



## CHEMISTRY

### BOOKS - U-LIKE CHEMISTRY (HINGLISH)

#### THE D-AND F-BLOCK ELEMENTS

##### Ncert Intext Questions

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

How can you say that it is a transition element ?

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

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

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

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

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

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

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

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9. Explain why  $Cu^+$  ion is not stable in aqueous solution.

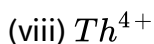
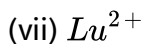
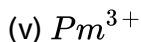
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10. Actinoid contraction is greater from element to element than lanthanoid contraction. Why ?

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### Ncert Textbook Exercises

1. Write down the electronic configuration of :



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

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3. Explain briefly how +2 state becomes more and more 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. In what way is the electronic configuration of the transition elements different from that of the non-transition elements ?

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

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9. Explain giving reasons :

- (i) Transition metals and many of their compounds show paramagnetic behaviour.
- (ii) The enthalpies of atomisation of the transition metals are high.
- (iii) The transition metals generally form coloured compounds.
- (iv) Transition metals and their many compounds act as good catalyst.

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10. 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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11. Describe the oxidising action of potassium dichromate and write the ionic equations for its reaction with :

(i) iodide

(ii) iron (II) solution and

(iii)  $H_2S$

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12. 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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13. For  $M^{2+} / M$  and  $M^{3+} / M^{2+}$  systems, the  $E^\circ$  values for some metals are as follows :

$Cr^{2+} / Cr$	$= - 0.9V$	$Cr^{3+} / Cr^{2+}$	$= - 0.4V$
$Mn^{2+} / Mn$	$= - 1.2V$	$Mn^{3+} / Mn^{2+}$	$= + 1.5V$
$Fe^{2+} / Fe$	$= - 0.4V$	$Fe^{3+} / Fe^{2+}$	$= + 0.8V$



Use this data to comment upon :

(a) the stability of  $Fe^{3+}$  in acid solution as compared to that of  $Cr^{3+}$  or  $Mn^{3+}$  and

(b) the ease with which iron can be oxidised as compared to the similar process for either chromium or manganese metals.

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

$Ti^{3+}$ ,  $V^{3+}$ ,  $Cu^+$ ,  $Sc^{3+}$ ,  $Mn^{2+}$ ,  $Fe^{3+}$  and  $Co^{2+}$ .

Give reasons for each.

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

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

- (a) electronic configuration
- (ii) oxidation state
- (iii) atomic and ionic sizes, and
- (d) chemical reactivity.

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17. How would you account for the following :

- (i) Of the  $d^4$  species,  $Cr^{2+}$  is strongly reducing while manganese (III) is strongly oxidising ?
- (ii) Cobalt (II) is stable in aqueous solution but in the presence of complexing reagents, it is easily oxidised ?
- (iii) The  $d^1$  configuration is very unstable in ions.

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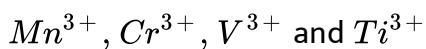
18. What is meant by 'disproportionation'? Give two examples of disproportionation reaction in aqueous solution.

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

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20. Calculate the number of unpaired electrons in the following gaseous ions :



Which one of these is the most stable in aqueous solution ?

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**21.** Give examples and suggest reasons for the following features of the transition metal chemistry :

(i) The lowest oxide of transition metal is basic, the highest is amphoteric acidic.

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

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**23.** What are inner transition elements ? Decide which of the following atomic numbers are the atomic numbers of the inner transition elements : 29, 59, 74, 95, 102, 104.



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24. The chemistry of the actinoid elements is not so smooth as that of the lanthanoids. Justify this statement by giving some examples from the oxidation state of these elements.



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



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27. Name the members of the lanthanoid series which exhibit +2 oxidation states. Try to correlate this type of behaviour with the electronic configuration of these elements.

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28. Write the electronic configurations of the elements with atomic numbers 61, 91, 101 and 109.

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29. Compare the general characteristics of the first series of 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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**30.** Write down the number of 3d electrons in each of the following ions :

$Ti^{2+}$ ,  $V^{2+}$ ,  $Cr^{3+}$ ,  $Mn^{2+}$ ,  $Fe^{2+}$ ,  $Fe^{3+}$ ,  $Co^{2+}$ ,  $Ni^{2+}$  and  $Cu^{2+}$

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



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**31.** 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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**32.** What can be inferred from the magnetic moment values of the following complex species ?

Example	Magnetic moment (BM)
$K_4[Mn(CN)_6]$	2.2
$[Fe(H_2O)_6]^{2+}$	5.3
$K_2[MnCl_4]$	5.9



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## Case Based Source Based Integrated Questions

1. Read the given passage and answer the questions number 1 to 5 that follow :

Originally the name transition metals was derived from the fact that their chemical properties were transitional between those of s and p-block elements. Now according to IUPAC, transition metals are defined as metals which have incomplete d-subshell either in the neutral atom or in their ions. Zinc, cadmium and mercury of Group 12 have full d configuration in their ground state as well as their common oxidation states and hence, are not regarded as transition metals. However, being the end members of the 3d, 4d and 5d transition series, respectively their chemistry is studied along with the chemistry of transition metals.



The presence of partly filled d or f-orbitals in their atoms makes transition elements different from that of the non-transition elements. Hence, transition elements and their compounds are studied separately. However, the usual theory of valence as applicable to the non-transition elements can be applied successfully to the transition elements also.

What is the original definition of transition metals ?



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2. Read the given passage and answer the questions number 1 to 5 that follow :

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What is the IUPAC definition of d-block elements ?



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**3.** Read the given passage and answer the questions number 1 to 5 that follow :

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Do zinc, cadmium and mercury come under transition elements ?



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Is the theory of valence applicable to transition elements ?



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5. Read the given passage and answer the questions number 1 to 5 that follow :

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Give the names of first four members of first transition series.



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**6.** Read the given passage and answer the questions number 1 to 5 that follow :

In general, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number. This is because the new electron enters a d-orbitals each time the nuclear charge increases by unity. It may be recalled that the shielding effect of a d-electron is not

that effective, hence the net electrostatic attraction between the nuclear charge and the outermost electron increases and the ionic radius decreases. The same trend is observed in the atomic radii of a given series. However, the variation within a series is quite small. An interesting point emerges when atomic sizes of one series are compared with those of the corresponding elements in the other series. We find an increase from the first (3d) to the second (d) series of the elements but the radii of the third (5d) series are virtually the same as those of the corresponding members of the second series. This phenomenon is associated with the intervention of the 4f orbitals which must be filled before the 5d series of elements begin. The filling of 4f before 5d orbitals results in a regular decrease in atomic radii called Lanthanoid contraction.

How does the radius of the same charge change as we move from manganese to nickel in first transition series ?



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7. Read the given passage and answer the questions number 1 to 5 that follow :

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Compare the shielding effect of s, p, d and f-orbitals.



