CHEMISTRY

BOOKS - PRADEEP CHEMISTRY (HINGLISH)

D- AND F-BLOCK ELEMENTS

Curiosity Questions

1. Which element / elements is / are alloyed with aluminium or tin in making air craft frames and jet engines and why?

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2. Which element is used in making bone nails for surgery and why?

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3. Explain why, tungsten is used for making the filaments of electric bulbs.

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4. Molybdenum is used as a target element for production of X - rays because it is

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5. Which solution is used by police to test that a person is drunk ? How is it done ?

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6. Which alloy is generally used in making bullets, shells and lighter flints? What is its composition ? With which other element it is generally alloyed and why ?

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7. Which compound is generally used in making optical glasses such as Crooke's lenses which protect eyes against UV light ?

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Advanced Problems

1. Pyrolustie on heating with KOH in the presence of air gives dark green compound (A).The solution of (A) on treatment with H_2SO_4 gives a purple coloured compound (B) which gives the following reactions :

(i) Alkaline solution of B on reaction with KI changes it into compound (C).

(ii) The color of the compound (B) disappears on treatment with acidic soluiont of $FeSO_4$.

(iii) On reaction with conc. H_2SO_4 compound (B) gives another compound (D) which can decompose to produce compound (E) along

with oxygen gas. Identify compounds (A) to (E) and write balanced chemical equation involved in each case.

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2. When an organge crystalline compound (A) was heated with common salt and concentrated sulphuric acid, an orange red gas (B) was evolved. Acidified solution of the comound (A) reacts with H_2O_2 to produce a deep blue solution due to the formation of comopund (C). The gas (B) on passing through NaOh solution gave a solution (D). The solution on reacting with an aqueous solution of lead acetate gave a yellow precipitate of (E).

Name the compounds A,B,C,D (present in the soluiotn) and E (present as ppt.)

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3. When a white crystalline compound X is heated with $K_2Cr_2O_7$ and concentrated H_2SO_4 a, a reddish brown gas A is evolved. On passing A

into caustic soda solutions, a yelow coloured solution of B is obtained. Neutralizing the solution B with acetic acid and on subsequent addition of lead acetate, a yellow precipitate C is obtained.When X is heated with NaOH solution, a colourless gas is evolved and on passing this gas into K_2HgI_4 solution, a reddish brown precipitate D is formed. Identify A,B,C,D and X. Write the equation of the reaction involved.

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4.

$$MCl_4(\text{colourless liquid}) \underset{\text{(B) white fumes}}{\overset{\downarrow}{\text{M}}} = \text{transition metal moist air} \xrightarrow{Zn+H_2O} \text{Purple co}$$

Identify (A), (B) and MCl_4 . Also explain colour differnece between MCl_4 and (A) .

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5. A mixed oxide of iron and chromium, $FeO.Cr_2O_3$ is fused with sodium carbonate in the presence of air to form a yellow 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 equations for each step.

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6. (a) A blackish brown coloured solid 'A' when fused with an alkali metal hydroxide in the presence of air, produces a dark green colored compound 'B' which upon electrolytic oxidation in alkaline medium gives a dark purple coloured compound 'C'. Identify A,B and C and write the reactions involved.

(b) What happesn when acidic solution of green compound (B) is allowed to stand for sometime? Give the equation involved. What is this type of reaction called ?

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7. Two colourless gas A and B are enclosed in two separate jars. When passed through acidified $K_2Cr_2O_7$ solution, turn the solution green. But gas A turns lead acetate paper black whereas if both the gases are passed into water, the solution develops a yellowish white turbidity. Identify the gases A and B and write balanced equations for the chemical reactions taking place.

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8. (i) An aqueous solution of a compound (A) is acidic towards litmus and (A) sublimes at about $300^\circ C$.

(ii) (A) on treatment with an excess of NH_4SCN gives a red coloured compound (B) and on treatment with a solution of $K_4\left[Fe(CN)_6\right]$ gives a blue coloured compound (C).

(iii) (A) on heating with excess of $K_2Cr_2O_7$ in the presence of concentrated H_2SO_4 evolves deep red vapours of (D).

(iv) On passing the vapour of (D) into a solution of NaOH and then adding the solution of acetic acid and lead acetate, a yellow precipitate of

compound (E) is obtained.

Identify (A) to (E) and give chemical equations for the reactions.

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9. There are two ores (A_1) and (A_2) of metal (M). When ore (A_1) is calcined, a black solid (S) is obtained along with liberation of CO_2 and water . The ore (A_1) on treatment with HCl and KI gives a precipitate (P) and ioidine is liberated . The ore (A_2) on roasting gives a gas (G) and metal (M) is set free. When gas (G) is passed through acidified $K_2Cr_2O_7$ solution, it turns green. Identify (M), (A_1), (A_2), (S), (P) and (G).

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10. A student had taken solutions of KI, H_2S, C_2H_5OH and NaBr in four separate test tube but he forgot to label them. By taking a mall sample of the solution from each of the four test tubes, suggest a method by which he can find out the solution in each test tube by using the same reagent in each of the test tubes. Give the reaction in each case.

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11. The number of moles of $KMnO_4$ that will be needed to react completely with one mole of ferrous oxalate in acidic solution is:

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Test Your Grip Multiple Choce Questions

1. Give general electronic configuration of d-block elements.

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

B. ns^2np^{1-6}

C. $(n-2)f^{0-14}(n-1)^{1-2}ns^2$

D. $(n-1)d^{1-5}ns^{1-2}$

Answer: A

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

A. Zn

B. Ru

C. Ag

D. Pb

Answer: d

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3. In first transition series which of the following has lowest enthalpy of atomisation?

A. Sc

B. Cu

C. Ti

D. Zn

Answer: d

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4. Irregular trend in the standard reduction potential value of first row transition elements is due to

A. regular variation of first and second row enthalpies

B. irregular variation of sublimation enthalpies

C. regular variation of sublimation enthalpies

D. increase in number of unpaired electrons

Answer: b

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5. Which element does not show variable oxidation state ?

A. Sc

B. V

C. Fe

D. Hg

Answer: a

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6. The maximum oxidation state of osmium is

A. $+6$

B. $+7$

C. $+8$

D. $+5$

Answer: c

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7. Which of the following oxidation states is the most common among the lanthanoids ?

A. 4

B. 2

C. 5

D. 3

Answer: d

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8. Which of the following cation is colourless in its aqueous solution

A. Fe^{2+}

B. Mn^{2+}

C. Ti^{3+}

D. Sc^{3+}

Answer: d

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9. Which metal has highest density ?

A. Pt

B. Os

C. W

D. Hg

Answer: b

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10. Formation of interstitial compound makes the transition metal

A. more soft

B. more ductile

C. more metallic

D. more hard

Answer: d

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11. Which of the following element about transition elements is incorrect ?

A. They show variable oxidation states

B. All the ions are coloured

C. They exhibit diamagnetic and paramagnetic properties

D. They exhiibit catalytic property

Answer: b

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12. Permanent magnets are generally made of alloys of

A. Fe

B. Co

C. Ni

D. Any one of these

Answer: d

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13. Which of the following oxides of chromium is amphoteric in nature?

A. CrO

B. Cr_2O_3

C. CrO_3

D. CrO_5

Answer: b

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14. In the reaction : $NaCl + K_2Cr_2O_7 +$ cons. $H_2SO_4 \xrightarrow{\text{heat}} X + Na_2SO_4 + K_2SO_4 + H_2O$, X is a reddish brown gas which gives a yellow solution on passing through water and a yellow precipitate on treating the solution with lead acetate solution . X could be

A. Cl_2

B. CrO_3

C. H_2CrO_4

D. CrO_2Cl_2

Answer: d

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15. In $KMnO_2$ on heating to red hot gives

A. $+2$

B. $+4$

C. $+6$

D. $+7$

Answer: d

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16. $KMnO_4$ on heating to red hot gives

A. $K_2MnO_4 + MnO_2 + O_2$

B. $K_2MnO_3 + MnO_2 + O_2$

C. $K_2O + MnO_2 + O_2$

D. None of these

Answer: b

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17. Which is the strongest base among the following ?

A. $La(OH)_3$

B. $Lu(OH)_3$

C. $Ce(OH)_3$

D. $Yb(OH)_3$

Answer: a

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18. The electronic configuration of gadolinium (At. No 64) is:

A. $[Xe]4f^8 5d^0 6s^2$

B. $[Xe]4f^7 5d^1 6s^2$

C. $[Xe]4f^3 5d^5 6s^2$

D. $[Xe]4f^6 5d^2 6s^2$

Answer: b

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

A. Ce

B. La

C. Lu

D. Pr

Answer: a

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20. Larger number of oxidation state are exhibited by the actinoids than those by the lanthanoids , the main reason being.

A. more energy difference between 5d and 6d than between 4f and 5d orbitals

B. more reactive nature of the antinoids than the lanthanoids

C. 4f orbitals more diffused than the 5f orbitals

D. lesser energy difference between 5f and 6d than between 4f and 5d orbitals.

Answer: d

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21. Which of the following factor may be regarded as the main cause of lanthanide contraction?

A. Poor shielding of one of the 4f-electrons by another in the subshell

B. Effective shielding of one of the 4f-electrons by another in the subshell

C. Poorer shielding of 5d electrond by 4f electrons

D. Greater shielding of 5d electrons by 4f electrons.

Answer: a

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22. Which of the following pairs has the same size ?

A. Zn^{2+}, Hf^{4+}

B. Fe^{2+}, Ni^{2+}

C. Zr^{4+}, Ti^{4+}

D. Zr^{4+}, Hf^{4+}

Answer: d

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23. The maximum oxidation state exhibited by actinide ions is

A. $+5$

B. $+4$

C. $+7$

D. $+8$

Answer: c

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Test Your Grip Fill In The Blanks

1. The general valence shell electronic configuration of transition elements is

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2. Third transition series starts with the element . . .. and ends at the element. . .....

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3. In the d-block, the elements which do not generally show the characteristics of transition elements include . . .., ... and . . ..

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4. Silver and gold atoms have nearly the same atomic radii due to . . . . . .

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5. Among the d-block elements, the highest melting point is shown by . . . . . .

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6. Among the transiton metals of the first series (leaving zinc which is not considered as a transition metal), the lowest meltaing point is shown by . . . . . .

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7. The only metal which has a positive standard reductions potential in the first transition series is . . ..

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8. The element of first transition series which shows maximum number of oxidation states is

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9. The reaction in which the same substance undergoes oxidation as well as reduction is called . . .. reaction.

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10. $\left[Ti(H_2O)_6\right]^{3+}$ is purple in colour because it is complimentary colour of

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11. Transition metals in which vacent spaces are occupied by small atoms such as hydrogen, carbon etc. are called . . ..

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12. Iron, cobalt and nickel are collectively called as . . .. metals.

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13. Copper, silver and gold are collectively called as . . .. metals.

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14. First synthetic elements is

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15. Chromite ore has the formula . . ..

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16. When $K_2Cr_2O_7$ is heated to white heat, the products formed are . . .., ... and . . ..

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17. When KOH is added to $K_2Cr_2O_7$ solution, the coloure changes from . . .. to . . .. due to the formation of . . ..

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18. $\overset{V}{Cr}O_4^{3-}$ in acidic medium undergoes disproportionation to form . . .. and . . ..

