கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) பயிற்சிப் பரீட்சை - 2024
General Certificate of Education (Adv.Level) Practice Examination - 2024

இரசாயனவியல் I Chemistry I	02 E I	ஒரு மணித்தியாலம் One hour

Universal gas constant $R = 8.314\ \text{J K}^{-1}\ \text{mol}^{-1}$ Planck's constant $h = 6.626 \times 10^{-34}\ \text{J s}$
Avogadro constant $N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$ Velocity of light $c = 3 \times 10^{8}\ \text{m s}^{-1}$

1. Which one of the following is an acidic oxide?
(1) MnO (2) CrO (3) Mn_2O_3 (4) NO (5) NO_2

2. Which of the following reactions is **false**?
(1) $2Na\ (s) + Cl_2(g) \rightarrow 2NaCl(s)$
(2) $Cu\ (s) + I_2\ (g) \rightarrow CuI_2(s)$
(3) $Xe\ (g) + F_2(g) \rightarrow XeF_2(g)$
(4) $Fe\ (s) + Cl_2(g) \rightarrow FeCl_2(s)$
(5) $I_2\ (s) + Cl_2(g) \rightarrow 2ICl(s)$

3. Select the correct statement with regard to halides.
(1) The oxidizing ability of halides increases from top to bottom in the group.
(2) All halides are good reducing agents.
(3) The oxide formed by the element F is OF_2.
(4) All halides take oxidation numbers from -1 to $+7$ when forming compounds.
(5) An aqueous solution of chlorine is used for bleaching.

4. Which of the following statements is true?
(1) The softness of group I elements decreases from top to bottom in the group.
(2) Solubility of group II hydroxides increases from top to bottom in the group.
(3) Nitrates of group II elements are water- insoluble.
(4) **Be** can react with cold water.
(5) All the elements in the group I can react with $N_2(g)$.

5. Which one of the following is true with regard to the element **N**?
(1) The basic hydride formed by the element nitrogen gives black coloured fume with HCl.
(2) Chloride of nitrogen gives only acidic products during hydrolysis.
(3) Disproportionation takes place in the decomposition reaction of $NH_4NO_3(s)$.
(4) When conc. H_2SO_4 is added to the salt sample, which contains NO_3^-, a reddish brown colour gas evolves.
(5) An aqueous solution of Al^{3+} gives green gelatinous precipitate with NH_3.

6. 34.0 g of ammonia reacts with 100.0 g of O_2 using Pt as catalyst. The maximum amount of resultant gas that evolves in the reaction is, (N = 14, O = 16)
(1) 28 g (2) 36 g (3) 60 g (4) 30 g (5) 45 g

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7. Metal Na reacts with excess H_2 . The product of this reaction is allowed to react with H_2O. 25.0 cm^3 of 1.2 mol dm^{-3} HCl(aq) is required to neutralize the above resultant solution. The mass of Na used is, (Na = 23).
(1) 1.15 g (2) 0.92 g (3) 0.69 g (4) 0.46 g (5) 0.23 g

8. Which of the following is **false**?
(1) Both $SbCl_3$ and $BiCl_3$ give white precipitate with water.
(2) $Cu^{2+}$and Fe^{3+}can be distinguished using $K_4[Fe(CN)_6]$.
(3) Most of the compounds of Vanadium in +4 oxidation state are blue in colour.
(4) Hydroxides of Cr and Co are insoluble in excess NaOH.
(5) When $Cr(OH)_3$ reacts with H_2O_2 in the presence of OH^-, results a yellow colour solution.

9. 1.33 g of solid sample which contains NaCl and KCl, is dissolved in water. When excess $AgNO_3$ is added, 2.87 g of AgCl(s) is precipitated. The approximate $(\frac{w}{w})$ % of NaCl in the solid sample is, (Na = 23, K = 39, N = 14, O = 16, Cl = 35.5, Ag = 108)
(1) 44% (2) 48% (3) 56% (4) 50% (5) 40%

10. A certain ammonium salt forms 30.4 g of green colour residue during the thermal decomposition. The weight of used ammonium salt is,
(1) 48.4 g (2) 50.0 g (3) 50.4 g (4) 60.8 g (5) 62.4 g

