FORM 4 MID TERM 2 2020

CHEMISTRY PAPER 2

1. (a) The grid given below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represents the actual symbols of the elements.

				Q					
O		███				R	S		
T		███					U		
V		███					Z		
		███							

   (i) Which element will require the least amount of energy to remove one of the outermost electrons. (1mk)

   ……………………………………………………………………………………………………….

   (ii) Select the most reactive non-metal   (1mk)

   ……………………………………………………………………………………………………….

   (iii)   Which of the elements has the greatest tendency of forming covalent compounds? Explain   (2mks)

   ……………………………………………………………………………………………………….

   ……………………………………………………………………………………………………….

   (iv)   What name is given to the family of elements to which elements **O,T** and **U** belong?

   ……………………………………………………………………………………………………….

   (v) An element W has atomic number 15 .Indicate the position of **W** on the grid .   (1mk)

   ……………………………………………………………………………………………………….

   (vi)Explain why the atomic radius of **S** is smaller than that of **R**   (2mks)

   ……………………………………………………………………………………………………….

   (vii)Explain why the atomic radius of **Z** is smaller than its ionic radius.   (1mk)

   ……………………………………………………………………………………………………….

   (b) Study the information given in the table below and answer question that follow.

Formular of compound	NaCl	$MgCl_2$	$AlCl_3$		$SiCl_4$	PCl_5	SCl_2
Boiling point ^{o}C	1470	1420	Sublimes at 180^oC		60	75	60
Melting point ^{o}C	800	710	✕		-70	-90	-80

   (i)   Give **two** chlorides that are liquids at room temperature. Give a reasons for your answer. (2mks)

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   ……………………………………………………………………………………………………….

   (ii)   Give a possible reason why $AlCl_3$ has much lower boiling point that $MgCl_2$ although both Aluminium and Magnesium are metals.   (2mks)

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2. A student set-up the following apparatus to prepare carbon (II) oxide from charcoal in the laboratory.
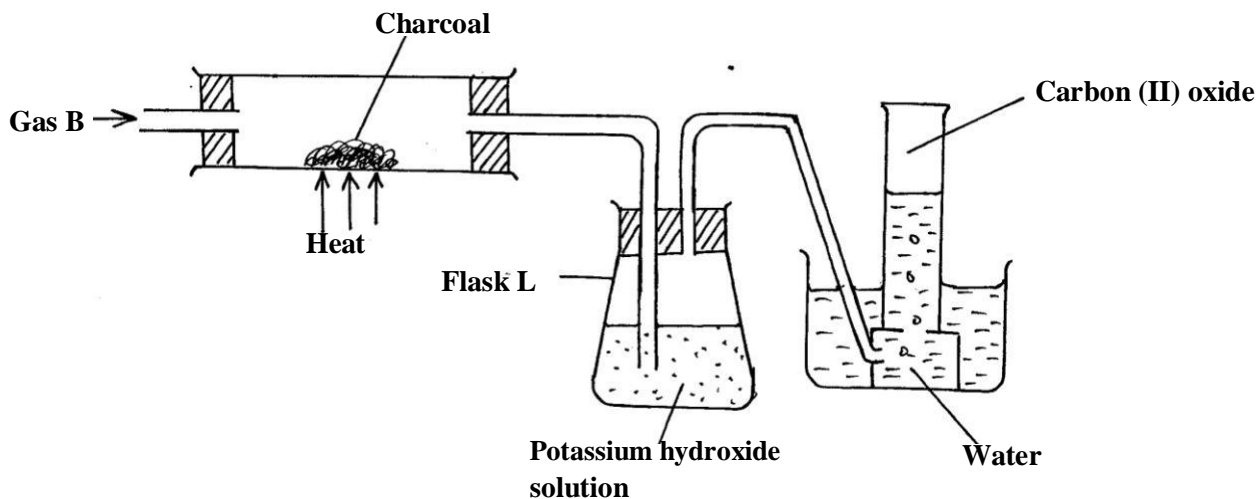
(a) (i)   State the purpose of potassium hydroxide solution.   (1mk)

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(ii)   Name **two** substances that react together to produce gas B   (1mk)

....

(b) Write balanced equations for reactions in:
(i)   Combustion tube   (1mk)

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(ii)   Flask **L**   (1mk)

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(c) Describe **two** simple tests that you would use to distinguish between carbon (IV) oxide and carbon (II) oxide   (2mk s)

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(d) In another experiment, the student reacted charcoal with excess concentrated nitric (v) acid.
(i)   State **two** observations made: (1mk)

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....

(ii)   Write balanced equation for the reaction   (1mk)

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....

(e) Carbon (II) oxide can also be prepared in the laboratory by reacting thanedioc acid and another substance.
(i) Name this substance and its role in this reaction   (2mks)

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....