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19. Reddish brown vapours formed when a chloride is heatedwith $K_2Cr_2O_7$ and conc.H_2SO_4 are due to the formation of . . ..

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20. Acidified $K_2Cr_2O_7$ on reaction with hydrogen peroxide give deep blue solution due to formation of

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21. Yellow coloure of $CrO_4^{2-}O_7$ or orange coloure of $Cr_2O_7^{2-}$ is not due to d-d transition but due to . . ..

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22. The powdered pyrolusite ore when fused with KOH in presence of air forms. . .....

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23. MnO_4^{2-} in acidic solution undergoes disportionation to give . . .. and . . ..

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24. When heated strongly , $KMnO_4$ decomposes to form . . .. and . . ..

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25. Prussian blue is formed when

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26. Which compound is formed when excess KCN is added to aqueous solution of copper sulphate?

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27. $(NH_4)_2Cr_2O_7$ on heating gives

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28. F block elements are known as

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29. The electronic configuration of the fourth transition element is

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30. The basic strength . . .. as we proceed from $La(OH)_3$ to $Lu(OH)_3$ (decreases or increases or remains constant).

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31. Mischmetal contains about . . .. percent of lanthanoids and is used in making Mg-based alloy called . . ..

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32. The most common mineral containing lanthanoids is.....

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33. Philospher's wool is the name given to the compound. . .....

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Conceptual Questions

1. Though copper , silver and gold have completely filled sets of d-orbitals yet they are considered as transition metals. Why?

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2. Name the elements which are not really transition elements but are discussed with them. Why is is so?

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3. Explain why transition elements have many irregularties in their electronic configuration.

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4. Explain why Fe is a transitioin metal but Na is not ?

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5. Why is there striking similarities (horizontal and vertical) in successive members of the transition series ?

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6. Why do the transition metal ions have high enthalpy of hydration ?

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7. Why the properties of third transition series are very similar to second transition series ? Or Why the second and third members in each group of the transition elements have very similar atomic radii ?

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8. Chromium is a typical hard metal while mercury is a liquid.

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9. The melting and boiling points of Zn , Cd and Hg are low. Why ?

Or Why Zn , Cd and Hg are soft and have low m.pt. ?

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10. The second ionisation enthalpies of both Cr and Cu are higher than those of the next element. Explain.

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11. K_2PtCl_6 is a well known compound whereas corresponding Ni compound is not known. Explain.

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12. Most of the transition metals do not displace hydrogen from dilute acids, why ?

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13. Explain why E° for Mn^{3+}/Mn^{2+} couple is more positive than that for Fe^{3+}/Fe^{2+} (At. Nos. Mn=25,Fe=26)?

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14. The E° value in respect of the electrodes $(Z=24)$, manganese $(Z=25)$ and iron $(Z=26)$ are :

$Cr^{3+}/Cr^{2+} = -0.4V$, $Mn^{3+}/Mn^{2+} = +1.5V$,

$Fe^{3+}/Fe^{2} = +0.8V$.

On the basic of the above information compare the feasibilities of further oxidation of their $+2$ oxidation states.

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15. Why do transition elements show variable oxidation state?

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

Illustrate with examples.

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

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18. How would you account for the fact that the transition metals and their compounds are found to be good catalysts in many processes?

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19. Why generally there is an increase in density of elements from titanium $(Z = 22)$ to copper $(Z = 29)$. In the first series of transition of transiton elements.

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20. Giving reasons indicate which one of the following would be coloured ?

Cu^+, V^{2+}, Sc^{3+}, Ni^{2+} (At. no. of Cu = 29, V = 23, Sc = 21, Ni = 28)

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21. Scandium forms no coloured ions, yet it is regarded as a transition elements. Explain why?

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22. A substance is found to have a magnetic moments of $3.9BM$.How many unpaired electrons does it contain?

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23. The paramagnetic character in $3d$ transition series elements increases up to Mn and then decreases. Explain why.

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24. Decide giving reason which one of the following pairs exhibits the property indicated :

(i) Sc^{3+} or Cr^{3+} exhibits paramagnetism(ii) V or Mn exhibits more number of oxidation states (Atomic numbers : $Sc = 21, Cr = 24, V = 23, Mn = 25$)

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25. (a) of the ions Ag^{+}, Co^{2+} and Ti^{+}, which one will be coloured in aqueous solution? (Atomic no. s: Ag=47,Co=27,Ti=22)

(b) If each ore each one of the above ionic species is in turn placed in a magnetic field, how will it respond and why?

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26. Why are the ionisation energies of 5d elements greater than 3d elements?

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27. Describe giving reason which one of the following pairs has the property indicated?

(a). Fe or Cu has higher melting point.

(b). Co^{2+} or Ni^{2+} has lower magnetic moment.

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28. Give reason for the following features of transition metal chemistry:

(i). The lowest oxide of a transition metal (say, chromium, atomic number 24) is basic whereas the highest oxide is usually acidic.

(ii) . Transition metals sometimes exhibit very low oxidation states such as $+1$ and 0.

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29. The 4d and 5d series of transition metals have more frequency metal-metal bonding in their compounds than do the 3d metals. Explain.

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30. Give reasons for each of the following:

(i) Size of trivalent lanthanoid cation decrease with increase in the atomic number.

(ii) Transition metal fluorides are ionic in nature whereas bromides and chlorides are usualy covalent in nature.

(iii) Chemistry of all the lanthanoids is quite similar.

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31. Assign reason for each of the following statement:

(i) The largest number of oxidation states are exhibited by the elements in their row transition elements.

(ii) The atomic radii decrease in Size with the increasing atomic number in the lanthanoid series

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32. (i) Which is a stronger reducing agent Cr^{2+} or Fe^{2+} and why ?

(ii) Explain why Cu^{+} ion is not stable in aqueous solution ?

(iii) Explain why Ce^{4+} is a stronger oxidizing agent.

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33. Assign reasons for each of the following :

(i) Manganese exhibits the highest oxidation state of $+7$.

(ii) Unlike $Cr^{3+}, Mn^{2+}, Fe^{93}+)$ and the subseuent M^{3+} ions of 3d series of elements , the 4d an 5d series metals generally do not form stable cationic species.

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34. Explain why Zn shown only $+2$ oxidation state.

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35. Why is first ionization enthalpy of Cu higher than that of Na ?

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36. Give reason 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) Transition metals show variable oxidation states.

(iii) Actinoids show irregularities in their electronic configurations.

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

$Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+}$

(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:

(i) $2MnO_4^- + 16H^+ + 5S^- \rightarrow$

(ii) $KMnO_4 \xrightarrow{heat}$

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38. Write the formula of different oxides of manganese. What is the oxidation state of Maganese in each of them ? Arrange them in order of their decreasing acidic character.

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

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40. In the titratin of Fe^{2+} ions with $KMnO_4$ in acidic medium, why dilute H_2SO_4 is used and not dilute HCl ?

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41. Give the relationship between the equivalent weight and molecular weight of $KMnO_4$ in (a) acidic (b) alkaline and (c) neutral media.

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42. Why is it not advisable to dissolve $KMnO_4$ in conc. H_2SO_4 ?

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43. Why in permanganate ion, there is a covalency between Mn and oxygen ?

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44. When chromite ore $FeCr_2O_4$ is fuse with NaOH in presence of air, a yellow coloured compound (A) is obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl formas an orange colured crystalline compound (C).

(i) Write the formulae of the compounds (A),(B) and (C).

(ii) Write one use of compounds (C).

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45. Briefly explain why electronic configuration of lanthanoids are not known with certainty.

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46. The $+3$ oxidation states of langthanum $(Z = 57)$, gadolinium $(Z = 64)$ and lutetium $(Z = 71)$ are especially stable. Why ?

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47. The outer electronic configuration of two members of the lanthanoid series are as follows :

$4f^15d^16s^2$ and $4f^75d^-6s^2$

What are their atomic numbers ? Predict the oxidation states exhibited by these elements in their compounds.

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48. Why Zr and Hf or Nb and Ta exhibit similar properties?

Or Zirconium (atomic number 40 and atomic number 72) occur together in minerals and they exhibit similar properties. Give reasons.

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49. Why Sm^{2+}, Eu^{2+} and Yb^{2+} ions in solutions are good reducing agents but an aqueous solution of Ce^{4+} is a good oxidizing agent ?

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50. One among the langthanides ,Ce(III), can be easily oxidized to Ce(IV) (At. No. of $Ce = 58)$. Explain why ? Or Of the lanthanides, cerium (At. No. 58) forms a tetrapositive ion, $Ce^{94} +)$ in aqueous solution. Why?

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51. Which out of the two, $La(OH)_3$ and $Lu(OH)_3$ is more basic and why ?

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52. The electronic configuration of actinide elements are not known with certainity . Explain.

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53. How would you account for the fact that actinoids exhibit a larger number of oxidation state than the corresponding lanthanoids?

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54. The actinide contraction differs from lanthanide contraction ? Explain.

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55. Account for the following :

(i) Oxidizing 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) Oxoanion of a metal show higher oxidation states.

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56. Account for the following :

(a) Europlum (II) is more stable than cerium (II).

(b) Transition metal have high enthalpies of atomisation . (c) Actinoid ions are generally coloured.

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Ncert Questions And Exercises With Ansers

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 transition metals exhibit higher enthalpies of atomisation ?

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3. Name the transition element which does not exhibit variable oxidation states .

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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 $VO_2^{\oplus} < Cr_2O_7^{2-} < MnO_4^{\ominus}$?

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6. For the first row transition metals the $E^{\ominus}$ value are:

V	Cr	Mn	Fe	Co	Ni	Cu
-1.18	-0.91	-1.18	-0.44	-0.28	-0.25	$+0.34$

Explain the irregularity in the above values.

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7. Why is the E^{Θ} value for the Mn^{3+}/Mn^{2+} couple much more positive than that for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+}

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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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Ncert Intext Unsolved Questions

1. Silver atom has completely filled d orbitals $\left(4d^{10}\right)$ in its ground state. How can you say 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 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 $E^0\left(M^{2+}/M\right)$ value for copper is positive $(+0.34V)$. What is possibly the reason for this?

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5. How would you account for the irregular of ionisation enthalpies (first) 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 magentic moment of M^{2+} 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 Exercises

1. Write down the electronic configuration of :

(a) Cr^{3+}

(b) Cu^{+}

(c) Co^{2+}

(d) Mn^{2+}

(e) Pm^{3+}

(f) Ce^{4+}

(g) Lu^{2+}

(h) Th^{4+}

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2. Why Mn^{2+} compounds are more stable than Fe^{2+} compounds towards 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 lanthanold contraction?

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8. What are the characteristics of th 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 the 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 giving reason :

(i) Transition metals and many of their compounds show paramagnetic behaviour.

(ii) The enthalpies of atomisation of the transition coloured compounds.

(iii) The transition metals generally form coloured compounds.

(iv) Transition metals and their many compuonds acts as good catalyst.

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

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

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 for its reaction with (i) iodide (ii) iron (ii) solution and (ii) H_2S

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16. Describe the preparation of potassium permanganate. How does the acidified permanganate solution react with (a) iron (ii) ions (b)SO_4 (c) oxalic acid ? Write the ionic equations for the reactions .

