Class	Index Number	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

SEMESTRAL ASSESSMENT TWO

SECONDARY THREE

CHEMISTRY **10 October 2016**

2 hours 15 minutes

Additional Materials:
OTAS

INSTRUCTIONS TO CANDIDATES
Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.
You may use a pencil for any diagrams or graphs.

SECTIONS A AND B

Section A: Multiple Choice Questions
Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice in soft pencil on the separate OTAS.

Section B: Structured Questions
Answer **all** questions. Write your answers in the spaces provided on the question paper.

A copy of the Periodic Table can be found on page 8 of Section C.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

For Examiner's Use	
Section A	20
Section B	50
Section C	30
Total	100

This document consists of 16 printed pages inclusive of this cover page.

Section A: Multiple Choice Questions (20 marks)
Answer all questions in the OTAS provided.

1. If a 10 cm^3 pipette was not available, which of the following would you carry out to measure a 10 cm^3 portion of a solution for an accurate titration?

   A Measure 10 cm^3 using a burette.
   B Measure 10 cm^3 using a measuring cylinder.
   C Weigh 10 times the mass of 1 cm^3 of water.
   D Measure 20 cm^3 from a pipette and divide the solution into two equal parts.

2. Some crystals of a compound were washed, filtered and then dried. A melting point determination gave a value of 197°C. The same crystals were then washed and dried again. The melting point this time was found to be 220°C.

   Which of the following is the best explanation for this?

   A A smaller quantity of crystals was used for the first melting point determination.
   B The crystals were impure when the first melting point determination was carried out.
   C The crystals were impure when the second melting point determination was carried out.
   D The thermometer was faulty and gave inconsistent results.

3. A gas is held in a closed, rigid container and the container is heated gradually.

   Which of the following statement is true?

   A Kinetic energy of the gas particles will increase.
   B The gas particles expand to take up more space.
   C The gas particles move farther apart from one another.
   D The intermolecular forces of attraction will increase.

4. Which of the following consists of particles which are in constant motion?

I a balloon filled with air
II diamond at room temperature
III ice at a temperature of -4 °C
IV molten lead

A I and IV
B II and III
C I, III and IV
D All of the above

5. The melting point and boiling point of some gases in air is shown below:

gas	melting point/ °C	boiling point/ °C
argon	-189	-186
nitrogen	-210	-196
oxygen	-219	-183

If only liquid oxygen is required, the temperature of a sample of air should be decreased to _____.

A -180 °C
B -182 °C
C -185 °C
D -196 °C

6. Which of the following pair of substances is made up of two mixtures?

A air and petroleum
B air and silicon dioxide
C barium nitrate and magnesium chloride
D limestone and diamond

7. An ion Q^{3-} contains 31 nucleons and 18 electrons. What does the nucleus of the ion Q^{3-} contains?

	number of protons	number of neutrons
A	15	15
B	15	16
C	16	15
D	18	13

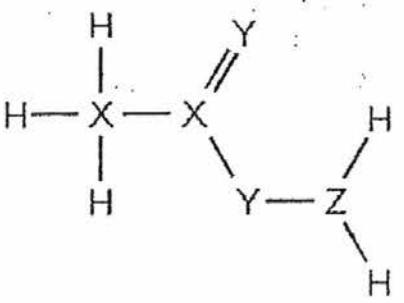
8. Element X has proton number n and forms an ionic compound X_2O. Element Y has proton number (n+2). What is the likely formula of the oxide of Y?

A YO
B Y_2O
C YO_3
D Y_2O_3

9. Fibre glass can be considered to be a mixture of ionic oxides and macromolecules. Which of the following **cannot** be present in fibre glass?

A Al_2O_3
B Na_2O
C SiO_2
D P_4O_{10}

10. The diagram shows the structure of a covalent compound containing the element hydrogen, H, and the unknown elements X, Y and Z.



To which groups of the Periodic Table do these three elements, X, Y and Z, belong?

	X	Y	Z
A	I	V	VI
B	IV	V	I
C	IV	VI	V
D	V	I	IV

11. Which of the following shows the number of atoms present in 4.25 g of ammonia gas at room temperature and pressure?

A 1.5×10^{23}
B 3×10^{23}
C 6×10^{23}
D 9×10^{23}

12. If 200 cm^3 of 0.1 mol/ dm^3 hydrochloric acid were added to 1 g of calcium carbonate, what would remain after the reaction?

A both of the reactants
B calcium carbonate
C hydrochloric acid
D neither of the reactants

13. A new indicator has just been produced in the laboratory. It changes colours according to the table below:

pH	colour
0 - 3	red
4 - 7	green
8 - 14	dark blue

This indicator would be suitable to distinguish between _____.

