

Class	Register Number	Name
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南洋女子中学校
NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2011
Secondary Three

CHEMISTRY

Paper 2

Structured Questions

Thursday

13 October 2011

1 hour 45 minutes

09 15 to 11 00h

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 writing 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 **9, 10** and **11 Either** or **11 Or**.

Write your answers on the writing paper provided.

At the end of the examination,

1. hand in **Section A** and **Section B** separately.
2. fasten all your written papers for Section B securely with the strings provided.
3. tick **11 Either** (for *Either*) or **11 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 15.

Examiner's Use	
Section A	
Section B	
9	
10	
11 <i>Either</i>	
11 <i>Or</i>	
Total	

This document consists of **15** printed pages.

Setters: GB/AS/ET

NANYANG GIRLS' HIGH SCHOOL

[Turn over]

Section A

Answer **all** questions.

Write your answers in the spaces provided.

A1 Answer the questions below by using the reagents listed below.

Cu(s)	AgNO ₃ (aq)	H ₂ SO ₄ (aq)
Na ₂ CO ₃ (aq)	NaOH(aq)	Cu(NO ₃) ₂ (aq)
(NH ₄) ₂ SO ₄ (aq)	BaCl ₂ (aq)	Zn(s)

Each reagent may be used once, more than once, or not at all.

Give **two** reagents which when mixed together

(a) would produce a soluble salt and a gas by using the titration method.

..... [1]

(b) would produce a blue precipitate.

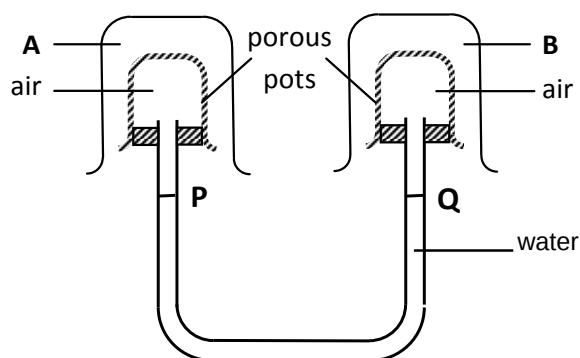
..... [1]

(c) would produce an alkaline gas upon warming.

..... [1]

[Total marks: 3]

A2 (a) The following questions refer to the diagram below.



Answer the following questions using the gases listed below.

hydrogen (H_2)
nitrogen (N_2)

oxygen (O_2)
methane (CH_4)

helium (He)
carbon monoxide (CO)

Each gas may be chosen once, more than once, or not at all

- (i) Which two gases, when placed into **A** and **B** respectively, will cause the water level at **P** to move up initially? Explain your answer.

.....
.....
.....

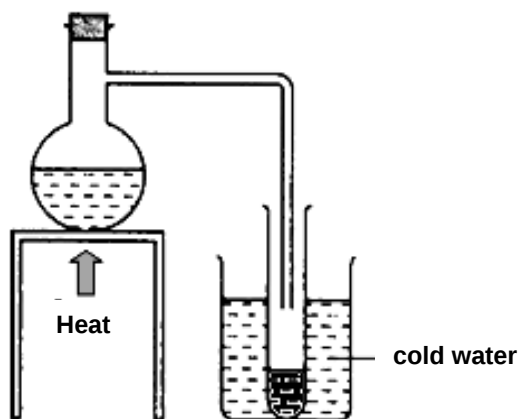
[2]

- (ii) What would be observed in the diagram above if **A** is helium at room temperature and **B** is helium at $60^\circ C$? Explain your answer.

.....
.....
.....

[2]

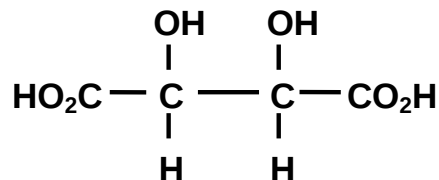
- A2 (b)** Some inks are dyes dissolved in water. The apparatus below illustrates how water may be separated from these inks.



- (i) On the diagram, label the ink and the pure water. [1]
- (ii) On the diagram, draw a thermometer to show where it should be suitably placed so as to collect pure water in the experimental set-up. [1]
- (iii) Name this method of separation. [1]
.....
- (iv) What is the purpose of the beaker of cold water? [1]
.....

[Total marks: 8]

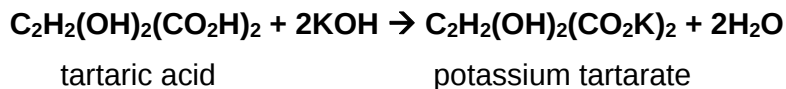
- A3 (a)** Tartaric acid is a weak dibasic organic acid that can be extracted from grape juice. It is purified by recrystallization. The structure of tartaric acid is shown below.



- (i) Define weak acid.