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17. For M^{2+}/M and M^{3+}/M^{2+} system, E° values for some metals are as follows ,

$Cr^2/Cr = -0.9Vl, Cr^{3+}/Cr^2 = -0.4V, Mn^{2+}/Mn = -1.2V, Mn^3$

Use this data to comment upon

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

(ii) the case with which iron can be oxidized as compared to the similar process for either Cr or Mn metals.

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

$Ti^{3+}, V^{3+}, Sc^{3+}, Mn^{2+}, Fe^{3+}, Co^{2+}$ and MnO_4^-

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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 lanthanoids with special reference to

(i) electronic configuration (ii) oxidation state (iii) atomci and ionic sizes (iv) chemical reactivity.

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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 ion: 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 actinods? 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 calculatel its magntic 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 types of behavior with the electronic configuration of these elements.

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

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34. 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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35. 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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36. Comments on the statement that elements of the first transition series

posses many properties different from those of heavier transition elements.

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37. 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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Ncert Exemplar Problems Multiple Choice Questions

1. Electronic confriguration of a transition element X in +3 oxidation states is $[Ar]3d^5$.

What is its atomic number?

A. 25

B. 26

C. 27

D. 24

Answer: B

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2. The electronic configurationo of Cu(II) is $3d^9$ whereas that of Cu(I) is $3d^{10}$. Which of the following is correct ?

A. Cu (II) is more stable

B. Cu(II) is less stable

C. Cu(I) and Cu(II) are equally stable.

D. Stability of Cu(I) and Cu(II) depends on nature of copper salts.

Answer: a

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3. Metallic radii of some transitions element are given below. Which of these elements will have highest density ?

Element	Fe	Co	Ni	Cu
Metallic radii/pm	126	125	125	128

A. Fe

B. Ni

C. Co

D. Cu

Answer: d

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4. Generally transition elements from coloured salts due to the presence of unpaired electrons. Which of the following compounds will be coloured in solid state?

A. Ag_2SO_4

B. CuF_2

C. ZnF_2

D. Cu_2Cl_2

Answer: b

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5. On addition of small amoung of $KMnO_4$ to concentrated H_2SO_4, a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following.

A. Mn_2O_7

B. MnO_2

C. $MnSO_4$

D. Mn_2O_3

Answer: a

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6. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition element, which shows highest magnetic moment.

A. $3d^7$

B. $3d^5$

C. $3d^8$

D. $3d^2$

Answer: b

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7. Which of the following oxidation state si common for all lanthanoids?

A. $+2$

B. $+3$

C. $+4$

D. $+5$

Answer: b

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8. Which of the following reactions are disproportionation reaction ?

A. $Cu^{+} \rightarrow Cu^{2+} + Cu$

B. $3MnO_4^- + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

C. $2KMnO_4 + \rightarrow K_2MnO_4 + 2H_2O$

D. $2MnO_4^- + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^+$

Answer: a:b

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9. When $KMnO_4$ solution is added to oxalic acid solution , the decolourisation is slow in the beginning but becomes instantaneous after some time because

A. CO_2 is formed as the product.

B. Reaction is exothermic.

C. MnO_4^- catalyses the reaction

D. Mn^{2+} acts as autocatalyst

Answer: d

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10. There are 14 elements in actinoid series. Which of the following elements does not belong to this series?

A. U

B. N_p

C. Tm

D. Fm

Answer: c

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11. $KMnO_4$ acts as an oxidising agent in acidic medium. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphide ions in acidic solution is

A. $\frac{2}{5}$

B. $\frac{3}{5}$

C. $\frac{4}{5}$

D. $\frac{1}{5}$

Answer: a

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12. Which of the following is amphoteric oxide?

$Mn_2O_7, CrO_3, Cr_2O_3, CrO, V_2O_5, V_2O_4$

A. V_2O_5, Cr_2o_3

B. Mn_2O_7, CrO_3

C. CrO, V_2O_5

D. V_2O_5, V_2O_5

Answer: a

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13. Gadolinium belongsd to 4f series. It's atomic number is 64. which of the following is the correct electronic configuration of gadolinium ?

A. $[Xe]4f^7 5d^1 6s^2$

B. $[Xe]4f^6 5d^2 6s^2$

C. $[Xe]4f^8 6s^2$

D. $[Xe]4f^9 5s^1$

Answer: a

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14. Interstitial compounds are formed when small atoms are dropped under the curved lattice of metals. Whether the following is not the characteristics property of interstitial compounds?

A. They have high melting points in comparison to pure metals

B. They are very hard

C. They retain metallic conductivity

D. They are chemically very reactive

Answer: d

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15. The magnetic moment is associated with its spin angular momentum and orbital angular momentum. Spin only magnetic moment value of Cr^{3+} ion is

A. 2.87 B.M.

B. 3.87 B.M.

C. 3.47 B.M.

D. 3.57 B.M.

Answer: b

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16. $KMnO_4$ acts as on oxidising agent in alkaline medium. When alkaline $KMnO_4$ is treated with KI, iodide ion is oxidised to .....

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17. Which of the following statements is not correct ?

A. Copper liberates hydrogen from acids

B. In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine

C. Mn^{3+} and Co^{3+} are oxidising agents in aqueous solution

D. Ti^{2+} and Cr^{2+} are reducing agents in aqueous solution

Answer: a

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18. When acidified $K_2Cr_2O_7$ solution is added to Sn^{2+} salts then Sn^{2+} changes to

A. Sn

B. Sn^{3+}

C. Sn^{4+}

D. Sn^{+}

Answer: c

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19. Higher oxidation state of manganese in fluoride is $+4(MnF_4)$ but highest oxidation state in oxides is $+7(Mn_2O_7)$ because

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20. Although zirconium belongs to 4d transition series and hafnium to 5d transition series even then they show similar physical and chemical properties because ..... .

A. both belong to d-block

B. both have same number of electrons

C. both have similar atomic radius

D. both belongs to the same group of the periodic table.

Answer: c

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21. Why HCl not used to make the mdeium acidic in oxidation reactions of $KMnO_4$ in acidic medium ?

A. Both HCl and $KMnO_4$ act as oxidising agents.

B. $KMnO_4$ oxidises HCl into Cl_2 which is also an oxidising agent.

C. $KMnO_4$ is a weaker oxidising agent than HCl

D. $KMnO_4$ acts as a reducing agents in the presence of HCl.

Answer: b

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Ncert Exemplar Problems Multiple Choice Question Ii

1. Generally transition elements and their salts are coloured due to the presence of unpaired electrons in metal ions. Which of the following compounds are coloured?

A. $KMnO_4$

B. $Ce(SO_4)_2$

C. $TiCl_4$

D. Cu_2Cl_2

Answer: a,b

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2. Transition elements show magnetic moment due to spin and orbital motion of electrons. Which of the following metallic ions have almost same spin only magnetic moment?

A. Co^{2+}

B. Cr^{2+}

C. Mn^{2+}

D. Cr^{3+}

Answer: a,d

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3. In the form of dichromate, Cr(VI) is a strong oxidising agent in acidic medium but Mo(VI) in $Mo0_3$ and W(VI) in $W0_3$ are not because

A. Cr(VI) is more stable than Mo(VI) and W (VI)

B. Mo(VI) and W (VI) are more stable than Cr(VI).

C. Higher oxidation states of heavier members of group-6 of transition series are more stable.

D. Lower oxidation states of heavier members of group -6 of transition series are more stable.

Answer: b,c

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4. Which of the following actinoids show oxidation states upto +7?

A. Am

B. Pu

C. U

D. Np

Answer: b,d

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5. General electronic configuration of actinoids is $(n-2)f^{1-14}(n-1)d^{0-2}ns^2$. Which of the following actinoids have one electron in 6d orbital?

A. U (Atomic no. 92)

B. Np (Atomic no . 93)

C. Pu (Atomic no. 94)

D. Am (Atomic no. 95)

Answer: a,b

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6. Which of the following lanthanoids show $+2$ oxidation state besides the characteristic oxidation state +3 of lanthanoids?

A. Ce

B. E u

C. Yb

D. Ho

Answer: b,c

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7. Which of the following ions show higher spin only magnetic moment value?

A. Ti^{3+}

B. Mn^{2+}

C. Fe^{2+}

D. Co^{3+}

Answer: b,c

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8. Transition elements form binary compounds with halogens. Which of the following elements will form MF_3 type compounds?

A. Cr

B. Co

C. Cu

D. Ni

Answer: a,b

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9. Which of the following will not act as oxidising agents?

A. CrO_3

B. MoO_3

C. WO_3

D. CrO_4^{2-}

Answer: b,c

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10. Although $+3$ is the characteristic oxidation state for lanthanoids but cerium also shows $+4$ oxidation state because

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Ncert Exemplar Problems Short Answer Questions

1. Why does copper not replace hydrogen from acids?

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2. Why E^{-} values for Mn, Ni and Zn are more negative than expected?

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

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4. Transition elements show high melting points. Why?

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

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

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7. 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 compound A, B and C.

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

Why?

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

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10. Ionisation enthalpies of Ce, Pr and Nd are higher than Th, Pa and U. Why?

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

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12. Although +3 oxidation stae is thje characteristic oxidation state of lanthanoids but cerium shows +4 oxidation state also. Why ?

Watch Video Solution

13. Explain why does colour of $KMnO_4$ disappear when oxalic acids is added to its solution in acidic medium.

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14. When orange solution containing $Cr_2O_7^{2-}$ 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?

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15. A solution of $KMnO_4$ on reduction yields either a colourless solution or a brown precipitate or a green solution depending on pH of the solution. What different stages of the reduction do these represent and how are they carried out ?

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

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17. E° of Cu is +0.34 V while that of Zn is -0.736 V. Explain.

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

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

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20. Reactivity of transition element decreases almost regularly from Sc to Cu. Explain.

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Matching Type Questions

1. Match the catalyst given in Column I with the processes given in Column II.

	Column I (Catalyst)		Column II (Process)
A.	Ni in the presence of hydrogen	1.	Ziegler-Natta catalyst
B.	Cu_2Cl_2	2.	Contact process
C.	V_2O_5	3.	Vegetable oil to ghee
D.	Finely divided iron	4.	Sandmeyer reaction
E.	$TiCl_4 + Al(CH_3)_3$	5.	Haber's process
		6.	Decomposition of $KClO_3$

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2. Match the compounds/elements given in Column I with uses given in Column II.

	Compound /Element	Use
A.	Lanthanoid oxide	Television screen
B.	Lanthanoid	Production of iron alloy
C.	Misch metall	Lanthanoid metal + iron
D.	Magnesium based alloy is constitute of	Bullets
E	Mixed oxides of lanthanoids are employed	Petroleum cracking

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3. Match the properties givens in Column I with the metals given in Column II.

	Column I (Porperty)		Colu
(i)	An element which can show $+8$ oxidation state	(a)	Mn
(ii)	3d block element that can show upto $+7$ oxidation state	(b)	Cr
(iii)	3d block element with highest melting point	(c)	Os
		(d)	Fe

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4. Match the statements given in Column I with the oxidation states given in Column II.

	Column I		Column II
A.	Oxidation state of Mn in MnO_2 is	1.	+2
B.	Most stable oxidation state of Mn is	2.	+3
C.	Most stable oxidation state of Mn in oxides is	3.	+4
D.	Characteristic oxidation state of lanthanoids is	4.	+5
		5.	+7

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5. Mathc the solutions given in Column I and the coloures given in Column II.