A aqueous ammonia and aqueous sodium hydroxide
B aqueous sodium chloride and water
C aqueous sodium nitrate and aqueous sodium hydroxide
D dilute hydrochloric acid and dilute sulfuric acid

14. Ethanoic acid, hydrochloric acid, nitric acid and sulfuric acid each dissociates in solution.

If Universal Indicator is placed in a 0.3 mol/dm^3 solution of each acid, which solution will produce a colour indicating the lowest pH?

A ethanoic acid
B hydrochloric acid
C nitric acid
D sulfuric acid

15. Which of the following pairs of solutions, when mixed, would be suitable for preparing an insoluble salt?

A copper(II) sulfate and sodium nitrate
B lead(II) nitrate and sodium chloride
C iron(II) sulfate and potassium chloride
D zinc chloride and potassium nitrate

16. Which of the following methods of preparation of a pure salt requires the use of a pipette and burette?

A $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$
B $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
C $KOH + HCl \rightarrow KCl + H_2O$
D $MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$

17. Which of the following solution can be used to distinguish between aqueous sodium hydroxide and aqueous ammonia?

A copper(II) sulfate solution
B iron(II) sulfate solution
C iron(III) chloride solution
D zinc nitrate solution

18. Different solids were added to separate portions of warm dilute sulfuric acid.

Which solid shows the correct observation?

	solid	observation
A	ammonium carbonate	alkaline gas produced
B	copper	gas evolved ignited with a pop sound
C	magnesium oxide	solid dissolved with no effervescence seen
D	zinc carbonate	gas evolved relights a glowing splint

19. Across the Period, there is a trend from metallic to non-metallic elements. This is caused by _____.

A an increase in number of electrons
B an increase number of electron shells
C an increase in number of neutrons
D an increase in number of valence electrons

20. Information about the possible carbonates of element Q is given below.

formula of carbonate	colour of carbonate	solubilty of carbonate in water
QCO_3	green	insoluble
$Q_2(CO_3)_3$	orange	insoluble

Which of the following statement is correct about Q?

A Q is a non-metal found either in Group VI or VII of the Periodic Table.
B Q is a transition metal.
C Q is in Group I of the Periodic Table.
D Q is in Group II of the Periodic Table.

Section B: Structured Questions (50 marks)
Answer all the questions in this section in the spaces provided.

1. Five test tubes containing different substances are given below.

   Test tube **A**: ethanol and water

   Test tube **B**: solid calcium carbonate and water

   Test tube **C**: solid ammonium chloride and water

   Test tube **D**: solid ammonium chloride and solid potassium chloride

   Test tube **E**: solid potassium chloride and water

   The mixture in each test tube is shaken. Using the letters given to the test tubes, identify the mixture(s) which can be separated by

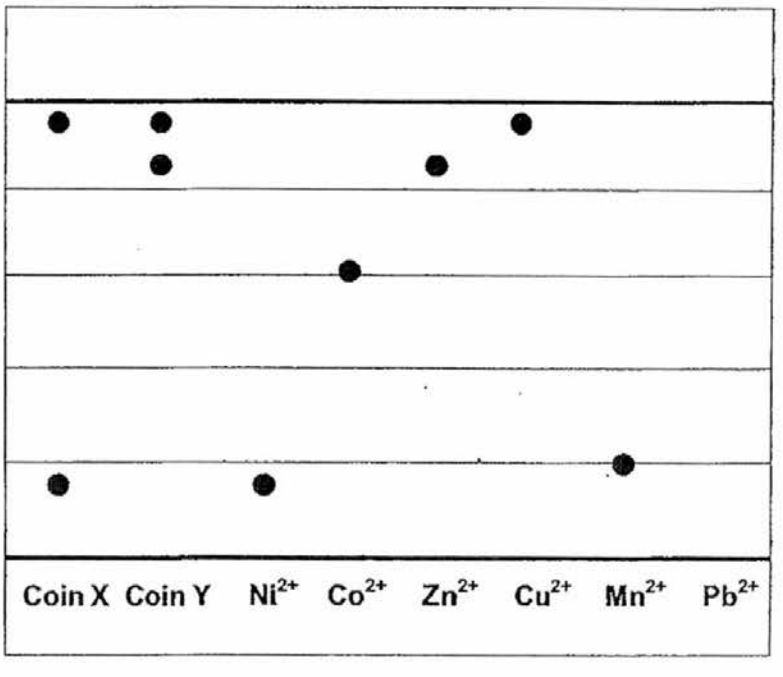
   (a) simple distillation .....[1]

   (b) filtration .....[1]

   (c) sublimation .....[1]

   [Total:3]

2. Two coins were dissolved in nitric acid separately to form solutions of the metals. The metals present were identified by paper chromatography. The results are shown in the figure below together with five other metal ions as standards.



