CHEMISTRY PP2
END TERM ONE EXAMS, 2022
TIME:

ANSWER ALL THE QUESTIONS

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

							I
	G				A		J
F	B	C		D		E	K
							L
						H	M

(i) Select an element that can form an ion with a change of -2. Give a reason for your answer. (2mks)

A - Reacts by gaining 2 electrons.

(ii) What type of structure would the oxide of G have? (1mk)

Giant ionic structure.

(iii) How does the reactivity of H and E compare? Give a reaction for your answer. (2mks)

E is more reactive than H / H is less reactive than E. E can easily gain electron / E has a higher electron affinity than H / E is more electronegative than H.

(b) 1.3g of B reacts completely when heated 1.2 litres of chlorine gas at s.t.p (molar gas volume at s.t.p is 22.4litres)

(i) Write an equation for the reaction between B and chlorine (1mk)

$B_{(s)} + Cl_{2(g)} \longrightarrow BCl_2$ // $Mg_{(s)} + Cl_{2(g)} \longrightarrow MgCl_{2(s)}$.

(ii) Determine the relative atomic mass of B. (2mks)

22.4L → 1mole
1.2L → ?
$\frac{1.2 \times 1}{22.4} = 0.05357$
mole ratio 1:1
mole of B => 0.05357
1.3g → 0.05357
? → 1mole
$\frac{1.3 \times 1}{0.05357} = 24.2673$

(c) Explain how you would expect the following to compare

(i) Atomic radius of F and B. (2mks)

F has a larger atomic radius than B / B has a smaller atomic radius than F. B has more protons than F thus higher nuclear charge o. force of attraction.

(ii) The P++ value of the aqueous solution of the oxide of B and D. (2mks)

B solution has pH above 7 while D solution has pH bellow 7.

~~11~~ ~~12~~. Study the information below and answer the questions (the letters do not represent the actual symbols of the elements.

elements	Electronic configuration	IE (kj/mol)
I	2.1	519
K	2.8.1	494
L	2.8.8.1	418

(i) What is Ionizations? (1mk)

It is the Minimum energy required to remove the outermost electrons of an isolated gaseous atom.

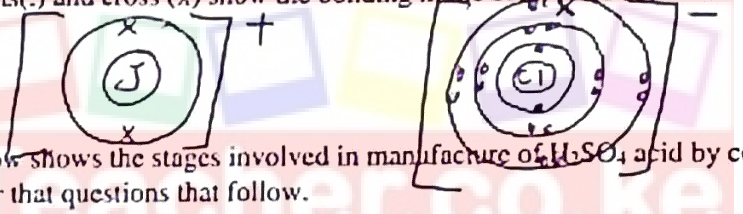
(ii) Explain why element L has the lowest Ionizations energy. (1mks)

L - has the largest atomic radius

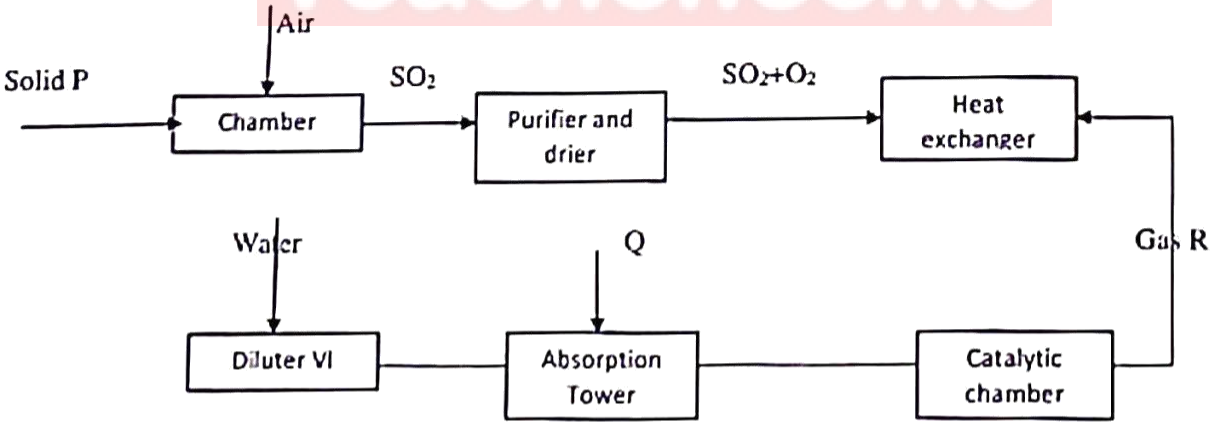
(iii) Write an equation for the reaction between K and water. (1mk)

$$2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)}$$

(iv) Using dots(.) and cross (x) show the bonding in the compound between J and Chlorine (1mk)



(2) ~~20~~. The flow chart below shows the stages involved in manufacture of H_2SO_4 acid by constant process. Study it and answer that questions that follow.