	Column I (Aqueous solution of salt)		Column II (Colour)
(i)	$FeSO_4.7H_2O$	(a)	Green
(ii)	$NiCl_2.4H_2O$	(b)	Light pank
(iii)	$MnCl_2.4H_2O$	(c)	Blue
(iv)	$CoCl_2.6H_2O$	(d)	Pale green
(v)	Cu_2Cl_2	(e)	Pink
		(f)	Colourless

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6. Match the property given in Column I with the element given in Column II.

	Column I(Property)
(i)	Lanthanoid which shows $+4$oxidation state
(ii)	llnathanoid which can show $+2$oxidation state
(iii)	Radiactive lanthaoid
(iv)	Lanthanoid which has $4f^7$electronic configuration in $+3$oxidation
(v)	Lanthanoid which has $4f^{14}$electronic configuration in $+3$oxidatio

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7. Match the properties given in Colunmn I with the emtals given in Column II.

	Column I (Property)		Column II (
(i)	Element with higher second ionisation enthalpy	(a)	Co
(ii)	Element with highest third ionisation enthalpy	(b)	Cr
(iii)	M in $M(CO)_6$ is	(c)	Cu
(iv)	Element with highest heat of atomisation	(d)	Zn
		(e)	Ni

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8. Match the column -

	Column-I		Column-II
(A)	Ba	(p)	Golden yellow
(B)	Ca	(q)	Apple green
(C)	Na	(r)	Brick Red
(D)	Rb	(s)	Violet

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9.

	Column I(Substance)		Column II(Eq. wt)
(A)	$KMnO_4$ in acidic solution	(p)	Mol.$wt/6$
(B)	$KMnO_4$ in alkaline solution	(q)	Mol.$wt/5$
(C)	$KMnO_4$ in neutral solution	(r)	Mol.$wt/3$
(D)	$K_2Cr_2O_7$ in acidic medium	(s)	Mol. $wt/1$

A. $A-s, B-r, C-q, D-p$

B. $A-q, B-s, C-r, D-p$

C. $A-r, B-s, C-p, D-q$

D. $A-p, B-s, C-q, D-r$

Answer:

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Assertion And Reason Type Questions

1. Assertion (A) $Cu(II)$ iodide is not known.

Reason (R) Cu^{2+} oxidises I^- to iodine.

A. Both assertion and reason are true and reason is the correct explanation of the assertion .

B. Both assertion and reason are true but reason is not the correc explanation of assertion.

C. Assertion is not true for reason is true

D. Both assertion and reason are false.

Answer: A

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2. Assertion (A) Separation of Zr and Hf is difficult.

Reason (R) Because Zr and Hf lie in the same group of the Periodic Table.

A. Both assertion and reason are true and reason is the correct explanation of the assertion .

B. Both assertion and reason are true but reason is not the correc explanation of assertion.

C. Assertion is not true for reason is true

D. Both assertion and reason are false.

Answer: b

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3. Assertion (A) Actinoids form relatively less stable complexes as compared to lanthanoids.

Reason (R) Actinoids can utilise their 5f orbitals alongwith 6d orbitals in bonding but lanthanoids do not use their 4f orbital for bonding.

A. Both assertion and reason are true and reason is the correct explanation of the assertion .

B. Both assertion and reason are true but reason is not the correc explanation of assertion.

C. Assertion is not true for reason is true

D. Both assertion and reason are false.

Answer: c

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4. Assertion (A) Cu cannot liberate hydrogen from acids.

Reason (R) Because it has positive electrode potential.

A. Both assertion and reason are true and reason is the correct explanation of the assertion .

B. Both assertion and reason are true but reason is not the correc explanation of assertion.

C. Assertion is not true for reason is true

D. Both assertion and reason are false.

Answer: a

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5. Assertion (A) The highest oxidation state of osmium is +8.

Reason (R) Osmium is a 5d-block element.

A. Both assertion and reason are true and reason is the correct explanation of the assertion .

B. Both assertion and reason are true but reason is not the correc explanation of assertion.

C. Assertion is not true for reason is true

D. Both assertion and reason are false.

Answer: b

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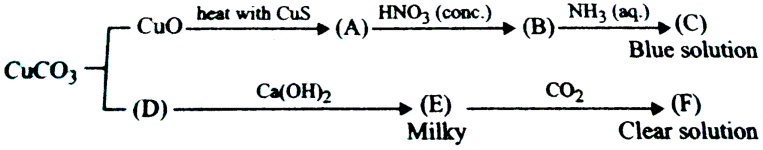
Long Answer Questions

1. Identify A to E and also explain the reactions involved.



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2. 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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3. 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 (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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4. On the basis of lanthanoid contraction, explain the following:

(i) Nature of bonding in La_2O_3 and Lu_2O_3.

(ii) Trends in the stability of oxo salts of lanthanoids from La to Lu.

(iii) Stability of the complexes of lanthanoids.

(iv) Radii of 4d and 5d block elements.

(v) Trends in acidic character of lanthanoids oxides.

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5. Answer the following questions

(i) Which element of the first transition series has highest second ionisation enthalpy?

(ii) Which element of the first transition series has highest third ionisation enthalpy?

(iii) Which element of the first transition series has lowest enthalpy of atomisation?

(b) Identify the metal and justify your answer.

(i) Carbonyl $M(CO)_5$

(ii) MO_3F

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6. Mention the type 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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7. (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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8. 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 liberate and a compound (D) of manganese alongwith other products is formed. Identify compounds A to D and also explain the reaction involved.

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Additional Questions Very Short Answer Questions

1. The transition elements are so named because

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2. Why are transition elements known as d-block elements ?

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3. The electronic configuration of a transition elements in $+3$ oxidatin stateis $[Ar]3d^7$. Find out atomic number.

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4. How many elements are presents in the d-block of the periodic table ?

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5. How many transiiton series of elements are there in the periodic table ? Name them.

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6. Write the general electronic configuration of transition elements or d-block elements.

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7. Each transition series contains only 10 elements because

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8. Zinc, cadmium and mercury are generally not considered as transition metals. Give reasons.

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9. In the transition series, starting from lanthanum $La(Z = 57)$, the next element hafnium $Hf(Z = 72)$ has an atomic number of 72. Why do we observe this jump in atomic number?

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10. Which out of the following is / are transition elements / s and why ?

Zn,Ag,Cd,Au.

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11. Both Cu and Zn have completely filled 3d atomic orbitals. Cu is considered as transition elements but Zn is not. Explain.

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12. The atomic sizesof Fe,Co and Ni are nearly same, Explain with reason.

Or Atomic size of 3d series elements from chromium to copper is almost the same. Give reason.

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13. How does the ionic/covalent character of the compounds of a transition metal vary with its oxidation state?

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14. Name the element in the 3d series that

(i) shows maximum oxidation state (ii) is diamagnetic

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15. What is the common oxidation state of Cu, Ag and Au ?

Watch Video Solution

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

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17. Which of the following is an example of disproportionation reaction?

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18. Write all posible oxidation state of an element having atomic number 25.

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19. Why does vanadium pentoxide act as a catalyst?

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20. Why Zn^{2+} salts are white while Ni^{2+} salts are blue

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21. Out of $\left[Sc(H_2O)_6\right]^{3+}$ and $\left[Ti(H_2O)_6\right]^{3+}$ ions which is coloured and why? Give reason.

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22. (a) Which metal in the first transition series (3d series) exhibits+ 1 oxidation state most frequently and why?

(b) Which of the following cations are coloured in aqueous solutions and why?

$Sc^{3+}, V^{3+}, Ti^{4+}, Mn^{2+}(At.\ \text{nos.}\ Sc = 21, V = 23, Ti = 22, Mn = 25)$

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23. Copper (I) compounds are white and diamagnetic while copper(II) compounds are coloured and paramagnetic. Explain.

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24. Which divalent metal ion has maximum paramagnetic character among the first transition metals? Why?

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25. Which of the two is paramagnetic : V (IV) or V (V) and why ?

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26. Which reagent can be used to identify Ni^{2+} ion ?

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27. What do you mean by 18 carat gold ?

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28. Which elements are called ferrous metals ?

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29. How many of the transition elements are called Platinum metals.

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30. What are coinage metals ? Give example .

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

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32. What happends when chromates are kept in acidic solution and dichromates in the alkaline solution?

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33. Complete the following reaction : $(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}}$

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34. Name one ore each of manganese and chromium.

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35. What happens when $KMnO_4$ is heated with conc. H_2SO_4 or acidified oxalic acid or treated with acidified $FeSO_4$?

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36. 1-butyne on reaction with hot alkaline $KMnO_4$ gives:

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37. Write ionic reaction for the reaction between MnO_4^- ions and oxalate ions at 333K.

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38. Complete the following:

$2MnO_4^-(aq) + 5H_2O_2(aq) \rightarrow 2Mn^{2+} + 8H_2O + \ldots..$

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39. Why $KMnO_4$ is used in cleaning surgical instruments in hospitals ?

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40. What is the basic difference between the electronic configuration of transition and inner transition elements?

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41. Write the electronic configuration of Gadolinium $(Z = 64)$ and its most stable oxidation state .

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42. Which is the most common oxidation state exhibited by lanthanoids ?

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43. What is meant by 'lanthanoid contraction'?

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44. Why is the separation of lanthanide elements difficult?

Watch Video Solution

45. Explain why lanthanoids are paramagnetic in nature ?

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46. Write any two uses of pyrophoric alloys.

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47. Give the general electronic configuration of actinides.

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48. Write the electronic configuration of the element with atomic number 102.

Watch Video Solution

49. What is the maximum oxidation state shown by actinides?

Watch Video Solution

Additional Questions Short Answer Questions

1. What is the basic difference between the electronic configuration of transition and inner transition elements?

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2. The ionization energies of the elements of first transitoin series do notvary much with increasing atomic number. Explain why

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3. The sums of first and second ionization energies and those of third and fourth ionization energies $\left(\text{in kJ mol}^{-1}\right)$ of nickel and platinum are:

(IE_1)	$+(IE)_2$	(IE_3)	$+(IE)_4$
Ni	2.49	Ni	8.80
Pt	2.66	Pt	6.70

Justify using above data why Ni^{+2} and Pt^{+4} are more stable than their corresponding counter part ions ?

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4. Explain why transition metals and their many compounds act as good catalyst.

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5. The tendency of the transition elements to form coloured compounds is attributed to

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6. Explain why transition metal ions usually show paramagnetic behaviour.

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

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

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9. Explain the following properties of transition elements.

(i) Variable oxidation states (ii) Complex formation

Watch Video Solution

10. Why do transition metals form coloured complexes ?

Watch Video Solution

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

$Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+}$

(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:

(i) $2MnO_4^- + 16H^+ + 5S^- \rightarrow$

(ii) $KMnO_4 \xrightarrow{heat}$

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12. Write down the formula of potassium dichromate.

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13. When H_2O_2 is added to a acidified solution of $K_2Cr_2O_7$:

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14. Give equation forchromyl chloride test.

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15. Name the gas evolved when concentrated HCI is added to powdered potassium dichromate. On passing the evolved gas through acidified KBr solution, the solution turns brown. Write the balanced equations for the reactions involved.

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16. Write an equation in ionic form to represent the oxidizing actionof $Cr_2O_7^{2-}$ in acidic medium.Also draw the structureof $Cr_2O_7^{2-}$ ion.

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

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18. Give the preparation of potassium permanganate from pyrolusite ore.