(a) Identify the metal elements that are present in coin **X** and coin **Y**.

.....

.....[2]

(b) Explain why different ions are found at different positions on the chromatogram.

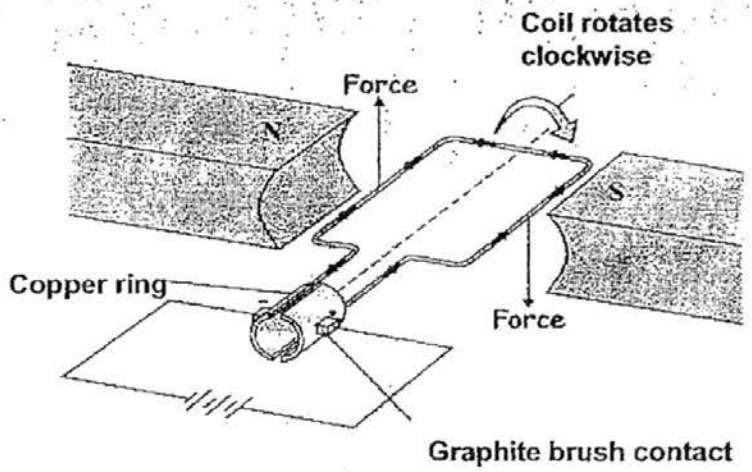
.....

.....[2]

(c) Add to the above diagram the spot for Pb^{2+}, which has an R_f value of 0.8. [1]

[Total: 5]

3. The diagram below shows the main parts of an electric motor.



Graphite brush contacts are used to conduct electricity to the copper ring. When electricity passes through the wires, the copper ring rotates rapidly, turning the motor which is connected to the drill bit. The ring does not become worn out.

(a) Explain, in terms of bonding and structure, why graphite and copper are able to conduct electricity.

(i) graphite

.....

.....

.....

.....[2]

(ii) copper

.....

.....

.....

.....[2]

(b) Explain why the copper ring does not become worn out easily though it is in constant contact with the graphite during the reaction.

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.....

.....[2]

[Total:6]

4. A student performs some tests on an unknown solution **T** which is known to contain two cations and one anion. She recorded her observations and deductions in the table shown below.

experiment number	procedure	observations	deductions
1	To a solution of **T**, add sodium hydroxide solution until no further change.	*White ppt formed.* *Ppt insoluble in excess sodium hydroxide solution.*	*Ca^{2+}, Pb^{2+}, Zn^{2+} or Fe^{3+} could be present.* *Ca^{2+} is present.*
2	Add aluminium powder to the mixture in expt 1. Warm the mixture.	*Gas produced turns moist red litmus blue.*	*CO_3^{2-} is present.*
3	To a solution of **T**, add ammonia solution until no further change.	*White ppt formed.* *Ppt insoluble in excess ammonia solution.*	*Al^{3+}, Pb^{2+}, Zn^{2+} could be present.* *Al^{3+} or Pb^{2+} could be present.*

(a) The student made three mistakes in her deductions. In the table below, state the experiment number in which the mistakes were made. Briefly explain your answer.

	experiment number	explanation
mistake 1		
mistake 2		
mistake 3		

[4]

(b) Describe a simple test to distinguish between aluminium ions and lead(II) ions.

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.....

.....

.....[2]

[Total: 6]

·87

5. Phosphine, PH_3, is a gas which has a smell of garlic. It is formed when white phosphorus is warmed with aqueous sodium hydroxide.

$$4P + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

(a) Draw a 'dot-and-cross' diagram to show how the electrons are arranged in phosphine. Show only the valence electrons.

[2]

(b) Calculate the maximum mass of phosphine (in tonnes) formed when 18.6 tonnes of phosphorus reacts with excess aqueous sodium hydroxide.

[3]
[Total:5]

6. When zinc nitrate is heated strongly, it decomposes to form zinc oxide.

$$2Zn(NO_3)_2\,(s) \rightarrow 2ZnO\,(s) + 4NO_2\,(g) + O_2\,(g)$$

In the above reaction, 7.8 g of zinc oxide was obtained when 18.9 g of zinc nitrate was heated strongly. Calculate the percentage yield of this reaction.