(a) A part from sulphur, identify other substance that can be used as a Solid P. (1mk)

Zn blende/ZnS, Galena/PbS, Copper Pyrites/$CuFeS_2$.

(b) What is the function of the purifier? (1mk)

To remove impurities which may poison the Catalyst.

(c) Give two functions of the heat exchanger. (1mk)

- To raise the temperature of the reacting gases ($SO_2 + O_2$).
- To lower the temperature of SO_3.

(d) State the optimum conditions for the reaction to take place at the catalytic chamber. (1mk)

- Catalyst Vanadium (V) oxide (V_2O_5), Pressure 2-3 atm.
- Temperature 450 °C

(e) Name

(i) Gas R. (1mk)

Sulphur (IV) oxide

(ii) Substance Q. (1mk)

Conc. Sulphuric (VI) acid.

(f) Write equations for the reaction taking place at the-;

(i) Catalytic chamber. (1mk)

$$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$$

(ii) Absorption tower. (1mk)

$$H_2SO_{4(l)} + SO_{3(g)} \longrightarrow H_2S_2O_{7(l)}$$

(g) Explain why Gas R cannot be dissolved in water to form sulphuric (VI) acid. (1mk)

Reaction is highly exothermic thus the acid formed boils to form a mist of fine droplets of sulphuric acid in air

(h) Exhaust gases this process are passed through Chimneys lined with calcium hydroxide to avoid pollution.

(i) Name this process. (1mk)

Scrubbing

(ii) Write the equation for the reaction taking place. (1mk)

$$Ca(OH)_{2(s)} + SO_{2(g)} \longrightarrow CaSO_{3(s)} + H_2O_{(l)}$$

(i) State the observation made when concentrated Sulphuric (VI) acid is poured into a beaker containing sugar crystals. Name the property of conc sulphuric acid. (1mk)

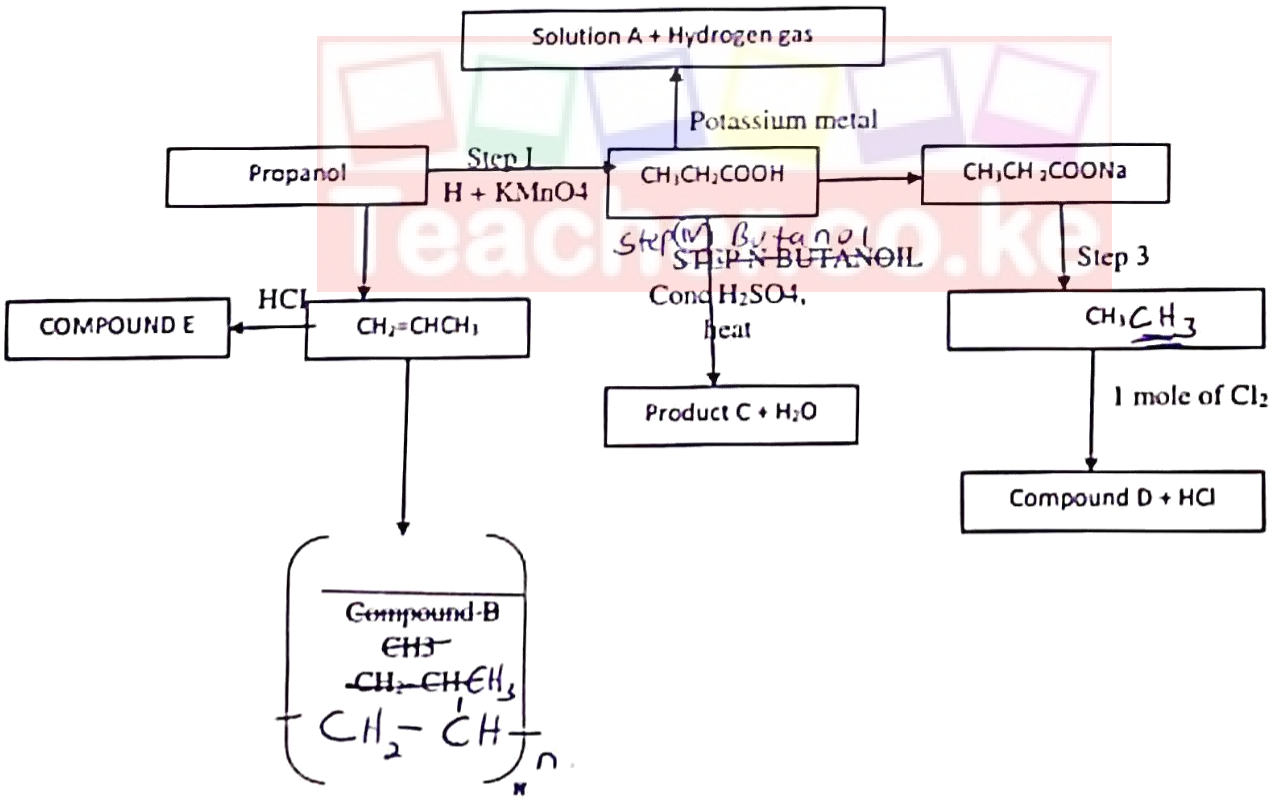
- Black solid is formed / Sugar turns from brown to Black.