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**8.** Read the given passage and answer the questions number 1 to 5 that follow :

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The radii of 5d series are virtually the same as those of the corresponding members of the second series. Explain.



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members of the second series. This phenomenon is associated with the intervention of the 4f orbitals which must be filled before the 5d series of elements begin. The filling of 4f before 5d orbitals results in a regular decrease in atomic radii called Lanthanoid contraction.

What is lanthanoid contraction ?



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Name the elements with atomic number 25, 26, 27.



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**11.** Read the given passage and answer the questions number 1 to 5 that follow :

The lowest common oxidation state of transition metals is + 2. To form the  $M^{2+}$  ions from the gaseous atoms, the sum of the first and second ionisation enthalpy is required in addition to the enthsualpy of atomisation. The dominant term is the second ionisation enthalpy which shows unusually high values for Cr and Cu where  $M^+$  ions have the  $d^5$  and  $d^{10}$  configurations respectively. The value for Zn is correspondingly

low as the ionisation causes the removal of 1s electron which results in the formation of stable  $d^{10}$  configuration. The trend in the third ionisation enthalpies is not complicated by the 4s orbital factor and shows the greater difficulty of removing an electron from the  $d^5(Mn^{2+})$  and  $d^{10}(Zn^{2+})$  ions. In general, the third ionisation enthalpies are quite high. Also, the high values for third ionisation enthalpies of copper, nickel and zinc indicate why it is difficult to obtain oxidation state greater than two for these elements.

Which is the lowest common oxidation state of transition metals?



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Which factors are to be considered to obtain +2 oxidation state of the metals ?



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Why is the second ionisation enthalpy of the metals Cr and Cu very high ?



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**14.** Read the given passage and answer the questions number 1 to 5 that follow :

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In the series Sc(Z = 21) to Zn(Z = 30), the enthalpy of atomisation of Zn is the lowest. Why?

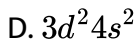
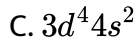
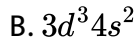
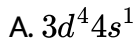


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Multiple Choice Questions



1. Electronic configuration of vanadium is



**Answer: B**



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2. Which of the following is not a transition element ?

A. Cr

B. Cu

C. Sc

D. As

**Answer: D**



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**3.** The colour of potassium dichromate is

A. orange.

B. yellow.

C. purple.

D. colourless.

**Answer: A**



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**4.** The electronic configuration  $3d^54s^2$  corresponds to the metal

A. vanadium.

B. scandium.

C. manganese.

D. chromium.

**Answer: C**

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5. The element in the first transition series that exhibits maximum number of oxidation states is

A. titanium.

B. zinc.

C. chromium.

D. manganese.

**Answer: D**

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6. Colour of  $Ti^{4+}$  ( $3d^0$ ) metal ion is

A. purple.

B. blue.

C. green.

D. colourless.

**Answer: D**



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7. Chromite ore is fused with  $Na_2CO_3$  in free excess of air. The yellow solution obtained is filtered and acidified with  $H_2SO_4$ . The colour of the resulting solution is

A. colourless.

B. pink.

C. orange.

D. green.

**Answer: C**

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8. With increase in atomic number the melting point of transition metals

A. first increases and then decreases.

B. remains constant.

C. first decreases and then increases.

D. increases continuously.

**Answer: A**

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9. Which of the properties listed below is not shown by interstitial compounds ?

- A. They are chemically reactive.
- B. They are very hard.
- C. They have high melting points.
- D. Their formulas do not correspond to any normal oxidation state.

**Answer: A**

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10. Relation between magnetic moment (spin-only formula) and number of unpaired electrons is given by

A.  $\mu = \sqrt{n(n + 2)}$

B.  $\mu = \sqrt{n^2 + 1}$

C.  $\mu = \sqrt{n(n + 1)}$

$$D. \mu = \sqrt{n(n + 3)}$$

**Answer: A**

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**11.** Finely divided iron is used as a catalyst in an industrial process. The name of the process is

- A. Contact process.
- B. Haber's process.
- C. Hydrogenation process.
- D. Oxidation process.

**Answer: B**

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12. Magnetic moment of transition metal ion is 5.92 BM (spin-only formula). The number of unpaired electrons in the metal ion is

- A. 4
- B. 5
- C. 2
- D. 3

**Answer: B**

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13. Atomic number and electronic configuration of Cerium are respectively

- A. 59,  $4f^1 5d^1 6s^2$
- B. 58,  $4f^1 5d^2 6s^1$
- C. 58,  $4f^1 5d^1 6s^2$
- D. 59,  $4f^1 5d^2 6s^1$



**Answer: C**

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14. A mixture of  $TiCl_4$  with  $Al(CH_3)_3$  is used as Ziegler catalyst for the manufacture of

A. polybutadiene.

B. PVC.

C. rubber.

D. polythene.

**Answer: D**

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15.  $MnO_2$  is fused with an alkali. We obtain a green mass which on acidic hydrolysis produces a solution which has the colour

A. dark purple.

B. yellow.

C. colourless.

D. blue.

**Answer: A**

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**16.** Greater range of oxidation states of actinoids is because

A. 5f, 6d and 7s levels are of comparable energies.

B. They possess large atomic numbers.

C. They possess large atomic masses.

D. They are radioactive.

**Answer: A**

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17. Which of the following is not produced using misch metal ?

- A. Bullets
- B. Space suits
- C. Lighter flints
- D. Shells

**Answer: B**



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18. Potassium permanganate titrations are not performed in the presence of hydrochloric acid because

- A. HCl is not available in pure form.
- B. HCl is oxidised to  $\text{Cl}_2$ .
- C. HCl is a hygroscopic substance.

D. HCl reacts with glass.

**Answer: B**



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19. Which of the following sets of configurations of actinoids is most stable ?

A.  $f^0, f^5, f^{10}$

B.  $f^0, f^7, f^{14}$

C.  $f^0, f^1, f^3$

D. none of the above

**Answer: B**



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20. The atomic number and electronic configuration of Plutonium respectively are

A. 94,  $5f^67s^2$

B. 95,  $5f^67s^2$

C. 94,  $5f^77s^1$

D. 95,  $5f^77s^1$

**Answer: A**



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### Assertion Reason Questions

1. Assertion (A) :  $V_2O_5$  catalyst is used in Haber's process for the manufacture of ammonia.

Reason (R) : The principal oxidation state for lanthanoids is +3 although +2 and +4 oxidation states are also exhibited.

- A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- C. Assertion (A) is correct, but Reason (R) is incorrect statement.
- D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: D**



[View Text Solution](#)

2. Assertion (A) : Acidified  $K_2CrO_7$  oxidises iodides to iodine.

Reason (R) : Sodium dichromate is more soluble than potassium dichromate.

- A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

- B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- C. Assertion (A) is correct, but Reason (R) is incorrect statement.
- D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: B**

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3. Assertion (A) : Potassium permanganate forms dark purple crystals which are isostructural with those of  $KClO_3$ .