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19. What happens when (i) $KMnO_4$ is heated (ii) $K_2Cr_2O_7$is heated.

Watch Video Solution

20. What happens when acidified $KMnO_4$reacts with $(i)H_2S$ (ii)Oxalic acid (iii)KNO_2 Write ionic reactions.

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21. Describe the oxidising property of $KMnO_4$ in neutral or faintly alkaline medium for its reactions with iodide and thiosulphate ions.

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22. What chemical changes take place when (i) MnO_2 is fused with KOH in air ?

(ii) pH of a chromate solutiona is progressively lowered?

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23. Write ionic equations for the conversion of (a)manganate to permanganate(b) permanganate to manganese (II) (c) chromate to dichromate.

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24. Write chemical equations for the following reactions:

(a) Oxidation of nitrite ion by MnO_4^- in acidic medium,

(b) Acidification of potassium chromate solution.

(c) Disproportionation of manganese (VI) in acidic solution.

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25. Complete the following chemical equations :

(i) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow$

(ii) $Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow$

Watch Video Solution

26. What is meant by disproporitonation of an oxidation state? Give an example.

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27. What happens when

(i) $(NH_4)_2Cr_2O_7$ is heated ? (ii) H_3PO_3 is heated ?

Write the equation

Watch Video Solution

28. Complete the following equations :

(i) $2MnO_4^- + 16H^+ + 5S^2 \rightarrow$

(ii) $KMnO_4 \xrightarrow{\text{heat}}$

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29. 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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30. What is lanthanoid contraction? What is its cause and what ar its consequences ?

Watch Video Solution

31. Misch metal is

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32. How would you account for the following : (i) Many of the transition elements are virtually the same as those of the corresponding members of the second series.

(iii) There is a greater range of oxidation states among the actinoids than among the lanthanoids.

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

(i) Actinoids contraction is greater than Lanthanoids contracation.

(ii) Transition metals form coloured compounds.

(b) Complete the following :

$2MnO_4^- + 6H^+ + 5NO_2^- \rightarrow$

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34. Give reasons for the following:

(i) Transition metals form alloys.

(ii) Mn_2O_3 is basic whereas Mn_2O_7 is acidic.

(iii) Eu^{2+} is a strong reducing agent.

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Additional Questions Long Answer Questions

1. Explain the following :

(i) Most of the transition elements show variable oxidation states.

(ii) Most of the compounds of transition elements are coloured.

(iii) Many transition elements and their compounds are paramagnetic .

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

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3. Which of the following compounds is formed when a mixture of $K_2Cr_2O_7$ and KCl is heated with conc. H_2SO_4 ?

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4. Assign reasons for the following :

(i) The enthalpies of atomisation of transition elements are high.

(ii) The transition metals and many of their compounds act as good catalyst.

(iii) From element to element the actinoid contraction is greater than the lanthanoid contraction.

(iv) The E° value for the Mn^{3+}/Mn^{2+} couple is much more positive

than that for Cr^{3+}/Cr^{2+}.

(v) Scandium (Z = 21) does not exhibit variable oxidation states and yet it is regarded as transition element.

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5. In acidic medium MnO_4^{2-}

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6. Give an explanation for each of the following observations :

(i) The gradual decrease in size (actinoid contraction) from element to element is greater among the actinoids than that among the lanthanoids (lanthanoid contraction).

(ii) The greatest number of oxidation states are exhibited by the members in the middle of a transition series.

(iii) With the same d-orbital configuration (d^4), Cr^{2+} ion is a reducing agent but Mn^{3+} ion is an oxidising agent.

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7. What are the value of p, q, r and s for the following reaction ?

$pO_3 + qHI \rightarrow I_2 + sH_2O$

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8. Why is the E^{Θ} value for the Mn^{3+}/Mn^{2+} couple much more positive than that for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+}

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9. (a) Complete the following chemical equations:

(i) $Cr_2O_7^{2-}(aq) + H_2S(g) + H^+(aq) \rightarrow$

(ii) $Cu^{2+}(aq) + I^-(aq) \rightarrow$

(b) How would you account for the following :

(i) The oxidising power of oxoanions are in the order $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

(ii) The third ionization enthalpy of manganess (Z = 25) is exceptionally high.

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

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10. M : N = 2 : 7 and M : O = 4 : 3, then what is (M + N) : (N + O)?

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11. Account for the following :

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

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12. 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 member of the second $(4d)$ serie

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

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

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Higher Order Thinking Skills

1. Why in any transition series, melting points first increase and then decrease and also they show a dip in the middle?

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2. Why hydrated copper sulphate is blue while anhydrous copper sulphate is white?

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3. Atomic radius of Cu is greater than that of Cr but ionic radius of Cr^{2+} is greater than that of Cu^{2+}. Give suitable explanation.

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4. Give reasons for the following :

Variation in the radii of transition elements are not as pronounced as those of representative elements.

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5. Mercurous ion is written as Hg_2^{2+} whereas cuprous ion is written as Cu^+. Explain.

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6. In what way do the d-block metals differ

from alkali and alklaine each metals ?

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7. Explain why a green solution of potassium manganate turns purple and a brown solid is precipitated when CO_2 gas is bubbled into the solution.

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8. Between Na^+ and Ag^+ , which is stronger Lewis acid and why?

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9. In which of the following there is a change in oxidation number ?

(a) An aqueous solution of CrO_4^{2-} is acidified.

(b) SO_2 gas is passed through acidified $Cr_2O_7^{2-}$ solution.

(c) $Cr_2O_7^{2-}$ solution is made alkaline.

(d)CrO_2Cl_2 is dissolved in NaOH.

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10. Write balanced equation for the followig :

(i) Potassium permanganate is added to hot solution of manganous sulphate.

(ii) Nitrogen is obtained in the reaction of aqueous ammonia with potassium permanganate.

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Value Based Questions

1. Vikash went to vegetable market with his elder sister, a M.Sc Botany student. There he saw many varieties of different vegetables such as different kinds of chilies (short, long, round, pungent, less pungent, green

reddish, orange), several varieties of potato and tomatoes. He asked his sister the following questions.

(i) What is the need of producing so many varieties of different crop plants.

(ii) What is the name of branch of science which deals with crop improvement ?

(iii) What are the methods used by plant breeders ?

(iv) What is hybridization ?

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2. Why is mercury used in thermometers ?

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Competitions Focus

1. Which of the following transition metals of 4d series has the lowest melting point?

A. $Ti(Z = 22)$

B. $V(Z = 23)$

C. $Cr(Z = 24)$

D. $Mn(Z = 25)$

Answer: D

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2. The correct of decreasing second ionisation enthalpy of $Ti(22), V(23), Cr(24)$ and $Mn(25)$ is

A. $Cr > Mn > V > Ti$

B. $V > Mn > Cr > Ti$

C. $Mn > Cr > Ti > V$

D. $Ti > V > Cr > Mn$

Answer:

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3. The number of unpaired electrons in gaseous species of Mn^{3+}, Cr^{3+} and V^{3+} respectively are.....and most stable species is.....

A. 4,3 and 2andV^{3+} is most stable

B. 3,3 and2 and Cr^{3+} is most stable

C. 4,3 and 2 and Cr^{3+} is most stable

D. 3,3 and 3 and Mn^{3+} is most stable.

Answer:

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4. The correct order of $E^{\circ}_{M^{2+}/M}$ Values with negative sign for the four successive elements Cr, Mn, Fe and Co is:

A. $Fe > Mn > Cr > Co$

B. $Cr > Mn > Fe > Co$

C. $Mn > Cr > Fe > Co$

D. $Cr > Fe > Mn > Co$

Answer:

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5. Which of the following ions is the most stable in aqueous solution ?

$(At.\ No.\ Ti = 22, V = 23, Cr = 24, Mn = 25)$

A. Mn^{2+}

B. Cr^{3+}

C. V^{3+}

D. Ti^{3+}

Answer:

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6. The stability of ferric ion is due to

A. half-filled d-orbitals

B. half-filled f-orbitals

C. compltetly filled d-orbitals

D. completely filledf-orbitals

Answer:

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7. Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have the highest $E^0_{M^{3+}/M^{2+}}$ value

A. $Co(Z = 27)$

B. $Cr(Z = 24)$

C. $Mn(Z = 25)$

D. $Fe(Z = 26)$

Answer:

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8. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^{\circ}_{M^{2+}/M}\right)$ value has a positive sign?

A. $Cu(Z = 29)$

B. $Fe(Z = 26)$

C. $Co(Z = 27)$

D. $Ni(Z = 28)$

Answer:

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9. Among the following pairs of ions the lower oxidation state in aqueous solution is more stable than the other in

A. Tl^{+}, Tl^{3+}

B. Cu^{+}, Cu^{2+}

C. Cr^{2+}, Cr^{3+}

D. V^{2+}, VO^{2+}

Answer:

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10. A transition metal ion exists in its highest oxidation state. It is expected to behave as

A. a chelating agent

B. a central metal in a coordination compound

C. an oxidizing agent

D. a reducing agent.

Answer:

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11. In context with the transition elements, which of the following statements is incorrect ?

A. In the highest oxidation states,the transiton metals show basic character and form cationic complexes.

B. In the highest oxidation states of the first five transition elements (Sc to Mn) , all the 4s and 3d electrons are used for bonding

C. Once the d^5 configuration is exceeded,the tendency to involve all the 3d electrons in bonding decrease.

D. In addition to the normal states, the zero oxidation state is also shown by these elementsin complexes.

Answer:

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12. For the four successive transition elements (Cr, Mn, Fe, and Co), the stability of $+2$ oxidation state will be there in which of the following order ?

$(At.\ Nos.\ Cr = 24, Mn = 25, Fe = 26, Co = 27)$

A. $Cr > Mn > Co > Fe$

B. $Mn > Fe > Cr > Co$

C. $Fe > Mn > Co > Cr$

D. $Co > Mn > Fe > Cr$

Answer:

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13. The titanium (atomic number 22) compound that does not exist is

A. TiO

B. TiO_2

C. K_2TiF_6

D. K_2TiO_4

Answer:

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14. Among $TiF_6^{2-}, CoF_6^{3-}, Cu_2Cl_2$ and $NiCl_4^{2-}$ (At. No. $Ti = 22, Co = 27, Cu = 29, Ni = 28$), the colourless species are -

A. Cu_2Cl_2 and $NiCl_4^{2-}$

B. TiF_6^{2-} and Cu_2Cl_2

C. CoF_6^{3-} and $NiCl_4^{2-}$

D. TiF_6^{2-} and CoF_6^{3-}

Answer:

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15. The colour of light absorbed by an aqueous solution of $CuSO_4$ is

A. orange-red

B. blue-green

C. yellow

D. violet

Answer:

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16. The catalytic activity of transition metals and their compounds is mainly due to

A. their ability to adopt variable oxidation states

B. their chemical reactivity

C. their magnetic behaviour

D. their unfilled d-orbitals

Answer:

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17. Among the following the compound that is both paramagnetic and coloured is

A. $K_2Cr_2O_7$

B. $(NH_4)_2[TiCl_6]$

C. $VOSO_4$

D. $K_3\left[Cu(CN)_4\right]$

Answer:

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18. The value of 'spin only' magnetic moment for one of the following configuration is $2.84B.M.$ The correct one is:

A. d^4 in strong ligand field)

B. d^4 (in weak ligand field

C. d^3 (in weak as well as strong fields)

D. d^5(in strong ligand field)

Answer:

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19. The correct statement about iron includes

(I) the oxidation state of iorn is $+6$ in K_2FeO_4

(II) that the iron shows $+2$ oxidation state with 6 electron in the 3d orbitals

(III) the common oxidation state of iron is $+3$ with five unpaired electron in the 3d orbital

A. 1,2 and 3

B. 3 and 4 only

C. 4 only

D. 3only

Answer:

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20. Which one of the following does not correctly represent the correct order of the property indicated against it

A. $Ti < V < Cr < Mn$: increasing melting points

B. $Ti < V < Mn < Cr$: increasing 2nd ionization enthalpy

C. $Ti < V < Cr < Mn$: increasing number of oxidation states

D. $Ti^{3+} < V^{3+} < Cr^{3+} Mn^{3+}$: increasing magnetic moment.

Answer:

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21. Which of the following arrangements does not represent the correct order of the property stated against it?