11. The cation present in the inorganic salt **P** forms a yellow colour complex with concentrated HCl, while it gives a black coloured precipitate when passing H_2S(g) in a basic medium. When $PbNO_3$ is added to the salt **P**, it gives a white precipitate immediately which turns to black colour after some time. Inorganic salt **P** can be,
(1) $NiCl_2$ (2) $Co(NO_3)_2$ (3) NiS_2O_3 (4) CuS_2O_3 (5) $Cr_2(SO_4)_3$

12. 9.08 g of a sample which contains only $NaHCO_3$, Na_2CO_3 and $(NH_4)_2CO_3$ is strongly heated and the obtained residue was dissolved in excess $CaCl_2$. The weight of the formed precipitate was 5.00 g. Mole ratio of $NaHCO_3$: Na_2CO_3 is 3 **:** 1. The number of moles of $(NH_4)_2CO_3$ is,
(1) 0.01 mol (2) 0.02 mol (3) 0.10 mol (4) 0.20 mol (5) 0.05 mol

13. A black precipitate is formed when H_2S gas is added to compound **P** in an acidic medium. A white colour precipitate is formed when the viscous compound which contains only O and H as constituents are added to the above resultant solution. **P** can be,
(1) $PbCl_2$ (2) $CuCl_2$ (3) $BiCl_3$ (4) $HgCl_2$ (5) $NiCl_2$

14. 0.159 g of Cu_2S is added to 500.0 cm^3 of 4.0 mol m^{-3} $KMnO_4$. 500.0 cm^3 of 1.0 mol m^{-3} $BaCl_2$ solution is added to the above resultant solution. What is the composition of SO_4^{2-} ion in ppm after the removal of precipitate? (1 mg dm^{-3} = 1 ppm) (Cu = 63.5, S = 32)
(1) 32 (2) 48 (3) 24 (4) 36 (5) 40

15. The molar ratio between $LiNO_3$ and $NaNO_3$ in their mixture is 1 : 6. When a certain mass of this mixture is heated, 190.4 dm^3 of gases evolved under standard temperature and pressure conditions. The weight of mixture that was heated is, (Li = 7, Na = 23, N = 14, O = 16)
(Volume of 1 mol gas in STP is 22.4 dm^3).
(1) 1158 g (2) 1024 g (3) 965 g (4) 836 g (5) 648 g

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- For each of the questions **16** to **20**, one or more responses out of the four responses (a), (b), (c) and (d) given is /are correct. Select the correct response or responses.

16. Which of the following is / are true?
(a) Oxidizing ability $HClO_4 < HClO_3 < HClO_2 < HOCl$
(b) Melting point $Ba < Sr < Mg < Be$
(c) Acidic strength $HNO_3 < HCl < H_2SO_4$
(d) Electronegativity of **N** atom $NH_3 < NCl_3 < NH_3OH < NOCl$

17. Which of the following statements is / are **false** regarding sulphur?
(a) SO_2 can act as a bleaching agent in basic mediums.
(b) Rhombic sulphur is very stable at high temperatures.
(c) H_2SO_4 can act as a good reducing agent.
(d) H_2S can be used as both oxidizing and reducing agent.

18. Which of the following statements is / are true regarding Cr ?
(a) $Cr_2O_7^{2-}$ is reduced to Cr^{3+} only in acidic mediums.
(b) Among the oxides of Cr, CrO_2 is amphoteric.
(c) Purple colour $[Cr(H_2O)_6]^{3+}$ solution gives a bluish green colour solution when reacting with NH_3.
(d) When excess NaOH is added to Cr^{3+} solution followed by the addition of H_2O_2, a yellow colour solution forms.

19. Which of the following statements is / are true?
(a) ClO^- is stable at low temperature. However both BrO^- and IO^- are unstable at low temperatures.
(b) A triatomic, linear shaped gas evolves in the thermal decomposition of NH_4NO_3.
(c) Only group I and II elements will answer the flame test.
(d) $SiCl_4$ gives unstable very weakly acidic compound when reacting with limited water.

20. Which of the following aqueous solutions gives black colour precipitate when H_2S is passed through the basic mediums?
(a) Mn^{2+} (b) Zn^{2+} (c) Ni^{2+} (d) Cu^{2+}

- In question Nos. **21** to **25**, two statements are given in respect of each question.. Select the correct response which best fits the two statements.

