IUPAC name for this alkane ?  
 [Apakah nama IUPAC alkana itu?]

[ 1 mark ]

**QUESTION 16**



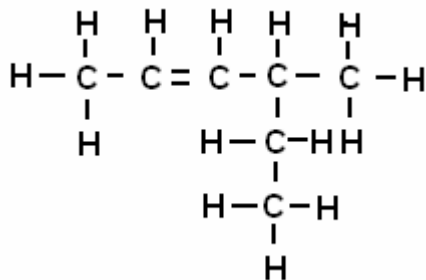
i. Name the homologous series for the hydrocarbon given above.  
 [Namakan siri homolog bagi hidrokarbon diatas]

ii. Give the IUPAC name for the above compound.  
 [Apakah nama IUPAC bagi alkana itu ? ]

[ 2 marks ]



## QUESTION 17



- Name the homologous series for the hydrocarbon given above.  
[*Namakan siri homolog bagi hidrokarbon diatas*]
- Give the IUPAC name for the above compound.  
[*Apakah nama IUPAC bagi alkena itu*] [ 2 marks ]

## QUESTION 18

A student carried out an experiment to determine the value of heat of displacement. Figure 3 shows the apparatus used in the experiment.

[*Seorang pelajar telah menjalankan satu eksperimen untuk menentukan nilai haba penyesaran. Rajah 3 menunjukkan susunan radas yang digunakan dalam eksperimen itu*]

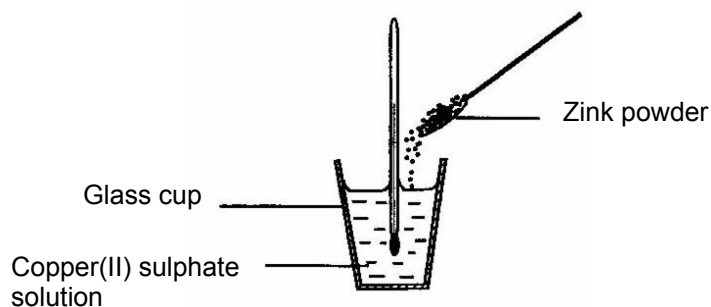


Figure 3

The following data obtained:  
[*Data berikut telah diperolehi*]

Initial temperature of copper(II) sulphate,  $\theta_1 = 28^\circ\text{C}$

[*Suhu awal kuprum(II) sulfat*]

Highest temperature of the mixture of product,  $\theta_2 = 48^\circ\text{C}$

[*Suhu tertinggi campuran hasil tindak balas*]

In this experiment, excess zinc is added to  $100 \text{ cm}^3$  of  $0.5 \text{ mol dm}^{-3}$  copper(II) sulphate.  
 Given that the specific heat of capacity of the solution is  $4.2 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$  and the density of the solution is  $1.0 \text{ g cm}^{-3}$ .

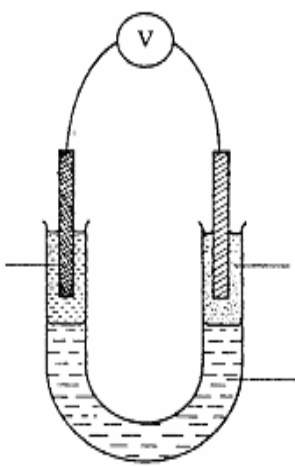
Draw the energy level diagram for the reaction.

*[Dalam eksperimen ini zink berlebihan ditambahkan kepada  $100 \text{ cm}^3$  larutan kuprum(II) sulfat  $0.5 \text{ mol dm}^{-3}$ . Diberi muatan haba tentu larutan ialah  $4.2 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$  dan ketumpatan bandingan ialah  $1.0 \text{ g cm}^{-3}$ .*

*Lukis gambar rajah aras tenaga bagi tindak balas itu]*

[ 2 marks ]

**QUESTION 19**



Potassium iodide solution, KI  
 $2\text{I}^- \rightarrow \text{I}_2 + 2\text{e}^-$

**Observation:**  
 Colourless  $\rightarrow$  yellow

Acidified potassium manganate(VII),  $\text{KMnO}_4$   
 $\text{MnO}_4^- + 5\text{e} + 8\text{H}^+ \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$