Reason (R) :  $MnO_4^-$  ions and  $ClO_4^-$  ions possess tetrahedral structures.

- A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: A**

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4. Assertion (A) : The overall decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanoide contraction.

Reason (R) : Permanganate titrations can be carried out in the presence of any mineral acid.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.



**Answer: C**



[View Text Solution](#)

5. Assertion (A) : Spin only formula to determine the magnetic moment

of a substance is :  $\mu = \sqrt{n(n + 2)}$

Reason (R) : A simple unpaired electron has a magnetic moment of 1.73 BM.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: B**



[View Text Solution](#)

6. Assertion (A) : Transition metals vary widely in their chemical activity.

Reason (R) : Many of transition elements are sufficiently electropositive to dissolve in mineral acids.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: B**



[View Text Solution](#)

7. Assertion (A) : Diamagnetic substances are attracted by magnetic fields.

Reason : Ferromagnetic substances are strongly attracted by magnetic field.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: D**



[View Text Solution](#)

8. Assertion (A) : Ions of the same charge in a given series show progressive decrease in radius with increasing atomic number.

Reason (R) : The new electron enters a d-orbital each time the nuclear charge increases by unity.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: A**



[View Text Solution](#)

9. Assertion (A) : Zinc, cadmium and mercury are not accepted as transition metal elements.

Reason (R) : Zinc, cadmium and mercury have full  $d^{10}$  configuration in their ground state as well as in their common oxidation states.

- A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
- B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- C. Assertion (A) is correct, but Reason (R) is incorrect statement.
- D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: A**



[View Text Solution](#)

**10.** Assertion (A) : The elements which give the greatest number of oxidation states occur in or near the middle of the series.

Reason (R) : The lowest common oxidation state of transition elements is +2.

- A. Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).

- B. Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
- C. Assertion (A) is correct, but Reason (R) is incorrect statement.
- D. Assertion (A) is incorrect, but Reason (R) is correct statement.

**Answer: B**

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## Fill In The Blanks

1. There is a gradual decrease in the size of atoms or  $M^{3+}$  ions across the series in actinoids. This is called \_\_\_\_\_.

 [View Text Solution](#)

2. The d-block elements form \_\_\_\_\_ compounds and complexes.

 [View Text Solution](#)

 [View Text Solution](#)

3. The transition metals and their compounds are known for their \_\_\_\_\_ activity.

 [View Text Solution](#)

4. The d-block consisting of groups \_\_\_\_\_ occupies the large middle section of the periodic table.

 [View Text Solution](#)

5.  $K_2CrO_4$  is \_\_\_\_\_ in colour but  $K_2Cr_2O_7$  is \_\_\_\_\_.

 [View Text Solution](#)

6. In chemical behaviour, earlier members of lanthanoids are quite reactive similar to \_\_\_\_\_.

 [View Text Solution](#)

7. In the Wacker process, the oxidation of ethyne to ethanol is catalysed by\_\_\_\_\_.

 [View Text Solution](#)

8. All the lanthanoids are\_\_\_\_\_soft metals and\_\_\_\_\_rapidly in air.

 [View Text Solution](#)

9. The manganate and permanganate ions are\_\_\_\_\_in shape.

 [View Text Solution](#)

Very Short Answer Questions 1 Mark Each



1. Write the formula of an oxo-anion of manganese (Mn) in which it shows the oxidation state equal to its group number.

 [View Text Solution](#)

2. Write the formula of an oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number.

 [View Text Solution](#)

3. Why is zinc not regarded as a transition element ?

 [View Text Solution](#)

4. Copper atom has completely filled d-orbitals in its ground state but it is a transition element. Why ?

 [View Text Solution](#)

5. Why first ionisation enthalpy of Cr is lower than that of Zn ?

 [View Text Solution](#)

6. What is meant by lanthanoid contraction ?

 [View Text Solution](#)

7. Why does copper not replace hydrogen from acids ?

 [View Text Solution](#)

8. Why is Bi(V) a stronger oxidant than Sb(V) ?

 [View Text Solution](#)

9. Write the outer electronic configuration of Cr atom ( $Z = 24$ ).

 [View Text Solution](#)

10. The electronic configuration of a transition element in +3 oxidation state is  $[Ar]3d^7$ . Find out its atomic number.

 [View Text Solution](#)

11. Which is more basic  $La(OH)_3$  or  $Lu(OH)_3$  ? Why ?

 [View Text Solution](#)

12. How is the magnetic moment of a species related to the number of unpaired electrons ?

 [View Text Solution](#)

13. Which property of the transition elements makes them good catalysts ?

 [View Text Solution](#)

14. What is the effect of increasing pH on  $K_2Cr_2O_7$  solution ?

 [View Text Solution](#)

15. Why is third ionisation energy of manganese [Atomic number = 25] unexpectedly high?

 [View Text Solution](#)

16. Why is electronic configuration  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$  not correct for the ground state of Cr(Z = 24) ?

 [View Text Solution](#)

17. Name the lanthanoid element which exhibits a +4 oxidation state besides +3 oxidation state.

 [View Text Solution](#)

18. What is the difference between the electronic configurations of lanthanoids and actinoids?

 [View Text Solution](#)

19. State a consequence of lanthanoid contraction shown by transition elements.

 [View Text Solution](#)

20. Why is that orange solution of  $K_2Cr_2O_7$  turns yellow on adding NaOH to it?



[View Text Solution](#)

21. Why do most transition metal ions show variable oxidation states ?



[View Text Solution](#)

22. Why is  $Ce^{4+}$  in aqueous solution a good oxidising agent?



[View Text Solution](#)

23. One unpaired electron in atom contributes a magnetic moment of 1.1 BM. Calculate the magnetic moment of Cr. [Atomic number = 24]



[View Text Solution](#)

24. Why do Zr and Hf exhibit similar properties?



[View Text Solution](#)

25. Name one ore of manganese and chromium.

 [View Text Solution](#)

26. What are the two important oxidation states of Group 6 elements of the Periodic Table ?

 [View Text Solution](#)

27. In the transition series, with an increase in atomic number, the atomic radius does not change very much. Why is it so ?

 [View Text Solution](#)

28. Write the atomic number of the element in which the filling of 3d subshell in the atom just starts.

 [View Text Solution](#)

29. What is lanthanoid contraction ?

 [View Text Solution](#)

30. In permanganate ion, all the bonds between Mn and O are covalent. Give reasons.

 [View Text Solution](#)

31. Which is the most stable oxidation state among lanthanoids ?

 [View Text Solution](#)

32. State the common characteristic of actinoids and lanthanoids which places them in the f-block of elements.

 [View Text Solution](#)



 [View Text Solution](#)

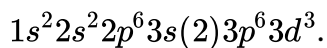
**33.** The electronic configuration of an element is  $3d^5 4s^2$ . Write its (i) most stable oxidation state and (ii) most oxidising state.