A. $Sc < Ti < Cr < Mn$: number of oxidation states

B. $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$: paramagnetic behaviour

C. $Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+}$: ionic size

D. $Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{3+}$: stability in aqueous solution.

Answer:

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22. Which of the following statements about the interstitial compounds is incorrect?

A. They retain metallic conductivity

B. Thry are chemically reactive

C. They are much harder than the pure metal

D. They have higher melting points than pure metal.

Answer:

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23. Magnetic moments $2.84B.M$ is given by :

(At. nos. ni = 28, Ti = 22, Cr = 24, Co = 27).

A. Cr^{2+}

B. Co^{2+}

C. Ni^{2+}

D. Ti^{3+}

Answer:

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24. Increasing basic properties of TiO_2, ZrO_2 and HfO_2 are in order :

A. $TiO_2 < ZrO_2 < HfO_2$

B. $ZrO_2 < HfO_2 < TiO_2$

C. $HfO_2 < TiO_2 < ZrO_2$

D. $TiO_2 < HfO_2 < ZrO_2$

Answer:

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25. Among the oxides, $Mn_2O_7(I), V_2O_3(II), V_2O_5(III), CrO(IV)$ and $Cr_2O_3(V)$, the basic oxides are

A. I and II

B. II and III

C. III and IV

D. II and IV

Answer:

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26. The acidic, basic or amphoric nature of Mn_2O_7, V_2O_5 and CrO are respectively.

A. acidic , acidic and basic

B. basic, amphoteric and acidic

C. acidic , amphoteric and basic

D. acidic, basic and amphoteric

Answer:

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27. In chromite ore, the oxidation number of iron and chromium are respectively.

A. $+3, \ +2$

B. $+3, \ +6$

C. $+2, \ +6$

D. $+2, \ +3$

Answer:

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28. $K_2Cr_2O_7$ reacts with NH_4Cl in presence of H_2SO_4. The product formed is

A. chromyl chlorate with green vapour

B. chromous chloride with white vapour

C. chromous chloride with blue vapour

D. chromyl chloride with deep red colour.

Answer:

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29. When hydrogen peroxide is added to acidified potassium dichromate, a blue colour is produced due to formation of :

A. CrO_3

B. Cr_2O_3

C. CrO_5

D. CrO_4^{2-}

Answer:

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30. When sulphur dioxide is passed in an acidified $K_2Cr_2O_7$ solution, the oxidation state of sulphur is changed from:

A. $+4$ to $+6$

B. $+6$ to $+4$

C. $+4$ to 0

D. $+4$ to $+2$

Answer:

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31. Which one of the following statements is correct when SO_2 is passed through acidified $K_2Cr_2O_7$ solution?

A. Green $Cr_2(SO_4)$ is formed.

B. The solution turns blue.

C. The solution is decolourised

D. SO_2 is reduced.

Answer:

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32. A mixture of salts $(Na_2SO_3 + K_2Cr_2O_7)$ in a test tube is treated with dil. H_2SO_4 and resulting gas is passed through lime-water. Which of the following observations is correct about this test

A. Solution in test tube becomes green and lime water turns milky

B. Solution is test tube is colourless and lime water turns milky.

C. Solution in test tube becomes green and lime water remains clear

D. Solution in test tube remains clear and lime water also remains clear.

Answer:

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33. How many moles of iodine are liberated when 1 mole potassium dichromate reacts with potassium iodide?

A. 1

B. 2

C. 3

D. 4

Answer:

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34. Which of the following will not give positive chromyl chloride test ?

A. $CuCl_2$

B. $HgCl_2$

C. $ZnCl_2$

D. $C_6H_5\overset{+}{N}H_3Cl^-$

Answer:

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35. In which of the following ions, the colour is not due to d-d transition?

A. $Ti(H_2O)_6^{3+}$

B. CoF_6^{3+}

C. CrO_4^{2-}

D. $\left[Cu(NH_3)_4\right]^{2+}$

Answer: C

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36. The bonds present in the structure of dichromate ion are

A. foru equivalent Cr-O bonds only

B. six equivalent Cr-O bonds and one O -O bond

C. six equivalent Cr-O bonds and one Cr-Cr bond

D. six equivalent Cr-O bonds and one Cr- O -Cr bond.

Answer: D

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37. Which of the following does not give oxygen on heating ?

A. $KClO_3$

B. $Zn(ClO_3)_2$

C. $K_2Cr_2O_7$

D. $(NH_4)_2Cr_2O_7$

Answer: D

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38. Identify the product and the colour when MnO_2 is fused with solid KOH in the presence of oxygen (O_2)

A. $KMnO_4$, purple

B. K_2MnO_4 , dark green

C. MnO, colourless

D. Mn_2O_3 ,brown

Answer: B

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39. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction

$3MnO_4^{2-} + 2H_2O \Leftrightarrow 2MnO_4^{2-} + MnO_2 + 4OH^-$

The reaction can go to completion by removing OH^- ions by adding.

A. HCl

B. KOH

C. CO_2

D. SO_2

Answer: C

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40. When a mananous salt is fused with a mixture of KNO_3 and and solid NaOH, the oxidation number of Mn change from +2 to:

A. $+4$

B. $+3$

C. $+6$

D. $+7)$

Answer: C

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41. In acidic medium MnO_4^{2-}

A. disproportionates to $MnO_2$to MnO_4^-

B. is oxidized to MnO_4^-

C. is reduced to MnO_2

D. is reduced to Mn^{2+}

Answer: A

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42. The coloured spot of $KMnO_4$ on any article can be bleached by

A. $SO_2 + H^+$

B. $C_2O_4^{2-} + H^+$

C. $H_2O_2 + H^+$

D. all of these

Answer: D

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43. MnO_4^- reacts with Br^- in alkaline pH to give

A. BrO_3^-, MnO_2

B. Br_2, MnO_4^{2-}

C. Br_2, MnO_2

D. BrO^-, MnO_4^{2-}

Answer: A

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44. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of HCl because HCl:

A. reducs permanganate to Mn^{2+}

B. oxidises oxalic acid to carbon dioxide and water

C. gets oxidized by oxalic acid to chlorine

D. furnishes H^+ ions in addition to those from oxalic acid.

Answer: A

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45. An explosion takes place when conc. H_2SO_4 is added to $KMnO_4$ due to formation of

A. MnO

B. Mn_2O_3

C. Mn_2O_5

D. Mn_2O_7

Answer: D

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46. $KMnO_4$gets reduced to

A. K_2MnO_4 in neutral medium

B. MnO_2 in acidic medium

C. Mn^{2+} in alkaline medium

D. MnO_2 in neutral medium

Answer: D

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47. The colour of $KMnO_4$ is due to

A. $L \rightarrow M$ charge transfer transition

B. $\sigma - \sigma^*$ transition

C. $M \rightarrow L$ charge transfer transition

D. d-d transition

Answer: A

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48. In acidic medium, H_2O_2 changes $Cr_2O_7^{2-}$ to CrO_5 which has two (-O-O-) bonds. Oxidation state of Cr in CrO_5 is

A. $+5$

B. $+3$

C. $+6$

D. -10

Answer: C

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49. The reaction of aqueous $KMnO_4$ with H_2O_2 i acidic conditions gives :

A. Mn^{4+} and O_2

B. Mn^{2+} and O_2

C. Mn^{2+} and O_3

D. Mn^{4+} and MnO_2

Answer: B

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50. Name the gas that can readily decolourise acidified $KMnO_4$ solution:

A. CO_2

B. SO_2

C. NO_2

D. P_2O_5

Answer: B

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51. Gadolinium belongsd to 4f series. It's atomic number is 64. which of the following is the correct electronic configuration of gadolinium ?

A. $[Xe]4f^9 5s^1$

B. $[Xe]4f^7 5d^1 6s^2$

C. $[Xe]4f^{6}5d^{2}6s^{2}$

D. $[Xe]4f^{8}6d^{2}$

Answer:

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52. The electronic configuration of Eu (Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are:

A. $[Xe]4f^{6}5d^{1}6s^{2}$, $[Xe]4f^{7}6s^{2}$ and $[Xe]4f^{8}5d^{1}6s^{2}$

B. $[Xe]4f^{7}6s^{2}$, $[Xe]4f^{7}5d^{1}6s^{2}$ and $[Xe]4f^{9}6s^{2}$

C. $[Xe]4f^{7}6s^{2}$, $[Xe]4f^{8}6s^{2}$ and $[Xe]4f^{8}5d^{1}6s^{2}$

D. $[Xe]4f^{6}5d^{1}6s^{2}$, $[Xe]4f^{7}65d^{1}$ and $[Xe]4f^{9}6s^{2}$

Answer:

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53. Cerium $(Z = 58)$ is an important nember of the lanthanoids . Which of the following statements about cerium is incorrect ?

A. The common oxidation states of cerium are $+3$ and $+4$

B. The $+3$ oxidation state of cerium is more stable than $+4$ oxidation state.

C. The $+4$ oxidation state of cerium is not known in solution

D. Cerium (IV) acts as an oxidaizing agent.

Answer:

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54. The atomic number of cerium (Ce) is 58. The correct electronic confguration of Ce^{3+} ions is :

A. $[Xe]4f^1$

B. $[Kr]4f^1$

C. $[Xe]4f^{13}$

D. $[Kr]4d^{1}$

Answer:

Watch Video Solution

55. The electronic configuration of Gd^{2+} is :

A. $[Xe]4f^{7}$

B. $[Xe]4f^{7}5d^{1}$

C. $[Xe]4f^{8}$

D. $[Xe]4f^{7}5d^{1}6s^{2}$

Answer:

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56. Which of the following exhibits only +3 oxidation state?

A. ac

B. Pa

C. U

D. Th

Answer:

Watch Video Solution

57. Lanthanide contraction is observed in:

A. Gd

B. At

C. Xe

D. ac

Answer:

Watch Video Solution

58. Because of lanthnoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Number in the parenthesis are atomic numbers)

A. Zr(40) and Hf (72)

B. Zr(40) and Ta (73)

C. Ti(22) and Zr (40)

D. Zr(40) and Nb(41)

Answer:

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59. The correct order of ionic radii Y^{3+} , La^{3+} , Eu^{3+} and Lu^{3+} is $(AT.\ No: Y = 39, La = 57, Eu = 63, Lu = 71)$

A. $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$

B. $Lu^{3+} < Y^{3+} < Eu^{3+} < La^{3+}$

C. $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$

D. $La^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$

Answer:

Watch Video Solution

60. The correct order of ionic radii of Ce, La, Pm and Yb in +3 oxidation state is

A. $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$

B. $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$

C. $Pm^{3+} < La^{3+} < Ce^{3+} < Yb^{3+}$

D. $Ce^{3+} < Yb^{3+} < Pm^{3+} < La^{3+}$

Answer:

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61. Identify the incorrect statement among the following:

A. Shielding power of 4f electrons is quite weak

B. There is a decrease in the radii of the atoms or ions as one proceeds from La to Lu

C. Lanthanoid contraction is the accumulation of successive shrinkages

D. As a result of lanthanoid contraction, the properties of4d series of the transiton elements have no similarities with the 5d seriesof the elements.