(ii) State **two** uses of carbon (II) oxide   (2mks)

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3. Use the standard electrode potential for the elements **A,B,C** and **D** given below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

$$E^{\theta} \text{ (volts)}$$

$A^{+2}{}_{(aq)} + 2e^- \longrightarrow A_{(s)}$ - 0.76

$B^{+2}{}_{(aq)} + 2e^- \longrightarrow B_{(s)}$ - 0.44

$C_{2(g)} + 2e^- \longrightarrow 2C^-{}_{(aq)}$ +0.54

$D^{+4}{}_{(aq)} + e^- \longrightarrow D^{+3}{}_{(aq)}$ + 1.61

a) Which element is the:

(i) Strongest oxidizing agent.   (1mk)

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(ii) Strongest reducing agent   (1mk)

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b) (i) Draw a labeled diagram of the electro chemical cell that would be obtained when half cell of element A and B are combined. (3mks)

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………

(ii) Calculate the E^{θ} value of the electrochemical cell constructed in 3b(i) above   (1mk)

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(iii) Which two elements if used together in a cell would produce the largest e.m.f   (1mk)

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c) Calculate the number of faradays required to completely reduce 0.1 mole of Fe^{+3} to Fe   (2mks)

d) One of the major application of electrolysis is electroplating .In chromium plating the steel article is usually plated first with nickel or copper then chromium in a plating bath which contain chromium compounds in sulphuric (VI) acid and water. Chromium deposits on the article.

(i) Give a reason why steel parts are chromium plated.   (1mk)

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(ii) Why is it necessary for the steel to be mated first with nickel or copper before chromium is applied?(1mk)

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(iii) Give an ionic equation for the process responsible for chromium plating (1mk)

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(iv) If an electrical current of 4.5 amperes is passed through the chromium plating for 20hours, what would be the steel article? Cr = 52.0, 1 faraday = 96,500 coulombs) (3mks)

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4 Study the flow chart below and answer questions that follow:
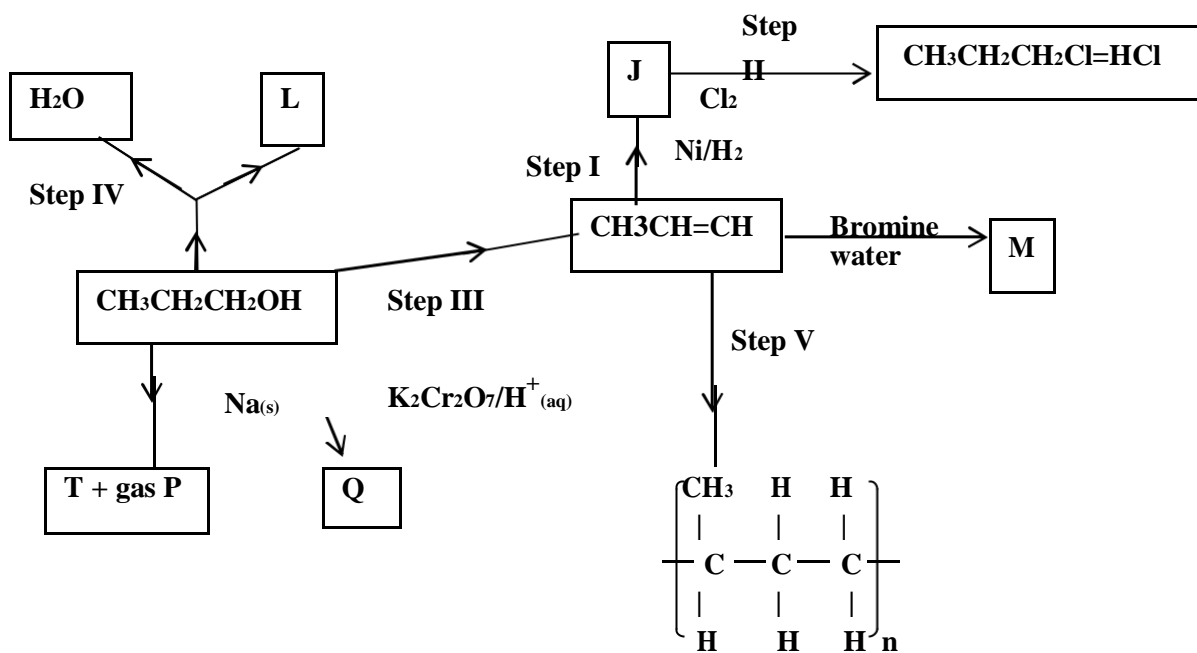
a) Name substance J and draw its structural formula (2mks)

Name : …………………………………………………………………………..

Structural formula:……………………………………………………………

b) What reagents and conditions are necessary for: (2mks)

(I) Step III

Reagent…………………………………………………………………………………..

Condition:…………………………………………………………………………………..

(II) Step II

Condition……………………………………………………………………………………….

c) Name the following:

   (i)   **L**: ……………………………………………………… (1mk)

   (ii)   Gas **P**: ……………………………………………… (1mk)

   (iii)   **Q** ……………………………………………………… (1mk)

   (iv)   **M**…………………………………………………….. (1mk)

d) Write the equation of the reaction that occur in step IV (1mk)

   ………………………………………………………………………………………………….

e) Give the name of Process in step **V** (1mk)

   ………………………………………………………………………………………………….

f) If the relative molecular mass of R is 21,000, determine the value of n. (C= 12.0, H = 1.0)   (2mks)
   ………………………………………………………………………………………………….
   ………………………………………………………………………………………………….