 [View Text Solution](#)

**34.** Why is HCl not used to acidify a permanganate solution in volumetric estimation of  $Fe^{2+}$  or  $C_2O_4^{2-}$ ?

 [View Text Solution](#)

**35.** Name the metal with tripositive charge represented by the following electronic configuration :



 [View Text Solution](#)

36. The d-electron configuration of  $Mn^{2+}$  and  $Ti^{2+}$  is  $d^5$  and  $d^2$ , respectively. Which one of these ions will be more paramagnetic ?

 [View Text Solution](#)

37. What is the general formula by which the electronic configuration of transition element is represented ?

 [View Text Solution](#)

38. The electronic configuration of an element is  $3d^5 4s^1$ . Write its (i) most stable oxidation state  
(ii) most oxidising state.

 [View Text Solution](#)

39. Out of  $Cr^{2+}$  and  $Cr^{3+}$ , which one is stable in aqueous solution ?

 [View Text Solution](#)

40. Why are Zn, Cd and Hg normally not regarded as transition elements ?

 [View Text Solution](#)

41. Which is the most stable oxidation state of Ti ( $Z = 22$ ) in aqueous solution ?

 [View Text Solution](#)

42. Write the ionic equation representing the oxidising property of acidified  $\text{KMnO}_4$  solution.

 [View Text Solution](#)

43. Why are compounds of transition metals, generally coloured ?

 [View Text Solution](#)

 [View Text Solution](#)

44. The size of the trivalent cation in the lanthanoid series decreases steadily as the atomic number increases. What is this known as ?

 [View Text Solution](#)

45. Why do most transition metal ions exhibit paramagnetism ?

 [View Text Solution](#)

46. Why does  $V_2O_5$  act as catalyst ?

 [View Text Solution](#)

47. Why do transition elements have high value of hydration enthalpy ?

 [View Text Solution](#)

48. Which trivalent cation is largest in lanthanoid series?

 [View Text Solution](#)

49. The electronic configuration of  $Co^{2+}$  and  $Cu^{2+}$  is  $d^7$  and  $d^9$ , respectively, which of these ions is expected to be more paramagnetic ?

 [View Text Solution](#)

50. Why is bivalent  $Ti^{2+}$  ion paramagnetic in nature ?

 [View Text Solution](#)

51. Which of the following ions is paramagnetic ?

$Sc^{3+}$  ( $Z = 21$ ),  $Cu^+$  ( $Z = 29$ )

 [View Text Solution](#)

52. Write outer electronic configuration of lanthanoids.

 [View Text Solution](#)

53. Name the first element of Group 3.

 [View Text Solution](#)

54. What is the general electronic configuration of the outer orbitals of d-block elements ?

 [View Text Solution](#)

55. Which element in the first transition series shows the maximum number of oxidation states ?

 [View Text Solution](#)

56. Some substances are strongly attracted by magnetic field. What do we call them?

 [View Text Solution](#)

57. What is the unit of magnetic moment ?

 [View Text Solution](#)

58. Which energy is lowered when we use a catalyst in a chemical reaction ?

 [View Text Solution](#)

59. Name a chemical which is used in leather industry and as an oxidant for the preparation of many azo compounds.

 [View Text Solution](#)

60. Which substance is fused with sodium carbonate in free excess of air to form sodium chromate ?

 [View Text Solution](#)

61. Out of sodium dichromate and potassium dichromate, which is more soluble ?

 [View Text Solution](#)

62. Which substance is fused with an alkali metal hydroxide and an oxidising agent to produce potassium permanganate ?

 [View Text Solution](#)

63. What is the name of the alloy obtained by the combination of 95% lanthanoid metal and 5% iron and traces of S, C, Ca and Al ?

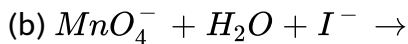
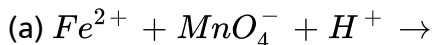




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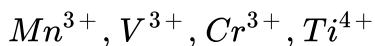
## Short Answer Questions 2 Marks Each

1. Complete and balance the following chemical equations :



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2. In the following ions :



(Atomic no. : Mn = 25, V = 23, Cr = 24, Ti = 22)

(a) Which ion is most stable in an aqueous solution ?

(b) Which ion is the strongest oxidising agent ?

(c) Which ion is colourless ?

(d) Which ion has the highest number of unpaired electrons ?



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3. Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids.

 [View Text Solution](#)

4. What are transition elements ? Write two characteristics of the transition elements.

 [View Text Solution](#)

5. Why do transition elements show variable oxidation states ? In 3d series (Sc to Zn), which element shows the maximum number of oxidation states and why ?

 [View Text Solution](#)

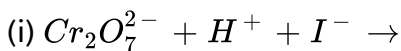
6. State reasons for the following:

(i) Cu (1) ion is not stable in an aqueous solution.

(ii) Unlike  $Cr^{3+}$ ,  $Mn^{2+}$ ,  $Fe^{3+}$  and the subsequent other  $M^{2+}$  ions of the 3d series of elements, the 4d and 5d series metals generally do not form stable cationic species.

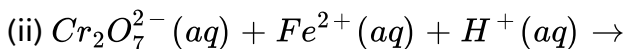
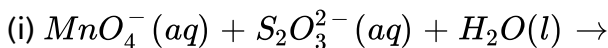
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7. Complete the following chemical equations :



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8. Complete the following chemical equations :



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9. Assign reasons for the following:

- (i) Copper(I) ion is not known in aqueous solution.
- (ii) Actinoids exhibit greater range of oxidation states than lanthanoids.

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10. How would you account for the following:

- (i)  $Cr^{2+}$  is reducing in nature while with the same d-orbital configuration  $(d^4)Mn^{3+}$  is an oxidising agent.
- (ii) In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.

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11. Explain the following observations:

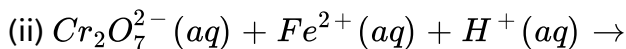
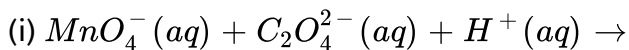
- (i) Generally there is an increase in density of elements from titanium ( $Z =$

22) to copper ( $Z=29$ ) in the first series of transition elements.

(ii) Transition elements and their compounds are generally found to be good catalysts in chemical reactions.

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**12.** Complete the following chemical reaction equations :



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**13.** Explain the following giving reasons :

(i) It is difficult to separate lanthanoid elements in pure state.

(ii) The transition elements form interstitial compounds.

 [View Text Solution](#)

14. The sum of the first and second ionisation enthalpies and those of third and fourth ionisation enthalpies of nickel and platinum are given below:

	$IE_1 + IE_2 (kJmol^{-1})$	$IE_3 + IE_4 (kJmol^{-1})$
<i>Ni</i>	2.49	8.80
<i>Pt</i>	2.66	6.70

Taking these values into account write :

- the most common oxidation state for Ni and Pt and its reason.
- the name of the metal (Ni or Pt) which can form compounds in +4 oxidation state more easily and why?