	First statement	Second statement
21.	HF can be used as a reducing agent.	F is the most electronegative element.
22.	Group I carbonates are stable and they will melt before they decompose into oxides.	Decomposition of $Li_2CO_3(s)$ occurs as follows, $Li_2CO_3(s) \xrightarrow{\Delta} Li_2O(s) + CO_2(g)$
23.	The electronegativity of *d*-block elements is higher than that of *s*-block elements.	*d*-block elements don't react with cold water.
24.	The solubility of sodium halides varies as $NaF < NaCl < NaBr < NaI$	Due to the increase in ionic radius of anions down the group, polarizability of anions increases.
25.	Both CrO_4^{2-} and $Cr_2O_7^{2-}$ form coloured solution in aqueous state.	Cations with partially filled *d* subshell show colours in their aqueous state.

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இரசாயனவியல் II Chemistry II	02 E II	ஒரு மணித்தியாலம் One hour

PART A - STRUCTURED ESSAY

*Answer **all two** questions on this paper itself. (Each question carries **100** marks)*

1. (a) The compound **M** is formed by two compounds which are **M1** and **M2**. The molar mass of **M** is 246 g mol^{-1}. **M1** is made up of three elements which are **A, B** and **C**. The oxidation number of **B** in compound **M** is +6. The elements **B** and **C** only form two stable gaseous compounds together. In these gaseous compounds, one of the gases gives a monobasic acidic solution while the other one gives a dibasic acidic solution, when each of them is dissolved in the water. In the group where element **A** belongs, the element below **A** gives orange-red colour in the flame test. The formation of blue colour is observed when the anhydrous $CuSO_4$ added to **M**.

(i) Identify **M**.

……..

(ii) Among the gaseous compounds formed by **B** and **C** together, **G1** is the compound with the least oxidation state and **G2** is the compound with the highest oxidation state. Draw the structures of **G1** and **G2** in the cages below.

G1 **G2**

(iii) Give the reactions of **G1** with the following substances.

I. Mg :

……..

II. $CuSO_4$:

……..

III. H_2O_2 :

……..

(iv) Suggest a method to distinguish **G1** from **G2**.

……..

……..

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(v) Consider the elements of group where **A** belongs to. Give them in the ascending order based on their melting point and density.

……..

……..

(vi) The cations of some elements in the group where **A** belongs to, are mainly responsible for the hardness of water. Give them below.

……..

(b) Answer the following questions with the help of compounds given below.

NO, $AsCl_3$, NCl_3, CO_2, HNO_2, $AlCl_3$, $HClO_3$

(i) Identify and write the appropriate compound.

I. Compound exists as a dimer only in the gaseous state (**P**) -

……...

II. Poisonous compound which has linear shape (**Q**) -

……..…….

III. Compound which reacts only with excess water to give two acids (**R**) -

……..…….

IV. Compound which can provide an acid by disproportionation reaction (**S**) -

……..…….

V. Very strong acidic compound (**T**) -

……...

(ii) Give the balanced chemical reactions related to the descriptions **R** and **S** each.

……..……

……..

2. (a) **A, B, C, D** and **E** are *s*-block metals. The bicarbonates of metals except **E** are only found in the aqueous state. **B** is an amphoteric metal that can form compounds with electron deficiency. The chloride of **B** exists as a polymer in the solid state. When a thin wire of metal **A** is burned, white flame is expelled. The sulfates of **C** and **D** are precipitates, and in the flame test, **D** expels crimson red colour. In the group where **D** belongs, the carbonate of **C** has the highest dissociation temperature. **E** is below an element that shows diagonal relationship with **A**, in the relevant group.

(i) Identify **A, B, C, D** and **E**.

A - ……. **B -** …….. **C -** …….

D - ……. **E -** ……..

(ii) Give the balanced chemical reaction related to the reaction of hydroxide of **E** with **B**.

……...……...

……..

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(iii) Which element in the group of metal **E** shows the highest first ionization energy?

……..

(iv) Why does the dissociation temperature of carbonate of **C** is greater than **B**?

……..

……..

……..

(b) **P, Q, X, Y** and **Z** are metals. All of these metals can form complex compounds. **X, Y** and **Z** are found in the devarda's alloy, with that **X** and **Z** are amphoteric. **Z** is used as anode in galvanic cell. The colour of the amine of **P** and the colour of the aqueous solution of ion of **Q** having the higher oxidation number, are the same. An isotope of **P** is widely used as a radiation source in radiotherapy. One of the hydroxides of element **P** forms an aqueous solution of +2 oxidation state during the reaction of it with conc. NH_3. This solution has the ability to auto oxidize. The cations of both metals **Q** and **Y** can oxidize I^- to I_2.

