ST. *BRUNO SSERUNKUMA SENIOR SECONDARY SCHOOL GGOL*

S.6 SELF ASSESSMENT REVISION QUESTIONS, 2020

PHYSICAL CHEMISTRY REVISION QUESTIONS

PAPER 2.

1). Methanoic acid and ethanoic acid are weak monobasic acids.

(a) (i) What is meant by the term mono basic acid

(ii) Write o an equation for the ionization of methanoic acid.

(iii) Write an expression for the ionization constant K_a for methanoic acid.

(b) 25cm^3 of 0.1M ethanoic acid solution was reacted with 50cm^3 of 0.05M sodium hydroxide solution

(i) Write the equation for the reaction that took place

(ii) Calculate the pH of the resultant solution (K_a for methanoic acid is 1.77 x 10^{-4} $moldm^{-3}$) (iii) Explain why the pH of the resultant solution is not equal to seven.

(c) Name a reagent that could be used to distinguish between methanoic acid and ethanoic acid and state is observed in each case when the each of the mistreated with the named reagent. (d) To 200cm^3 of 0.075M ethanoic acid was added with 123g of sodium ethanoate to make a solution.

(i) Calculate the pH of the resultant solution.

(ii) 10cm^3 of 0.1M hydrochloric acid was added to the resultant solution in (d) above. Calculate the change in pH of the resultant solution (Ka = 1.8 x 10^{-5} $moldm^{-3}$)

2. (a)(i) State Raoult's law and mention its limitations.

(ii) Explain what is meant by the term ideal solution

(b) Water (100^0C) and nitric acid (86^0C) when mixed forms a miscible liquid mixture that deviate negatively from Ideal solution.

(i) Explain why the mixture deviates negatively from ideality.

(ii) Draw a well labeled temperature –composition diagram for the mixture (Azeotropic mixture composition and boiling point are 68% nitric acid and 120.5^{O}C)

(c)(i) Describe the shape of the diagram

(ii) Explain what happens when 80% of the solution containing nitric acid is fractionally distilled.

(d) (i) Calculate the morality of nitric acid in the Azeotropic mixture.

(i) Given one method that could be used to increase the percentage of nitric acid in the azeotropic mixture

3). (a) (i) Define the term lattice energy

(ii) State two factors that affect lattice energy

(b) The Thermodynamic data for aluminum, fluorine and aluminum fluoride are given below.

-The standard enthalpy of formation of aluminum fluoride is $-130KJmol^{-1}$

-The standard enthalpy of atomization of aluminum is $+314\ kJmo1^{-1}$

-The standard enthalpy of bond dissociation of fluorine is $+158\ kJmo1^{-1}$

-First ionization energy of aluminum is $+577\ kJmo1^{-1}$

-Second ionization energy of aluminum is $+1820\ kJmo1^{-1}$

-Third ionization energy of aluminum is $+2740\ kJmo1^{-1}$

-First electron affinity of fluorine is $-348\ kJmo1^{-1}$

(i) Draw an energy level diagram for formation of aluminum fluoride.

(ii) Use the diagram you have drawn to determine the lattice energy of aluminum fluoride

(iii) Given that the hydration energies of aluminum ions and fluoride ions are -4690 and $-364kjmo1^{-1}$ respectively. Calculate the enthalpy of solution of aluminum fluoride and comment on the solubility of aluminum fluoride in water.

4). (a) State;

(i) Partition law

(ii) Three limitations of the law

(b) Describe an experiment to determine the partition co-efficient of butane -1, 4-dioic acid between ethoxyethane and water.

(ii) State two advantages and disadvantage of using ethoxyethane as a solvent in this experiment.

(c) An aqueous solution containing 10g of butane 1, 4-dioic acid per litre. When $100cm^3$ of this solution is shaken with $20cm^3$ of ethoxyethane, the ethoxyethane layer extracts 0.8g of butane 1,

4-dioic acid calculate mass of butane -1, 4-dioic acid extracted when 500cm^3 of the aqueous layer was shaken with.