 [View Text Solution](#)

15. Compare the relative stability of +2 oxidation states in aqueous solutions for the metals having in their atoms the outer electron configurations,  $3d^3 4s^2$ ,  $3d^6 4s^2$  and  $3d^5 4s^2$ .

 [View Text Solution](#)

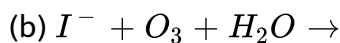
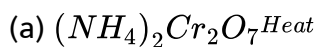
16. A mixed oxide of iron and chromium  $FeO \cdot Cr_2O_3$  is fused with sodium carbonate in the presence of air to form a yellow coloured compound (A). On acidification the compound (A) forms an orange coloured compound (B), which is a strong oxidising agent. Identify

(i) the compounds (A) and (B).

(ii) write balanced chemical equation for each step.

 [View Text Solution](#)

17. Complete the following reactions :



 [View Text Solution](#)

18. Why  $E^\circ$  values for Mn, Ni and Zn are more negative than expected ?

 [View Text Solution](#)

19. Out of  $Cu_2Cl_2$  and  $CuCl_2$ , which is more stable and why ?

 [View Text Solution](#)

20. Although fluorine is more electronegative than oxygen, but the ability of oxygen to stabilise higher oxidation states exceeds that of fluorine. Why ?

 [View Text Solution](#)

21. Transition metals show high melting points. Why?

 [View Text Solution](#)

22. When  $Cu^{2+}$  is treated with KI, a white precipitate is formed. Explain the reaction with the help of chemical equation.

 [View Text Solution](#)



23. When a brown compound of manganese (A) is treated with HCl it gives a gas (B). The gas taken in excess reacts with  $NH_3$  to give an explosive compound (C). Identify compounds A, B and C.



[View Text Solution](#)

24. Explain why

(i)  $E^\circ$  for  $Mn^{3+}/Mn^{2+}$  couple is more positive than that for  $Fe^{3+}/Fe^{2+}$  ?

(ii)  $Ce^{3+}$  can be easily oxidised to  $Ce^{4+}$  ?

[Atomic numbers : Mn = 25, Fe = 26 Ce = 58]



[View Text Solution](#)

25. With the help of ionic equations, describe what happens when

(i) pH of a solution of dichromate ions is raised.

(ii) Potassium manganate is electrochemically oxidised.



[View Text Solution](#)

26. Although Zr belongs to 4d and Hf belongs to 5d transition series, but it is quite difficult to separate them. Why?



[View Text Solution](#)

27. The outer electronic configurations of two transition metals are (i)  $3d^5 4s^2$  and (ii)  $3d^6 4s^2$  respectively. Based on this information predict the relative stability of +2 and +3 oxidation state of these metals. Which of the two exhibits larger number of oxidation states ?



[View Text Solution](#)

28. The second and third rows of transition elements resemble each other much more than they resemble the first row. Explain why ?



[View Text Solution](#)

29. Although  $Cr^{3+}$  and  $Co^{2+}$  ions have the same number of unpaired electrons but the magnetic moment of  $Cr^{3+}$  is 3.87 BM and that of  $Co^{2+}$  is 4.87 BM. Why?

 [View Text Solution](#)

30. Although +3 oxidation state is the characteristic oxidation state of lanthanoids but cerium shows +4 oxidation state also. Why?

 [View Text Solution](#)

31. When orange solution containing  $CrO_7^{2-}$  ion is treated with an alkali, a yellow solution is formed and when  $H^+$  ions are added to yellow solution, an orange solution is obtained. Explain why does this happen?

 [View Text Solution](#)

32. Explain why does the colour of  $KMnO_4$  disappear when oxalic acid is added to its solution in acidic medium.

 [View Text Solution](#)

33.  $E^\circ$  of Cu is + 0.34 V while that of Zn is – 0.76 V. Explain.

 [View Text Solution](#)

34. The halides of transition elements become more covalent with increasing oxidation state of the metal. Why?

 [View Text Solution](#)

35. Reactivity of transition elements decreases almost regularly from Sc to Cu. Explain.

 [View Text Solution](#)

**36.** Explain any one of the following statements :

(i) The transition metals are well-known for the formation of interstitial compounds.

(ii) The largest number of oxidation states are exhibited by manganese in the first series of transition elements.

 [View Text Solution](#)

**37.** Answer the following questions :

(i) Which element in the first series of transition elements does not exhibit variable oxidation states and why?

(ii) Why do actinoids, in general, exhibit a greater range of oxidation states than the lanthanoids ?

 [View Text Solution](#)

**38.** How do you account for the following:

(i) all scandium salts are white ?

(ii) the first ionisation enthalpies of 5d transition elements are higher than those of the 3d and 4d transition elements in respective groups ?

 [View Text Solution](#)

**39.** Why is the +2 oxidation state of manganese quite stable, while the same is not true for iron ?

 [View Text Solution](#)

**40.** While filling up of the electrons in the atomic orbitals, the 4s orbital is filled before the 3d orbital but reverse happens during the ionisation of the atom. Explain why ?

 [View Text Solution](#)

41. Write complete equations for

(i) Oxidation of  $Fe^{2+}$  by  $Cr_2O_7^{2-}$  in acidic medium.

(ii) Oxidation of  $S_2O_3^{2-}$  by  $MnO_4^-$  in neutral aqueous medium.

 [View Text Solution](#)

42. Identify the following :

(i) Oxoanion of chromium which is stable in acidic medium.

(ii) The lanthanoid element that exhibits +4 oxidation state.

 [View Text Solution](#)

### Long Answer Questions | 3 Marks Each

1. Give reasons :

(a)  $E^\circ$  value for  $Mn^{3+} / Mn^{2+}$  couple is much more positive than that for  $Fe^{3+} / Fe^{2+}$ .

(b) Iron has higher enthalpy of atomisation than that of copper.

(c)  $Sc^{3+}$  is colourless in aqueous solution whereas  $Ti^{3+}$  is coloured.

 [View Text Solution](#)

2. (a) Account for the following :

(i) Transition metals form large number of complex compounds.

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

(iii)  $E^\circ$  value for the  $Mn^{3+} / Mn^{2+}$  couple is highly positive (+1.57 V) as compare to  $Cr^{3+} / Cr^{2+}$ .

(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.

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3. (a) Account for the following:

(i) Transition metals show variable oxidation states.

(ii) Zn, Cd and Hg are soft metals.



(iii)  $E^\circ$  value for the  $Mn^{3+} / Mn^{2+}$  couple is highly positive (+1.57 V) as compared to  $Cr^{3+} / Cr^{2+}$ .

(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.