(i) Identify **P, Q, X, Y** and **Z**.

P - ..…… **Q** - ..…… **X** - …….

Y- ……. **Z** - ……..

(ii) Give the chemical formula of the amine of **P** and its colour.

……..

……..

(iii) Arrange **P, Y** and **Z** in the ascending order according to the following characteristics.

I. Melting point -

……...

II. Electronegativity -

……..

III. Electric conductivity -

……...

IV. Atomic radius -

……..

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❋ Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$

❋ Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$

PART B - ESSAY

*(This Question carries **150 marks**.)*

3. (a) An aqueous solution **X** contains **three** cations and **three** anions. The experiments regarding the identification of these ions and their respective observations are given below.

Test No.	Test	Observation
1	Excess $Ba(NO_3)_2$ is added to a small portion of solution **X**.	A pale yellow precipitate **(P_1)** is formed.
2	Cold dilute HCl is added to the filtered solution.	No precipitate.
3	H_2S gas is bubbled through the solution from (2) above.	A black precipitate **(P_2)** is formed.
4	The solution is boiled till all the H_2S gas is removed. A few drops of conc. HNO_3 is added and the solution is heated further. The resulting solution is cooled and NH_4OH/NH_4Cl is added.	A brown precipitate **(P_3)** is formed.
5	H_2S gas is bubbled through the filtered solution obtained above in (4).	A black precipitate **(P_4)** is formed.
6	$AgNO_3$ is added to the remaining solution.	Formation of yellow precipitate **(P_5)** is observed.
7	Acidified KSCN is added to a fresh portion of **X**.	No considerable observation.

All the precipitates obtained above are separated and subjected to the following experiments.

Test No.	Test	Observation
8	Conc. HCl is added to **P_1**.	A part of **P_1** resulted an orange solution **(Q_1)**. The remaining **P_1** gave a yellow coloured precipitate (**P_6**) and a colourless pungent gas **(R)**. The orange solution **Q_1** is reacted with **R** and changed to green.
9	Conc. HCl is added to **P_2**.	A clear solution (**Q_2**) is obtained.
10	Water is added to **Q_2**. Dilute HCl is added again.	A precipitate (**P_7**) is formed. **P_7** is dissolved.
11	Conc. HCl is added to **P_4**.	A blue colour solution (**Q_3**) is obtained.
12	Conc. NH_3 is added to **P_5**.	No considerable observation.

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(i) Identify the cations and anions in the solution **X**.
(ii) Identify the precipitates from $\mathbf{P_1}$ to $\mathbf{P_7}$.
(iii) Identify the solutions $\mathbf{Q_1}$, $\mathbf{Q_2}$ and $\mathbf{Q_3}$.
(iv) State the balanced chemical equations for the reactions take place in tests **8, 10** and **11**.
(v) Explain the colour change that occurs when water is added to solution $\mathbf{Q_3}$ with the help of reactions.
(vi) Explain using the reactions, how gas **R** contributes to the manufacturing of an industrially important acid.

(b) A solid sample was found to contain $CO(NH_2)_2$, $(NH_4)_2CO_3$, $NaNO_2$ and inert impurities. 15.00 g of the above solid sample was dissolved in water and diluted to 200.00 cm^3 (Hereafter referred to as solution **Y**). A 50.00 cm^3 portion of the solution **Y** was taken and treated with an excess amount of NaOH. Then the solution was heated until the complete evacuation of NH_3. The volume of 0.12 mol dm^{-3} HCl required to neutralize the remaining solution was 25.00 cm^3. To another 25.00 cm^3 portion of solution **Y**, Al powder was added followed by an excess amount of NaOH, and the mixture was heated. The liberated NH_3 gas was completely absorbed by 0.25 mol dm^{-3}, 60.00 cm^3 HCl. The volume of 0.05 mol dm^{-3} NaOH required to neutralize the remaining HCl was 10.00 cm^3. The mass of precipitate obtained when adding $Ba(NO_3)_2$ solution to the 100.00 cm^3 of solution **Y** was 0.2167 g. Calculate the mass percentage of each of the compounds in the solid sample.
(Relative atomic mass: Ba=137, C=12, O=16, N=14, Na=23, H=1)

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