Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2012
Secondary Three

CHEMISTRY **1 hour 45 minutes**

Paper 2 **0915 to 1100**

Thursday **11 October 2012**

Additional materials: Writing papers

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Section A (40 marks)
Answer **all** questions and write your answers in the spaces provided on the question paper.

Please note that if you do not write your answers in the spaces provided specially for that purpose, that section of the paper will be awarded ZERO marks.

Section B (30 marks)
Answer **all** questions including questions **6, 7** and **8 *Either*** or **8 *Or*.**
Write your answers on the separate writing paper provided. At the end of the examination,
1. fasten all your work securely together;
2. tick **8 *Either*** (for *Either*) or **8 *Or*** (for *Or*) in the grid below to indicate which question you have answered.

INFORMATION FOR CANDIDATES

The intended number of marks is given in the brackets [ ] at the end of each question or part question. You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

Use of Scientific Calculator is allowed.

A copy of the Periodic Table is found on page 12.

Examiner's Use	
Section A	
Section B	
6	
7	
8 *Either*	
8 *Or*	
Total	

Section A

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

A1 The electronic configurations of the atoms of two elements, **V** and **W,** are listed below.

V: 2. 5

W: 2. 8. 2

(a) Predict and explain which element, **V** or **W,** has a lower melting point. [3]

(b) Another element **R**, in the same period as **W**, forms a compound with oxygen with the formula $\mathbf{R_2O}$.

$\mathbf{R_2O}$ is a gas at room temperature.

(i) Predict whether $\mathbf{R_2O}$ will conduct electricity in molten state. [1]

(ii) Draw the 'dot and cross' diagram for the compound $\mathbf{R_2O}$. [2]

(c) A new element **U** was discovered and two of its properties were listed below.

1. It forms a compound with **V** with the formula $\mathbf{U_3V_2}$**.**
2. $\mathbf{U_3V_2}$ is a conductor of electricity in molten and aqueous state.

(i) Suggest a suitable Group in the Periodic table to place the new element **U**. [1]

[Total marks: 7]

(ii) State and explain whether element **U** is able to conduct electricity in the solid state. [2]

A2 In the preparation of magnesium nitrate, a reaction was carried out by adding excess magnesium hydroxide solid to ensure all acid is used up.

(a) Explain why magnesium hydroxide can be used in excess but not nitric acid. [2]

(b) The hydrated product obtained has the formula $\mathbf{Mg(NO_3)_2 \cdot 6H_2O}$.

(i) State the number of ions present in each unit of hydrated magnesium nitrate. [1]

(ii) State the type(s) of bond(s) present in a unit of anhydrous magnesium nitrate. [1]

[Total marks: 6]

A3 (a) Student **A** decided to prepare a pure sample of potassium nitrate in the laboratory. He added 4.80 g of solid potassium carbonate to 24.00 cm^3 of 1.67 mol/dm^3 dilute nitric acid. The solution obtained was then filtered and the final product was obtained by crystallization of the filtrate.

(i) Write a chemical equation with state symbols for this reaction [2]

(ii) Show with calculation, the limiting reagent for the reaction. [2]

(iii) The percentage yield of the above reaction was 170%.
Calculate the mass of product collected by the student. [1]

(iv) A significant amount of the excess reactant was present in the final product, thus resulting in a yield greater than 100%.
Explain why the excess reactant was not removed during the experiment. [1]

[Total marks: 6]

(b) Another student, **B,** wanted to prepare the same salt by titrating 30.00 cm^3 of 0.400 mol/dm^3 potassium hydroxide to 20.0 cm^3 of dilute nitric acid. The solution obtained was then filtered and the final product was obtained by crystallization of the filtrate.

(i) Write the ionic equation for this reaction. [1]

(ii) Calculate the concentration of the dilute nitric acid used. [2]

(c) State whether the method used by student **A** or **B** is more suitable for the preparation of a sample of pure dry potassium nitrate. [1]

[Total marks: 4]

A4 The strength of an acid is determined by the extent it dissociates in a given volume of water. The stronger an acid, a larger percentage of it will dissociate into ions when dissolved in water.

Properties of two acids **HA** and **H_2B** were investigated. Assume that only acidic hydrogens are shown in the formula.