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4. Account for the following:

(a)  $CuCl_2$  is more stable than  $Cu_2Cl_2$ .

(b) Atomic radii of 4d and 5d series elements are nearly same.

(c) Hydrochloric acid is not used in permanganate titrations.

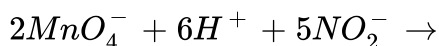
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5. (a) How would you account for the following:

(i) Actinoid contraction is greater than lanthanoid contraction.

(ii) Transition metals form coloured compounds.

(b) Complete the following equation :





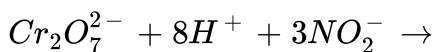
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6. (a) Account for the following:

(i)  $Cu^+$  is unstable in an aqueous solution.

(ii) Transition metals form complex compounds.

(b) Complete the following equation:



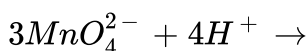
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7. (a) How would you account for the following:

(i) Highest fluoride of Mn is  $MnF_3$ , whereas the highest oxide is  $Mn_2O_7$ .

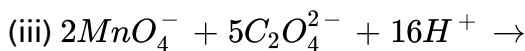
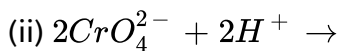
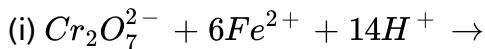
(ii) Transition metals and their compounds show catalytic properties.

(b) Complete the following equation:



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8. Complete the following chemical equations :



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9. How would you account for the following:

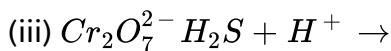
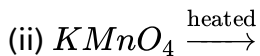
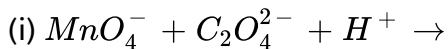
(i) Among lanthanoids, Ln (III) compounds are predominant. However, occasionally in solutions or in solid compounds, +2 and +4 ions are also obtained.

(ii) The  $E_{M^{2+}/M}^\circ$  for copper is positive (0.34 V). Copper is the only metal in the first series of transition elements showing this behaviour.

(iii) The metallic radii of the third (5d) series of transition metals are nearly the same as those of the corresponding members of the second series.

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10. Complete the following chemical equations :



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11. How would you account for the following ?

(i) The atomic radii of the metals of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second (4d) series.

(ii) The  $E^\circ$  value for the  $Mn^{3+} / Mn^{2+}$  couple is much more positive than that for  $Cr^{3+} / Cr^{2+}$  couple or  $Fe^{3+} / Fe^{2+}$  couple.

(iii) The highest oxidation state of a metal is exhibited in its oxide or fluoride.

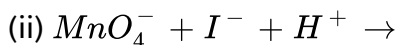
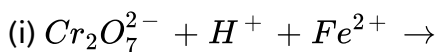
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12. Explain the following facts :

- (a) Transition metals act as catalysts.
- (b) Chromium group elements have the highest melting points in their respective series.
- (c) Transition metals form coloured complexes.

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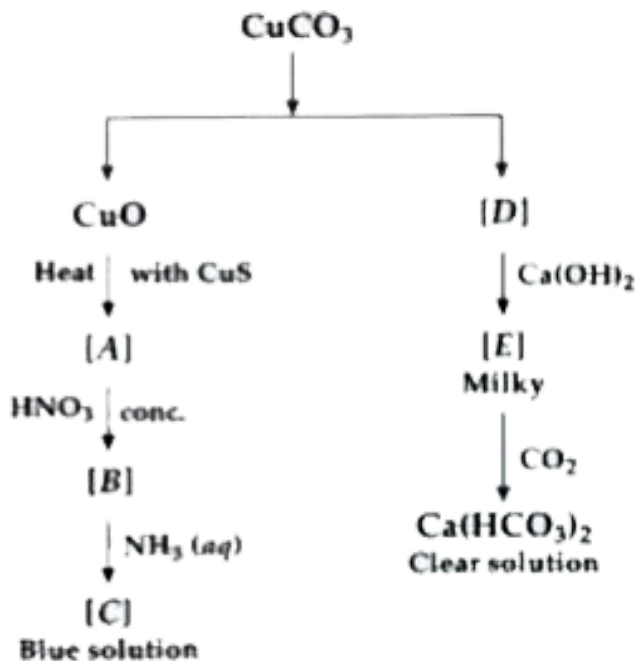
13. (a) Complete the following chemical equations for reactions in aqueous media :



(b) How many unpaired electrons are present in  $Mn^{2+}$  ion (At. no. of Mn = 25) ? How does it influence magnetic behaviour of  $Mn^{2+}$  ions ?

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14. Identify A to E and explain the reactions involved.



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15. Write chemical equations for the following reactions :

- Oxidation of nitrite ion by  $\text{MnO}_4^-$  in acidic medium.
- Acidification of potassium chromate solution.
- Disproportionation of manganese(VI) in acidic solution.

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**16.** Account for the following:

- (a) Europium(II) is more stable than cerium(II).
- (b) Transition metals have high enthalpies of atomisation.
- (c) Actinoid ions are generally coloured.

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**17.** When a chromite ore (A) is fused with sodium carbonate in free excess of air and the product is dissolved in water, a yellow solution of compound (B) is obtained. After treatment of this yellow solution with sulphuric acid, compound (C) can be crystallised from the solution. When compound (C) is treated with KCl, orange crystals of compound (D) crystallise out. Identify (A) to (D) and also explain the reactions.

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18. When an oxide of manganese (A) is fused with KOH in the presence of an oxidising agent and dissolved in water, it gives a dark green solution of compound (B). Compound (B) disproportionates in neutral or acidic solution to give purple compound (C). An alkaline solution of compound (C) oxidises potassium iodide solution to a compound (D) and compound (A) is also formed. Identify compounds (A) to (D) and also explain the reactions involved.



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19. A violet compound of manganese (A) decomposes on heating to liberate oxygen and compounds (B) and (C) of manganese are formed. Compound (C) reacts with KOH in the presence of potassium nitrate to give compound (B). On heating compound (C) with conc.  $H_2SO_4$  and NaCl, chlorine gas is liberated and a compound (D) of manganese along with other products is formed. Identify compounds (A) to (D) and also explain the reactions involved.



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20. Mention the types of compounds formed when small atoms like H, C and N get trapped inside the crystal lattice of transition metals. Also give physical and chemical characteristics of these compounds.

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21. (a) Write the electronic configuration of the element with atomic number 102.

(b) What is lanthanoid contraction ? What is its effect on the chemistry of the elements which follow the lanthanoids?

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22. The magnetic moments of few transition metal ions are given below :

Metal ion	Magnetic moment (BM)
$Sc^{3+}$	0.00
$Cr^{2+}$	4.90
$Ni^{2+}$	2.84
$Ti^{3+}$	1.73

(At. no. Sc = 21, Ti = 22, Cr = 24, Ni = 28)

Which of the given metal ions :

(i) has the maximum number of unpaired electrons ?