[3]
[Total:3]

7. Calcium sulfate is a salt which is often used as a drying agent. It is found naturally in a hydrated form called gypsum which has the formula $CaSO_4.xH_2O$.

(a) Anhydrous calcium sulfate can be obtained from gypsum by heating it. A sample of gypsum crystals is heated for 5 minutes with its mass being recorded at one-minute intervals using an electronic balance. The data is tabulated below.

Time/ min	Mass of solid/ g
0	3.4
1	3.2
2	3.0
3	2.8
4	2.7
5	2.7

Using the data, determine *x*. Show your working clearly.

[3]

(b) State a simple test to determine if calcium sulfate is completely dry after the experiment. Include the expected observation.

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.....[2]

(c) (i) Name the reagents used to prepare a pure dry sample of calcium sulfate.

.....[2]

(ii) Outline a laboratory method for the preparation of a pure dry sample of calcium sulfate.

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.....[2]

[Total: 9]

8. John Newlands was one of the first chemists who attempted to classify elements in a systematic way based on atomic weight. In 1866, he suggested that there was a repeating pattern of elements with similar properties every eighth element. Part of Newlands' Periodic Table using his symbols is shown below.

H	F	Cl	Co/Ni
Li	Na	K	Cu
Gl	Mg	Ca	Zn
Bo	Al	Cr	Y
C	Si	Ti	In
N	P	Mn	As
O	S	Fe	Se

(a) The symbols **Gl** and **Bo** have been changed in the Modern Periodic Table. State the current symbols used for **Gl** and **Bo**.

Gl: .....[1]

Bo: .....[1]

(b) Describe one similarity and two differences between the Newland's Periodic Table and Modern Periodic Table.

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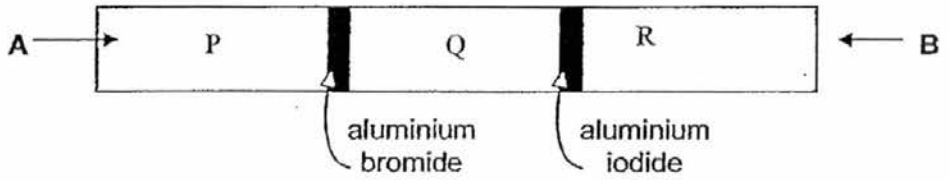
.....[3]

[Total: 5]

9. A student set up an experiment below. A circular plate of powdered aluminium bromide and powdered aluminium iodide was placed inside a tube. The whole tube was heated and chlorine gas was blown into the tube from **A**.



(a) State what you will see at zones P, Q and R respectively after about five minutes.

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.....

.....[3]

(b) State the type of reaction that occurs in the above experiment.

.....[1]

(c) Write a balanced chemical equation for any reaction that occurs.

.....[1]

(d) State the differences in observations obtained at zones P, Q and R, if any, if chlorine is blown in from **B** instead of **A**.

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.....[3]

[Total:8]

Class	Index Number	Name

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MARIS STELLA HIGH SCHOOL

SEMESTRAL ASSESSMENT TWO

SECONDARY THREE

CHEMISTRY **10 October 2016**

2 hours 15 minutes

Additional Materials:
Nil

INSTRUCTIONS TO CANDIDATES

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use paper clips, glue or correction fluid.
You may use a pencil for any diagrams or graphs.

SECTION C

Section C: Free Response Questions
Answer **all** questions. Write your answers in the spaces provided on the question paper.

A copy of the Periodic Table is printed on page 8.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

For Examiner's Use	
Q 1	12
Q 2	9
Q3	9
Total	30

Section C: Free Response Questions (30 marks)
Answer all the questions in the spaces provided.

1. An experiment is conducted using the apparatus set-up in **Fig 1.1** to investigate the electrical conductivity of various substances. The electrical conductivity can be measured by obtaining the conductance value using datalogger. The higher the conductance value, the higher the electrical conductivity of the substance.