- Dehydrating agent.

3. (a) What is an unsaturated hydrocarbon compound (1mk)

Are Carbons with high Carbon hydrogen ratio and burn With yellow sooty flame.

(b) The scheme below shows a series of reactions starting with propanol. Study it and answer the questions that follow.



(i) Name the type of reaction in step I and II (2mks)

Step I => Oxidation

Step II => Dehydration

(ii) Write the equation for the reaction that takes place in Step III (1mks)

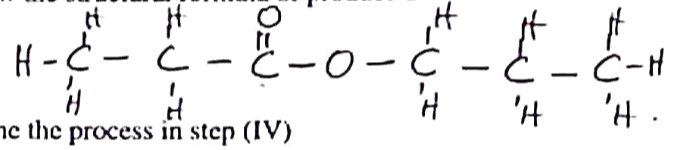
$CH_3CH_2COONa + NaOH \longrightarrow CH_3CH_3 + Na_2CO_3$.

(iii) Name the substance labelled A, C, D and E. (2mks)

A - Potassium propanoate D - Chloroethane

C - Butyl Propanoate E - Chloropropane or 2-chloropropane

(iv) Draw the structural formula of product C (1mk)



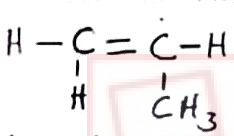
(v) Name the process in step (IV) (1mk)

Esterification.

(vi) Name compound B and state the type of reaction involved in its formation. (2mks)

- Polypropene,
- Polymerisation.

(vii) If the relative molecular mass of B is 35,700 determine the value of n. (2mks)



$= 42$. $\frac{35\,700}{42} = 850$.

(4) 8. Acidified potassium Manganate (VII) solution oxidises Iron (ii) to Iron (III) as shown in the Ionic equation below. If 0.2M $KMnO_4$ solution is needed to react with 25cm³ of 0.1M Iron (II) ammonium Sulphate, Calculate the volume of KMnO4 solution required. (3mks)

$MnO^{4-}_{(aq)} + 5Fe^{2+}_{(aq)} + 8H^{+}_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)} + 5Fe^{3+}_{(aq)}$

Mass of iron compound $= \frac{25 \times 0.1}{1000}$

$= 0.0025$ moles.

0.2 moles is in 1000cm³

0.0025 moles $\Rightarrow$?

$\left(\frac{0.0025 \times 1000}{0.2}\right) = 12.5\,cm^3$

(b) 12g of a mixture of sodium Sulphate and Sodium Carbonate were mixed with distilled water in a flask and topped up t 100cm³. 25cm³ if this solution required 12.5cm³ of 0.2M Sulphuric (VI) acid for complete reaction.

(i) Write down the chemical equation for the reaction that occurred between the mixture and Sulphuric (VI) acid (1mk)

$H_2SO_{4(aq)} + Na_2CO_{3(aq)} \longrightarrow Na_2SO_{4(aq)} + CO_{2(g)} + H_2O_{(l)}$.