Answer:

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62. Knowing that the chemistry of lanthanoids (Ln) is dominated by its $+3$ oxidation state, which of the following statement is incorrect?

A. The ionic sizes of Ln(III) decrease in general with increasing atomic number.

B. Ln(III) compounds are generally colourless

C. Ln(III)hydroxides are mainly basic in character

D. Because of the large size of the Ln(III) ions, the bonding in its compounds is predominantly ionic in character.

Answer:

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63. Among the following lanthanoid ions, the paramagnetic ion is

A. Ce^{4+}

B. Yb^{2+}

C. Lu^{3+}

D. Eu^{2+}

Answer:

Watch Video Solution

64. Consider the following statement in respect of Lantinanoids :

(i) The basic strength of hydroxides of lanthanoids increases from $La(OH)_3$ to $Lu(OH)_3$.

(ii) The lanthanoid ions Lu^{3+}, Yb^{2+} and Ce^{4+} are diamagnetic.

Which of the statements (s) given above is /are correct ?

A. 1 only

B. 2 only

C. both 1and 2

D. Neither 1 and 2

Answer:

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65. In context of the lanthanoids, which of the following statements is not correct?

A. All the members exhibit $+3$ oxidation state

B. Because similar properties, the separation of lanthanoids is not easy.

C. Availability of 4f electrons results in the formation of compounds in $+4$ state forall the members of the series.

D. There is a gradual decrease in the radii of the members with increasing atomic number in the series

Answer:

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66. Consider the following statements:

(I) La$(OH)_3$ is the least basic among the hydroxides of lanthanoids.

(II) Zr^{4+} and Hf^{4+} possess almost same ionic radii.

(III) Cr^{4+} can act as an oxidising agent .

which of the above statement is/ are true?

A. I and II

B. II and III

C. II only

D. I and II

Answer:

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67. Which is not the correct statement about the chemistry of 3d and 4f series elements

A. 3d-elements show more oxidation statesthan 4f-series elements ?

B. The energy difference between 3d and 4s orbitals is very little

C. Europium (II) is more stable than Ce(II)

D. The paramagnetic character in 3d -series elements increases from scandium to copper.

Answer:

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68. Which of the following elements shows maximum number of different oxidation states in its compounds ?

A. Eu

B. La

C. Gd

D. Am

Answer:

Watch Video Solution

69. Which of the following is not an actinoid ?

A. Curium $(Z = 96)$

B. Californium $(Z = 98)$

C. Uranium $(Z = 92)$

D. Terbium $(Z = 65)$

Answer:

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70. Among the following pairs the maximum, oxidation states is shown by

A. U and Np

B. Np and Pu

C. Pu and An

D. U and Pa

Answer:

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71. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because

A. the 5f orbitals extend farther from the nucleus than the 4f orbitals

B. the 5f orbitals are more buried than the 4f orbitals

C. there is a similarly between 4f and 5f orbitals in their angular part of the wave function

D. the actinoids are more reactive than the lanthanoids

Answer:

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72. The reason for greater range of oxidation state in actinoids is attributed to:

A. the radioactive number of actinoids

B. actinoid contraction

C. 5f,6d and 7s levels having comparable energies

D. 4f and 5d levels being close in energies

Answer:

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73. Reason of lanthanoid contraction is

A. negligible screening effect of 'f' -orbitals

B. increasing nuclear charge

C. decreasing nuclear charge

D. decreasing screening effect

Answer:

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74. Which one of the following statements related to lanthanons is incorrect ?

A. All the lanthanons are much more reactive than aluminium

B. $Ce(+4)$ solutions are widely used as oxidizing agent in volumetric analysis

C. Europium shows $+2$ oxidation state

D. The basicity decreases as the ionic radius decreases from Pr to Lu.

Answer:

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75. All Cu(II) halides are known except the iodide. The reason for it is that

A. iodide ion is a bulky ion

B. Cu^{2+} oxidizes iodide to iodine

C. Cu^{2+} (aq) has much more negative hydration enthalpy

D. Cu^{2+} ion has smaller size

Answer:

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76. In nitroprusside ion, the iron and NO exist as $Fe(II)$ and NO^+ rather than Fe^{III} and NO. These forms can be differentiated by

A. estimating the concentration of iron

B. measuring the concentration ofCN^-

C. measuring the solidestate magnetic moment

D. thermally decomposig the compound.

Answer:

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77. A red solid is insoluble in water. However, it becomes soluble if some KI is added to water. Heating the red solid in a test tube results in liberation of some violet coloured fumes and droplets of a metal appear on the cooler parts of the test tube. The rod solid is:

A. HgI_2

B. HgO

C. Pb_3O_4

D. $(NH_4)_2Cr_2O_7$

Answer:

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78. $\left[Fe(H_2O)_5NO\right]^{2+}$ is a complex formed during the brown ring test for NO_3^- ion. In this complex.

A. NO transfers its electron to Fe^{2+} so that we have iron as $Fe(I)$ and NO as $NO^{\cdot}(+)$

B. There are three unpaired electron so that its magnetic moment is 3.87 B.M.

C. The colour is due to charge transfer

D. All the above statements are correct.

Answer:

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79. When Hg_2Cl_2 ionizes, the ins produced and the unpaired electrons present on the cation respectively are

A. $2Hg^+$ and $2Cl^-$, two

B. Hg_2^{2+} and $2Cl^-$, two

C. Hg_2^{2-} and $2Cl^-$, one

D. Hg_2^{2+} and $2Cl^-$, zero

Answer:

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80. Prussian blue is -

A. $K_3\left[Fe(CN)_6\right]$

B. $K_4\left[Fe(CN)_6\right]$

C. $Kfe\left[Fe(CN)_6\right]$

D. $Fe_4\left[Fe(CN)_6\right]$

Answer:

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81. Which one of the following reactions involves disproportionation ?

A. $2H_2SO_4 + Cu \rightarrow CuSO_4 + 2H_2O + SO_2$

B. $As_2O_3 + 3H_2S \rightarrow As_2S_3 + 3H_2O$

C. $2KOH + Cl_2 \rightarrow KCl + KOCl + H_2O$

D. $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

Answer:

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82. Pick out the correct statements from the following

1. Cobalt (III) is more stable in octahedral complexes

2. Zinc forms coloured complexes

3. Most of the d-block elements and their compounds are ferromagnetic

4. Osmium show (VIII) oxidation state

5. Cobalt (II) is more stable in octahedral complexes

A. 1 and2

B. 1 and 3

C. 2 and 4

D. 1 and 4

Answer:

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83. Which out of the following belong to 3d-series?

A. copper

B. cobalt

C. gold

D. silver

Answer:

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84. Transition elements have greater tendency to form complexes because

A. They have vacant d orbitals

B. They have large size

C. They have large charge / size ratio

D. they have two electrons in their outermost shells.

Answer:

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85. The colour of the transition metal ions is due to

A. d-d transition

B. charge transfer

C. change in the geometry

D. none

Answer:

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86. Which of the following show oxidation state of $+4$?

A. Ce

B. Ac

C. Th

D. U

Answer:

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87. Potassium manganate (K_2MnO_4) is formed when:

A. Chloride is passed through aqueous $KMnO_4$ solution.

B. Manganese dioxide is fused with potassium hydroxide in air.

C. Formaldehyde reacts with potassium permanganatein presence of strong alkali.

D. Potassium permanganate reacts with H_2SO_4.

Answer:

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88. Which of the following statement(s) is (are) correct with reference to the ferrous and ferric ions ?

A. Fe^{3+} gives brown colour with potassium ferricyanide

B. Fe^{2+} gives blue precipitate with potassium ferricyanide

C. Fe^{3+} gives red colour with potassium thiocyanate

D. Fe^{2+} gives brown colour with ammonium thiocyanate.

Answer:

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89. Which of the following statement(s) is/are correct when a mixture of NaCl and $K_2Cr_2O_7$ is genetly warmed with conc. H_2SO_4 ?

A. a deep red vapour is evolved

B. The vapour when passed into NaOH solution gives yellow solution of Na_2CrO_4

C. chlorine gas is evolved

D. chromyl chloride is formed

Answer:

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90. Reduction of the metal centre in aqueous permanganate ion involves

A. 3 electrons in neutral medium

B. 5 electrons in neutral medium

C. 3 electrons in alkaline medium

D. 5 electrons in acidic medium.

Answer:

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91. The correct statement(s) about Cr^{2+} and Mn^{3+} is(are)

[Atomic number of $Cr = 24$ and $Mn = 25$]

A. Cr^{2+} is a reducing agent

B. Mn^{3+0} is an oxidizing agent

C. Both Cr^{2+} and Mn^{3+} exhibit d^4electronic configuration

D. When Cr^{2+} is used as a reducing agent, the chromium ion attains d^5 configuration

Answer:

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Comprehension 1

1. In any transition series, from left to right, the d-orbitals are progressively filled and their properties vary accordingly.

Q. Which element do you expect to have the smallest atomic radius?

A. Sc

B. Zn

C. La

D. Hg

Answer: B

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2. In any transition series, from left to right, the d-orbitals are progressively filled and their properties vary accordingly.

Q. Which element do you expect to have the highest melting point?

A. La

B. W

C. Os

D. Pt

Answer:

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3. In any transition series, from left to right, the d-orbitals are progressively filled and their properties vary accordingly.

Q. Which element do you expect to have the highest melting point?

A.

B.

C.

D.

Answer:

Watch Video Solution

4. In any transition series, from left to right, the d-orbitals are progressively filled and their properties vary accordingly.

Q. Which of the following is the correct order of second ionisation energy ?

A.

B.

C.

D.

Answer:

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5. The element of 3d transition series are given as :

Sc Ti C Cr Mn Fe Co Ni Cu Zn

Answer the following :

(i) Which element has the highest melting point and why ?

(ii) Which element is a strong oxidizing agent in +5 oxidation state and why ?

(ii) Which element is soft and why ?

A.

B.

C.

D.

Answer:

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6. Read the passage given below and answer the following questions:

Within the 3d series, manganese exhibits oxidation states in aqueous solution from +2 to +7, ranging from $Mn^{2+}(aq)$ to MnO_4^- (aq). Likewise, iron forms both $Fe^{2+}(aq)$ and $Fe^{3+}(aq)$ as well as the FeO_4^{2-} ion. Cr and Mn form oxyions CrO_4^{2-}, MnO_4^-, owing to their willingness to form multiple bonds . The pattern with the early transition metals-in the 3d

series up to Mn, and for the 4d, 5d metals up to Ru and Os—is that the maximum oxidation state corresponds to the number of "outer shell" electrons. The highest oxidation states of the 3d metals may depend upon complex formation (e.g., the stabilization of Co^{3+} by ammonia) or upon the pH (thus MnO_4^{2-} (aq) is prone to disproportionation in acidic solution). Within the 3d series, there is considerable variation in relative stability of oxidation states, sometimes on moving from one metal to a neighbor, thus, for iron, Fe^{3+} is more stable than Fe^{2+}, especially in alkaline conditions, while the reverse is true for cobalt. The ability of transition metals to exhibit a wide range of oxidation states is marked with metals such as vanadium, where the standard potentials can be rather small, making a switch between states relatively easy.