(i) 50cm^3 of ethoxyethane

(ii) Two successive 25cm^3 portion of the ethoxyethane.

(d) Comment of on your results in (c) above.

(e) State two applications of partition coefficient.

5). (a) Define each of the following terms

(i) Enthalpy of neutralization

(ii) Enthalpy is a reaction

(iii) Bond energy

(b) Use of the following thermo chemical data to calculate the enthalpy of reaction in the equation below

$2C_2H_{6(g)} + 70_{2(g)} \longrightarrow 4CO_{2(g)} + 6H_2O_{(i)}$

Enthalpy of formation of carbon dioxide is -394 kJmo1^{-1}

Enthalpy of formation of water is -286 kJmo1^{-1}

(c)Explain each of the following observation

(i) The enthalpy of neutralization of a weak acid with a strong base is less than that between a strong acid with a strong base.

(ii) The bond energies of the halogens are 158, 242, 192 and 151 kJmo1^{-1} for Flourine, Chlorine, Bromine and Iodine respectively.

(d) During the experiment to determine the enthalpy of neutralization between hydrochloric acid and sodium hydroxide, 25cm^3 of 1.0M hydrochloric acid was pipetted into a plastic beaker and titrated with 1.0M sodium hydroxide from the burette. The temperature of the solution was recorded after every addition of the sodium hydroxide solution in the table below.

Value of NaOH added (cm^3)	0	10	20	25	30	35	40	45
Temperature of soln (^{O}C)	22	24.7	27.4	28.2	28.2	28.3	280	27.3
Temperature change (^{O}C)	0	2.7	5.4	6.2	6.5	6.3	6.0	5.8

(i).Plot a graph of temperature change against volume of sodium hydroxide solution added.

(ii) Determine the maximum temperature change from the graph.

(iii) Determine the volume of the sodium hydroxide solution at the end point.

(i) . Using 4.18kjmoi^{-1} C^{-1} kg^{-1} as the Specific heat capacity of the solution, calculate the enthalpy of neutralization of the reaction.

6). (a) Define the terms

(i) Conductivity

(ii) Molar conductivity

(b) The table below shows the molar conductivities of an aqueous solution of sodium hydroxide

Concentration (moldn^{-3}	0.01	0.04	0.09	0.16	0.25	0.36
Molar conductivity (n^{-1}cm^{2}ma^1	238	230	224	217	210	202

(i) Plot a graph of molar conductivity against of sodium hydroxide a t infinite dilution.

(ii) Explain the shape of the graph

(c). (i) Draw a sketch graph to show the change in the conductivity with volume of ammonia solution when 25cm^3 of 0.1M methanoic a acid is filtrated with 0.1M ammonia solution.

(ii) Explain the shape of the graph.

(c)The conductivity of a saturated solution of silver phosphate at 25 ^{o}C is 2.661 x 10^{-6} Scm^{-1} and that a of pure water is 1.519 x 10^{-6} Scm^{-1}. If the molar ionic conductivities of silver ion and phosphate ions at infinite dilution at 25^{0}C are 61.9 and 2405cm^{2}moi^{-1} respectively, calculate the

(i) Solubility of silver phosphate in moldm-3 at 25^{0}C

(ii) Solubility product of silver phosphate at 25^{0}C and state its unit

7. Explain what is meant by

(i) Emission spectrum

(ii) Absorption spectrum of hydrogen

(b) The atomic spectrum of hydrogen is given by the following relationship;

$$= \lambda_H(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$

(i) What does λ_H represent?

(ii) What do the terms n_1 and n_2 represent

(c) The spectrum of hydrogen comprises of a number of lines which may be divided into a number of series.

(i) Why does the spectrum consist of line?

(ii) Why is there a small number of series in the spectrum?

(iii) Explain why each series converges and in what direction it converges.

(d) What do you under by the term first ionization energy?
(e) State the factors that affect ionization energy

8. Define the following terms

(i) Eclectic point

(ii) Eutectic mixture

(b) The table below shows the melting points and compositions of various mixtures of bismuth and cadmium.