Dilute sulfuric acid

**Observation:**  
 purple  $\rightarrow$  colourless

**Ionic Equation:**

**Oxidizing agent** :  
 [Agen pengoksidaan]

**Reducing agent** :  
 [Agen penurunan]

NOTE:

OXIDIZING AGENTS	OBSERVATION	REDUCING AGENTS	OBSERVATION
$\text{KmnO}_4$	$\text{MnO}_4^- \rightarrow \text{Mn}^{2+}$ Purple $\rightarrow$ colourless	$\text{Cl}^-$	$\text{Cl}^- \rightarrow \text{Cl}_2$ Colourless $\rightarrow$ pale yellow
$\text{K}_2\text{Cr}_2\text{O}_7$	$\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$ Orange $\rightarrow$ green	$\text{Br}^-$	$\text{Br}^- \rightarrow \text{Br}_2$ Colourless $\rightarrow$ orange
$\text{Cl}_2$	$\text{Cl}_2 \rightarrow \text{Cl}^-$ Pale yellow $\rightarrow$ colourless	$\text{I}^-$	$\text{I}^- \rightarrow \text{I}_2$ Colourless $\rightarrow$ yellow
$\text{Br}_2$	$\text{Br}_2 \rightarrow \text{Br}^-$ Orange $\rightarrow$ colourless		
$\text{Fe}^{3+}$	$\text{Fe}^{3+} \rightarrow \text{Fe}^{2+}$ Yellow $\rightarrow$ pale green		

## ESSAY SECTION

## QUESTION 1

Elements	Electron arrangement
W	2.6
X	2.8.2
Y	2.8.7

The above table shows the electrons arrangement for the elements W, X and Y. Based on the electrons arrangement, explain how the bonds are formed between [Jadual diatas menunjukkan susunan electron bagi unsure W, X dan Y. Terangkan dari segi susunan elektron bagaimana ikatan kimia terbentuk antara: ]

- i. W and Y, and [ 5 marks ]
- ii. X and Y [ 7 marks ]

**QUESTION 2**

Table 1 shows the observations from some test carried out on salt Y.

[Jadual 1 menunjukkan pemerhatian ke atas ujian yang dijalankan ke atas garam Y.]

Test Ujian	Observation Pemerhatian
I: Heating of solid salt Y and test with moist blue litmus paper <i>Pemanasan pepejal garam Y dan diuji dengan kertas litmus biru lembap</i>	A metal oxide is formed and acidified brown gas released. <i>Suatu oksida logam terbentuk dan gas berwarna perang dan berasid dibebaskan.</i>
II: Salt Y solution is mixed with excess sodium hydroxide solution <i>Larutan garam Y dicampurkan dengan larutan natrium hidroksida berlebihan</i>	A white precipitate which is insoluble in excess sodium hydroxide is formed <i>Mendakan putih yang tidak larut dalam natrium hidroksida berlebihan terbentuk.</i>

**Table 1**  
**Jadual 1**

- i. Identify an anion that is present in Test I and describe a chemical test to verify the anion .  
*[Kenal pasti satu anion yang hadir dalam Ujian I and huraikan satu ujian kimia untuk menentusahkan anion itu. ]*  
[4 marks]
  
- ii. Identify cation that are present in Test II and describe a chemical test to verify the cations.  
*[Kenal pasti kation yang hadir dalam Ujian II and huraikan satu ujian kimia untuk menentusahkan kation itu.]*  
[4 marks]

**QUESTION 3**

Elaborate an experiment to determine the heat of combustion of ethanol. In your elaboration, include a labeled figure and an explanation on how you would determine the heat of combustion.  
*[Huraikan satu eksperimen untuk menentukan haba pembakaran bagi etanol. Dalam huraian anda sertakan gambar rajah berlabel dan terangkan cara penentuan nilai haba pembakaran itu.]*

[12 marks]

**QUESTION 4**

Alkanes, alkenes, alcohols and carboxylic acids are four different homologous series. Construct a table to show the general formula, the functional group and the name of a member in each of the series that has less than four carbon atoms.