..... [1]

- (ii) Tartaric acid reacts with aqueous potassium hydroxide according to the equation shown below.



A test analysis showed that 11.3 g of potassium tartarate was formed when 9.0 g of impure tartaric acid were used. Calculate the percentage purity of tartaric acid.

[3]

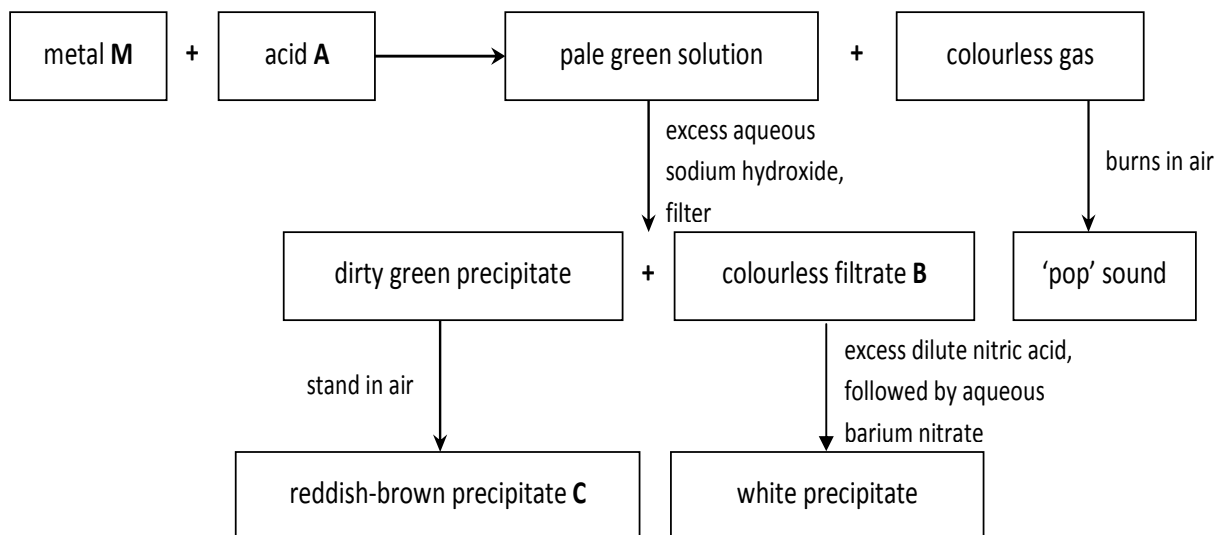
- (b) All hydrocarbons undergo complete combustion to form carbon dioxide and water only.

A 20.0 cm³ sample of a hydrocarbon of formula C_xH₄ required 60.0 cm³ of oxygen for complete combustion. If both volumes are measured at r.t.p., what is the value of x?

[2]

[Total marks: 6]

A4 (a)



(i) Write the chemical formula for **A**, **B**, **C** and **M**.

A

B

C

M

[2]

(ii) Give the ionic equation, including the state symbols, for the formation of the dirty green precipitate.

..... [2]

(b) A colourless solution is suspected to contain either aluminium or lead(II) ions.

Describe a chemical test which can be used to identify the metal ions present in the colourless solution and describe the expected observations.

.....

.....

..... [2]

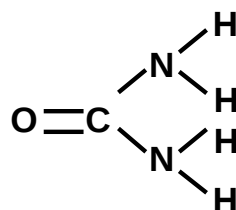
[Total marks: 6]

- A5 (a)** Fertilisers are added to the soil to provide the element nitrogen which improves crop yields. A farmer has the choice of two fertilisers, ammonium nitrate, NH_4NO_3 , or diammonium hydrogen phosphate, $(\text{NH}_4)_2\text{HPO}_4$.

Show by calculation which of these fertilisers is more effective in improving crop yields.

[2]

- (b)** Urea, $\text{CO}(\text{NH}_2)_2$, is one of the fertilisers manufactured from ammonia. Its structural formula is given below.



Draw a diagram showing the arrangement of the valence electrons in one molecule of urea, using the following legend.

Use o to represent an electron from a carbon atom
Use x to represent an electron from a hydrogen atom, oxygen atom
Use · to represent an electron from a nitrogen atom

[2]

[Total marks: 4]

A6 (a) In an experiment, 25.0 cm^3 of 1.0 mol/dm^3 of barium chloride solution is added to 100 cm^3 of 1.0 mol/dm^3 of sulfuric acid.

- (i)** Write the balanced chemical equation, including the state symbols, for the reaction between barium chloride and sulfuric acid.

[1]

.....

- (ii)** Show by calculation which substance acts as a limiting reagent.

[2]

- (b)** Describe briefly how to make pure and dry sodium nitrate crystals in the school laboratory.

.....

.....

.....

.....