(ii) forms colourless aqueous solution ?

(iii) exhibits the most stable +3 oxidation state ?

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### Long Answer Questions | 5 Marks Each

1. (a) (i) How is the variability in oxidation states of transition metals different from that of the p-block elements ?

(ii) Out of  $Cu^+$  and  $Cu^{2+}$  which ion is unstable in aqueous solution and why ?

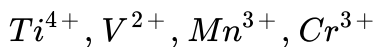
(iii) Orange colour of  $Cr_2O_7^{2-}$  ion changes to yellow when treated with an alkali. Why ?

(b) Chemistry of actinoids is complicated as compared to lanthanoids.

Give two reasons.

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2. (a) Following are the transition metal ions of 3d series :



(Atomic numbers : Ti = 22, V = 23, Mn = 25, Cr = 24)

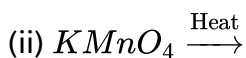
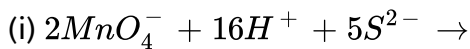
Answer the following :

(i) Which ion is most stable in an aqueous solution and why ?

(ii) Which ion is a strong oxidising agent and why ?

(iii) Which ion is colourless and why ?

(b) Complete the following equations :



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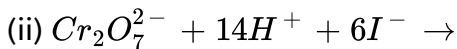
3. (a) Account for the following :

(i) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.

(ii)  $Cr^{2+}$  is a strong reducing agent.

(iii)  $Cu^{2+}$  salts are coloured while  $Zn^{2+}$  salts are white.

(b) Complete the following equations :



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4. The elements of 3d transition series are given as :

Sc Ti V Cr Mn Fe Co Ni Cu Zn

Answer the following :

(i) Write the elements which shows maximum number of oxidation states.

Give reason.

(ii) Which element has the highest m.p. ?

(iii) Which element shows only +3 oxidation state ?

(iv) Which element is a strong oxidising agent in +3 oxidation state and why ?

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5. (a) Blackish brown coloured solid (A) which is an oxide of manganese, when fused with alkali metal hydroxide and an oxidising agent like  $KNO_3$ , produces a dark green coloured compound (B). Compound (B) on disproportionation in neutral and acidic solution gives a purple coloured compound (C). Identify (A), (B) and (C) and write the reaction involved when compound (C) is heated to 513 K.

(b) (i)  $E^\circ_{M^{3+}/M^{2+}}$  values for the first series of transition elements are given below. Answer the question that follows.

Metal	Ti	V	Cr	Mn	Fe	Co
$E^\circ_{M^{3+}/M^{2+}}$	- 0.37	- 0.26	- 0.41	+ 1.57	+ 0.77	+ 1.97

Identify the two strongest oxidising agents in the aqueous solution from the above data.

(ii) Cu (I) ion in aqueous solution is not known

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

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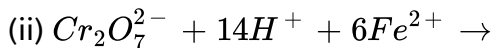
6. (a) Account for the following:

(i)  $Ce^{4+}$  is a strong oxidising agent in aqueous solution.

(ii) Transition metals have high enthalpy of atomisation.

(iii) Mn shows maximum number of oxidation states in 3d series.

(b) Complete the following equations:



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7. (a) How will you prepare :

(i)  $K_2MnO_4$  from  $MnO_2$  ?

(ii)  $Na_2Cr_2O_7$  from  $Na_2CrO_4$  ?

(b) Account for the following:

(i)  $Mn^{2+}$  is more stable than  $Fe^{2+}$  towards oxidation to +3 state.

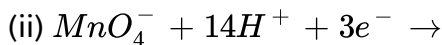
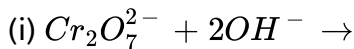
(ii) The enthalpy of atomisation is lowest for Zn in 3d series of the transition elements.

(iii) Actinoid elements show wide range of oxidation states.



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8. (a) Complete the following equations :



(b) Account for the following:

(i) Zn is not considered a transition element.

(ii) Transition metals form a large number of complexes.

(iii) The  $E^\circ$  value for the  $Mn^{3+} / Mn^{2+}$  couple is much more positive than that for  $Cr^{3+} / Cr^{2+}$  couple.



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9. (i) Name the element of 3d transition series which shows maximum number of oxidation states. Why does it show so?

(ii) Which transition metal of 3d series has positive  $E^\circ (M^{2+} / M)$  value and why?

(iii) Out of  $Cr^{3+}$  and  $Mn^{3+}$ , which is a stronger oxidising agent and why?

(iv) Name a member of the lanthanoid series which is well known to exhibit +2 oxidation state.

(v) Complete the following equation :



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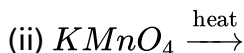
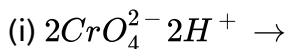
10. (a) Give reasons for the following:

(i)  $\text{Mn}^{3+}$  is a good oxidising agent.

(ii)  $E^\circ - (M^{2+} / M)$  values are not regular for first row transition metals (3d series).

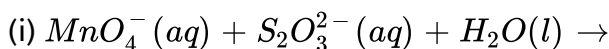
(iii) Although 'F' is more electronegative than 'O', the highest Mn fluoride is  $\text{MnF}_4$ , whereas the highest oxide is  $\text{Mn}_2\text{O}_7$ .

(b) Complete the following equations :

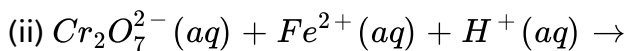


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11. (a) Complete the following chemical equations :







(b) Explain the following observations:

(i)  $La^{3+}$  ( $Z = 57$ ) and  $Lu^{3+}$  ( $Z = 71$ ) do not show any colour in solutions.

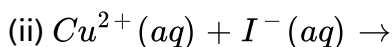
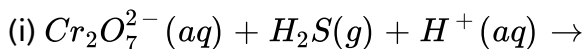
(ii) Among the divalent cations in the first series of transition elements, manganese exhibits the maximum paramagnetism.

(iii)  $Cu^+$  ion is not known in aqueous solutions.



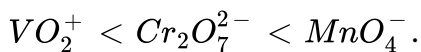
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12. (a) Complete the following chemical equations :



(b) How would you account for the following:

(i) The oxidising power of oxoanions are in the order



(ii) The third ionisation enthalpy of manganese ( $Z = 25$ ) is exceptionally high.

(iii)  $Cr^{2+}$  is a stronger reducing agent than  $Fe^{2+}$ .



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13. (a) (i) Which is stronger reducing agent  $Cr^{2+}$  or  $Fe^{2+}$  and why?
- (ii) Explain why  $Cu^+$  ion is not stable in aqueous solutions.
- (iii) Explain why  $Ce^{4+}$  is a strong oxidising agent.
- (b) Describe the oxidising property of  $KMnO_4$  in neutral or faintly alkaline medium for its reaction with iodide ions and thiosulphate ions.