Percentage	20	35	50	65	80	95
Melting point (^{O}C)	226	190	156	154	242	300

Draw a well labeled phase diagram for cadmium-bismuth system. Use your graph to;

(i) Determine the melting points of pure cadmium and pure bismuth.

(ii) Determine the composition and melting point of the eclectic mixture.

(iii) Describe what happen when a liquid mixture containing 10% of cadmium at 350^0C is gradually cooled.

(iv). Determine the mass of bismuth that crystallized when 200g of the mixture containing 25% cadmium was cooled from 300^0C to 168^0C

(c)(i). State two similarities between a eutectic mixture and a pure metals.

(ii) State two uses of eutectic mixtures

9).(a) Methyl orange can be used as an acid base indicator.

(i) What is meant by the term acid base indicator?

(ii) Describe briefly how methyl orange works as an acid base indicator.

(iii) The indicator constant K_{in}, for methyl orange is 2.0×10^{-4} moldm^{-3}. Determine the approximate pH working range for methyl orange.

(b) 50cm^3 of 0.02M ethanoic acid was pipetted into a clean conical flask and 2-3 drops of phenolphthalein indicator added and the mixture titrated with an equal volume 0.02M sodium hydroxide solution until the equivalence point had reached.

(i) What is meant by the term equivalence point?

(ii) State the colour change at equivalence point

(iii) Calculate the pH of the mixture at equivalence point (Ka of ethanoic acid = 1.75×10^{-5} $moldm^{-3}$ and K_w for water = 1.0×10^{-14} mol^2dm^6)

(c) Sodium hydroxide was added to 25cm3 of 0.1M ethanoic acid and the pH of the solution was measured at intervals. The results are given in the table below

vol of NaOH(cm^3)	0	4	8	12	16	20	22	22.5	23	24	28
pH of mixture	2.8	3.5	4	4.5	5.1	5.8	7	9	10.5	11.4	12.3

(i) Plot a graph of pH against volume of sodium hydroxide

(ii) Explain the shape of the curve

(iii) Determine the pH at the end point

(iv) Calculate the molarity of sodium hydroxide solution

10)(a). Explain what is meant by the term order of a reaction.

(b) Describe an experiment that can be carried out to show that the decomposition of hydrogen peroxide solution follows first order kinetics.

(c) The iodination of propanone in acidic solution takes place according to the equation.

$CH_3COCH_{3(aq)} + I_{2(aq)} \longrightarrow CH_3COCH_{3(aq)} + HI_{(aq)}$

The rate of the reaction as followed by withdrawing $10cm^3$ samples from the reaction mixture quenching and filtrating against standard sodium thiosulphate solution. The following results were obtained.

Time (min)	0	10	20	30	40
Vol of $Na_2S_2O_{3(cm3)}$	8.0	6.5	5.0	3.5	2.0

(i) Plot a graph of volume of sodium thiosulphate against time.

(ii) What is the order reaction with respect to iodine. Explain your answer.

(i) Write an expression for the rate of the reaction if the reaction is first order over all.

(ii) What would be the effect on the gradient of your graph of doubling the initial concentration of iodine. Give a reason for your answer.

11). (a).Explain what is meant by;

(i) Osmosis

(ii) Osmotic pressure

(b) (i) With the aid of a well labeled diagram, describe an experiment you would perform under typical laboratory conditions to determine the relative formula mass of a solute using osmotic pressure method.

(ii) State the weaknesses of the osmotic pressure method.

(iii) Suggest why osmotic pressure measurements are more suitable for determining high value relative formula masses such as polymers than any other colligative property

(iv). State one practical applicable of reverse osmosis

(c) The osmotic pressures at various concentrations of a solute in a certain solvent G at 25^0C were shown below.

