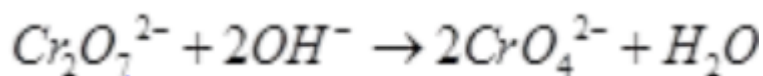


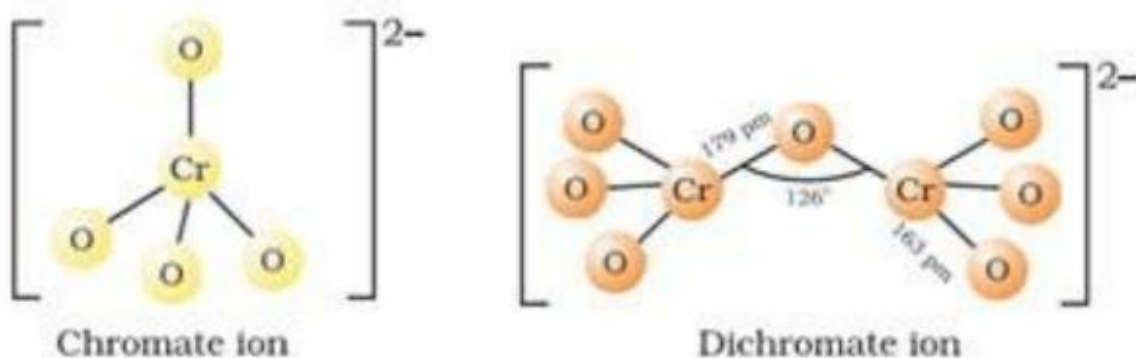
D&F BLOCK ELEMENTS

ANSWER KEY

1. The steady decrease in the ionic radius from La^{3+} to Lu^{3+} is termed as lanthanoid contraction.
2. The variability of oxidation state of transition elements is due to incompletely filled d-orbitals and presence of unpaired electrons, i.e. (ns) and (n - 1) d electrons have approximate equal energies.
3. Permanganate ion, i.e., MnO_4^- with oxidation number +7
4. Zinc, cadmium and mercury have fully filled configuration. Therefore they are not considered as transition metal.
5. General electronic configuration of d-block elements is $(n-1) d^{1-10} ns^{1-2}$
6. The ionization potential values are governed by various ionization enthalpy values, bond enthalpy values and hydration enthalpy values.
7. Compounds formed by trapping small atoms like H, C, or N inside the crystal lattices of metals eg. TiC, etc.
8. When a base is added to orange coloured potassium dichromate its colour changes to yellow due to formation of potassium chromate.



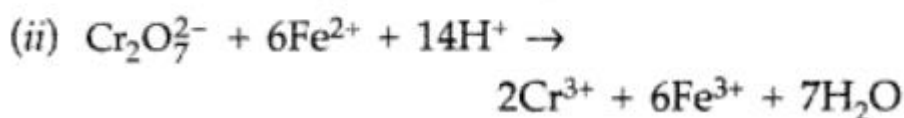
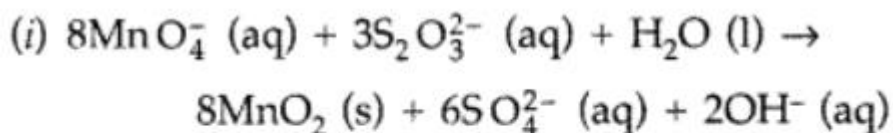
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10. The complications in the actinoid series is due to i) Existence of a wide range of oxidation states. ii) Their radioactivity.
11. The actinoid contraction is more than Lanthanoid contraction as the shielding Power of 5f orbitals is poorer than 4f orbitals.
12. Actinoids can show many oxidation states as in actinoids 5f orbitals are filled which are not as buried as Lanthnoids and can also participate in bonding to a greater extent besides 6d and 7s electrons.
13. Catalytic properties shown by transition metals can be explained due to

- (i) Presence of variable valency and ability of elements to form complexes. (ii) Surface of metals where the reaction can occur.
14. (i) When a Lanthanoid reacts with dil- acid, it liberate hydrogen gas.
(ii)When a Lanthanoid reacts with water, it forms hydroxide.
15. $\text{Cr}_2\text{O}_7^{2-}$ (dichromate ion) in which oxidation state of Cr is +6 which equal to its group number 6.
16. (i) From titanium to copper the atomic size of elements decreases and mass increases as a result of which density increases.
(ii) The catalytic properties of the transition elements are due to the presence of unpaired electrons in their incomplete d- orbitals and variable oxidation states.
17. (i) Because of presence of unpaired d electrons, which undergoes d-d transition by absorption of energy from visible region and then the emitted light shows complementary colours. This is how transition elements form coloured compounds.
(ii) Zinc in its common oxidation state of +2 has completely filled d-orbitals. Hence considered as non-transition element.
18. (i) $\text{Cu}^{2+}(\text{aq})$ is much more stable than $\text{Cu}^+(\text{aq})$. This is because although second ionization enthalpy of copper is large but Δ_{hyd} (hydration enthalpy) for $\text{Cu}^{2+}(\text{aq})$ is much more negative than that for $\text{Cu}^+(\text{aq})$ and hence it more than compensates for the second ionization enthalpy of copper. Therefore, many copper (I) compounds are unstable in aqueous solution and undergo disproportionation as follows :
$$2\text{Cu}^+ \rightarrow \text{Cu}^{2+} + \text{Cu}$$

(ii) Because of very small energy gap between 5f, 6d and 7s subshells all their electrons can take part in bonding and shows variable oxidation states.
19. (i) Because presence of unpaired d electrons, which undergoes d-d transition by absorption of energy from visible region and then the emitted light shows complementary colours.
(ii) Manganese exhibits highest oxidation of +7 among 3d series of transition elements because all the oxidation states are exhibited from +2 to +7 by Mn and no other element of this series shows this highest state of oxidation
20. (i) Cr^{2+} has the configuration $3d^4$ which easily changes to d^3 due to stable half filled t_{2g} orbitals. Therefore Cr^{2+} is reducing agent. While Mn^{2+} has stable half filled d^5 configuration. Hence Mn^{3+} easily changes to Mn^{2+} and acts as oxidising agent.
(ii) Due to presence of more unpaired electrons and use of all 4s and 3d electrons in the middle of series
- 21.