*[Alkana, alkane, alcohol dan asid karboksilik adalah merupakan empat siri homolog yang berbeza.*

*Bina satu jadual untuk menunjukkan formula am, kumpulan berfungsi dan nama bagi ahli dalam siri berkenaan dimana bilangan atom carbonnya kurang daripada tiga.]*

[13 marks]

**ANSWERS FOR MODULE JUJ 2008****Activity 1 :Answers with in correct terms, words or incorrect key words.**

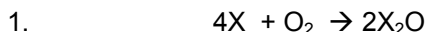
1. Brown precipitate
2. Atom that achieved octet/duplet electron arrangement.
3. Melting point is the temperature where solid changes to liquid.
4. Colourless solution
5. The rate of reaction for Experiment II is higher/lower than Experiment I
6. Nucleus contains 1 proton and 1 neutron
7. sodium atom donates one electron
8. Magnesium is more reactive than zinc
9. Electrochemical series
10. In the electrochemical series, magnesium is more electropositive than zinc.
11. In the reactivity series, magnesium is more reactive than zinc.

**Activity 2:**

1. Hydrocarbon
2. Isomers
3. Empirical formula
4. Electrolysis
5. Oxidizing agent
6. Reducing agent
7. Exothermic reactions
8. Endothermic reactions
9. Heat of neutralization
10. Melting point
11. Strong alkali
12. Strong acid
13. Weak alkali
14. Weak acid
15. The rate of reaction
16. Salts
17. Activation energy
18. Saponification
19. Redoxs
20. Unsaturated hydrocarbon
21. Double dissociation reactions/precipitate reactions
22. Vulcanization
23. The heat of displacement
24. Polymerisation
25. Polymers



### Activity 3: Mole Concept

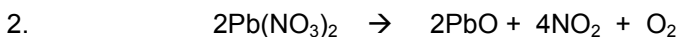


(i) Calculate the number of moles of element X.

$$\begin{aligned} \text{Mass for 1 mol of X} &= 23\text{g} \\ \text{mol for 2.3g X} &= 2.3 / 23 \\ &= 0.1 \text{ mol} \end{aligned}$$

(ii) Calculate the maximum mass of  $X_2O$  formed.

1. Ratio of mol:  $X:X_2O$  is 4:2
2. Mol of X = 0.1 mol  
Mol of  $X_2O$  = 0.05 mol
3. Mass of  $X_2O$  formed = 0.05 x RMM  $X_2O$   
= 0.05 x [2(23) + 16]  
= 3.1g



(i) Mass of lead (II) oxide

$$\begin{aligned} \text{Ratio of mol between } Pb(NO_3)_2 : PbO &\text{ is } \underline{2:1 @ 1:1} \\ \text{RMM for } Pb(NO_3)_2 &= 1Pb + 2[1N + 3O] \\ &= 1(207) + 2[1(14) + 3(16)] \\ &= 331 \\ \text{Mass for 1 mol } Pb(NO_3)_2 &= 331\text{g} \\ \text{Mol for 7.282g } Pb(NO_3)_2 &= 7.282 / 331 \\ &= \underline{0.022 \text{ mol}} \\ \text{Mass of PbO} &= 0.022 \times \text{RMM PbO} \\ &= 0.022 \times 223\text{g} = \underline{4.906\text{g}} \end{aligned}$$

(ii) Volume of nitrogen dioxide released

$$\begin{aligned} \text{Ratio of mol between } Pb(NO_3)_2 : NO_2 &\text{ is } \underline{2:4 @ 1:2} \\ \text{Mol of } NO_2 &= 0.022 \times 2 \\ &= 0.044 \text{ mol} \\ \text{Volume of nitrogen dioxide released} &= 0.044 \times 22.4 \text{ dm}^3 \\ &= 0.9856 \text{ dm}^3 \end{aligned}$$

(iii) Volume of oxygen produced in the experiment.

$$\begin{aligned} \text{Ratio of mol between } Pb(NO_3)_2 : O_2 &\text{ is } \underline{2:1 @ 1:0.5} \\ \text{Mol of } O_2 &= 0.022 \times 0.5 \\ &= 0.011 \text{ mol} \\ \text{Volume of oxygen produced in the experiment} &= 0.011 \times 22.4 \text{ dm}^3 \\ &= 0.2464 \text{ dm}^3 \end{aligned}$$