Concentration	1.2	2.5	3.6	4.8	6.0	7.2
Osmotic pressure (Nm^{-2})	25	39	55	77	94	112

(i) Plot a graph of osmotic pressure against concentration in gl^{-1} (ii)
Workout the relative formula mass (R=8.3138).

INORGANIC CHEMISTRY

1). Beryllium, Magnesium, Calcium, Strontium and Barium are Group (II) elements of the periodic table

(a) Explain briefly how the following vary down the group.

(i) Electro positivity

(ii) Melting points

(b) Briefly describe how the following compounds can be prepared in the laboratory.

(i) Calcium carbide

(ii) Strontium hydride

(iii) Barium peroxide

(d) Potassium chromate solution was added to barium nitrate solution followed by dilute nitric acid drop-wise until in excess. (i) State what was observed

(ii) Write equation for reaction that took place.

2). Discuss the chemistry of Aluminum and chromium showing.

(a) Similarities

(b) Differences. (Illustrate your answers with equations where necessary)

3).The atomic numbers and the melting points of the elements of period 3 of the periodic table are shown

Elements	Na	Mg	Al	Si	P	S	Cl	Ar
Atomic No.	11	12	13	14	15	16	17	18
Mpt/K	371	922.0	933.5	168.3	317	392	172.2	83.8

(a) (i). Plot a graph of melting point against atomic number.

(ii). Explain the shape of the graph

(b) Describe and explain how the oxides of Magnesium, Aluminum and Silicon react with;

(i) Sodium hydroxide

(ii) Hydrochloric acid

(c) State the type of bonding the oxide of sodium and phosphorous.

4). (a) Explain the trend in the boiling point of group (VII) elements.

(b) Explain why;

(i) The bond dissociation energy of fluorine is less than that of chlorine

(ii) Hydrofluoric acid is weak in dilute aqueous solution but stronger in concentrated solutions.

(iii) The acid strength of the hydrides of group (VII) elements increases down the group

(c) Describe the reaction of fluorine and bromine with

(i) Water

(ii) Sodium hydroxide

(d) Write equation for the reaction between sulphuric acid and potassium iodide.

5). Sodium, Magnesium, Aluminum, Silicon, Sulphur and Chlorine are Period 3 elements.

(a) Describe reactivity of each element with cold water.

(b) Explain the trend in melting points of the oxides of the elements.

(c) Beryllium is in group (II) element but its properties are similar to those of Aluminum. Describe four properties in which beryllium is similar to aluminum.

6). Carbon, Silicon, Tin and Lead belong to group IV of the Periodic Table. (a) Describe the reactions of the elements with;

(iii). Water

(iv) . Sulphuric acid

(b) Write the equation for the reaction between

(i) Silicon and hydrofluoric acid

(ii) . Lead and ethanoic acid

(iii) Lead (II) oxide and sodium hydroxide

(c)Describe the reaction of sodium hydroxide with;

(ii) . Silicon

(iii). Lead

7). (a) (i) Describe a general method for preparing the halogens (except fluorine) in the laboratory and write an equation for the reaction.

(ii) Hydrogen chloride can be prepared by reacting sodium chloride together with concentrated sulphuric acid however hydrogen bromide cannot be prepared using the same method. Explain

(b) Describe the reaction of fluorine with sodium hydroxide

(c) Explain why Iodine is more soluble in sodium hydroxide solution than water (d) State what will be observed when a few drops of concentrated sulphuric acid is heated together with sodium iodide. Write equation for the reaction

8. (a) Explain what is meant by the terms;

(i) Transition metal element
(ii) D-block element

(b) (i) State the common oxidation states of chromium and lead.

(ii) Discuss the similarity in chemical properties of chromium and lead.

(Your answer should include reactions leading to the formation of complexes with aqueous ammonia and hydrochloric acid.)

(c) Lead (IV) oxide and concentrated nitric acid were added to aqueous solution of manganese (II) sulphate and mixture warmed state and explain what is observed

(d) Cobalt (III) chloride 6- water has the chemical formula $oCl_3 6H_2O$ and exhibits hydrated isomerism.

