



Established in 1879

Raffles Girls' School

(SECONDARY)

Name: _____

Class: 4 /

Register No: _____

CHEMISTRY YEAR FOUR

Pen-and-Paper Assessment 2

Thursday

09 May 2019

1 hour

INSTRUCTIONS TO CANDIDATES

This question paper contains two sections.

Section A - Answer **ALL** the questions and record your answers on the OMR answer sheet.

Section B - Answer **ALL** the questions and write your answers in the spaces provided.

Use only a black or dark blue pen.

Do not use correction tape or fluid.

Omission of essential working or units, or expressing answers with incorrect significant figures will result in a loss of marks.

INFORMATION FOR CANDIDATES

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 40.

A copy of the Periodic Table on page 16 is provided for your reference.

The weightage for this paper is 20%.

For examiners' use

Section / Question	Marks Obtained
A	10
B1	4
B2	11
B3	8
B4	7
Working Statement	
Units	
Significant Figures	
Total marks	40

Parents's / Guardian's Name: _____

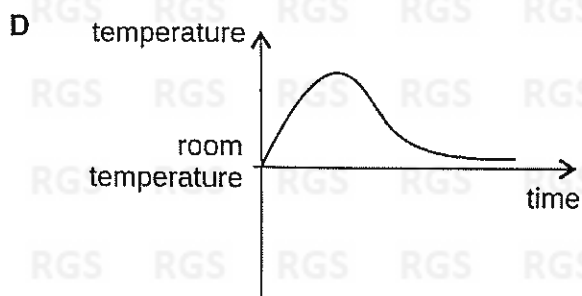
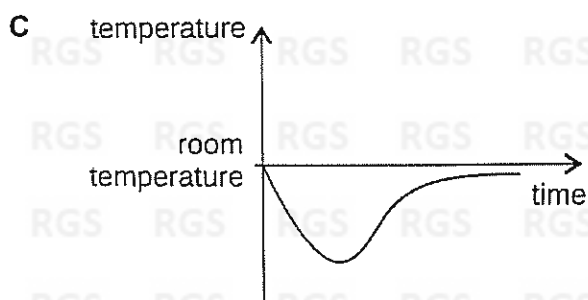
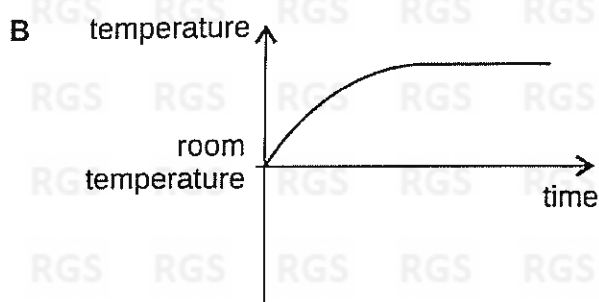
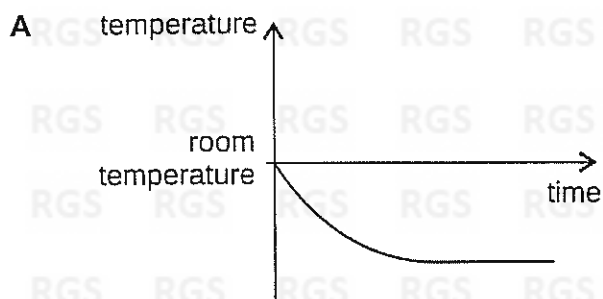
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Date: _____

Section A – Multiple Choice Questions [10 marks]

There are 10 questions in this section. Answer all questions. For each question, there are four possible answers (A, B, C, and D). Choose the most appropriate answer and record your choice on the OMR answer sheet.

1. The dissolving of a salt in water is an endothermic process. Which graph shows the temperature changes that occur when the salt is stirred with water until no further change in temperature is observed?



2. In the manufacture of iron by the blast furnace, which are the main gases that escape from the top of the blast furnace?

- A nitrogen, oxygen and steam
- B oxygen, carbon dioxide and sulfur dioxide
- C nitrogen, carbon dioxide and carbon monoxide
- D carbon monoxide, carbon dioxide and hydrogen

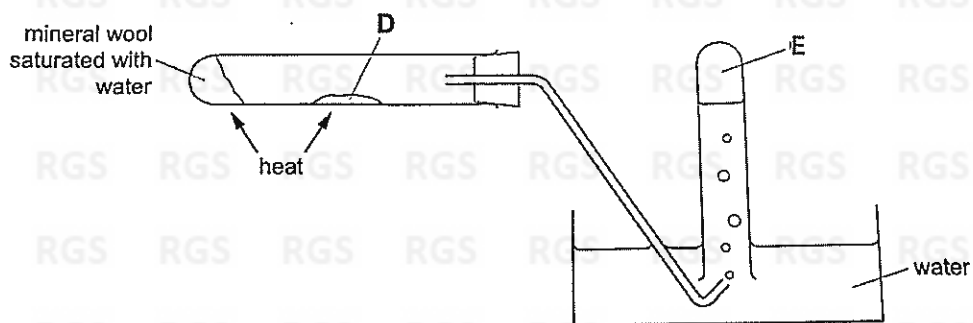
3. Which of the following reactions involves a positive change in enthalpy?

- A $\text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2$
- B $2\text{C}_6\text{H}_6 + 15\text{O}_2 \rightarrow 12\text{CO}_2 + 6\text{H}_2\text{O}$
- C $2\text{AgNO}_3 + \text{Fe} \rightarrow 2\text{Ag} + \text{Fe}(\text{NO}_3)_2$
- D $\text{H}_2\text{SO}_4 + 2\text{KOH} \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

4. Some carbonates decompose on heating to produce metal oxides and carbon dioxide gas. Which one of the following shows the correct order of temperature needed for decomposition?

- | | lowest temperature | —————→ | highest temperature |
|---|--------------------|-----------------|---------------------|
| A | MgCO_3 | CuCO_3 | ZnCO_3 |
| B | CuCO_3 | ZnCO_3 | MgCO_3 |
| C | ZnCO_3 | MgCO_3 | CuCO_3 |
| D | ZnCO_3 | CuCO_3 | MgCO_3 |

5. In the experiment shown, steam is passed over a heated solid **D**. Gas **E** is produced and collected.



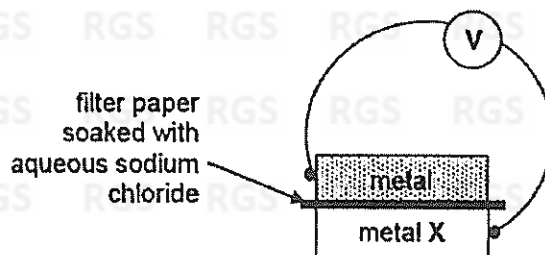
What are substances **D** and **E**?

	D	E
A	lead	oxygen
B	silver	oxygen
C	zinc	hydrogen
D	copper	hydrogen

6. An iron key is to be electroplated with copper using aqueous copper(II) sulfate as the electrolyte. Which of the following correctly shows the materials used for the electrodes and the half equation at the cathode?

	cathode	anode	half equation
A	iron key	copper	$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$
B	iron key	copper	$\text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$
C	copper	iron key	$\text{Cu}(\text{s}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$
D	copper	iron key	$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$

7. The set-up shown below was used to compare the reactivities of four metals **P**, **Q**, **R** and **S** with metal **X**.



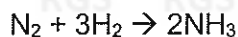
In each case, the voltmeter was recorded as follows:

metal under test	direction of electron flow	voltage recorded / V
P	P to X	+0.87
Q	X to Q	-1.20
R	R to X	+1.58
S	S to X	+0.36

What is the correct order of decreasing reactivity of metals **P**, **Q**, **R** and **S**?

- A** **P, Q, R, S**
B **R, P, S, Q**
C **Q, S, P, R**
D **R, Q, P, S**
8. Which of the following statement is true about the reactions of an element that lies between zinc and lead in the reactivity series?
- A** The metal reacts with sodium oxide when heated.
B The metal liberates hydrogen when reacted with dilute nitric acid.
C The metal displaces calcium from an aqueous solution of a calcium salt.
D The metal forms an oxide which decomposes back to the metal on heating.

9. In the Haber Process, nitrogen and hydrogen gases are combined to form ammonia gas under high temperature and pressure.



The relevant bond energies under the above conditions are provided below:

bond type	N=N	N≡N	N-H	H-H
energy (kJ/mol)	410	994	390	436

What is the enthalpy change for the reaction?

- A -38 kJ/mol
B -622 kJ/mol
C +260 kJ/mol
D +1132 kJ/mol
10. During electrolysis, 0.015 moles of chromium metal is deposited on the cathode when 0.090 moles of electrons is passed through a molten electrolyte containing chromium.

Which of the following substances can be the electrolyte?