5. A student set-up the apparatus shown below in order to determine the percentage by volume of oxygen in the air. Study it and answer the questions that follow.

Phosphorus

Measuring cylinder

Wire

Start of experiment
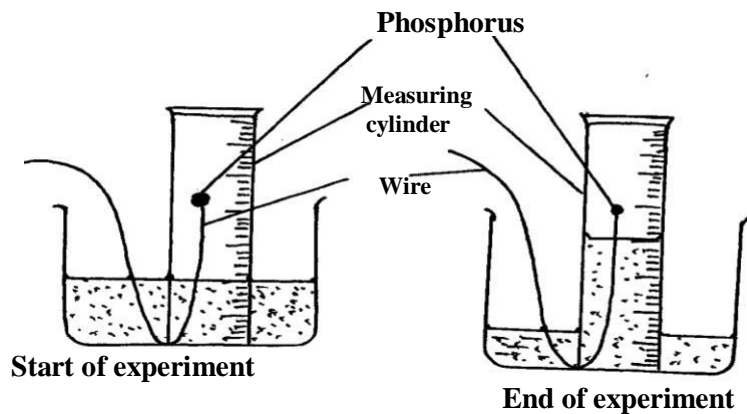
End of experiment

a) (i) State one observations made in the measuring cylinder at the start of the experiment. Explain (2mks)

   ………………………………………………………………………………………………….
   ………………………………………………………………………………………………….

   (ii)   The pH of the contents of the beaker at the end of the experiment was found to be 4. Explain the observation.(2mks)

   ………………………………………………………………………………………………….
   ………………………………………………………………………………………………….

   (iii)   The volume of air in the measuring cylinder at the end f the experiment was measured study the data given below and answer the questions that follow.

   Volume of air at start of the experiment = 30.65 cm^3

   Volume of air at the end of the experiment = 24.28 cm^3

   Determine the percentage volume of oxygen in the air. (1mk)

b) State and explain the observation made when a mixture of magnesium powder and copper (II) oxide is heated in a crucible (2mks)

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c) State **two** air pollutants produced by motor vehicles. (1mk)

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6.   (a) The results below were obtained in an experiment conducted by form 3 students from Ratansi secondary School using magnesium

Mass of the crucible + Lid = 19.52g

Mass of the crucible + Lid + magnesium ribbon = 20.36g

Mass of the crucible + Lid + magnesium oxide = 20.92g

(i)   Use the results to find the percentage mass of magnesium and oxygen in magnesium oxide. (2mks)

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(ii)   Determine the empirical formula of magnesium oxide. (Mg = 24.0, O = 16.0) (2mks)

b) Sodium hydroxide pellet were accidentally mixed with sodium chloride, 8.8g of the mixture were dissolved in water to make one litre of solution. $50cm^3$ of the solution was neutralized by $20.0cm^3$ of 0.25M sulphuric (VI) acid.
(i) Write an equation for the reaction that took place. (1mk)

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(ii) calculate the:

I.   Number of moles of the substance that reacted with sulphuric (VI) acid (2mks)

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II.   Number of moles of the substance that would react with sulphuric (VI) acid in the one litre solution(1mk)

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(iii)   The percentage of sodium chloride in the mixture. (2mks)

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7. (a) Use the bond energies given in the table below to calculate the enthalpy change for the reaction

$C_2H_{6(g)} + Br_{2(g)} \longrightarrow C_2H_5Br_{(g)} + HBr_{(g)}$
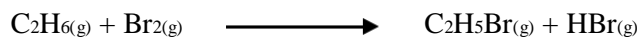
Bond	C – H	C – Br	Br – Br	H – Br
Bond energy KJ/mol	413	280	193	365

(b) On the space provided below, sketch the cooling curve that would be obtained when a boiling tube containing water at 80^oC is immersed in a freezing mixture maintained at -10^oC (2mks)

(c) Butane C_4H_{10} cannot be prepared directly from its elements but its standard heat of formation (ΔH^{θ}_f),
can be obtained indirectly.
The following heats of combustion are given
ΔH^{θ}_c (Carbon) = - 393 kJ/mol
ΔH^{θ}_c (Hydrogen) = - 286 kJ/mol

(i) Draw an energy cycle diagram linking the heat of formation of butane with its heat of combustion and the heat of combustion of its constituents elements. (2mks)

(ii) Calculate the heat of formation of butane ΔH_f (C_4H_{10}) (2mks)

d) Given that the lattice enthalpy of potassium chloride is + 690 kJ/mol and hydration enthalpies of K^+ and Cl^- are -322kJ and – 364kJ respectively. Calculate the enthalpy of solution of potassium chloride. (2mks)