### Activity 4: Answer technique

#### Question 1

- i.  $\text{Na}_2\text{SO}_4 + \text{Pb}(\text{NO}_3)_2 \rightarrow \text{PbSO}_4 + 2\text{NaNO}_3$   
[ correct formula for reactant – 1m , correct formula for product – 1m ,balanced – 1m ]
- ii. 1 mole of sodium sulphate reacts with 1 mole of lead(II) nitrate to produce 1 mol of lead(II) sulphate and 2 mole of sodium nitrate. – 1m
- iii. lead(II) sulphate – 1m
- iv.  $\text{mol} = \frac{MV}{1000}$  ,  $\text{mol} = \frac{0.5(10)}{1000} = 0.005 \text{ mol}$
- v.  $1 \text{ mol Na}_2\text{SO}_4 \rightarrow 1 \text{ mol PbSO}_4$  - 1m  
 $0.005 \text{ mol Na}_2\text{SO}_4 \rightarrow 0.005 \text{ mol PbSO}_4$  .1m  
 $\text{mass of PbSO}_4 = 0.005 [ 207 + 32 + 4(16)]$   
 $= 1.515\text{g}$  -1m

#### Question 2

Observation 1:

- i. Yellow precipitate formed
- ii. Final volume of the solution increases

Observation 2.

- i. The initial burette reading is  $5.65 \text{ cm}^3$
- ii. The final burette reading is  $3.65 \text{ cm}^3$
- iii. Pink colour of the solution change to colourless
- iv. Final volume of the solution increases

Observation 3:

- i. Final temperature is lower than initial temperature
- ii. Bubbles released
- iii. The final volume of the solution increases

#### Question3

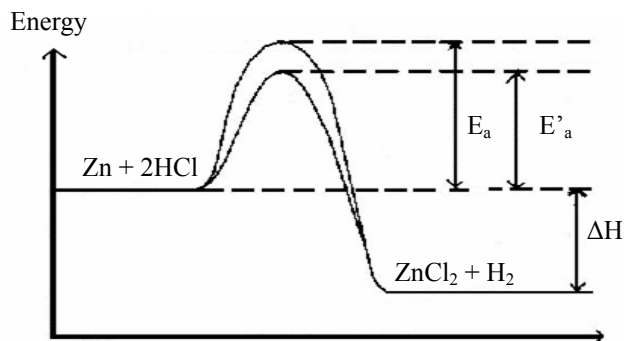
- (a)
- |                       |  |
|-----------------------|--|
| copper(II) sulphate : | $\text{Cu}^{2+} + \text{SO}_4^{2-} \rightarrow \text{CuSO}_4$          |
| sodium chloride :     | $\text{Na}^+ + \text{Cl}^- \rightarrow \text{NaCl}$                    |
| lead(II) nitrate :    | $\text{Pb}^{2+} + 2\text{NO}_3^- \rightarrow \text{Pb}(\text{NO}_3)_2$ |



**Question 4**

- i.  $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
- ii.  $\text{O}^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{O}$
- iii.  $2\text{Na} + 2\text{H}^+ \rightarrow 2\text{Na}^+ + \text{H}_2$
- iv.  $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$
- vi.  $5\text{Fe}^{2+} + \text{MnO}_4^- + 8\text{H}^+ \rightarrow 5\text{Fe}^{3+} + \text{Mn}^{2+} + 4\text{H}_2\text{O}$
- v.  $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 9\text{e}^- \rightarrow \text{Cr}^{3+} + 7\text{H}_2\text{O}$

**Question 5**



**Question 6**

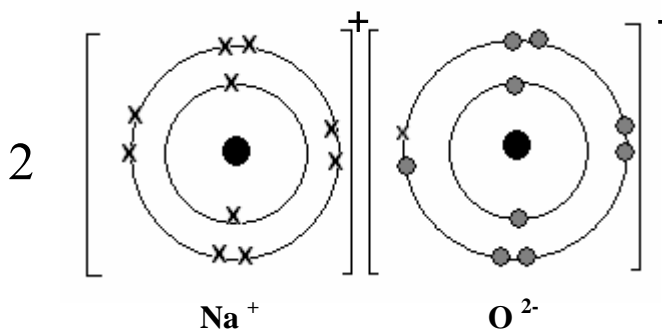
Type of gases	Method	Observation
Hydrogen	Put in lighted wooden splinter into the test tube	'POP' sound hear/heard
Oxygen	Put in glowing wooden splinter into the test tube	Glowing wooden splinter lights up / rekindles
Chlorine	Put in moist blue litmus paper into the test tube	Moist blue litmus paper turns red and then bleaches



