CBSE Test Paper-04

Class - 12 Chemistry (The d- & f- Block Elements)

1. Which forms protective and non-corrosive oxide layer?
   a. Cu
   b. Zn
   c. Cr
   d. Ni
2. 4d transition elements series are from
   a. La to Hg
   b. Sc to Zn
   c. Y to Cd
   d. Ce to Lu
3. Zinc carbonate is precipitated from zinc sulphate solution by the addition of
   a. $CaCO_3$
   b. $NaHCO_3$
   c. Na_2CO_3
   d. $MgCO_3$
4. The inner transition metals of 5f series is known as
   a. Lanthanoids
   b. Zirconium
   c. None of these
   d. Actinoids
5. How many carats are in 87.5% gold?
   a. 15
   b. 21
   c. 24
   d. 18
6. State a consequence of lanthanide contraction shown by transition elements.
7. Why do transition metals have high enthalpy of hydration?

8. What is the highest oxidation state shown by Cr (Z= 24)

9. Arrange the following in increasing order of basic character? MnO, MnO_2, Mn_2O_7

10. Complete and balance the following reaction.
$2MnO_4^- + H_2O + I^- \rightarrow$

11. What is meant by disproportionation reaction? Give example.

12. With the help of ionic equation describe what happens when
    i. pH of a solution of dichromate ions is raised.
    ii. potassium manganate is electrochemically oxidized.

13. What are actinoids? Describe briefly the physical and chemical properties of actinoids.

14. What are the characteristics of transition elements and why are they called transition elements? Which of the d-block elements may not be regarded as the transition elements?

15. a. Explain the following:
        i. Transition elements tend to be unreactive with increasing atomic number in the series.
        ii. d-block elements exhibit more oxidation state than f-block elements.
    b. A green chromium compound (A) on fusion with alkali gives yellow compound (B) which on acidification gives an orange coloured compound (C) 'C' on treatment with NH_4Cl given an orange coloured product (D) which on heating decomposes to give back (A). Identify A, B, C and D. Write equation for the reactions.

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Solutions

1. c. Cr

   Explanation: Oxygen combines with chromium to create a protective film of chromium oxide (Cr_2O_3) on the surface.

2. c. Y to Cd

   Explanation: 4d series arises from Y ($4d^1\ 5s^2$) to Cd ($4d^{10}\ 5s^2$).

3. b. $NaHCO_3$

   Explanation: $ZnSO_4 + 2NaHCO_3 \rightarrow ZnCO_3 + Na_2SO_4 + H_2O + CO_2$

4. d. Actinoids

   Explanation: Inner transition metals of 5f series is known as Actinoids.

5. b. 21

   Explanation: Carat = $24\ \times\ \left(\frac{M_g}{M_m}\right) = 24 \times 87.5/100 = 21$

   M_g= 87.5 and M_m= 100

6. The overall decrease in atomic and ionic radii from lanthanum to lutetium is a unique feature in the chemistry of the lanthanoids. The cumulative effect of the contraction of size of lanthanide elements is known as lanthanoid contraction. It causes the radii of the members of the third transition series to be very similar to those of the corresponding members of the second series. For example radii of Zr (160 pm) and Hf (159 pm) are almost identical.

7. Transition metal ions are smaller in size and have higher charge density, therefore have higher enthalpy of hydration.

8. Cr (Z=24) has configuration as $[Ar]3d^5 4s^1$. Thus, the highest oxidation state shown by chromium (Z=24) is + 6.

9. $Mn_2O_7 < MnO_2 < MnO$

   Oxides with low oxidation state of metal have less charge density and thus oxides of

these metal are basic in nature.

10. $KMnO_4$ act as a good oxidising agent in acidic medium as well as in neutral and alkaline medium. In neutral and alkaline medium MnO_4^- itself get reduced to MnO_2 and I^- will oxidises to IO_3^-

    $$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

11. The reaction in which same substance is oxidized and reduced is called disproportionation reaction.

    $Cu^+ \rightarrow Cu + Cu^{2+}$ is an example of disproportionation reaction.

12. i. $\underset{(Orange)}{Cr_2O_7^{2-}} + \underset{higher\ pH}{2OH^-} \rightleftharpoons \underset{(yellow)}{2CrO_4^{2-}} + H_2O$

    when pH is increased, i.e. solution is more basic, orange coloured dichromate ion changes to yellow coloured chromate ion.

    ii. $MnO_4^{2-} \xrightarrow{Electrolysis} \underset{Purple}{MnO_4^-} + e^-$

13. The fourteen elements after actinium (89) i.e., from thorium (atomic number 90) to lawrencium (atomic number 103) are called actinoids. The last electrons in these elements enter the f-orbitals. Their physical and chemical properties are as follows:

    i. All actinoids are radioactive.
    ii. They show +2, +3, +4, +5, +6, +7 oxidation state.
    iii. They form oxocations.
    iv. They are paramagnetic in nature.

14. **Characteristics of transition elements:**

    i. Most of the transition elements form coloured compounds.
    ii. Their compounds are generally paramagnetic in nature.
    iii. They have great tendency to form complexes.
    iv. They show variable oxidation states.

    They are called transition elements because they are less electropositive than s-block elements and more electropositive than p-block elements. Transition elements should have incompletely filled d orbital in its ground state or more

stable oxidation state.

Zn, Cd, Hg are not regarded as transition elements because they have completely filled d orbitals.

15. a. i. Transition metal form layer of oxides on their surface due to which they become unreactive. Secondly, reactivity decreases with increase in atomic number due to decrease in size and increase in ionization energy.

ii. In d-block elements, electrons of s-orbital and d-orbitals both take part in bond formation. In f-block elements due to poor shielding effect of f-electrons effective nuclear charge increases therefore, lesser number of oxidation states are shown.

b. $\underset{'A'}{2Cr_2O_3} + 8\,NaOH + 3O_2 \rightarrow \underset{Yellow\,'B'}{4Na_2CrO_4} + 4H_2O$

$\underset{'B'}{2Na_2CrO_4} + H_2SO_4 \rightarrow \underset{Orange\ \text{'C'}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$

$2NH_4Cl + Na_2Cr_2O_7 \rightarrow \underset{(Orange\ \text{'D'})}{(NH_4)_2Cr_2O_7} + 2NaCl$

$\underset{Ammonium\ dichromate}{(NH_4)_2Cr_2O_7} \xrightarrow{heat} N_2 + \underset{Green}{Cr_2O_3} + 4H_2O$

So, Compound A = Cr_2O_3, compound B= Na_2CrO_4, compound C = $Na_2Cr_2O_7$, compound D= $(NH_4)_2Cr_2O_7$