233/2 – Chemistry - Paper 2

(Theory)

July 2018

Name …….Index Number…….

Candidate's Signature…… Date……

Instructions to candidates

a) Write your name and index number in the space provided
b) Answer ALL the questions in the spaces provided
c) All workings must be shown clearly
d) Candidates should answer the questions in English

For Examiner's use only

Question	Maximum Score	Candidate's Score
1	13	
2	12	
3	11	
4	10	
5	10	
6	13	
7	11	
Total Score	80	

1. i) One mole of Heptane was thermally cracked, two hydrocarbons Q and P were formed. Q was alkene molecule with three carbon atoms.

(a) Draw the structural formula of the hydrocarbons.

Q 1mk

P 1mk

b) Name the compounds that can be used to prepare Ethene in the laboratory. (1mk)

c) Name the compound formed when Q undergoes self addition reaction. (1mk)

d) State one disadvantage of using the product named in (i) (d) above. (1mk)

ii) An organic compound J has the following percentage by mass, carbon, 64.86%, hydrogen, 13.51% and the rest oxygen. The relative molecular mass of the compound is 74.

[C=12. H=1 O=16]

a) Work out the molecular formula of compound J. (3mks)

b) To which homologous series does compound J belong? (1mk)

c) Write a balanced chemical equation for the reaction that occurs when compound J reacts with sodium metal. (1mk)

d) Name the type of reaction indicated in (c) above. (1mk)

e) (i) Name the organic compound formed when compound J reacts with excess acidified potassium manganate (VII). (1mk)

ii) State the observation made in (e) (i) above. (1mk)

2. (A) The table below gives information about some oxides. Study the information and use it to answer the questions that follow.

Formula of oxide	Melting point	Effect of adding water to oxide	Effect of electric current on molten oxide	Effect of adding aqueous sodium hydroxide to oxide
Na_2O	920	Dissolves readily	Conducts; $Na_{(s)}$ and $O_{2\,(g)}$ produced	(a)
P_2O_5	563	Dissolves readily	(b)	(c)
SO_3	17	Dissolves readily	Does not conduct	Reacts readily
Al_2O_3	2045	Does not dissolve readily	(d)	Reacts readily

i. Write the missing information for spaces a to d (2mks)

ii. Write equations for the reactions that take place between
a) SO_3 gas and water (1mk)

b) SO_3 gas and sodium hydroxide (1mk)

iii. Why is it not advisable to carry out reaction ii (a) above in the laboratory? (1mk)

iv. Explain the difference in the melting points of P_2O_5 and SO_3 (1mk)

v. Phosphorous (V) oxide dissolves in water to form phosphoric acid. State and explain how the ability of concentrated phosphoric acid to conduct electricity compares to that of dilute phosphoric acid (2mks)

(B) During the industrial manufacture of hydrochloric acid, hydrogen gas and chlorine gas are the raw materials.

i. Write an equation for the reaction that occurs between hydrogen and chlorine in the burning chamber (1mk)

ii. What is the purpose of the glass beads in the absorption chamber after the reaction between chlorine and hydrogen? (1mk)

iii. Given that the percentage purity of the hydrochloric acid manufactured is 35% and its density is 1.18g/cm^3 determine the concentration of the acid. (H=1, Cl=35.5) (2mks)

3. a) In an experiment to determine the heat of displacement of copper by iron, $50cm^3$ of 0.2M copper (II) sulphate solution was reacted with excess iron filings and the following results were obtained

Initial temperature of copper (II) sulphate solution = 25.0^o C

Final temperature of copper (II) sulphate + iron filings = 31.0^0 C

Mass of iron filings used =1.0g

(Assume density of solution = $1.0g/cm^3$, specific heat capacity = $4.2Jg^{-1}K^{-1)}$

Calculate

I Temperature change (½ mark)

II Mass of the solution used (½ mark)

III Heat evolved during the reaction. (1mark)

IV Molar heat of displacement in kilojoules mol^{-1} (2marks)

V Write a thermochemical equation for the reaction above. (2marks)

VI Explain why excess iron filings were used in the experiment. (1mark)

b) (i) Define a fuel. (1mark)

(ii) Given the equation for the formation of Butanol,

$4C_{(s)} + 5H_{2(g)} + ½ O_{2(g)} \longrightarrow C_4H_9OH_{(l)}$

Calculate the standard enthalpy change for the formation of Butanol using the following information.