Question 7

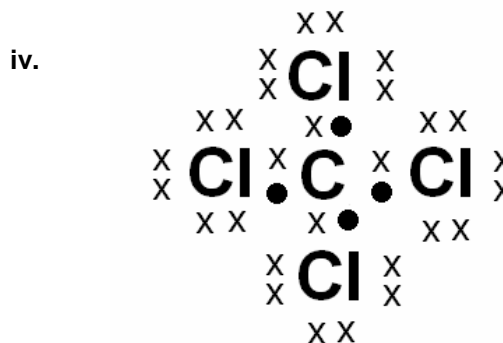
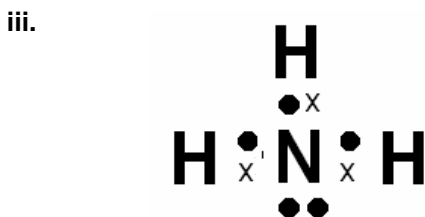
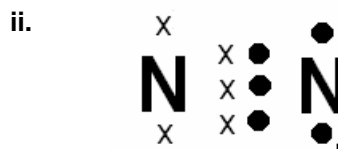
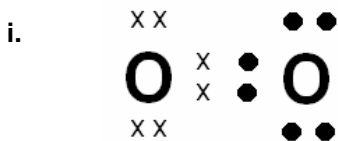
Monomer	Polymer	Structure of monomer	Structure of polymer
Ethene	polyethene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{H} \end{array}$	$\left[ \begin{array}{cc} \text{H} & \text{H} \\   &   \\ -\text{C} & - & \text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_n$
Chloroethene	Polyvinyl chloride/ PVC/Polychloroethene	$\begin{array}{c} \text{H} & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{Cl} \end{array}$	$\left[ \begin{array}{cc} \text{H} & \text{H} \\   &   \\ -\text{C} & - & \text{C}- \\   &   \\ \text{H} & \text{Cl} \end{array} \right]_n$
Styrene	Polystyrene/ Polyphenyethene	$\begin{array}{c} \text{C}_6\text{H}_5 & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{Cl} \end{array}$	$\left[ \begin{array}{cc} \text{C}_6\text{H}_5 & \text{H} \\   &   \\ -\text{C} & - & \text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_n$
Propene	polypropene	$\begin{array}{c} \text{CH}_3 & & \text{H} \\ & \diagdown & / \\ & \text{C} = \text{C} \\ & / & \diagdown \\ \text{H} & & \text{Cl} \end{array}$	$\left[ \begin{array}{cc} \text{CH}_3 & \text{H} \\   &   \\ -\text{C} & - & \text{C}- \\   &   \\ \text{H} & \text{H} \end{array} \right]_n$

Question 9





Question 10



Question 11

- (a) pink colour → colourless
- (b) Titration – 1m  
neutralization reaction – 1m
- (c)  $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

$$\text{mol NaOH} = \frac{0.5(25)}{1000} = 0.0125 \text{ mol} \quad - 1\text{m}$$

$$1 \text{ mol NaOH} \rightarrow 1 \text{ mol HCl} \quad - 1\text{m}$$

$$\text{Molarity of HCl} = \frac{0.0125}{12.5/1000} = 1.0 \text{ mol dm}^{-3} \quad - 1\text{m}$$

- (d)  $M_a V_a = M_b V_b$   
 $(0.5)(25) = M_b(100) - 1\text{m}$   
 $M_b = 1 \text{ mol dm}^{-3} \quad - 1\text{m}$

- (e) 1. Add dilute sulphuric acid and ferum(II) sulphate solution. - 1m
- 2. Drops slowly concentrated sulphuric acid. - 1m
- 3. Brown ring formed - 1m