(Cotton, S. A. (2011). Lanthanides: Comparison to 3d metals. Encyclopedia of inorganic and Bioinorganic Chemistry.)

In the following questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices on the basis of the above passage.

Assertion: The highest oxidation states of the 3d metals depends only on electronic configuration of the metal.

Reason: The number of electrons in the (n-1)d and ns subshells determine the oxidation states exhibited by the metal.

A.

B.

C.

D.

Answer:

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Comprehension 2

1. $KMnO_4$ is prepared from the mineral pyrolusite, MnO_2 (deep purple colour). It acts as an oxidising agent in the neutral, alkaline as well as acidic medium in acidic medium it is used in volumetric analysis for estimation of Fe^{2+}, $Cr_2O_4^{2-}$ salts etc. The titrations are carried out in presence of H_2SO_4. However, before using it as a titrant, it is first

standardised with standard oxalic acid solution or Mohr's salt solution . In one of the experiments on titration 26.8g of dry pure sodium oxalate $\left(Mw = 123gmol^{-1}\right)$ was dissolved in 1L of distilled water and then 100 mL of $2MH_2SO_4$ were added. The solution was cooled. Now to this solution $0.1MKMnO_4$ solution was added till a very faint pink colour persisted.

Q. When pyrolusite is fused with KOH and $KClO_3$, we get

A.

B.

C.

D.

Answer:

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2. $KMnO_4$ is prepared from the mineral pyrolusite, MnO_2 (deep purple colour). It acts as an oxidising agent in the neutral, alkaline as well as

acidic medium in acidic medium it is used in volumetric analysis for estimation of Fe^{2+}, $Cr_2O_4^{2-}$ salts etc. The titrations are carried out in presence of H_2SO_4. However, before using it as a titrant, it is first standardised with standard oxalic acid solution or Mohr's salt solution . In one of the experiments on titration 26.8g of dry pure sodium oxalate $\left(Mw = 123gmol^{-1}\right)$ was dissolved in 1L of distilled water and then 100 mL of $2MH_2SO_4$ were added. The solution was cooled. Now to this solution $0.1MKMnO_4$ solution was added till a very faint pink colour persisted.

Q. The purple colour of $KMnO_4$ is due to

A.

B.

C.

D.

Answer:

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3. $KMnO_4$ is prepared from the mineral pyrolusite, MnO_2 (deep purple colour). It acts as an oxidising agent in the neutral, alkaline as well as acidic medium in acidic medium it is used in volumetric analysis for estimation of Fe^{2+}, $Cr_2O_4^{2-}$ salts etc. The titrations are carried out in presence of H_2SO_4. However, before using it as a titrant, it is first standardised with standard oxalic acid solution or Mohr's salt solution . In one of the experiments on titration 26.8g of dry pure sodium oxalate $\left(Mw = 123gmol^{-1}\right)$ was dissolved in 1L of distilled water and then 100 mL of $2MH_2SO_4$ were added. The solution was cooled. Now to this solution $0.1MKMnO_4$ solution was added till a very faint pink colour persisted.

Q. Mohr's salt, $FeSO_4(NH_4)_2SO_{46}H_2O$, is preffered over $FeSO_{4.7}H_2O$ for standardisation of $KMnO_4$ solution because.

A.

B.

C.

D.

Answer:

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4. $KMnO_4$ is prepared from the mineral pyrolusite, MnO_2 (deep purple colour). It acts as an oxidising agent in the neutral, alkaline as well as acidic medium in acidic medium it is used in volumetric analysis for estimation of Fe^{2+}, $Cr_2O_4^{2-}$ salts etc. The titrations are carried out in presence of H_2SO_4. However, before using it as a titrant, it is first standardised with standard oxalic acid solution or Mohr's salt solution . In one of the experiments on titration 26.8g of dry pure sodium oxalate $\left(Mw = 123gmol^{-1}\right)$ was dissolved in 1L of distilled water and then 100 mL of $2MH_2SO_4$ were added. The solution was cooled. Now to this solution $0.1MKMnO_4$ solution was added till a very faint pink colour persisted.

Q. When pyrolusite is fused with KOH and $KClO_3$, we get

A.

B.

C.

D.

Answer:

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5. $KMnO_4$ is prepared from the mineral pyrolusite, MnO_2 (deep purple colour). It acts as an oxidising agent in the neutral, alkaline as well as acidic medium in acidic medium it is used in volumetric analysis for estimation of Fe^{2+}, $Cr_2O_4^{2-}$ salts etc. The titrations are carried out in presence of H_2SO_4. However, before using it as a titrant, it is first standardised with standard oxalic acid solution or Mohr's salt solution . In one of the experiments on titration 26.8g of dry pure sodium oxalate $\left(Mw = 123gmol^{-1}\right)$ was dissolved in 1L of distilled water and then 100 mL of $2MH_2SO_4$ were added. The solution was cooled. Now to this solution $0.1MKMnO_4$ solution was added till a very faint pink colour persisted.

Q. When pyrolusite is fused with KOH and $KClO_3$, we get

A.

B.

C.

D.

Answer:

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6. Potassium permanganate is prepared from the mineralpyrolusite, MnO_2. Its crystals have deep purple colour. It acts as an oxidizing agentin the neutral, alkaline as well as acidic medium. In acidic medium , it is used in volumetric analysis for estimation of ferrous salts, oxalates etc. The titrations are carried out in presence of H_2SO_4. However ,before using it as a titrant, it is first standized with standard oxalic acid solution or Mohr salt solution. In one of the experiments on titration , 13.4 g of dry pure sodium oxalate (molar mass $= 134gmol^{-1}$) was dissolved in 100mLof distilled waterand then 100 mL of 2M H_2SO_4 were added. The

solution, was cooledto $25.30^{\circ}C$. Now to this solution , 0.1 M $KMnO_4$ solution was added till a very faint pink colour persisted.

If of 0.1 M $K_2Cr_2O_7$ solution were used in place 0.1 M $KMnO_4$ in presence of H_2SO_4 in each case, the volume of 0.1 M$K_2Cr_2O_7$ solution used would be

A. 200 mL

B. 400 mL

C. 333.3 mL

D. 666.6 mL

Answer:

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Comprehension 3

1. Trnsition elements show variable oxidation states. This is due to their valence electrons which are found in two different orbitals i.e., ns and (n-

1) d. Up to (+II) oxidation state ns electrons are involved, but in higher oxidation states, electrons of (n-1) d sub-shells are also involved.

The most common oxidation state shown by Ist row of transition elements is

A. $(+II)$

B. $(+III)$

C. $(+IV)$

D. all of these

Answer:

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2. Trnsition elements show variable oxidation states. This is due to their valence electrons which are found in two different orbitals i.e., ns and (n-1) d. Up to (+II) oxidation state ns electrons are involved, but in higher oxidation states, electrons of (n-1) d sub-shells are also involved.

The transition metal which shows the highest oxidation state is

A. Mn

B. Pt

C. Fe

D. Ni

Answer:

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3. Trnsition elements show variable oxidation states. This is due to their valence electrons which are found in two different orbitals i.e., ns and (n-1) d. Up to (+II) oxidation state ns electrons are involved, but in higher oxidation states, electrons of (n-1) d sub-shells are also involved.

the cause of variable oxidation states among transition elements is that

A. They all exist in more than one oxidation state

B. They all form complex compounds

C. The valence electrons in them are found in two different subshells.

D. They all have paired subshells.

Answer:

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Matrix Match Type Questions

1.

	Column I		Column II
(A)	Copper	(p)	Forms a colured salt
(B)	Silver	(q)	Dissolves only in royal water
(C)	Gold	(r)	Not a transition element
(D)	Mercury	(s)	Has the electronic configuration $(n-1)d^{10}ns^1$

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2. On adding $KMnO_4$ to cold conc. H_2SO_4, it gives

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	Column I		Column II
	(A) Lanthanum	(p)	shows an oxidation state of $+3$
3.	(B) Cerium	(q)	shows an oxidation state of $+4$
	(C) Thorium	(r)	is a rare earth
	(D) Uranium	(s)	is an actinoid

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Integer Type Questions

1. The answer to each of the following questions is a single digit integer ranging from 0 to 9. It the correct answers to the questions numbers A, B, C and S (say) are 4, 0,9 and 2 respectively thent the correct darkening of bubbles should be us shown on the side :

Total number of elements present in the 2nd short period is

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2. The answer to each of the following questions is a single digit integer ranging from 0 to 9. It the correct answers to the questions numbers A, B,

C and S (say) are 4, 0,9 and 2 respectively thent the correct darkening of bubbles should be us shown on the side :

How many series of elements constitute f- block elements

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3. The oxidation state of Cr in CrO_5 is

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4. How many of the transition elements are called Platinum metals.

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5. The number of electrons present in the 4f-subshell of Gd (Z = 64) is

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6. The coefficient of H_2SO_4 on balancing the equation

$K_2Cr_2O_7 + H_2SO_4 + KI \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O + I_2$ is

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7. The oxidation number of Mn in the product of alkaline oxidative fusion of MnO_2 is

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8. Consider the following list of reagent

Acidified$K_2Cr_2O_7$, alkaline$KMnO_4$, $CuSO_4$, H_2O_2, Cl_2, O_3, $FeCl_3$, HNO

The total number of reagents that can oxidise aqueous iodide iodine is

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9. in neutral or faintly alkaline solution, 8 moles of permanganate anion quantitatively oxidize thiosulphate anions to produce X moles of a sulphur containing product. The magnitude of X is

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Assertion Reason Tyep Questions Type 1

1. Assertion: Tt^{3+} salts are coloured whereas Ti^{4+} salts are white. Ti^{3+} is less stable than Ti^{4+}

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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2. Assertion: The metals of 4d and 5d greater enthalpies of atomisation than the corresponding elements of the 3d series.

Reason: The metal-metal bond in 4d and 5d series are stronger than those in the 3d series.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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3. Assertion : Manganese show a maximum oxidation state of $+5$.

Reason : Manganese has 5 electrons in the $3d$ subshell.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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4. Assertion: MnO is basic whereas Mn_2O_7 is acidic.

Reason: Higher the oxidation state of a transition metal in its oxide,

greater is the acidic character.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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5. Statement 1 : Ce^{3+} has the tendency to charge to Ce^{4+}.

Statement 2 : Ce^{3+} used as an oxidizing agent in volumetric analysis.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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6. Assertion : Lanthanoids show a limited of ixidation states wheres actanoids show a large number of oxidation states.

Reason : Energy gap between $4f$, $5d$ and $6s$ subshells is small wheras that between $5f$, $6d$ and $7s$ subshell is large.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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7. Assertion: If a strong acid is added to a solution of potassium chromate it changes its colour from yellow to orange.

Reason: The colour change is due to the oxidation of potassium chromate.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation of Statement -1

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation of Statement-1

C. Statement-1 is True, