Class	Register Number	Name

南洋女子中学校
NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2015
Secondary Three

CHEMISTRY **1 hour 45 minutes**
Paper 2 Theory Paper **0930 – 1115 hrs**
Wednesday **7 October 2015**
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.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer **all** questions including questions **7, 8** and **9 *Either*** or **9 *Or*.**
Write your answers on the separate writing paper provided.
At the end of the examination,
1. fasten all your answers to **Section B** securely together;
2. tick **9 *Either*** (for *Either*) or **9 *Or*** (for *Or*) in the grid below to indicate which question you have answered.
3. hand in **Section A** and **Section B separately**

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.

The use of scientific calculators is allowed.

A copy of the periodic table is found on page 12.

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

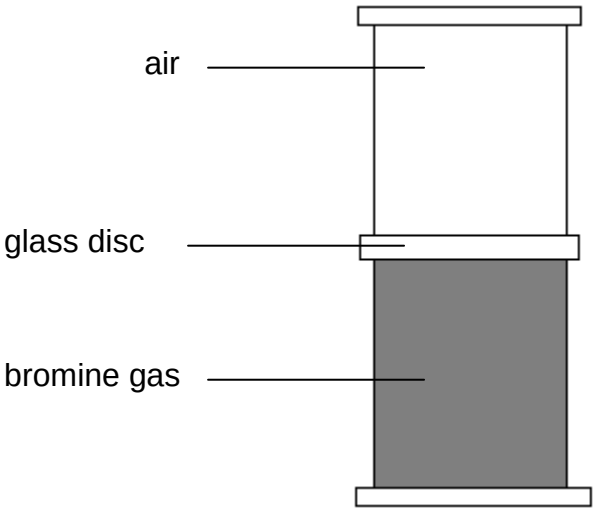
This document consists of 12 printed pages.

Section A

Answer **all** questions.

Write your answers in the spaces provided.

A1 In an experiment, two gas jars were set up as shown below.



(a) State the observation when the glass disc was removed. [1]

_____

(b) What difference would you observe if the experiment is repeated using nitrogen dioxide gas instead of bromine gas? [1]

_____

(c) Pure bromine exists as a liquid and boils at 58.8^{o}C. A small sample of liquid bromine was heated slowly and its temperature was monitored. State how one can tell whether the sample of bromine was impure. [2]

_____

_____

_____

_____

Total [4]

A2 Brine is an impure solution of sodium chloride. The main impurity in brine is calcium chloride. It is removed by reacting brine with sodium carbonate.

$$CaCl_2\ (aq) + Na_2CO_3(aq) \rightarrow CaCO_3(s) + 2NaCl(aq)$$

(a) State the type of reaction shown. [1]

(b) Construct an ionic equation for the above reaction. [1]

(c) Suggest how the calcium carbonate is removed from the mixture. [1]

Total [3]

A3 Sodium nitride (Na_3N) is a solid with a melting point which is above 1000^oC. When sodium nitride is added to excess dilute hydrochloric acid, a violent reaction takes place, producing a solution which contains 2 salts. When the solution is boiled with aqueous sodium hydroxide, a pungent gas is evolved which turns moist red litmus blue.

(a) State the type of bonding present in the compound. [1]

(b) Describe the bonding and structure in solid sodium nitride. [2]

(c) State a physical property of sodium nitride other than its high melting point and boiling point. [1]

(d) State the nature of hydrochloric acid in terms of strength and basicity. [2]

(e) Construct a chemical equation with state symbols for the reaction between sodium nitride and hydrochloric acid. [2]

Total [8]

A4 0.400 g of magnesium carbonate is completely dissolved in 100 cm^3 of sulfuric acid. 25.0 cm^3 of the resultant solution is pipetted into a conical flask and titrated with 20.50 cm^3 of 0.400 g dm^{-3} aqueous sodium hydroxide.

(a) State a suitable indicator for the titration described above. [1]

(b) Sulfuric acid is a strong acid. Define the term 'strong'. [1]

(c) Construct chemical equations, with state symbols, for the two reactions described above. [2]

(d) Calculate the number of moles of sulfuric acid used in the titration with aqueous sodium hydroxide. [3]

(e) Calculate the number of moles of sulfuric acid that reacted with the magnesium carbonate. [2]

(f) Hence, calculate the concentration of the sulfuric acid used in the reaction with magnesium carbonate. [2]

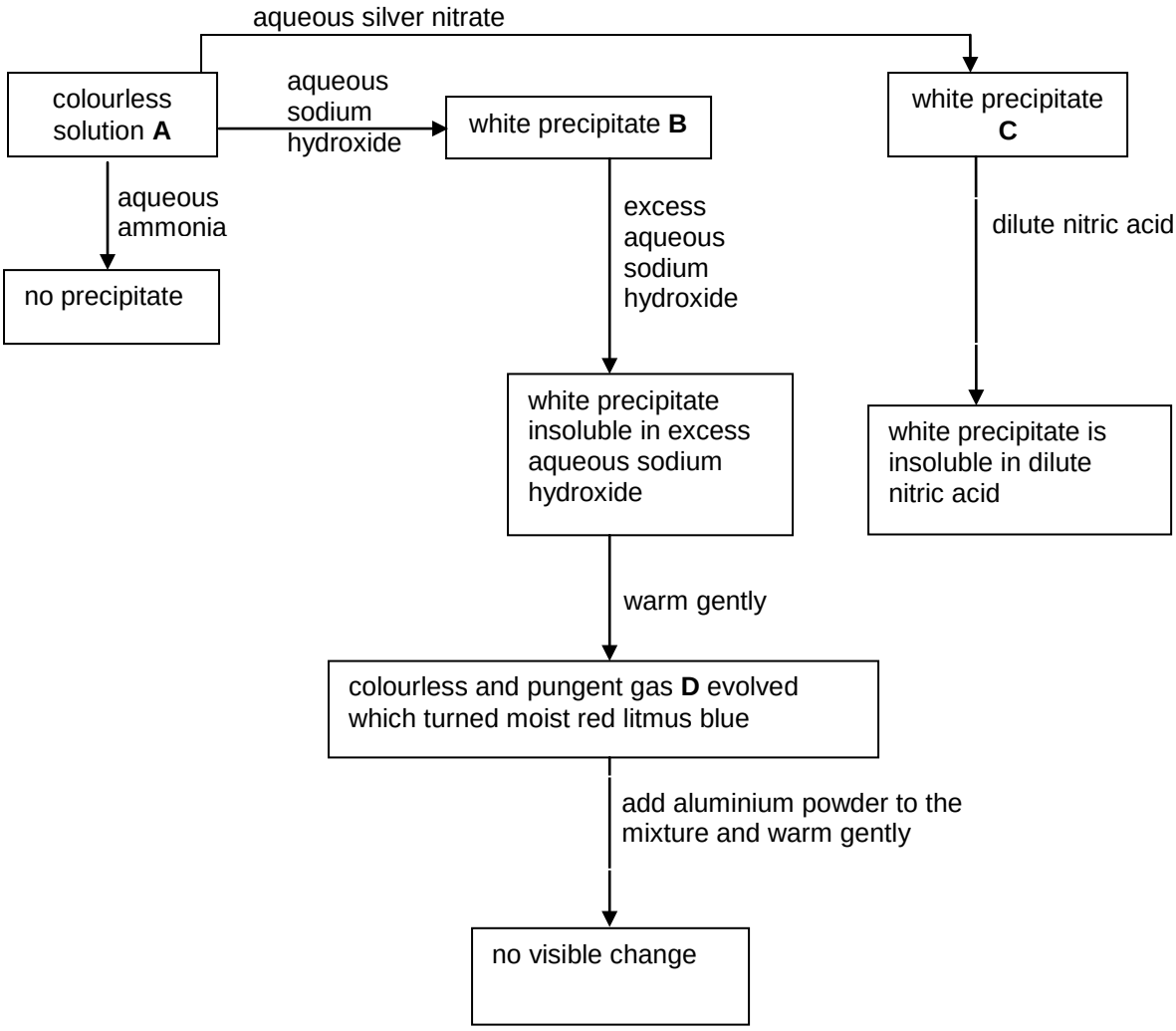
(g) Suggest a method and suitable reagents for preparing a pure and dry sample of magnesium carbonate. [2]

_____

_____

Total [13]

A5 Study the flow chart given and answer the questions that follow.



(a) Identify the white precipitates, **B** and **C**. [2]

(b) Write the ionic equation for the formation of gas **D.** [1]

(c) Identify the two ionic compounds present in solution **A**. [2]

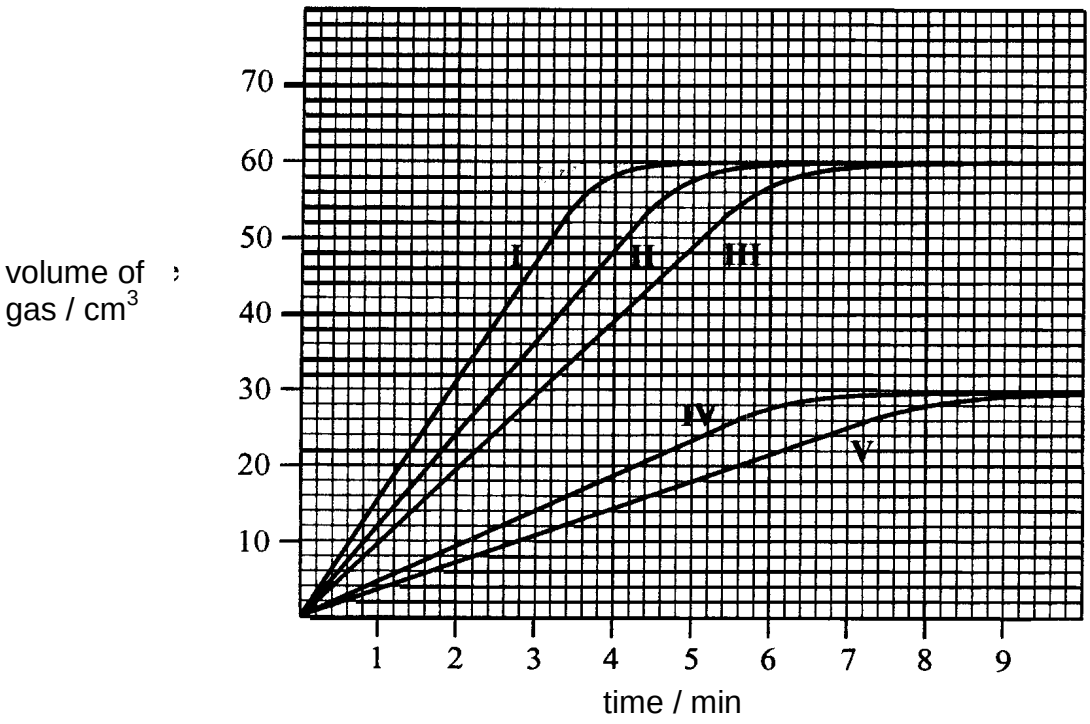
(d) Explain why the sulfate ion cannot be present in solution **A**. [1]

Total [6]

A6 A series of experiments were carried out to compare the rate of reaction of acid with zinc under different conditions. In each experiment, 13.5 g of zinc and 25 cm^3 of acid were used. The conditions for each experiment are shown in the table below.

experiment	form of zinc	acid used	concentration of acid used / mol dm^{-3}
A	large pieces	HCl	0.200
B	powder	HCl	0.200
C	powder	HCl	0.100
D	powder	CH_3COOH	0.100
E	large pieces	H_2CO_3	0.100

The gas given off was collected and its total volume was measured every 15 seconds for 10 minutes. The results obtained were plotted as shown.



(a) State the two factors that affected the rate of reaction in the five experiments above. [2]

(b) For each of the experiments **A** to **E**, state which of the curves **I** to **V**, corresponds to the results obtained. [4]

experiment	**A**	**B**	**C**	**D**	**E**
curve					

Total [6]

Section B

Answer **three** questions from this section on the writing papers provided.

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

B7

(a) Magnesium silicide is prepared by heating a mixture of magnesium and silicon. Write a chemical equation for the formation of magnesium silicide. [1]

(b) When magnesium silicide is reacted with dilute hydrochloric acid, a very reactive compound of silane, with a chemical formula of SiH_4, is produced. Silane has a boiling point of -112^oC.

(i) Describe the type of bonding found in silane and explain why the boiling point of silane is low. [2]

(ii) Draw a Lewis diagram to show the electronic arrangement of silane. [1]

(iii) Suggest two other physical properties of silane. [2]

(c) Magnesium is in Group II and Period 3 of the Periodic Table. It occurs in nature as a mixture of three isotopes having the relative abundances as given below:

mass number	% abundance
24	78.99
25	10.00
26	11.01

State the number of neutrons in the most abundant isotope of magnesium and write down the electronic configuration of the magnesium ion. [2]

(d) Cadmium with a mass number of 112 and atomic number of 48 was discovered in 1817 by two German scientists, Friedrich Stromeyer and Karl Samuel Leberecht Hermann.