**Question 12**

- (a) the negative ion / ion with negative charge
- (b) Electrode X : anode  
Electrode Y : cathode
- (c) Electrical energy  $\rightarrow$  chemical energy
- (d) (i)  $\text{Cu}^{2+}$  ,  $\text{SO}_4^{2-}$  ,  $\text{H}^+$  ,  $\text{OH}^-$   
(ii) X :  $\text{SO}_4^{2-}$  ,  $\text{OH}^-$   
Y:  $\text{Cu}^{2+}$  ,  $\text{H}^+$
- (e) (i) X: brown deposited  
Y: gas bubble up/ colourless gas produced

**Question 13:**C.  $\text{Pb}^{2+}$ **Question 14:**

Soluble salt	Insoluble salt
Potassium sulphate, $\text{K}_2\text{SO}_4$ , Zinc sulphate, $\text{ZnSO}_4$	Lead(II) sulphate, $\text{PbSO}_4$ , Barium sulphate, $\text{BaSO}_4$

**Question 15**

- (a) lead(II) ion, zinc ion, Aluminium ion
- (b) lead(II) ion
- (c)  $\text{Pb}^{2+} + \text{SO}_4^{2-} \rightarrow \text{PbSO}_4$
- (d) (i) Magnesium ion and Calcium ion  
(ii) - Add excess ammonia solution  
- white precipitate formed  
- magnesium ion present  
- no white precipitate/colorless  
- calcium ion present

**Question 16**

2,3,4 – trimethylhexane

**Question 17**

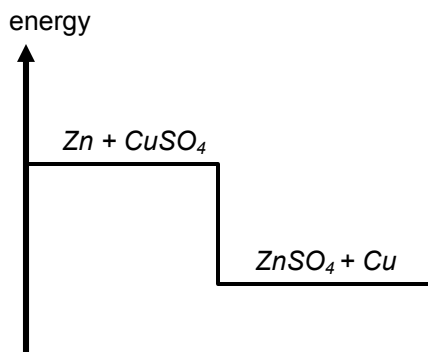
- i. alkene  
ii. pent – 2 – ene

**Question 18**

- i. alkene  
ii. 4 -methylhex-2-ene



**Question 19**



**Question 20**

Ionic equation:  $10I^- + 2MnO_4^- + 16H^+ \rightarrow 5I_2 + 2Mn^{2+} + 8H_2O$   
 Oxidizing agent:  $KMnO_4$  / acidified potassium manganate(VII)  
 Reducing agent: KI / Potassium iodide

**Essay Section**

**Question 1**

W and Y

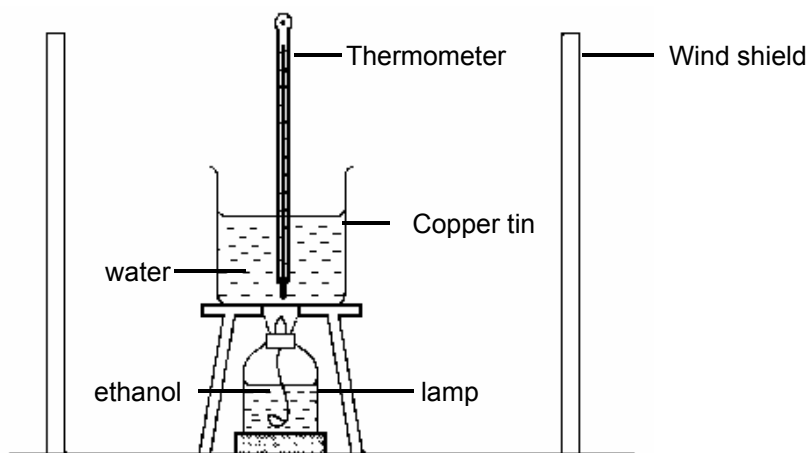
1. Electron arrangement for atom W is 2.8.1.
2. Atom W donate/loss/transfer one electron to achieved octet electron arrangement to forming a positive ion  $W^+$ .
3. Electron arrangement for atom Y is 2.8.7.  
Atom Y receive/accept one electron to achieved octet electron arrangement to forming a negative ion  $Y^-$ .
4. Both ions are attracted to each other due to the existence of a strong electrostatic between the oppositely-charged ion.
5. Ionic compound WY formed.
6. [Draw the electron arrangement for the compound formed]