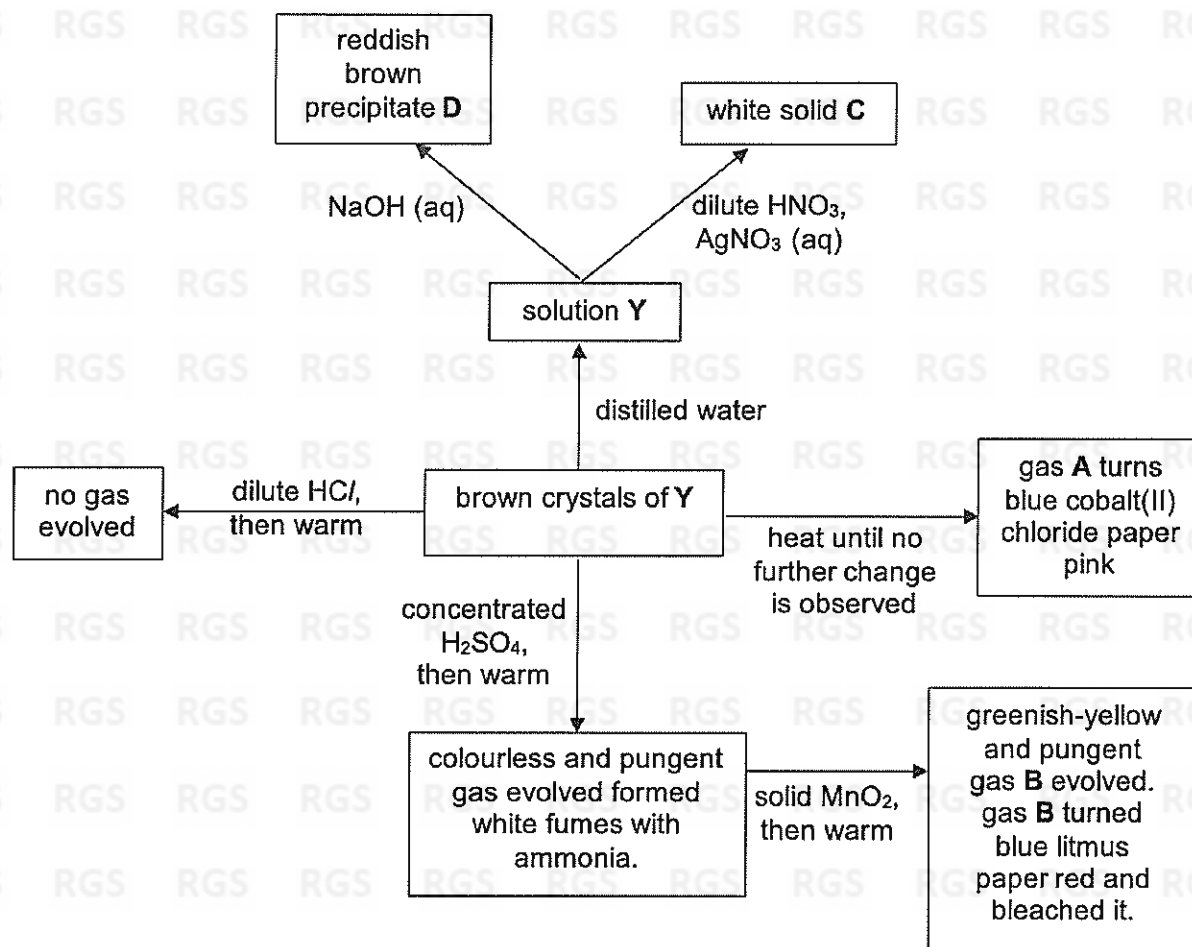
- A CrCl_4
B CrBr_2
C $\text{Cr}(\text{NO}_3)_6$
D $\text{Cr}_2(\text{SO}_4)_3$

----- End of Section A -----

Section B (30 Marks)

Answer **ALL** questions and write your answers in the spaces provided.

B1 Use the information provided below to identify unknowns **A – D**.



A: _____

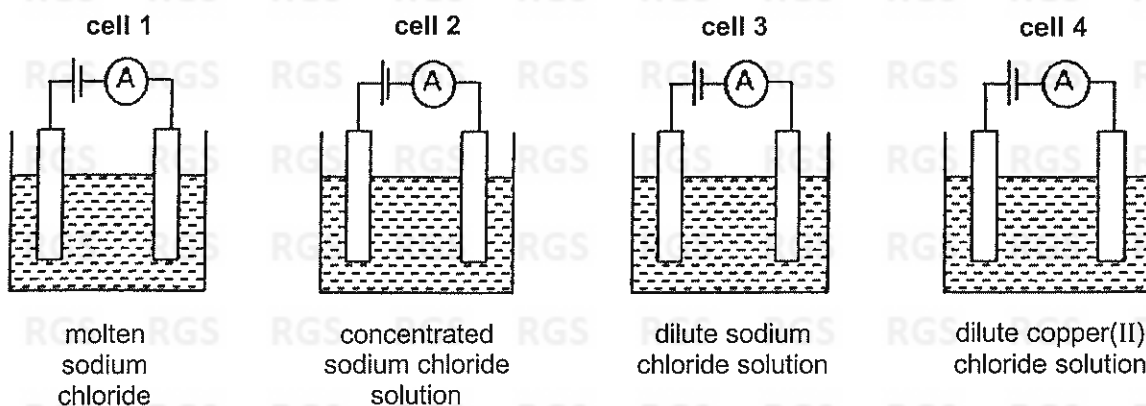
B: _____

C: _____

D: _____

[4]

B2 The diagrams show the electrolysis of four different electrolytes, using graphite electrodes.



(a) In which of the cells above can sodium metal be extracted? Explain your answer.

_____ [2]

(b) The gases produced at the electrodes in **cell 2** and **cell 3** are collected and their volumes are measured.

(i) Identify the gas formed at the anode of **cell 3** and describe a test to identify the gas.

Identity of gas: _____ [1]

Test to identify gas:

_____ [1]

(ii) Explain why the gases collected at the anode in **cell 2** and **cell 3** are different.

 _____ [2]

- (iii) With the aid of half-equations, explain why the volume of gas collected at the cathode in **cell 3** is twice the volume of gas collected at the anode.

Cathode: _____ [1]

Anode: _____ [1]

Explanation:

_____ [1]

- (c) Explain why the reading of the ammeter in **cell 4** decreases when a few drops of lead(II) nitrate solution are added to the electrolyte.

_____ [2]

B3 Ethanol ($\text{C}_2\text{H}_5\text{OH}$) is manufactured by reacting ethene (C_2H_4) with steam at high temperature and pressure in the presence of phosphoric acid as a catalyst.

(a) Write a balanced equation for the reaction.

[1]

(b) Given relevant information on bond energies, calculate, in the space below, the quantity of heat liberated when 1 mole of ethanol is produced.

molecule	molecular structure
ethene	<pre> H H C = C H H </pre>
ethanol	<pre> H H H H — C — C — O — H H H </pre>

bond	bond energy (kJ/mol)
C-H	410
C-C	350
C=C	610
C≡C	840
C-O	360
C=O	740
O-O	150
O=O	496
O-H	460
H-H	436

[3]

- (c) Draw a labelled energy profile diagram for the manufacture of ethanol from ethene and steam.



[2]

- (d) Direct ethanol fuel cells or DEFCs are a category of fuel cell in which ethanol is burnt directly to produce energy. The equation below describes the overall reaction that takes place in a DEFC.



Calculate the mass of ethanol required to produce 3×10^5 kJ of energy.

[2]

- B4** Table 4.1 below shows the standard electrode potential (E^θ) of some metals, measured in volts. The more negative the value of the standard electrode potential, the more easily the metal will ionise by losing its electrons. Generally, the more easily a metal loses its electrons, the more reactive the metal.

metal	E^θ/V
A	-0.67
B	-0.15
C	-0.47
D	+0.43
E	-0.31

Table 4.1

- (a) Rank the five metals given in table 4.1 in order of **increasing** reactivity.

_____ [1]

- (b) In an experiment, three of the metals (A, B and D) were added separately to their metal nitrate solutions in small amounts.

The results of the reactions with A and D are shown in table 4.2.

Complete the table with observations expected for metal B.

	aqueous nitrate of metal A	aqueous nitrate of metal B	aqueous nitrate of metal D
metal A		green solution turned colorless and grey metal coated with a blue solid	purple solution turned colorless and grey metal coated with a reddish-brown solid
metal B			
metal D	no visible reaction	no visible reaction	

Table 4.2

[2]

- (c) Approximately \$620 million worth of metal **F** was consumed in 2016. Metal **F** is used as plating material on cars and bicycles to give a polished mirror finish to an alloy of metal **G**. Metal **F** can be extracted by electrolysis of its molten ore while **G** is extracted by reduction of its ore by carbon in a blast furnace.

- (i) Would the alloy of metal **G** corrode if the coating of metal **F** on a bicycle is scratched? Explain your answer.

[2]

- (ii) Give **two** reasons why it is important to recycle metals.

[2]

— End of Paper —

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The Periodic Table of Elements

Group																							
I	II	III										IV	V	VI	VII	0							
		1 H hydrogen 1																2 He helium 4					
		proton (atomic) number atomic symbol name relative atomic mass																					
3 Li lithium 7	4 Be beryllium 9																	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24																	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84						
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131						
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -						
87 Fr francium -	88 Ra radium -	89 – 103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -		114 Fl flerovium -		116 Lv livermorium -								
lanthanoids																							
57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175									
89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -									
actinoids																							

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