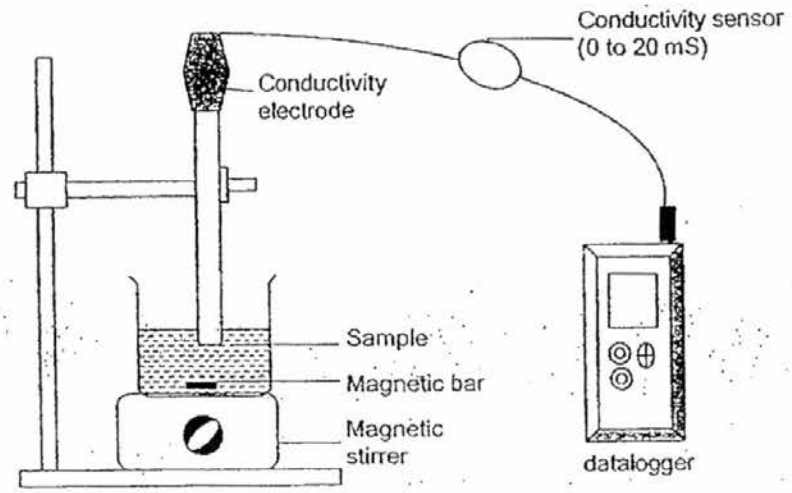

Fig 1.1

The following results were obtained and presented in the table below:

No	Sample	Conductance value/mS
1	Distilled water	0.00
2	Magnesium oxide	0.00
3	0.10 mol/dm^3 NaOH (aq)	17.40
4	1.00 mol/dm^3 H_2SO_4 (aq)	31.40
5	0.10 mol/dm^3 H_2SO_4 (aq)	31.40
6	0.01 mol/dm^3 H_2SO_4 (aq)	6.11
7	1.00 mol/dm^3 ethanoic acid (aq)	1.39
8	Cooking oil	0.00

(a) Using the information in the table, what can you conclude about the effect of diluting the samples of sulfuric acid on electrical conductivity?

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.....[2]

(b) State the relationship between the strength of acid and its electrical conductivity. Explain with reference to the examples given in the table.

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.....

.....

.....[2]

(c) Based on the results given, comment on the electrical conductivity of

(i) distilled water and
(ii) magnesium oxide

Account for the electrical conductivity of these two substances.

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.....[2]

(d) Ethanoic acid solution was added dropwise to 50 cm^3 of aqueous sodium hydroxide using the following apparatus set-up in **Fig 1.2.**

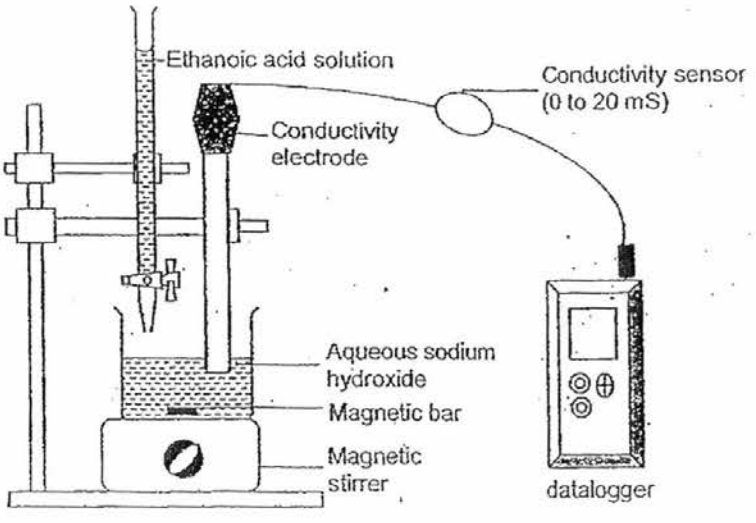

Fig 1.2

The electrical conductivity is measured during titration as shown in the graph below in **Fig 1.3.**

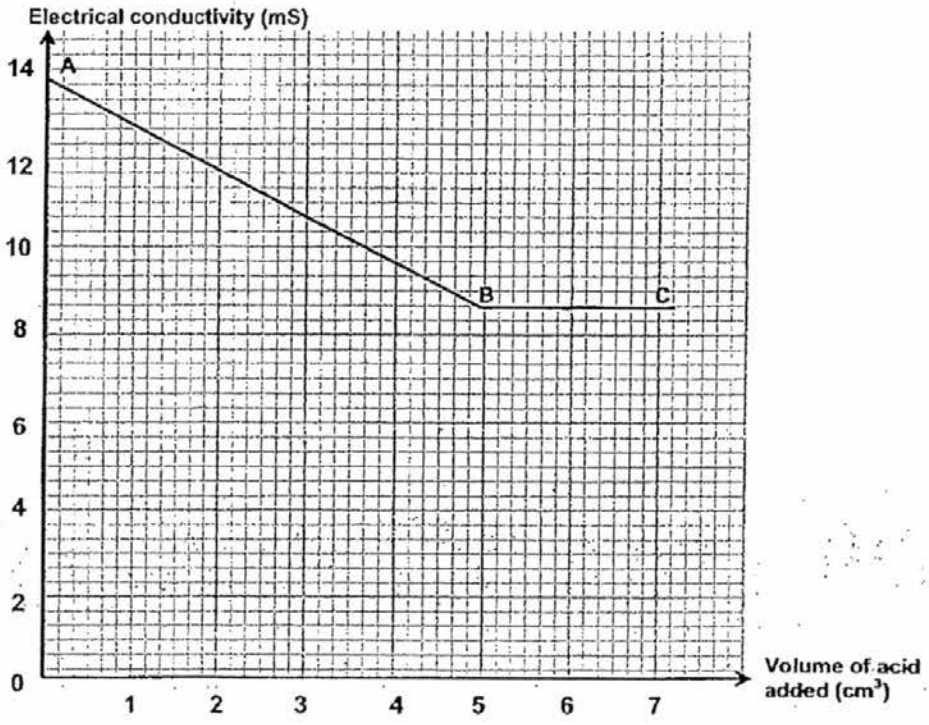

Fig 1.3

(i) Describe and explain the shape of the graph from **A** to **B**.

.....

.....[2]

(ii) Suggest why the mixture is still able to conduct electricity from **B** to **C**.

.....

.....[1]

(iii) From the graph above, calculate the concentration of the aqueous sodium hydroxide, given that the concentration of ethanoic acid is 1.002 mol/dm^3.

[3]
[Total: 12]

2. Cobalt is a transition metal found in Period 4 of the Periodic Table.

(a) Given that cobalt can form ions of +2 and +3 charge, write the chemical formula of cobalt(III) sulfate.

.....[1]

(b) Explain in terms of bonding and structure, whether cobalt(III) sulfate has a high melting point or a low melting point.

.....

.....

.....

.....[2]

(c) Name the alkali metal in the same period as cobalt.

.....[1]

(d) Describe what you will observe when a piece of the alkali metal in **(c)** is added into water.

.....

.....

.....[2]

(e) Describe one similarity and two differences between transition metals and alkali metals.

.....

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.....

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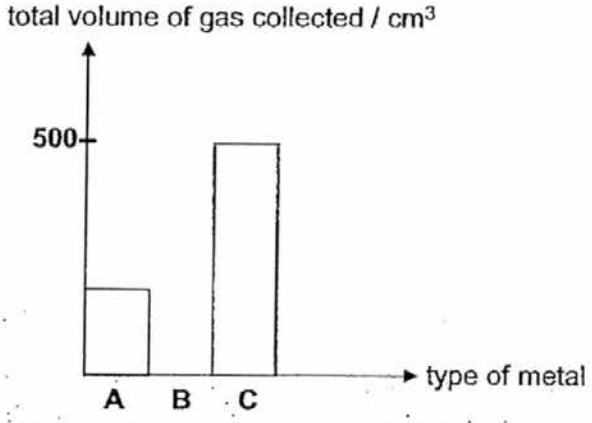
.....[3]
[Total:9]

192

3. Equal masses of 3 pieces of metals, **A**, **B** and **C**, were added separately to 20 cm^3 of dilute sulfuric acid in a boiling tube. The total volume of gas produced, at room conditions, for each experiment is shown below. Only a colourless solution remains when metal **A** and metal **C** react completely with the acid respectively.



The three metals used are silver, magnesium and zinc.

(a) Name one other main apparatus which is used in the experiment.

.....[1]

(b) State the chemical symbol of metals **A** and **B**.

A: .....[1]

B: .....[1]

(c) (i) Write a balanced chemical equation between magnesium and the acid.

.....[1]

(ii) Calculate the mass of magnesium which is used in the experiment.

[2]

(d) (i) Using your answer in **3(b)**, write a balanced chemical equation between metal **A** and the acid.

.....[1]

(ii) Hence calculate the maximum volume of gas which is produced (at room temperature and pressure) when equal mass of metal **A** reacts with the acid.

[2]
[Total:9]

End of paper

193

The Periodic Table of Elements

Group I	Group II										Group III	Group IV	Group V	Group VI	Group VII	Group 0
																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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103

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

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

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

Secondary 3 Chemistry SA2 Solutions

Section A

1	2	3	4	5	6	7	8	9	10
A	B	A	D	C	A	B	D	D	C
11	12	13	14	15	16	17	18	19	20
C	D	C	D	B	C	A	C	D	B

Section B

Q		Suggested solutions
1	a	C and E
	b	B
	c	D
2	a	X: Nickel and copper Y: Zinc and copper
	b	The ions have different solubility in nitric acid/ solvent used. Hence, they travel at different speed.
	c	Place on the 4th line
3	a	Graphite is a covalent substance with a giant molecular structure. Each carbon atom is covalently bonded to three other carbon atoms. Hence, there is one valence electron which is not used for bonding. These electrons are mobile/ free-moving hence graphite can conduct electricity
	b	Copper is a metal with giant metallic lattice structure. The lattice of positive ions is surrounded by 'sea' of delocalized electrons. These delocalized electrons are mobile/ free-moving hence copper can conduct electricity.
	c	Graphite is soft and slippery/smooth. Thus, there is minimal friction between the copper rings and graphite brush contacts.

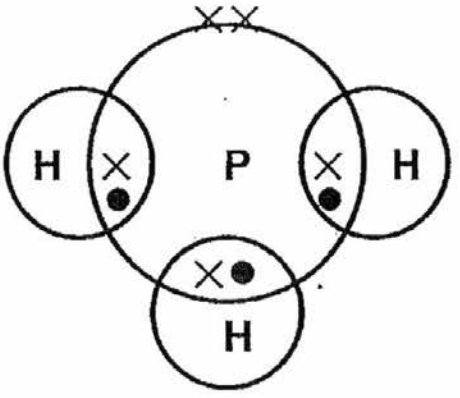
<table>
<tr><td>4</td><td>a</td><td colspan="3"><table>
<tr><th></th><th>Expt no</th><th>Explanation</th></tr>
<tr><td>Mistake 1</td><td>1</td><td>Fe^{3+} ion does not form white precipitate when sodium hydroxide is added to solution T.

Alternative answer:
Fe^{3+} ion forms red-brown precipitate when sodium hydroxide is added to solution T.</td></tr>
<tr><td>Mistake 2</td><td>1</td><td>Al^{3+} ion should also be deduced as a possible ion to be present when sodium hydroxide is added to solution T.

Alternative answer:
Al^{3+} ion forms white precipitate when sodium hydroxide is added to solution T.</td></tr>
<tr><td>Mistake 3</td><td>2</td><td>NO_3^- should be present instead of CO_3^{2-} when aluminium powder is added.</td></tr>
</table></td></tr>
<tr><td></td><td>b</td><td colspan="3">Test: Add dilute hydrochloric acid/ dilute sulfuric acid into test-tube containing Al^{3+} and Pb^{2+} ion separately.

Observation: White precipitate formed in test-tube containing Pb^{2+} ion. No white precipitate formed/ No visible change in test-tube containing Al^{3+} ion.

Alternative answer:
Test: Add potassium iodide solution into test-tube containing Al^{3+} and Pb^{2+} ion separately.

Observation: Yellow precipitate formed in test-tube containing Pb^{2+} ion. No white precipitate formed/ No visible change in test-tube containing Al^{3+} ion.</td></tr>
<tr><td>5</td><td>a</td><td colspan="3"> 
</td></tr>
</table>

	b	From the equation, 4 mol of P produces 1 mol of PH_3 Using mass ratio, (4 × 31 g) = 124 g of P produces (31+3) g = 34 g of PH_3 124 tonnes of P produces 34 tonnes of PH_3 18.6 tonnes of P produces $\frac{18.6}{124} \times 34 = 5.1$ tonnes of PH_3
6		no of moles of $Zn(NO_3)_2 = \frac{18.9g}{\{65+2[14+(3\times16)]\}g}$ = 0.1 mol From the equation, 2 mol of $Zn(NO_3)_2$ produces 2 mol of ZnO 0.1 mol of $Zn(NO_3)_2$ produces 0.1 mol of ZnO Theoretical mass of ZnO = 0.1 mol × (65+16) g = 8.1 g % yield = $\frac{7.8g}{8.1g} \times 100\%$ = 96.3%
7	**a**	Mass of water = 3.4 g – 2.7 g = 0.7 g no of moles of $CaSO_4 = \frac{2.7g}{[40+32+(4\times16)]g} = 0.019853$ no of moles of $H_2O = \frac{0.7g}{(2+16)g} = 0.038889$ $x = \frac{0.038889}{0.019853} = 2$
	b	**Test:** Add anhydrous copper (II) sulfate powder to calcium sulfate. **Observation:** The white copper (II) sulfate powder remains unchanged. Alternative answers: **Test:** Use cobalt(II) chloride paper. **Observation:** The blue cobalt(II) chloride paper remains unchanged. **Test:** Continue heating the sample until there is no further change in mass. **Observation:** No change in mass.