$C_{(s)} + ½\ O_{2(g)} \longrightarrow CO_{2(g)}\ \Delta H^{\theta}_{c} = -394KJ\ mol^{-1}$

$H_{2(g)} + ½\ O_{2(g)} \longrightarrow H_2O_{(l)}\ \Delta H^{\theta}_{c} = -286\ KJ / mol$

$C_4H_9OH_{(l)} + 6O_{2(g)} \longrightarrow 4CO_{2(g)} + 5H_2O_{(l)} - \Delta H^{\theta}_{c} = -2567\ KJ/mol$

(3marks)

4. The table below shows the positions of some elements in the periodic table. The letters are not the actual symbols of the elements.

						A		
	B		C		D		E	
F	G							
							H	

a) Select an element that can form an ion with a charge of +2. Explain your answer.(2mks)

b) What type of structure would the oxide of C have? Explain your answer.(2mks)

c) How does the reactivity of H compare with that of E? Explain your answer.(2mks)

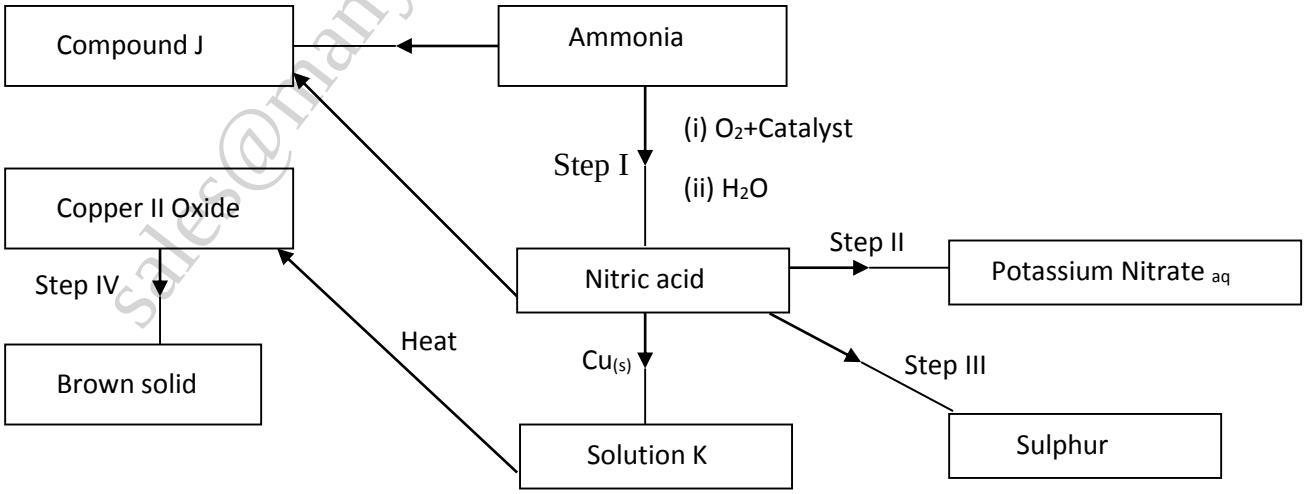
d) Explain how you would expect the following to compare.

(i) Atomic radii of F and G. (1mk)

(ii) The pH values of aqueous solution of the oxide of B and D. (1mk)

e) Draw a diagram to represent a stable ion of element D. (2mks)

5 (a) The scheme below shows various reactions starting with ammonia. Study it and answer the questions that follow.



(i) Name the catalyst in step I (1mk)

(ii) In step I, a series of reactions take place. Write any two equations for any of the reactions taking place in step I (2mks)

(iii) Write the equation for the reaction that takes place in step II (1mk)

(iv) Explain how the reaction in step III takes place (1mk)

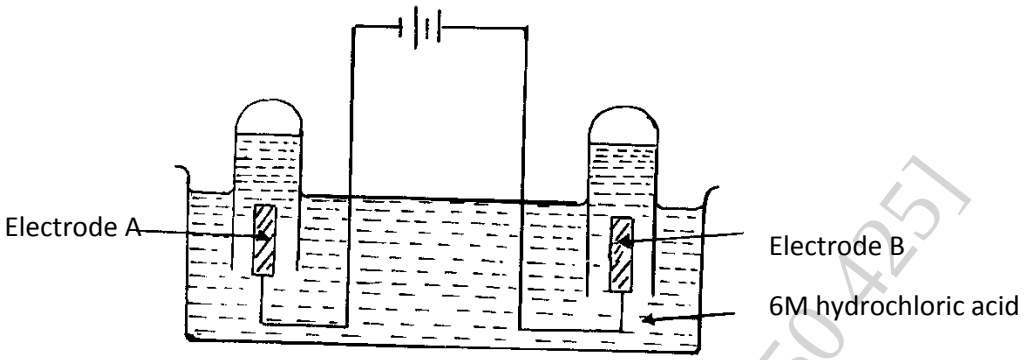
(v) Name a metal that can be added to solution K to form a brown solid (1mk)

(vi) Write the formula of compound J (1mk)

(vii) Calculate the percentage of Nitrogen by mass that is present in compound J (1mk)

(b) (i) Ammonia can be used to manufacture ammonium sulphate $(NH_4)_2SO_4$ and ammonium phosphate $(NH_4)_3PO_4$ fertilizers. Give one advantage that ammonium phosphate has over ammonium sulphate as a fertilizer.(H=1, N=14, O=16, P=31, S=32) (2mk)

6 a) The set up below was used during the electrolysis of 6M hydrochloric acid using inert electrodes.