(a) State the basicity of acid **H_2B**. [1]

(b) Both **HA** and **H_2B** were dissolved in the 1.00 dm^3 of water separately.

(i) When 3 moles of **HA** was dissolved, only 4 moles of ions were produced. Find the number of moles of **HA** that dissociated. [1]

(ii) When 4 moles of **H_2B** was dissolved, 6 moles of ions were produced. Find the number of moles of **H_2B** that dissociated. [1]

(iii) Hence, state which acid is a stronger acid. [1]

(c) When dry hydrogen chloride gas was passed through a solid zinc strip in an experiment, there was no visible change. A student thus made the following conclusion, "The solid is not zinc as all metals will react with acid."

Pick out and explain two errors present in the student's conclusion. [2]

[Total marks: 6]

A5 (a) Crude oil is a liquid mixture made up of different organic substances which needs to be separated. **Fig. 1** shows the fractional distillation of crude oil into fractions **A** to **D**.

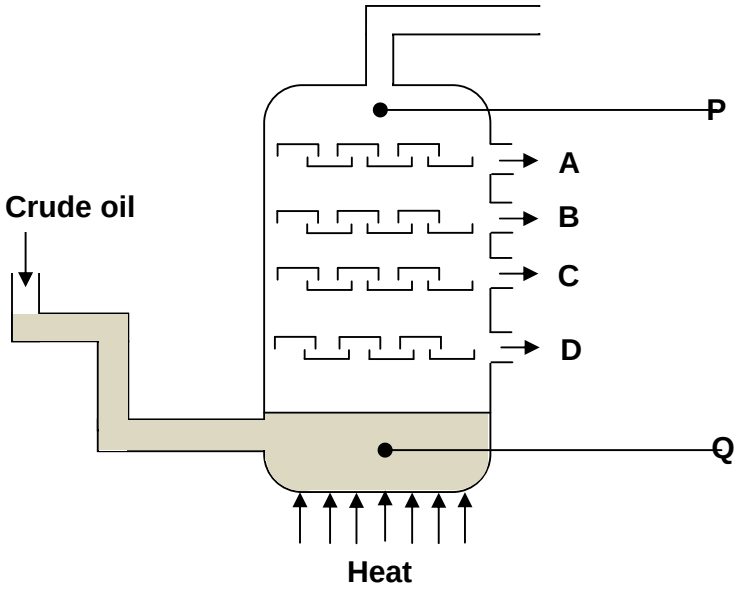

Fig. 1

(i) Arrange the different fractions in the order of decreasing boiling point. [1]

_____

(ii) Describe the differences in movement and arrangement of particles present at points **P** and **Q** in **Fig.1**. [2]

_____

_____

_____

[Total marks: 3]

(b) Some of the fractions obtained from **Fig.1** are used as fuels. One example is methane, CH_4, a gas which undergoes complete combustion in the presence of excess oxygen to produce energy. However, incomplete combustion of methane with oxygen often occurs to produce carbon monoxide and water vapor.

(i) Write a chemical equation with state symbols for the incomplete combustion of methane in oxygen. [2]

(ii) Using your equation in **(i)**, find the mass of methane that was burnt if 30 cm^3 of carbon monoxide was produced. Assume all gas volumes are measured at r.t.p. conditions. [2]

(iii) If the total volume of methane and oxygen that reacted was 50 cm^3, what is the number of water vapor molecules produced? [2]

(c) Methane belongs to a group of compounds called hydrocarbons. Hydrocarbons are compounds containing only carbon and hydrogen.

An unknown hydrocarbon was found to contain 85.7% carbon. Find its empirical formula. [2]

[Total marks: 8]

Section B

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

Question **B8** is in the form of either/or and only **one** of the alternatives should be attempted. Each question carries **ten** marks.

B6 You must use the substances listed in the table below for the identities of five unknowns, **A** to **E**.

Ammonia	Carbon dioxide	Hydrogen
Water vapour	Chlorine	Copper(II) oxide
Sodium oxide	Copper(II) carbonate	Calcium carbonate
Copper(II) sulfate	Copper(II) chloride	Iron(II) sulfate

The three reactions involving the unknown substances **A** to **E** are described below.

Reaction 1: Black solid **A** reacted with sulfuric acid solution to form a blue solution **B** only.

Reaction 2: Green solid **C** reacted with aqueous hydrochloric acid to produce a blue solution and a colourless and odourless gas **D**. Gas **D** formed white precipitate in calcium hydroxide solution.

Reaction 3: Ammonium chloride reacted with aqueous sodium hydroxide upon warming and produced a colourless and pungent gas **E**.

(a) State the name of gas **E**. [1]

(b) Describe the confirmatory test and observation to confirm the identity of gas **E**. [2]

(c) State the names of substances **A**, **B**, **C** and **D**. [4]

(d) Write the ionic equation for **Reaction 1**. [1]

(e) Name the substance formed when gas **D** is dissolved in water. [1]

(f) Amy added the substance formed in **Question B6(e)** to sodium hydroxide solution and she did not observe any colour change. Hence, she concluded that there was no reaction taking place. Explain clearly whether her conclusion is correct. [1]

B7 Sophia wants to make copper(II) nitrate from the reaction of copper(II) oxide and dilute nitric acid. She added 8.00 g of copper(II) oxide to an aqueous solution containing 0.500 moles of nitric acid. At the end of the experiment, Sophia obtained 9.45 g of copper(II) nitrate.

(a) Write the chemical equation with state symbols for the reaction of copper(II) oxide and nitric acid forming copper(II) nitrate and water. [2]

(b) Determine the limiting reagent in the reaction with supporting calculations. [2]

(c) Calculate the percentage yield of the copper(II) nitrate produced. [3]

(d) Sophia realized that the 8.00 g of copper(II) oxide she used was impure. Assuming the impurity of the copper(II) oxide was the only factor that affected the yield in **Question B7(c)**, state the percentage purity of 8.00 g of copper(II) oxide. Your answer must be supported by correct calculations or clear explanations. [1]

(e) In another experiment conducted by another student, Sally, the percentage yield of copper(II) nitrate is 80.0%. Calculate the mass of copper(II) oxide required if Sally wants to obtain 12.0 g of copper(II) nitrate at the end of the experiment. [2]

B8 ***EITHER*** **(a)** A solution contains 8.00 g/dm^3 of H**X**O_3. In a titration, 25.0 cm^3 of this acid reacted completely with 31.70 cm^3 of 0.100 mol/dm^3 aqueous sodium hydroxide

(i) Calculate the concentration of the acid in mol/dm^3. [3]

(ii) Calculate the relative molecular mass of the acid. [2]

(iii) Deduce the identity of the acid. [1]

(b) A solution contains 5.00 g/dm^3 of impure phosphoric acid (H_3PO_4). In a titration, 25.0 cm^3 of the acid reacted with 20.80 cm^3 of 0.120 mol/dm^3 sodium hydroxide. Calculate the percentage purity of the phosphoric acid. [4]

B8 ***OR*** **(a)** Hydrated iron(II) sulfate has the formula $FeSO_4.\boldsymbol{x}H_2O$. 30.0 g of the hydrated iron(II) sulfate was dissolved in distilled water and the volume made up to 1.00 dm^3 of aqueous solution. In a titration, 25.0 cm^3 of the solution reacted with 27.00 cm^3 of 0.0200 mol/dm^3 potassium manganate(VII). The equation for the reaction is:

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$$

(i) Calculate the number of moles of $KMnO_4$ that reacted. [1]

(ii) Calculate the number of moles of $FeSO_4$ in 25.0 cm^3 of the solution. [1]

(iii) Hence determine the number of moles of $FeSO_4$ in 1.00 dm^3 of the solution. [1]

(iv) Calculate the mass of anhydrous iron(II) sulfate in 1.00 dm^3 of solution. [1]

(v) Hence deduce the value of $\boldsymbol{x}$ in the formula $FeSO_4.\boldsymbol{x}H_2O$. [2]

(b) In a titration experiment, 40.00 cm^3 of 4.92 g/dm^3 of a dibasic acid is completely neutralized by 20.0 cm^3 of 0.200 mol/dm^3 sodium hydroxide. Calculate

(i) the concentration of the acid in mol/dm^3. [3]

(ii) the relative molecular mass of the acid. [1]

The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series	140 Ce cerium 58	141 Pr Praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	162 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
†90-103 Actinoid series	232 Th thorium 90	– Pa protactinium 91	238 U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lr lawrencium 103

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