



CHEMISTRY

NCERT - NCERT CHEMISTRY(ENGLISH)

THE D AND F BLOCK ELEMENTS

Solved Examples

1. On what ground can you say that scandium ($Z = 21$) is a transition element but zinc ($Z = 30$) is not?

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2. Why do the transition elements exhibit higher enthalpies of atomisation?

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3. Which transition element does not exhibit variable oxidation state?



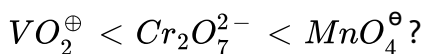
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4. Why is Cr^{2+} reducing and Mn^{3+} oxidising when both have d^4 configuration?



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5. How would you account for the increasing oxidising power in the series



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6. For the first row transition metals the $E^{\ominus}(M^{+2}/M)$ value are:

V
-1.18

Cr
-0.91

Mn
-1.18

Fe
-0.44

Co
-0.28

Ni
-0.25

Cu
+0.34

Explain the irregularity in the above values.



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7. Why is the value for $\frac{Mn^{3+}}{Mn^{2+}}$ couple much more positive than that for $\frac{Cr^{3+}}{Cr^{2+}}$ or $\frac{Fe^{3+}}{Fe^{2+}}$? Explain



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8. Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.



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9. What is meant by disproportionation of an oxidation state ? Give an example



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10. Name a member of the lanthanoid series which is well known to exhibit $+4$ oxidation state.



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11. Explain the following terms :

(a) Chemistry of all Lanthanoids is so identical .

(b) Silver atom has completely filled d- orbitals ($4d^{10}$) in its ground state .

How can you say that is a transition elements ?



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12. In the series $Sc(Z = 21)$ to $Zn(Z = 30)$ the enthalpy of atomisation of zinc is the lowest, i.e., 126 kJ mol^{-1} . Why?



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13. Which of the 3d series of the transition metals exhibits the largest number of oxidation states and why?



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14. The $E^0(M^{2+} / M)$ value for copper is positive (+ 0.34V). What is possibly the reason for this?



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15. How would you account for the irregular variation of ionization enthalpies (first and second) in the first series of the transition elements ?



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16. Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only?



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17. Which is a stronger reducing agent Cr^{2+} or Fe^{2+} and why?



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18. Calculate the spin only magnetic moment of M^{2+} ion ($Z = 27$).



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19. Explain why Cu^{+} ion is not stable in aqueous solutions ?



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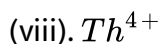
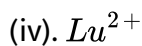
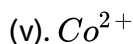
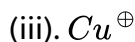
20. Actinoid contraction is greater from element to element than lanthanoid contraction Why?



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Exercise

1. Write down the electronic configuration of:



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2. Why are Mn^{2+} compounds more stable than Fe^{2+} toward oxidation to their +3 state?



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3. Explain briefly how +2 state become more and stable in the first half of the first row transition elements with increasing atomic number?



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4. To what extent do the electronic configurations, decide the stability of oxidation states in the first series of the transition elements? Illustrate your answer with examples.



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5. What may be the stable oxidation state of the transition element with the following d electron configurations in the ground state of their atoms : $3d^3$, $3d^5$, $3d^8$ and $3d^4$?



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6. Name the oxometal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number.



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7. What is lanthanoid contraction? What are the consequences of lanthanoid contraction?



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



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9. In what way is the electronic configuration of the transition elements different from that of the non-transition elements?



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10. What are the different oxidation states exhibited by the lanthanoids?



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11. Explain and give reason.

(a) Transition metal and many of their compounds show paramagnetic

behavior.

(b) The enthalpies of atomisation of the transition metal are high .

(c) The transition metals generally form coloured compounds.



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12. What are interstitial compounds? Why are such compounds well known for the transition metals?



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13. How is the variability in oxidation states of transition metals different from that of the non transition metals?

Illustrate with examples.



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14. Describe the preparation of potassium dichromate from iron chromite ore. What is the effect of increasing pH on a solution of potassium dichromate?



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15. Describe the oxidising action of potassium dichromate and write the ionic equations of reaction with:

(i). Iodide

(ii). Iron (II) solution and

(iii). H_2S



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16. Describe the preparation of potassium permanganate. How does the acidified permanganate solution react with (i) iron(II) ions (ii) SO_2 and (iii) oxalic acid? Write the ionic equations for the reactions.



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17. For $\frac{M^{2+}}{M}$ and $\frac{M^{3+}}{M^{2+}}$ systems the E^\ominus values for some metals are as follows.

$$\begin{aligned} \frac{Cr^{2+}}{Cr} - 0.9V, \quad \frac{Cr^{3+}}{Cr^{2+}} - 0.4V \\ \frac{Mn^{2+}}{Mn} - 1.2V, \quad \frac{Mn^{3+}}{Mn^{2+}} + 1.5V \\ \frac{Fe^{2+}}{Fe} - 0.4, \quad \frac{Fe^{3+}}{Fe^{2+}} + 0.8V \end{aligned}$$

Use this data comment upon:

(i). The stability of Fe^{3+} in acid solution as compared to that of Cr^{3+} or Mn^{3+} and (ii). The case with which iron can be oxidised as compared to a similar process for either chromium or manganese metal.



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18. Predict which of the following will be coloured in aqueous solution?

Ti^{3+} , V^{3+} , Cu^{\oplus} , Sc^{3+} , Mn^{2+} , Fe^{2+} and Co^{2+} Give reasons for each.



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19. Compare the stability of +2 oxidation state for the elements of the first transition series.



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20. Compare the chemistry of actinoids with that of the lanthanoids with special reference to:



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21. How would you account for the following:

A) Of the d^4 species Cr^{2+} is strongly reducing while manganese(III) is strongly oxidizing.

B) Cobalt(II) is stable in aqueous solution but in the presence of complexing reagents it is easily oxidized.

C) The D^1 configuration is very unstable in ions.



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22. What is meant by 'disproportionation'? Give two examples of disproportionation reaction in aqueous solution.



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23. Which metal in the first series of transition metals exhibits +1 oxidation state most frequently and why?



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24. Calculate the number of unpaired electrons in the following gaseous ions: Mn^{3+} , Cr^{3+} , V^{3+} and Ti^{3+} . Which one of these is the most stable in aqueous solution?



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25. Give examples and suggest reason for the following features of the transition metals Chemistry.

(ii). A transition metal exhibits highest oxidation state in oxides and fluorides.

(iii). The highest oxidation state is exhibited in oxoanions of a metal.



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26. Indicate the steps in the preparation of:

(i). $K_2Cr_2O_7$ from chromite ore.

(ii). $KMnO_4$ from pyrolusite ore



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27. What are alloys? Name an important alloy which contains some of the lanthanoid metals . Mention its uses.



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28. What are inner-transition elements? Decide which of the following atomic number are the numbers of the inner transition elements:

29, 59, 74, 95, 102, 104



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29. The chemistry of the actinoid elements is not so smooth as that of the lanthanoid. Justify this statement by giving some example from the oxidation state of these elements



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30. Which is the last element in the series of the actinoids? Write the electronic configuration of this element. Comment on the possible oxidation state of this element.



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31. Use Hund's rule to derive the electronic configuration of Ce^{3+} ion, and calculate its magnetic moment on the basis of spin-only formula.



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32. Name the member of the lanthanoids series which exhibit +4 oxidation states and those which exhibit +2 oxidation state. Try to correlate this type of behavior with the electronic configuration of these elements.



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33. Compare the chemistry of actinoids with that of the lanthanoids with special reference to:



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34. Write the electronic configuration of the elements with the atomic number 61, 91, 101 and 109.

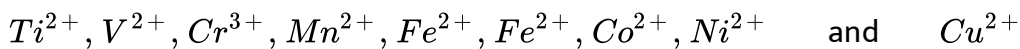
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35. Compare the general characteristics of the first series of the transition metals with those of the second and third series metals in the respective vertical columns. Give special emphasis on the following points:

- (i) electronic configurations
- (ii) oxidation states
- (iii) ionisation enthalpies and
- (iv) atomic sizes.

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36. Write down the number of 3d electrons in each of the following ions:



indicate how would you expect the five 3d orbitals to be occupied for these hydrated ions (octahedral).

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37. Comment on the statement that elements of the first transition series possess many properties different from those of heavier transition elements.



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38. What can be inferred from the magnetic moment values of the following complex species ?
(Example, Magnetic, (BM)), ($K_4[Mn(CN)_6]$, 2.2), ($[Fe(H_2O)_6]^{2+}$, 5.3)



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