(i) Identify the anions and cations present in the solution.

Anions: (1 mark)

Cations: (1 mark)

(ii) When the electrolysis is done over a period of time, a mixture of gases is obtained at electrode B. Identifying the gases, explain this observation (3 marks)

(iii) During the electrolysis, a current of 2 amperes was passed through the solution for 3 hours, 20 minutes. Calculate the volume of the gas produced at electrode A (1 Faraday = 96500 Coulombs and molar gas volume at room temperature is 24000 cm^3) (3 marks)

b) State any two applications of electrolysis (2 marks)

c) Use the information below on standard electrode potentials to answer the questions that follow:

	E Θ volts
$Cu^{2+} + 2e^- \longrightarrow Cu$	+ 0.34
$Fe^{2+} + 2e^- \longrightarrow Fe$	- 0.44
$Na^+ + e^- \longrightarrow Na$	- 2.92
$Mg^{2+} + 2e^- \longrightarrow Mg$	- 2.71
$Pb^{2+} + 2e^- \longrightarrow Pb$	- 0.14
$½ F_2 + e^- \longrightarrow F^-$	+ 2.87
$½ Br_2 + e^- \longrightarrow Br^-$	+ 1.09
$H^+ + e^- \longrightarrow ½ H_2$	0.00

i) From the list select:

I. The strongest reducing agent. Give a reason (1 mark)

II. The strongest oxidizing agent. Give a reason (1 mark)

ii) Calculate the e.m.f. of the cell constructed in (i) above (1 mark)

7. The factors which affect the rate of reaction between lead carbonate and dilute nitric (v) acid were investigated by carrying out three experiments

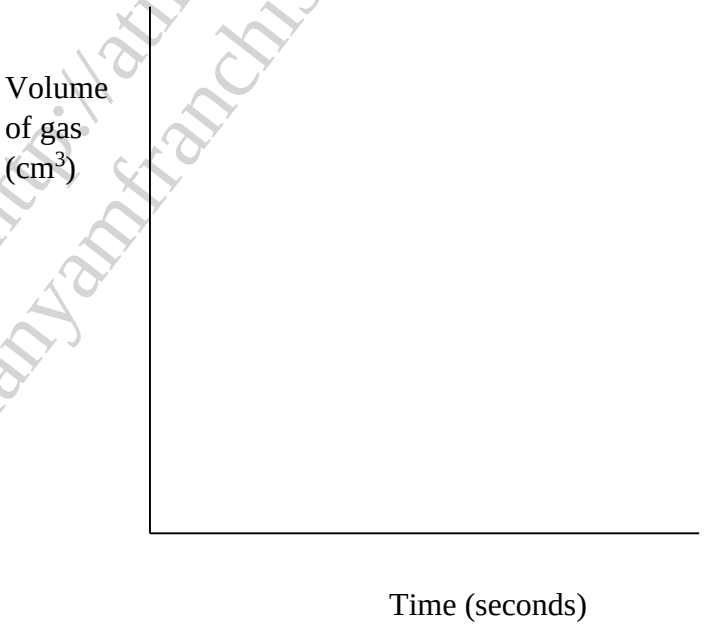
Experiment	Lead Carbonate	Concentration of nitric (v) acid
1	Lumps	4M
2	Powdered	4M
3	Lumps	2M

a) Other than concentration, name the other factor that was being investigated in the experiment (1mk)

b) For each experiment, the same volume of acid (excess) and mass of lead (II) carbonate were used and the volume of gas liberated measured with time.

i) Draw a setup that can be used to investigate the rate of reaction for one of the experiments (3mks)

ii) On the grid provided, sketch the curves obtained when the volume of gas produced was plotted against time for each of the experiments and label each as 1,2 or 3 (3mks)



iii) Write an equation for the reaction that took place (2mks)

c) If the experiments were carried out using dilute hydrochloric acid in place of dilute nitric (v) acid, the reaction would start, slow down and eventually stop. Explain these observations. (2mks)