(ii) Calculate the number of moles of H_2SO_4 which reacted with the mixture. (2mks)

$\text{Moles} = \frac{\text{Molarity} \times \text{Volume}(cm^3)}{1000}$

$\left(\frac{12.5 \times 0.25}{1000}\right) = 0.003125$ moles.

(iii) Determine the number of moles of the substances in the mixture that reacted with H_2SO_4 (2mks)

Mole ratio is 1:1

$= 0.003125$ moles.

(iv) Determine the molarity of the substance in C above. (2mks)

$\text{Molarity} = \frac{\text{No. moles} \times 1000}{\text{Volume in } (cm^3)}$

$\left(\frac{0.003125 \times 1000}{25}\right) = 0.125M.$

(v) What was the mass of Sodium Carbonate in the mixture? (2mks)

Mass = moles × ~~Mass~~ RFM.

? $= 0.003125 \times 106$

$= 0.33g.$

(vi) What was the percentage of Sodium Sulphate in Mixture. (2mks)

$(12g - 0.33) = 11.67g.$

$\frac{11.67g}{12g} \times 100\% = 97.25\%.$

5. (a) What is meant by molar heat of neutralization (1mk)

This is the heat energy released when one mole of water is formed from a reaction between an acid and an alkali

(b) State Hess's law. (2mks)

The energy changes in converting reactants to product is the same regardless of the route by which the chemical changes occurs.

(c)Given the following molar heat of combustion of graphite, hydrogen and anthracene as

$\Delta H^\circ C$ (graphite) = -394 kj/mol

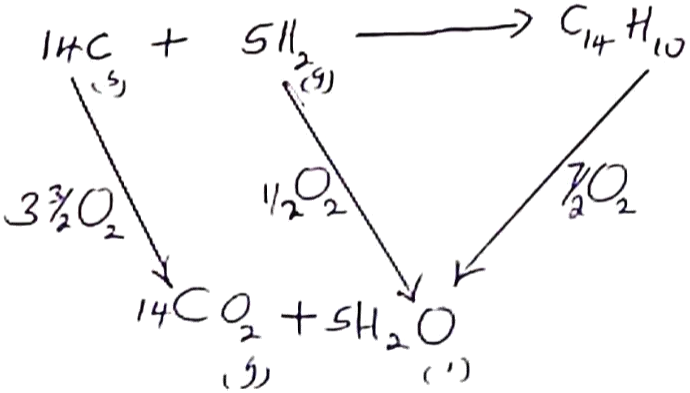
$\Delta H^\circ C(N2)$ = -286Kj/mol

$\Delta H^\circ C(C14H10)$ = -7114 kj/mol

i) Write down the equation for formation of anthracene (1mks)

$14C_{(s)} + 5H_{2(g)} \longrightarrow C_{14}H_{10(g)}$.

ii) Draw an energy cycle diagram that links heat of formation of anthracene with heat of combustion of hydrogen, graphite and anthracene (3mks)



iii) Calculate the standard heat of formation of anthracene. (2mks)

$\Delta H_c C + \Delta H_c H_2 - \Delta H_c C_{14}H_{10} = \Delta H_f C_{14}H_{10}$

$14(-394) + 5(-286) - (-7114) = x$

$-5516 + -1430 = x + -7114$

$(-6946 + 7114)$

$= +168\ KJ\ mol$

(d) When excess Iron fillings were added to 25.0cm³ of 0.4M Copper (ii) Sulphate solution, temperature rose by 15.0°C. Other than rise in temperature,

a) State and explain any other observation made. (2mks)

- Red brown solid deposits, copper ions oxidises to Copper metal
- Colour changes from blue to light green because hydrated Cu^{2+} ions are removed and replaced with Fe^{2+} ions

b) Determine the molar heat change (C=4.2 J/gK- density of water=1g/cm³. (3mks)