Cadmium sulfide, CdS, is found in synthetic cadmium pigments for plastics. State the number of protons, neutrons and electrons of a cadmium ion in cadmium sulfide. [2]

Total [10]

B8

(a) The relative atomic mass of lead depends on its source due to the differing proportions of isotopes.

Two samples of lead, **A** and **B**, were subjected to analysis. The mass spectrum of sample **A** was analysed and the following results showed the mass-to-charge ratio (m/e) values for the ions and their corresponding percentage abundances. Mass-to-charge ratio (m/e) indicates the mass number of the isotopes.

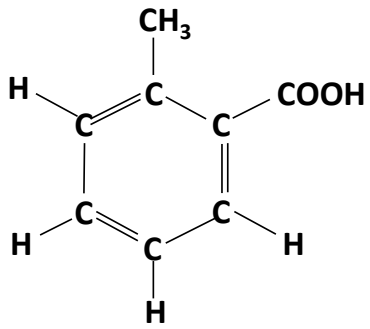
m/e value of peak	% abundance
204	2.7
206	48.0
207	41.5
208	7.8

(i) Calculate the relative atomic mass of lead sample **A**. [1]

(ii) When 1.000 g of lead sample **B** was converted to lead(II) chloride, the mass was 1.341 g. Calculate the relative atomic mass of lead sample **B**. [2]

(iii) Using the answers from **(a)(i)** and **(a)(ii)**, deduce whether the two samples have identical isotopic compositions. [1]

(b) Compound **X** has the following structure.



(i) Describe a chemical test to determine whether compound **X** is acidic. [2]

(ii) The group of atoms, COOH, gives the acidic properties to compound **X**. Draw the structure of the salt formed when compound **X** reacts with aqueous sodium hydroxide. [1]

(c) In hospitals, barium sulfate is mixed with food and ingested by the patient prior to taking the X-ray of the digestive tract.

(i) Explain why barium carbonate cannot be used in this procedure. [1]

(ii) Barium sulfate is prepared by using solid barium hydroxide as a starting reagent. Write the ionic equations involved in preparing barium sulfate. [2]

Total [10]

B9
EITHER

Ascorbic acid, represented by the chemical formula of H_2**A**, is used as a vitamin supplement and an antioxidant in some brands of orange juice.

(a) Ascorbic acid has the following composition by mass:

C: 40.9% H: 4.6% O: 54.5%

(i) Calculate the empirical formula of ascorbic acid. [2]

(ii) A sample of 4.00 g of ascorbic acid requires 22.7 cm^3 of 1.00 mol dm^{-3} of aqueous sodium carbonate for complete reaction. Calculate the molecular formula of ascorbic acid. [3]

(b) A student performed an experiment to determine the mass of ascorbic acid in a 750 cm^3 bottle of orange juice.

She pipetted 25.0 cm^3 of the juice and titrated it with 0.00500 mol dm^{-3} of aqueous sodium hydroxide. The volume of aqueous sodium hydroxide required was 11.30 cm^3.

(i) Calculate the number of moles of aqueous sodium hydroxide used in the titration. [1]

(ii) Calculate the concentration of ascorbic acid in the orange juice in mol dm^{-3}. [2]

(iii) Calculate the mass of ascorbic acid in the bottle of orange juice. [2]

Total [10]

B9
OR

1.30 g of **X**CO_3 was dissolved in 100 cm^3 of 32.0 g dm^{-3} of dilute nitric acid and made up to 250 cm^3 in a graduated flask with deionised water.

25.0 cm^3 of the solution pipetted from the graduated flask required 26.80 cm^3 of 0.100 mol dm^{-3} aqueous sodium hydroxide for neutralisation.

(a) Write a chemical equation for the reaction of the carbonate, **X**CO_3, with dilute nitric acid. [1]

(b) Calculate the number of moles of dilute nitric acid added to **X**CO_3. [2]

(c) **(i)** Calculate the number of moles of dilute nitric acid that reacted with aqueous sodium hydroxide. [2]

(ii) Calculate the number of moles of dilute nitric acid that remained in the graduated flask after reaction with the carbonate. [2]

(d) Calculate the number of moles of dilute nitric acid that had reacted with the carbonate. [1]

(e) Calculate the relative molecular mass of the carbonate, **X**CO_3. [2]

Total [10]

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
†90-103 Actinoid 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
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

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

The volume of one mole of any gas is 24 dm^3 at room temperature and