

INDIAN SCHOOL MUSCAT

CHEMISTRY DEPARTMENT

QUESTION BANK

d and f Block Elements

1. Zinc, cadmium and mercury are not considered as transition metals. Why? 1
2. Write the general configuration of d- block elements. 1
3. What is the ore of $K_2Cr_2O_7$ and $KMnO_4$? 1
4. What is the effect of adding a base to potassium dichromate? 1
5. The chemistry of actinoids is more complicated than lanthanoids. Why? 1
6. What is the general valence configuration of f-block elements? 1
7. Actinoid contraction is more than lanthanoid contraction. Give reason. 1
8. Actinoids show larger number of oxidation states than lanthanoids. Why? 1
9. Write the electronic configuration of Cr^{3+} ion (atomic number of Cr = 24)? 1
10. Explain $CuSO_4 \cdot 5H_2O$ is blue while $ZnSO_4$ and $CuSO_4$ are colourless? 1
11. Why is the third ionisation energy of Manganese ($Z = 25$) is unexpectedly high? 1
12. Silver (Ag) has completely filled d-orbitals ($4d^{10}$) in its ground state. How can you say that it is a transition element. 1
13. The +3 oxidation state of lanthanum ($Z = 57$), gadolinium ($Z = 64$) and lutetium ($Z = 71$) are especially stable. Why? 1
14. Mention one consequence of Lanthanoid Contraction? 1

15. The first ionization enthalpies of $5d$ - series elements is higher than those of $3d$ and $4d$ series elements why? 1
16. Why Mn^{2+} compounds are more stable than Fe^{2+} compounds towards oxidation to their $+3$ state? 1
17. What are interstitial compounds? 1
18. Write the chemical equation for the reaction of thiosulphate ions and alkaline potassium permanganate. 1
19. Write the electronic configuration of Lu^{3+} (At. No. = 71) 1
20. What is the most common oxidation state of actinoids? 1
21. Why is Cd^{2+} ion white? 1
22. Transition metals generally form coloured ions. Why? 2
23. Which of the following will be colored? 2
 Sc^{3+} , V^{2+} , Mn^{2+} , Cu^+ , Ni^{2+} .
24. Give an explanation for the catalytic properties shown by transition metals. 2
25. Draw the structure of chromate and dichromate ions? 2
26. Describe the steps of preparation of $KMnO_4$? 2
27. Draw the structure of manganate and permanganate ions? 2
28. What is the composition of misch metal? Give its one use. 2
29. What happens when 2
(a) A lanthanoid reacts with dil- acid
(b) A lanthanoid reacts with water.
30. Write the chemical equation, when the yellow colour of aqueous solution of Na_2CrO_4 changes to orange on passing CO_2 gas? 2

31. The stability of Cu^{2+} (aq) is more than that of Cu^+ (aq). Why? 2
32. Write complete chemical equations for 2
- (a) Oxidation of Fe^{2+} by Cr_2O_7^- in acidic medium
- (b) Oxidation of Mn^{2+} by MnO_4^- in neutral or faintly alkaline medium.
33. (a) Why do transition metals show high melting points? 2
- (b) Out of Fe and Cu, which one would exhibit higher melting point?
34. Describe giving reason which one of the following pairs has the property indicated : 2
- (a) Cr^{2+} or Fe^{2+} (stronger reducing agent).
- (b) Co^{2+} or Ni^{2+} (lower magnetic moments).
35. Of the ions Co^{2+} , Sc^{3+} , Cr^{3+} which one will give colourless aqueous solution 2
and how will each of them respond to magnetic field and why?
36. Account for the following : 2
- (a) Copper shows its inability to liberate hydrogen gas from the dilute acids.
- (b) Scandium ($Z = 21$) does not exhibit variable oxidation states.
37. The following two reactions of HNO_3 with Zn are given. 2
- (a) $\text{Zn} + \text{conc. HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{X} + \text{H}_2\text{O}$
- (b) $\text{Zn} + \text{dil. HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{Y} + \text{H}_2\text{O}$
- Identify X and Y and write balanced equations.
38. Account for the following : 2
- (a) Transition metals and majority of their compounds act as good catalysts.
- (b) From element to element, actinoid contraction is greater
than lanthanoid contraction
39. Explain the steps of preparation of potassium dichromate? 2

40. What is the lanthanoid contraction? What are its causes and consequences? 3
41. Account for the following : 3
- (a) $\text{La}(\text{OH})_3$ is more basic than $\text{Lu}(\text{OH})_3$
 - (b) Zn^{2+} salts are white.
 - (c) $\text{Cu}(\text{I})$ compounds are unstable in aqueous solution and undergo disproportionation.
42. Describe the oxidising action of potassium dichromate with following. Write ionic equations for its reaction with. 3
- (a) Iodide ion (b) Iron (II) (c) H_2S .
43. What happens when 3
- (a) thiosulphate ions react with alkaline KMnO_4 .
 - (b) ferrous oxalate reacts with acidified KMnO_4 .
 - (c) sulphurous acid reacts with acidified KMnO_4
- Write the chemical equations for the reactions involved.
44. (a) Deduce the number of 3d electrons in the following ions : 3
- Fe^{3+} , Cu^{2+} and Sc^{3+} .
- (b) Why do transition metals form alloys.
 - (c) Write any two characteristics of interstitial compounds.
45. How do you account for the following? 3
- (a) With the same d-orbital configuration (d^4), Cr^{2+} is a reducing agent while Mn^{3+} is an oxidising agent.
 - (b) The actinoids exhibit a larger number of oxidation states than the corresponding members in the lanthanoid series.
 - (c) Most of transition metal ions exhibit characteristic colours in aqueous solutions.

46. Give reasons- 5

- (i) Transition metals have high melting points.
- (ii) Second and third transition series have similar radii.
- (iii) Second ionization is difficult from Cu and Cr whereas it is easy for Zn.
- (iv) Most of the transition elements are paramagnetic.
- (v) Transition elements form alloys.

47. Complete and balance:- 5

- i) $5\text{Fe}^{2+} + \text{MnO}_4^- + 8\text{H}^+ \rightarrow$
- ii) $5\text{NO}_2^- + 2\text{MnO}_4^- + 6\text{H}^+ \rightarrow$
- iii) $2\text{MnO}_4^- + \text{H}_2\text{O} + \text{I}^- \rightarrow$
- iv) $8\text{MnO}_4^- + 3\text{S}_2\text{O}_8^{2-} + \text{H}_2\text{O} \rightarrow$
- v) $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{Fe}^{2+} \rightarrow$

48. A green compound 'A' on fusion with NaOH in presence of air forms yellow 5

compound 'B' which on acidification with dilute acid, gives orange solution of compound 'C'. The orange solution when reacted with equimolar ammonium salt gives compound 'D' which when heated liberates nitrogen gas and compound 'A'.

Identify compounds A to D and write the chemical equation of the reactions involved.

49. Assign reasons for the following : 5

- (a) There are no regular trends in E° values of M^{2+}/M systems in 3d series.
- (b) There is gradual decrease in the ionic radii of M^{2+} ion in 3d series.
- (c) Majority of transition metals form complexes.
- (d) Ce^{3+} can be easily oxidised to Ce^{4+}
- (e) Tantalum and palladium metals are used to electroplate coinage metals.

50. Account for the following : 5
- (a) Actinoids display a variety of oxidation states.
 - (b) Yb^{2+} behaves as a good reductant.
 - (c) Cerium (IV) is a good analytical reagent.
 - (d) Transition metal fluorides are ionic in nature while chlorides and bromides are covalent in nature.
 - (e) Hydrochloric acid attacks all the actinoids.
51. Explain by giving suitable reason : 5
- (a) Co(II) is stable in aqueous solution but in the presence of complexing agent it is readily oxidised.
 - (b) Eu^{2+} , Yb^{2+} are good reductants whereas Tb^{4+} is an oxidant.
 - (c) AgCl dissolves in ammonia solution
 - (d) Out of Cr^{2+} or Fe^{2+} , which one is a stronger reducing agent?
 - (e) The highest oxidation state is exhibited in oxoanions of a transition metal.
52. When a white crystalline compound A is heated with $\text{K}_2\text{Cr}_2\text{O}_7$ and conc. H_2SO_4 , a reddish brown gas B is evolved, which gives a yellow coloured solution C when passed through NaOH . On adding CH_3COOH and $(\text{CH}_3\text{COO})_2\text{Pb}$ to solution C, a yellow coloured ppt. D is obtained. Also on heating A with NaOH and passing the evolved gas through K_2HgI_4 solution, a reddish brown precipitate E is formed. Identify A, B, C, D and E and write the chemical equations for the reactions involved. 5
53. (a) Describe the preparation of potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$). Write the chemical equations of the reactions involved. 5

(b) "The chromates and dichromates are interconvertible by the change in pH of medium." Why? Give chemical equations in favour of your answer.

54. Explain giving reasons : 5

(a) Transition metals are less reactive than the alkali metals and alkaline earth metals.

(b) E^0 of Cu^{2+}/Cu is highly positive.

(c) Elements in the middle of transition series have higher melting points.

(d) The decrease in atomic size of transition elements in a series is very small.

55. (a) Compare the chemistry of the actinoids with that of lanthanoids with reference to: 5

(i) electronic configuration

(ii) oxidation states

(iii) chemical reactivity

(b) How would you account for the following :

(i) Of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidising.

(ii) The lowest oxide of a transition metal is basic whereas highest is amphoteric or acidic.