$\Delta H = McT$

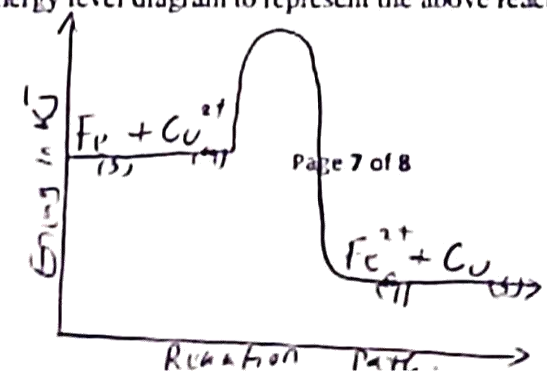
$(25 \times 4.2 \times 15) = 1575J$

$0.01 \rightarrow 1575$

$1 \rightarrow x$

$x = -157.5\ KJ$

c) Draw an energy level diagram to represent the above reaction. (2mks)



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7. Consider the following reaction at equilibrium

a) $PCl_{5(g)} \rightleftharpoons PCl_3(g) + Cl_2(g)$

b) Complete the table to show the effect of different factors on the position of equilibrium.

factor		Effect on Equilibrium position
i)	Decrease in pressure	- Equilibrium shift to the right. (1mks) - Forward reaction favoured.
ii)	Removing Chlorine	- Equilibrium shift to the right (1mks) - Forward reaction favoured.
iii)	Adding helum to the mixture	- NO effect - helium is inert. (1mks)

(b) Ammonia can be converted to nitrogen (ii) Oxide as shown in the equation below.

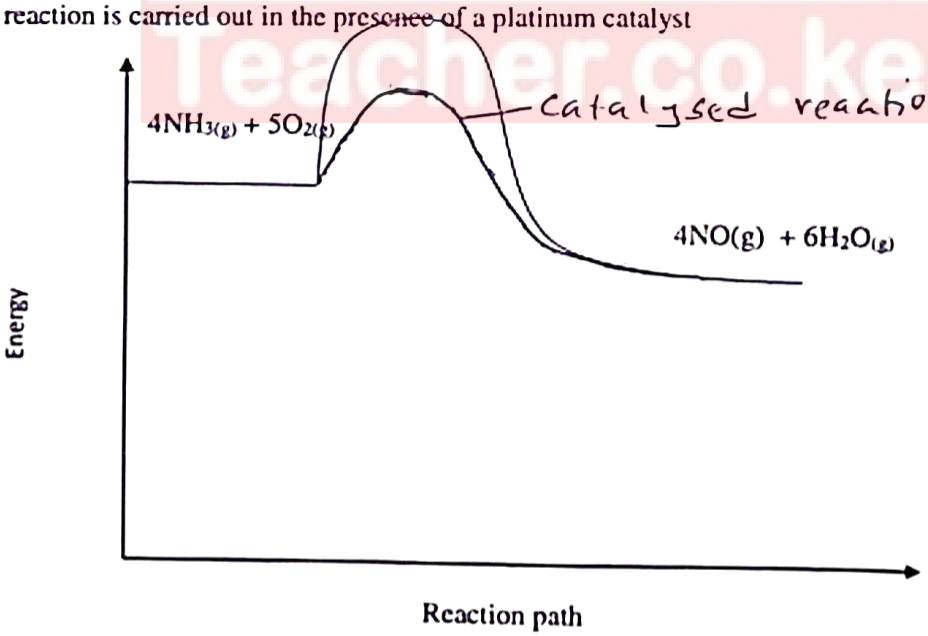
$4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$

i) Explain how on increase in temperature would affect the yield of Nitrogen (II) Oxide. (2mks)

The reaction is exothermic hence increase in temperature would lower the yield of Nitrogen (II) oxide.

ii) On the energy level diagram above, sketch the energy level diagram that would be obtained if the reaction is carried out in the presence of a platinum catalyst (2mks)

Below.



c) The reaction below is in equilibrium

$Br_{2(aq)} + H_2O_{(l)} \rightleftharpoons OBr^- + Br^- + 2H^+$

(j) State and explain the effect on the equilibrium when the dilute hydrochloric acid is added. (2mks)

- H^+ ions are introduced which react with colourless bromide and hypobromide ions to form yellow-orange aqueous bromine. Equilibrium shifts from right to left.
- Backward reaction favoured.

(ii) What is the effect of increasing hydrogen and Chlorine? Explain. (2mks)

$$H_{2(g)} + Cl_{2(g)} \rightleftharpoons 2HCl_{(g)}$$

- No effect on the yield of hydrogen chloride. The number of molecules of reactants equals the number of molecules of products.