	ci	Reagents used: Calcium nitrate solution and sodium sulfate solution
	cii	1. Mix calcium nitrate solution in a beaker containing sodium sulfate solution 2. Filter the mixture to obtain calcium sulfate as residue. 3. Wash residue with some distilled water. 4. Dry the residue in between filter papers.
8	a	Gl: Be Bo: B
	b	Similarity: • Some elements such as F and Cl with the same number of valence electrons are grouped together./ • Both Co and Ni have the same atomic mass in both Tables. Differences: • Elements with the same number of valence electrons such as F and Cl are arranged in horizontal rows in Newland's Periodic Table instead of vertical columns in the Modern Periodic Table. • No noble gases or only group I to VII elements and transition metals shown in Newland's Periodic Table. • Elements are arranged by increasing proton number in the Modern Periodic Table but arranged by increasing atomic weight in Newland's Periodic Table. • Transition elements are differentiated from other elements in the Modern Periodic Table but not so in Newland's Periodic Table.
9	a	P: green-yellow gas Q: red-brown/ orange-red gas R: violet gas
	b	Displacement reaction
	c	$2AlBr_3 + 3Cl_2 \rightarrow 2AlCl_3 + 3Br_2$ **OR** $2AlI_3 + 3Br_2 \rightarrow 2AlBr_3 + 3I_2$
	d	Green-yellow gas will appear in Zone R. Violet gas/ black solid will be seen in zone Q. Violet gas/ black solid will be seen in zone P.

Section C

Q		Suggested solutions
1	a	When the solution is diluted 10 times, there is no effect on the electrical conductivity. When the solution is diluted 100 times, there is a sharp decrease in the electrical conductivity.
	b	1M H_2SO_4 has a higher conductance value than 1M ethanoic acid. Hence, strong acid has higher electrical conductivity than weak acid.
	c	**(i)** Distilled water does not conduct electricity as it is a covalent compound and there are no mobile electrons or ions present to conduct electricity. **(ii)** Magnesium oxide does not conduct electricity as the ions are held in fixed positions by strong electrostatic forces of attraction in the solid state. Hence, there is absence of mobile ions to conduct electricity.
	di	Electrical conductivity decreases from A to B. The hydroxide ions are slowly neutralised by the hydrogen ions to form water, leading to fewer mobile ions present in the solution.
	dii	Excess ethanoic acid and sodium ethanoate have mobile ions. These mobile ions can conduct electricity.
	diii	$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$ No of moles of ethanoic acid used $= \frac{5.0}{1000} \times 1.002 = 0.00501$ mol From the equation, 1 mol of CH_3COOH reacts with 1 mol of NaOH 0.00501 mol of CH_3COOH reacts with 0.00501 mol of NaOH Concentration of NaOH = 0.00501 mol $\times \frac{1000}{50}$ dm^3 $= 0.1002$ mol/dm^3 or $= 0.100$ mol/dm^3

2	a	$Co_2(SO_4)_3$
	b	Cobalt (III) sulfate is an ionic compound with giant ionic lattice structure. A large amount of energy is needed to weaken the strong electrostatic forces of attraction between ions. Hence cobalt (III) sulfate would have high melting point.
	c	Potassium
	d	Effervescence is seen. Potassium reacts explosively and melts to form a ball that darts around on the surface of water. A lilac flame may be seen.
	e	Similarity: Both transition metals and alkali metals are good conductors of electricity or heat. Both have giant metallic lattice structure. Differences (any two): • Transition metals are hard while alkali metals are soft. • Transition metals have high melting point while alkali metals have low melting point. • Transition metals form coloured compounds while alkali metals form white compounds. • Transition metals form ions of variable oxidation state while alkali metals do not. • Transition metals can be used as catalyst but alkali metals cannot. • Transition metals cannot react with cold water but alkali metals can.
3	a	Gas syringe/ electronic balance/ measuring cylinder
	b	A: Zn B: Ag
	ci	$Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

	cii	No of moles of $H_2 = \frac{500cm^3}{24000cm^3} = 0.020833$ From the equation, 1 mol of Mg produces 1 mol of H_2 0.020833 mol of Mg produces 0.020833 mol of H_2 Mass of Mg = 0.020833 mol × 24 g = 0.5 g
	di	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
	dii	No of moles of $Zn = \frac{0.5g}{65\,g} = 0.0076923$ mol From the equation, 1 mol of Zn produces 1 mol of H_2 0.0076923 mol of Zn produces 0.0076923 mol of H_2 Maximum volume of H_2 = 0.0076923 mol × 24 dm^3 = 0.18462 = 0.185 dm^3

(97)