.....

.....

.....

[3]

.....

[Total marks: 6]

A7 When potassium is burnt in oxygen, it forms potassium peroxide (K_2O_2).

In spaceships, potassium peroxide is dissolved in water to form potassium hydroxide and oxygen. Potassium hydroxide removes carbon dioxide while oxygen is required for breathing.

In a particular spaceship, 13.2 g of potassium peroxide is dissolved in 0.500 dm^3 of water.

(a) Write the balanced chemical equation for the reaction between potassium peroxide and water.

..... [1]

(b) Calculate the number of moles of potassium hydroxide.

[2]

(c) Calculate the mass of oxygen gas produced.

[1]

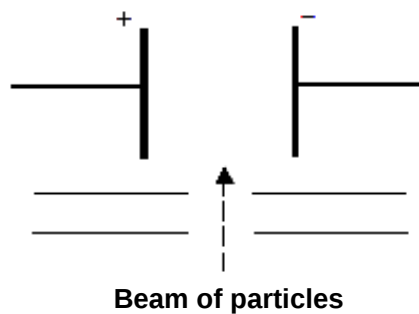
(d) Calculate the volume of oxygen gas produced when the gas is cooled to room temperature and pressure.

[1]

[Total marks: 5]

- A8** In the 19th and 20th centuries, scientists established the atomic theory and showed that three sub-atomic particles, electron, neutron, and proton, exist. The masses and charges of these three particles were subsequently determined.

When separate beams of electrons, neutrons or protons are passed through an electric field in the apparatus below, they behave differently.



- (a) Which of these three particles will be deflected the most by the electric field?

..... [1]

- (b) In which direction will this particle be deflected? Explain your answer.

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

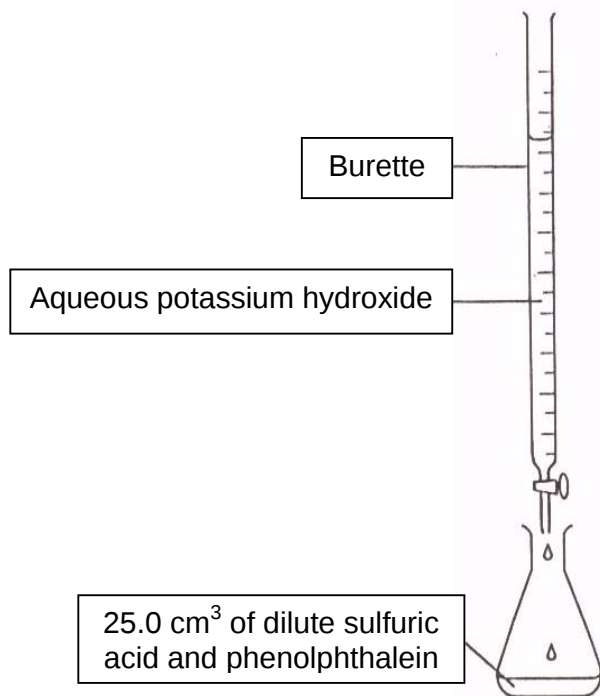
[Total marks: 2]

Section B

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

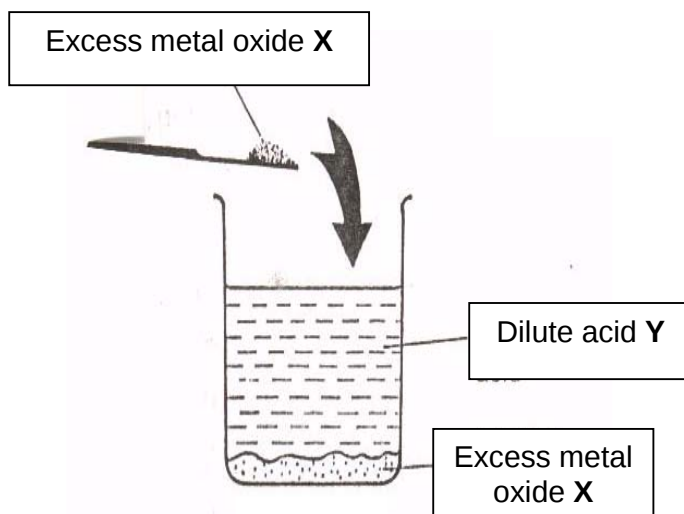
The last question is in the form of either/or and only **one** of the alternatives should be attempted. Each question carries **ten** marks.