22. (i) $\text{Cu}^{2+}(\text{aq})$ is much more stable than $\text{Cu}^+(\text{aq})$. This is because although second ionization enthalpy of copper is large but Δ_{hyd} (hydration enthalpy) for $\text{Cu}^{2+}(\text{aq})$ is much more negative than that for $\text{Cu}^+(\text{aq})$ and hence it more than compensates for the second ionization enthalpy of copper. Therefore, many copper (I) compounds are

unstable in aqueous solution and undergo disproportionation as follows :



(ii) Because high enthalpies of atomisation of 4d and 5d series and high ionization enthalpies, the M.P. and B.P. of heavier transition elements are greater than those of first transition series which is due to stronger intermetallic bonding. Hence 4d and 5d series metals generally do not form stable cationic species.

23. (i) The catalytic properties of the transition elements are due to the presence of unpaired electrons in their incomplete d- orbitals and variable oxidation states.
 (ii) Metal-metal bonding is more frequent for the 4d and the 5d series of transition metals than that for the 3d series as these have their electrons of outer most shell at greater distance from the nucleus, as compared to atoms of 3d transition metals.
24. Transition metals form coloured ions due to d-d transition. Coloured ions will be those which have unpaired electrons.

Sc^{3+}	$3d^0$	Colourless
V^{2+}	$3d^3$	Coloured
Mn^{2+}	$3d^5$	Coloured
Cu^+	$3d^{10}$	Colourless
Ni^{2+}	$3d^8$	Coloured.

25. Preparation of potassium dichromate takes place in three steps.
 Step 1: Fusion of chromite ore with sodium or potassium carbonate in free excess of air.
 Step 2: Conversion of Sodium Chromate to Sodium Dichromate by acidifying it.
 Step 3: Conversion of sodium dichromate to potassium dichromate by reacting it with KCl.
26. Lanthanoid contractions – The cumulative effect of the regular decrease in size or radii of Lanthanoid with increase in atomic number is called Lanthanoid contraction.
 Causes - The shape of f orbitals is diffused. They have poor shielding effect due to which the effective nuclear charge increase with increase in atomic number. This causes a decrease in atomic radii.
 (a) In transition elements, there are large number of unpaired electrons in their atoms, thus they have a stronger inter atomic interaction and thereby stronger bonding between the atoms. Due to this they have high enthalpies of atomization.
 (b) Because of the availability of d-orbitals, they can easily form intermediate products which are activated. The sizes of transition metal atoms and ions are also favourable for transition complex formation with the reactants.
27. (a) Copper exhibits + 1 oxidation state more frequently i.e., Cu^+ because of its electronic configuration $3d^{10}4s^1$. It can easily lose $4s^1$ electron to give stable $3d^{10}$ configuration.

(b) $\text{Sc}^{3+} = 4s^0 3d^3 =$ no unpaired electron

$\text{V}^{3+} = 3d^2 4s^0 = 2$ unpaired electron

$Ti^{4+} = 3d^0 4s^0 =$ no unpaired electron

$Mn^{2+} = 3d^5 4s^0 =$ 5 unpaired electron

Thus V^{3+} and Mn^{2+} are coloured in their aqueous solution due to presence of unpaired electron.

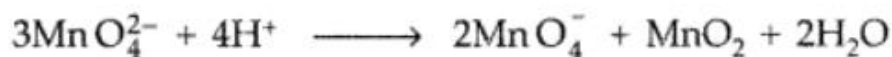
28. (i) $Cu^{2+}(aq)$ is much more stable than $Cu^+(aq)$. This is because although second ionization enthalpy of copper is large but Δ_{hyd} (hydration enthalpy) for $Cu^{2+}(aq)$ is much more negative than that for $Cu^+(aq)$ and hence it more than compensates for the second ionization enthalpy of copper. Therefore, many copper (I) compounds are unstable in aqueous solution and undergo disproportionation as follows :



(ii) The ability of O_2 to stabilize higher oxidation states exceeds that of fluorine because oxygen can form multiple bonds with metals.

29. i) The transition metals and their compounds are usually paramagnetic because of the presence of unpaired electrons in their d-orbitals.
(ii) The transition metals exhibit variable oxidation states because of very close energies of incompletely filled $(n - 1)d$ orbitals and ns orbitals due to which both can participate in bonding.

30. Potassium Permanganate ($KMnO_4$) is prepared from pyrolusite ore (MnO_2). The ore (MnO_2) is fused with an alkali metal hydroxide like KOH in the presence of air or an oxidising agent like KNO_3 to give dark green potassium manganate (K_2MnO_4). K_2MnO_4 disproportionates in a neutral or acidic solution to give potassium permanganate.



Oxidation of oxalic acid is Oxidised at 333 K:

