Holiday Assignments

Section Name (A/L)

Subject : Chemistry **Grade: 13 E Science** **Medium: English**

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Instructions:

- Answer **ALL** questions.
- Use of calculator is not allowed.

Part A: General Chemistry

1. A 0.33 g sample of $Pb(NO_3)_2$ contaminated with $NaNO_3$ was dissolved in 100.0 cm^3 of water. Excess H_2S gas was then bubbled through this solution until the precipitation was complete. The mass of the dried precipitate was 0.20 g. Find the percentage purity (w/w) of the sample.
2. Hydrogen atoms absorb energy so that the electrons are excited to energy level $n = 4$. Electrons then undergo transitions $n = 4 \rightarrow n = 3$ and $n = 3 \rightarrow n = 2$. Which transition will give spectral emission lines of higher frequency? What is the energy of a photon resulting from the transition $n = 4 \rightarrow n = 3$?
3. For a solute of molar mass $W\ g\ mol^{-1}$, show that the molarity **M**, and molality **m**, of the solution are related by,

   Where d is the density of the solution in g ml^{-1}.

Part B: Inorganic Chemistry

1. Following tests were carried out with an aqueous solution containing an inorganic salt **X**.

	Test	Observation
(1)	$Dil.HCl$ was added to an aqueous solution of **X**.	Gas **Y** evolved while giving a clear solution.
(2)	Gas **Y** was passed through water and a solution of $BaCl_2$ was then added subsequently.	A white precipitate **Z** formed and it was soluble in acid.
(3)	H_2O_2 was added to the aqueous solution (2) above. Then a solution of $BaCl_2$ was added.	A white precipitate **K** formed and it was insoluble in acids.
(4)	$NaOH$ was added dropwise to an aqueous solution of **X**.	A white precipitate was formed initially, was dissolved in the presence of excess reagent.
(5)	Aqueous NH_3 was added dropwise to an aqueous solution of **X**.	A white precipitate was formed initially, was dissolved in the presence of excess reagent.

i. Identify gas **X**.
ii. Identify the white precipitates **Y** and **K**.
iii. Write the reaction between aqueous **Y** and $\boldsymbol{H_2O_2}$.
iv. Identify the white precipitates formed in (4) and (5). Why these precipitates dissolve in presence of excess reagent.

2. Explain how you would distinguish each compound using the method mentioned only.

$Na_2CO_{3(aq)}$
$NaCl_{(aq)}$
$Na_2S_2O_{3(aq)}$
} Adding a solution of $Pb(NO_3)_{2(aq)}$ and subsequent heating.

$NH_4NO_{3(s)}$
$Al(NO_3)_{3(s)}$
$(NH_4)_2SO_{3(s)}$
} Using solutions of $NaOH_{(aq)}$ and $HCl_{(aq)}$.

3. **A** is a salt formed by a metal belongs to s-block of the periodic table. It gives a light green colour flame in the flame test. When salt **A** is heated with the powder of metal **B** and solution **C**, it gives a colourless gas **D** and a colourless solution **E**. When solution **F** is added dropwise to solution **E**, a white gelatinous precipitate **G** formed. **G** dissolves in excess **F** to form a colourless solution **H**. When solution **F** is mixed with a Cu^{2+}ion solution, a yellow colour solution which contains complex ion **I**, with the coordination number 4 is formed. When solution **A** is mixed with solution **J**, a precipitate **K** formed which is insoluble in $dil.HNO_3$. When gas **D** is passed through solution **J**, a light green precipitate **L** formed which dissolves to forms a blue violet colour solution **M** with excess **D** gas.

i. Identify **A** to **M.**
ii. Give the IUPAC names of **I**,**M** and **L**.
iii. Write balanced chemical equations for the following,

A. $Cu^{2+} + \boldsymbol{F} \rightarrow \boldsymbol{I}$
B. $\boldsymbol{A} + \boldsymbol{J} \rightarrow \boldsymbol{K}$
C. $\boldsymbol{J} + \boldsymbol{D} \rightarrow \boldsymbol{L}$
D. $\boldsymbol{I} + \boldsymbol{D} \rightarrow \boldsymbol{M}$

Part C: Physical Chemistry

1. Consider the following gaseous reaction.

$$NO_{2(g)} + CO_{(g)} \rightarrow NO_{(g)} + CO_{2(g)}$$

a) The overall order of this reaction is 2. Write three rate equations which satisfy the kinetic requirement.

b) At $T\,K$, reaction rates for different concentrations of $NO_{2(g)}$ and $CO_{(g)}$ are given in the table below.

	$[NO_{2(g)}]/mol\,dm^{-3}$	$[CO_{(g)}]/mol\,dm^{-3}$	$Rate\ of\ reaction/mol\,dm^{-3}s^{-1}$
(1)	$1.20\ x\ 10^{-3}$	$1.20\ x\ 10^{-3}$	$2.00\ x\ 10^{-3}$
(2)	$1.19\ x\ 10^{-3}$	$2.40\ x\ 10^{-3}$	$1.98\ x\ 10^{-3}$
(3)	$3.60\ x\ 10^{-3}$	$1.18\ x\ 10^{-3}$	$1.80\ x\ 10^{-3}$

i. Find the order of the reaction with respect to $NO_{2(g)}$.
ii. Find the order of the reaction with respect to $CO_{(g)}$.
iii. Write the rate expression for the reaction.
iv. Calculate the rate constant at $T\ K$.
v. If this reaction takes place in two steps, propose a suitable mechanism with balanced equations.

2. Consider the following solutions named as A, B, C and D.

A ⟶ $0.1\ mol\ dm^{-3}\ HCl$ solution
B ⟶ $0.1\ mol\ dm^{-3}\ HCl + 0.1\ mol\ dm^{-3}\ CH_3COOH$ solution
C ⟶ $0.1\ mol\ dm^{-3}\ CH_3COOH + 0.1\ mol\ dm^{-3}\ CH_3COONa$ solution
D ⟶ $0.1\ mol\ dm^{-3}\ CH_3COOH + 0.05\ mol\ dm^{-3}\ CH_3COONa$ solution

$K_a\ (CH_3COOH) = 1.8\ x\ 10^{-5}\ mol\ dm^{-3}$

i. Calculate the initial pH values of each of these solutions.
ii. Arrange these solutions in the increasing order of their initial pH.
iii. Calculate the change in pH (ΔpH) that takes place in these solutions when $1\ cm^3$ of $0.1\ mol\ dm^{-3}\ NaOH$ is added to $1\ dm^3$ of these solutions.
iv. Arrange these solutions in the increasing order of ΔpH.
v. Identify the solutions that can show a buffer action.
vi. From the solutions stated in (v) above, identify the buffer solution with the highest buffering capacity.

3. $1.5\ mol$ of $SO_{2(g)}$, $3\ mol$ of $O_{2(g)}$ and $4.5\ mol$ of $SO_{3(g)}$ were placed in a closed rigid container at 35^0C (room temperature). The following equilibrium was then achieved.

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

The initial pressure of the system was $1.5\ x\ 10^5\ Nm^{-2}$.

i. Calculate the partial pressures of each species at35^0C.
ii. Calculate the reaction quotient (Q_P), of the above reaction at 35^0C.

The following standard Gibb's free energy changes are provided to you.

Compound	$\Delta G_f^0/kJ\ mol^{-1}$
$SO_{2(g)}$	-300.2
$SO_{3(g)}$	-374.2

iii. Calculate ΔG^0 for the reaction.
iv. Find the ΔG value for the forward reaction using the following relationship.

$$\Delta G = \Delta G^0 + 2.303\ RT \log(Q_P)$$

v. Comment on the spontaneity of the forward reaction at 35^0C using the above calculated ΔG value.

Part D: Organic Chemistry

1. Using your basic knowledge in organic chemistry explain the following.

i. Conc. H_2SO_4 catalyzes esterification reactions.

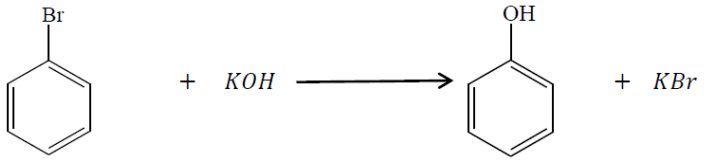
ii. Friedel-Crafts alkylation of benzene generally leads to poly substituted products.

iii. Aromatic amines undergo diazotization at very low temperatures.

iv. Amides are neutral against a litmus reaction.

v. Aldehydes are more reactive than ketones against nucleophiles.

2. Comment on the feasibility of the reaction given below.



3. Using the chemicals/reagents listed below, carry out the following synthesis starting from benzene.

Chemical/reagent list,
$CH_3CH_2CH_2Cl$, CH_3CH_2OH, CH_3MgCl, CH_3COCl, anhy $AlCl_3$, H_2O, KCN
$LiAlH_4$, Conc. H_2SO_4, PBr_3