- B9** In an experiment, 25.0 cm^3 of dilute sulfuric acid was titrated with aqueous potassium hydroxide to form 0.0333 mol/dm^3 of potassium sulfate. The pure and dry sample of the salt weighed 0.261 g . (Assume that the percentage yield of the salt is 100%)



- (a) Write the balanced chemical equation, including state symbols, for the reaction involved in the above experiment. [2]
- (b) Calculate the number of moles of potassium sulfate formed. [1]
- (c) Determine the volume of the aqueous potassium hydroxide reacted. [2]
[Note: Assume the volume of all solutes is negligible.]
- (d) Calculate the concentration of:
- (i) dilute sulfuric acid reacted in mol/dm^3 . [1]
- (ii) aqueous potassium hydroxide reacted in g/dm^3 . [2]
- (e) When methyl orange is used as the indicator, describe and explain the observation in the conical flask as the titration progresses. [2]

- B10** The following diagram illustrates an experiment to prepare a sulfate salt **Z** by reacting excess metal oxide **X** with dilute acid **Y**.



- (a) Metal oxide **X** is prepared by burning copper powder in oxygen. The metal oxide **X** contains 80% copper by mass. Determine the empirical formula of the metal oxide **X**. [3]
- (b) Write down the
- (i) name of dilute acid **Y** used to prepare salt **Z**. [1]
 - (ii) chemical name of salt **Z**. [1]
 - (iii) ionic equation, including state symbols, for the preparation of salt **Z** from metal oxide **X** and dilute acid **Y**. [2]
- (c) Why should the metal oxide **X** be added in excess? [1]
- (d) Will it be suitable to produce salt **Z** by reacting copper(II) nitrate with potassium sulfate? Explain your answer. [2]

B 11
EITHER

- (a) Two *isotopes* of phosphorus are ^{31}P and ^{33}P .

Explain the term *isotopes*, in terms of atomic number and nucleon number with reference to the two given isotopes of phosphorus. [1]

- (b) Selenium, Se, is in Group VI of the Periodic Table.

(i) How many electrons are in the outer shell of an atom of selenium? [1]

(ii) Predict, with an explanation, the formula of the ion formed by selenium in compounds. [2]

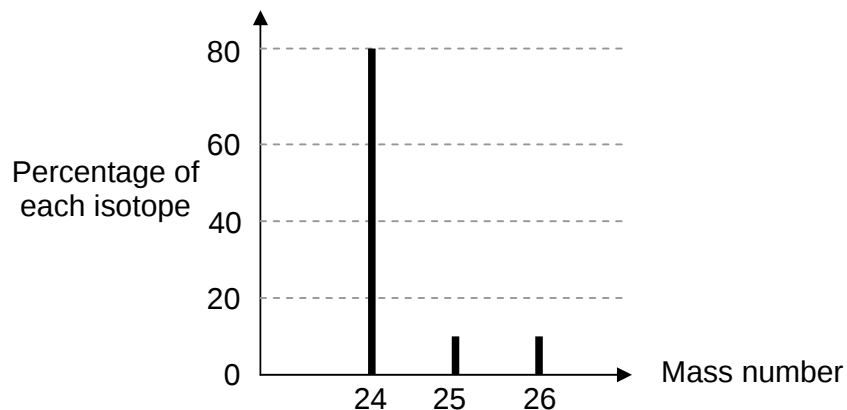
- (c) Calcium carbide is produced industrially in an electric arc furnace from a mixture of lime, CaO and coke, C, at approximately 2000 °C. Carbon monoxide is produced as a by-product.

(i) Predict, with a reason, the type of bonding you would expect to find in calcium carbide. [2]

(ii) Draw a dot and cross diagram to show only the valence electrons in Ca^{2+} and C_2^{2-} ions, given that each carbon in C_2^{2-} also achieves an octet electronic structure by sharing 3 pairs of electrons. [2]

(iii) Explain, in terms of structure and bonding, the difference in the melting points between calcium carbide and carbon monoxide. [2]

- B 11** **(a)** An element **E** was analyzed in the mass spectrometer and the result is shown below.
OR



- (i)** Explain the term 'isotope' in terms of atomic number and nucleon number. [2]
 - (ii)** Identify the element **E**, showing clearly how you arrive at the answer. [2]
- (b)** Silicon forms volatile hydrides called silanes with the general formula $\text{Si}_n\text{H}_{2n+2}$ ($n=1,2,3,\dots$). **X** is the second member of silanes (i.e. $n=2$), with melting point -132.5°C and boiling point -14.5°C .
- (i)** Write the molecular formula of **X**. [1]
 - (ii)** Draw a 'dot and cross' diagram to represent the electronic structure of **X**, showing only the valence electrons. [2]
 - (iii)** In what state will **X** be at room temperature? [1]
 - (iv)** Explain why **X** has low melting and boiling points. [2]

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 Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18						
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36						
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	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	209 Po Polonium 84	85 At Astatine	86 Rn Radon						
Fr Francium 87	Ra Radium 88	227 Ac actinium 89																					

*58-71 Lanthanoid series

†90-103 Actinoid series

a	X
Key	b

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

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	144 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	238 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103

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