X and Y

1. Electron arrangement for atom X is 2.8.2.
2. Atom W donate/loss/transfer two electrons to achieved octet electron arrangement to forming a positive ion  $X^{2+}$ .
3. Electron arrangement for atom Y is 2.8.7.
4. Each of atom Y receive/accept one electron to achieved octet electron arrangement to forming a negative ion  $Y^-$ .
5. Both ions are attracted to each other due to the existence of a strong electrostatic between the oppositely-charged ion.
6. Ionic compound  $XY_2$  formed.
7. [Draw the electron arrangement for the compound formed]

**Question 2**

- i.
  - Ion present is nitrate ion,  $\text{NO}_3^-$
  - salt Y is dissolved in water
  - dilute sulphuric acid and iron(II) sulphate solution is added.
  - Concentrated sulphuric acid are added slowly.
  - a brown ring formed
- ii.
  - Aluminium/ $\text{Al}^{3+}$ , lead(II) /  $\text{Pb}^{2+}$ , Magnesium ion,  $\text{Mg}^{2+}$  present
  - potassium iodide/KI solution is added to solution X
  - yellow precipitate is formed
  - shows the presence of lead(II)/ $\text{Pb}^{2+}$  ion
  - no precipitate is formed
  - indicates the presence of aluminium(III) ion/  $\text{Al}^{3+}$  / magnesium ion/ $\text{Mg}^{2+}$

**Question 3****Material**

Ethanol, water

**Apparatus**

Copper tin, thermometer, lamp/spirit lamp, measuring cylinder, balance

**Procedure/Method**

1. 100 cm<sup>3</sup> of water is poured into the copper tin.
2. The initial temperature of water is recorded.
3. A lamp is filled with ethanol and weighed is recorded.
4. Placed a lamp under a copper tin and the lamp is lit
5. Stir the water in the copper tin is heated until its temperature increases by 30 °C .
6. The flame of the lamp is put off and a maximum temperature is recorded.
7. The lamp is weighed again, and the mass is recorded.



Results:

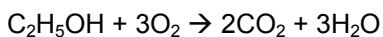
Initial mass of lamp + ethanol	=	xg
Final mass of lamp + ethanol	=	yg
Mass of ethanol that is burned	=	(x-y)g
Initial water temperature	=	$\theta_1$ °C
Final water temperature	=	$\theta_2$ °C
Rise of temperature	=	( $\theta_1 - \theta_2$ )
	=	$\theta_3$ °C
Volume of water	=	100 cm <sup>3</sup>

Calculation:

$$\begin{aligned} \text{Heat change} &= mc\theta \\ &= 100 \times 4.2 \times \theta_3 \end{aligned}$$

$$\text{Number of moles} = \frac{\text{mass}}{\text{rms}}$$

$$\text{Number of moles of ethanol} = \frac{x-y}{46} = z \text{ mol}$$



2 mol of C<sub>2</sub>H<sub>5</sub>OH combusts to release a J of heat

$$\text{Therefore, 1 mol of C}_2\text{H}_5\text{OH combusts to release } \frac{a}{z} \text{ J} = b \text{ J} = \frac{b}{1000} \text{ kJ}$$

$$\text{The heat of combustion of ethanol, } \Delta H = - \frac{b}{1000} \text{ kJ mol}^{-1}$$

**Question 4**

A table that contains:

1. label of complete heading (homologous series, alkene, alcohol, carboxylic acid, general formula, functional group, member)
2. correct general formula
3. correct functional group
4. correct name of member

answer:

Homologous series	General formula	Functional group	Member
Alkane	$C_nH_{2n+2} - 1m$	Single bond / C-C - 1m	Methane/Ethane/Propene/Butane - 1m
Alkene	$C_nH_{2n} - 1m$	Double bond / C=C - 1m	Ethene/ propene/ butane/ pentene - 1m
Alcohol	$C_nH_{2n+1}OH - 1m$	Hydroxyl group/ OH / -OH - 1m	Ethanol/ Propanol/ Butanol/ Pentanol - 1m
Carboxylic acid	$C_nH_{2n+1}COOH - 1m$	Carboxyl group / COOH - 1m	Ethanoic/ propanoic/ butanoic/ pentanoic acid - 1m