(i) Explain what is meant by the term isomerism

(ii) Write the chemical formula of their isomers exhibited by $CoCl_3 6H_2O$

(iii) Name the two methods that can be used to distinguish among the three isomers identified in (d) (ii) above.

(e) Describe briefly how one of the methods mentioned in b (ii) can be used to distinguish among them.

ORGANIC **CHEMISTRY AND APLLIED**

1). Write short notes on each of the following, giving a suitable mechanism of the reaction in each case.

(i) Nucleophilic substitution reactions

(ii) Electrophilic substitution reactions

(iii) Free radical substitution reactions

(iv) Electrophilic addition reactions

(v) Nucleophilic addition reaction

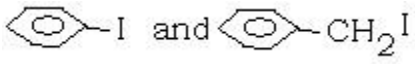
(vi) Electrophilic elimination reaction

(vii) Dehydration of alcohols

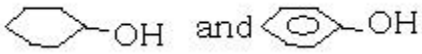
(viii) Esterification reactions (ix) Condensation reaction 2). Name a reagent that can be used to distinguish between each of the following pairs of organic compounds. In each case, state

what would be observed if each member of the pair is separately treated with the reagent you have named.

$CH_2=CH_2$ and $HC \equiv C\text{-}H$



iii.



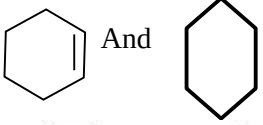
i. ii.

iv. HCOOH and CH_3COOH

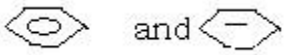
v. $Na_2C_2O_4$ and CH_3COON_a vi. CH_3COCH_3 and CH_3CH_2CHO vii. $CH_3CH_2CH_2CH_2OH$ and $CH_3CH_2CH(OH)CH_3$ viii. $CH_3CH_2C \equiv CH$ and $CH_3C \equiv C\text{-}CH_3$ ix. CH_3CHNH_2 and $(CH_3)_2NH$

x. CH_3CHO and CH_3CH_2CHO

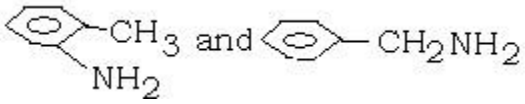
xi.



xii.

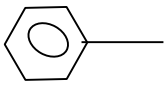


xiii.



3). Complete the following equations/reactions giving a detailed mechanism of the reaction in each case.

(a)



$CH_3 + Cl_2 \xrightarrow{UV}$

Excess

(b) $CH_3CH_2CH_2CH_2OH \xrightarrow[(170^0C)]{\text{Conc. } H_2SO_4}$

CH_3

CH_3-C - CH-CH_3 $\xrightarrow[(180^0C)]{\text{Conc. } H_2SO_4}$

CH_3 OH

(c)

(d) CH_3CH_2-CHCH_3 $\xrightarrow[\text{Heat}]{NaOH_{(aq)}}$

Br

(e) CH_3CH_2-CHCH_3 $\xrightarrow[\text{Heat}]{CH_3OH/NaOH}$

Br

(f) $CH_3CH{=}CH_2$ $\xrightarrow[(2)\ H_2O,\ \text{warm}]{(1)\ \text{Conc. } H_2SO_4}$

(g) +  $CH_3CH{=}\ CH_2$ $\xrightarrow{H^+}$

$CH_3CH{=}\ CH{-}CH_3 + Cl_2$ $\xrightarrow[\textbf{(h)}]{H_2O}$

(i) $(CH_3)_3$ C-Br $\xrightarrow[300^0C]{}$ CH_3OH/KOH

O

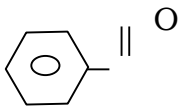
+  **(j)** $\xrightarrow{AlBr_3}$ CH_3C-Br $\longrightarrow$