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14. Explain the following:

- (a) Actinoids show large number of oxidation states.
- (b) The transition metals form a large number of complex compounds.
- (c) Chromium is a typical hard metal while mercury is a liquid.
- (d)  $MnO$  is basic while  $Mn_2O_7$  is acidic in nature.
- (e) Silver is a transition metal but zinc is not.

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15. (a) Account for the following :

(i) Oxidising power in the series  $VO^{2+} < Cr_2O_7^{2-} < MnO_4^-$ .

(ii) Actinoid contraction is greater from element to element than lanthanoid contraction.

(iii) Oxoanions of a metal show higher oxidation state.

(b) What is Misch metal ? Give its one use.



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16. (a) Out of  $Ag_2SO_4$ ,  $CuF_2$ ,  $MgF_2$  and  $CuCl$ , which compound will be coloured and why ?

(b) Explain :

(i)  $CrO_4^{2-}$  is a strong oxidising agent while  $MnO_4^{2-}$  is not

(ii) Zr and Hf have identical sizes.

(iii) The lowest oxidation state of manganese is basic while the highest is acidic.

(iv) Mn (II) shows maximum paramagnetic character amongst the divalent ions of the first transition series.



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17. Give reasons for the following:

(a) Transition metals have high enthalpies of atomisation,

(b) Among the lanthanoids, Ce (III) is easily oxidised to Ce (IV).

(c)  $Fe^{3+} | Fe^{2+}$  redox couple has less positive electrode potential than  $Mn^{3+} | Mn^{2+}$  couple.

(d) Copper (I) has  $d^{10}$  configuration, while copper (II) has  $d^9$  configuration, still copper (II) is more stable in aqueous solution than copper (I).

(e) The second and third transition series elements have almost similar atomic radii.



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18. (a) In the titration of  $FeSO_4$  with  $KMnO_4$  in the acidic medium, why is dil.  $H_2SO_4$  used instead of dil. HCl ?

(b) Give reasons :

(i) Among transition metals, the highest oxidation state is exhibited in

oxoanions of a metal.

- (ii)  $Ce^{4+}$  is used as an oxidising agent in volumetric analysis.
- (iii) Transition metals form a number of interstitial compounds.
- (iv)  $Zn^{2+}$  salts are white while  $Cu^{2+}$  salts are blue.



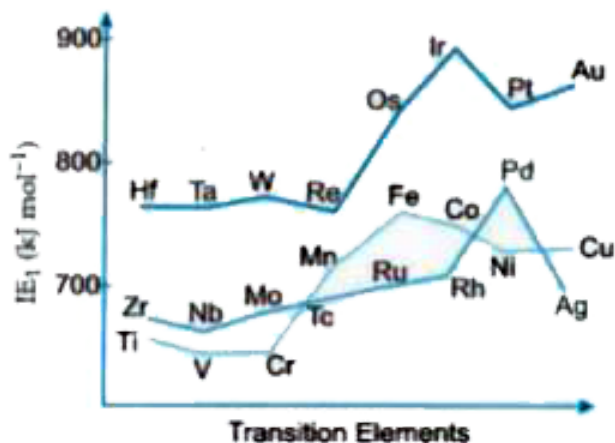
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**19. (a)** Write balanced equations to represent what happens when

(i)  $Cu^{2+}$  is treated with KI.

(ii) Acidified potassium dichromate solution is reacted with iron (II) solution (ionic equation).

(b) (i) The figure given below illustrates the first ionisation enthalpies of first, second and third series of transition elements. Answer the questions that follow :



Which series amongst the first, second and third series of transition elements have the highest first ionisation enthalpy and why?

(ii) Separation of lanthanoid elements is difficult. Explain.

(iii)  $Sm^{2+}$ ,  $Eu^{2+}$  and  $Yb^{2+}$  ions in solution are good reducing agents but an aqueous solution of  $Ce^{4+}$  is a good oxidising agent. Why?

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20. (a) Transition metals can act as catalysts because these can change their oxidation state. How does Fe(III) catalyse the reaction between iodide and persulphate ions?

(b) Mention any three processes where transition metals act as catalysts.

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21. Consider the standard electrode potential values ( $M^{2+}/M$ ) of the elements of the first transition series.

<i>Ti</i>	<i>V</i>	<i>Cr</i>	<i>Mn</i>	<i>Fe</i>	<i>Co</i>	<i>Ni</i>	<i>Cu</i>
-1.63	-1.18	-0.90	-1.18	-0.44	-0.28	-0.25	+0.

Explain :

- $E^\circ$  value for copper is positive.
- $E^\circ$  value of Mn is more negative as expected from the trend.
- $Cr^{2+}$  is a stronger reducing agent than  $Fe^{2+}$ .



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## Self Assessment Test Section A Multiple Choice Questions Choose The Correct Option

1. Which of the following is not a transition element ?

A. Chromium

B. Copper

C. Manganese

D. Indium

**Answer: D**

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2. General electronic configuration of transition elements is

A.  $(n - 1)d^{1-10}ns^{1-2}$

B.  $(n - 2)^{1-10}ns^{1-2}$

C.  $(n - 1)d^{1-8}ns^2$

D.  $(n - 2)^{1-10}ns^2$

**Answer: A**

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3. Properties like variety of oxidation states, formation of coloured ions and complex compound formation are due to

- A. partly filled s-orbitals.
- B. partly filled p-orbitals.
- C. partly filled d-orbitals.
- D. completely filled d-orbitals.

**Answer: C**



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4.  $n$  being the number of unpaired electrons, the magnetic moment  $\mu$  of a molecule is given by

A.  $\sqrt{n(n - 2)}$

B.  $\mu = \sqrt{n(n + 2)}$

C.  $\sqrt{n(n - 1)}$

$$D. \mu = \sqrt{n(n+1)}$$

**Answer: B**

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5. The energy used in the excitation of an electron from a lower energy d-orbital to a higher energy d-orbital lies in

- A. UV range.
- B. IR range.
- C. X-ray range.
- D. Visible range.

**Answer: D**

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6. Assertion (A) : A variety of steel and stainless steel can be prepared by using Cr, V, W, Mo and Mn.

Reason (R) : As the oxidation number of a metal increases, ionic character decreases.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement

**Answer: B**



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7. Assertion (A) : Whenever half-filled or fully filled configuration of the metal is disturbed after removing the electrons, a high value of I.E. is observed.

Reason (R) : Paramagnetic substances are repelled by the magnetic field where as diamagnetic substances are attracted by the magnetic field.

A. Both Assertion (A) and Reason (R) are correct statements, and

Reason (R) is the correct explanation of the Assertion (A).

B. Both Assertion (A) and Reason (R) are correct statements, but

Reason (R) is not the correct explanation of the Assertion (A).

C. Assertion (A) is correct, but Reason (R) is incorrect statement.

D. Assertion (A) is incorrect, but Reason (R) is correct statement

**Answer: C**

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