O

(k) $\xrightarrow{\text{Dil } OH^-}$

$$2\ CH_3\ C\text{-}CH_3 \longrightarrow$$

(m) $CH_3\ C(=O)\text{-}CH_3 + NH_2NH\text{-}Z \xrightarrow{H^+}$

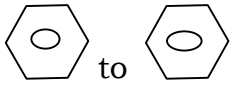
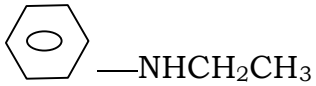
(n)  $CH3 + NaHSO_3 \longrightarrow$

(o) $CH_3\ CH_2OH + CH_3\ COOH \xrightarrow{H^+}$

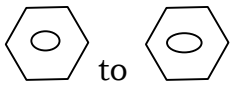
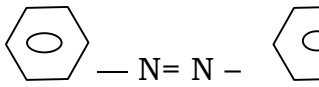
(p) $CH_3\ C(=O)\text{-}O\text{-}C(=O)\text{-}CH_3 + CH_3CH_2NH_2 \longrightarrow$

(q) $CH_3\ C{\equiv}C\text{-}H + H_2O \xrightarrow[60\ ^0C]{HgSO_4/H_2SO_4}$

4). Show using appropriate equations and reagents that can be used to synthesize the compounds on the right hand side from those on the left hand side of the arrow.

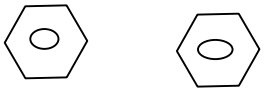
(a)  to 

(b) $CH_2 = CH_2$ to $CH_3CH_2OCH_2CH_3$

(c)  to 

(d) $CH_3CH_2CH_3$ to $CH_3C(=O)\ CH_3$

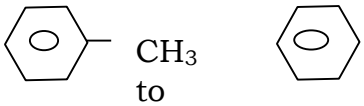
N-NH- 

(e) 

to — $COOCH_2CH_3$

(f) $HC \equiv C - H$ to $CH_3 CH = CH - CH_3$

(g) $CH_3 CH_2 Br$ to $CH_3 CH_2CH_2OH$

(h) 

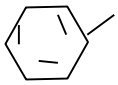
to

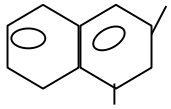
(i) $CH_3 CH_2 CH_2OH$ to

$CH_3 - C - CH_3$

$\|$

N – OH

to 

(j) NO_2 

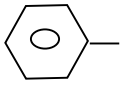
OH

N = N – 

(k)

$CH_3 CH_2 CH_2CH_3$ to $CH_3 C \equiv C - CH_3$

(m) $CH_3 CH_2 COOH$ to $CH_3 CH_2NH_2$

(n) CH_3CH_3 to  NH_2

(o) $CH_3\ CHCH_2CH_3$ to CH_3CH_2COOH

Cl

(p) $CH_3 - C = C - CH_3$ to $CH_3CH_2CH_2Br$

$CH_3\ CH_3$

(q) $H\ C \equiv C - H$ to $CH_3\ CH_2\ COOH$

(r) $CH_3 - C(CH_3)(CH_2CH_3)$ to CH_3COCH_3

Br

5). (a)(i) Distinguish between fats and oils.

(ii) State the raw materials used in the manufacture of soap (iii) Describe briefly how soap can be manufactured from named oil (iv)Describe briefly how soaps perform their cleaning action.

(v) Outline the disadvantages and advantages of using soaps in laundries.

(a) Detergents have come up and almost replaced soaps in most laundries.

(i) Give an example of a typical detergent and describe briefly how the detergent can be obtained from its raw materials.

(ii) State the essential differences between soaps and detergents.

(iii) Outline the advantages and disadvantages of use of detergents in homes and laundries.

(iv) Explain what is meant by the terms: plastics and polymers

(b) Giving suitable and the essential structural requirement of the monomers, explain each of the following terms;

(i) Addition polymerization

(ii) Condensation polymerization

(iii) Thermosetting plastics

(iv) Thermo softening plastics

(c) Natural rubber is widely used in life today.

(i) Name the monomer of natural rubber and give its structural formula.

(ii) Briefly explain how the properties of natural rubber can be improved.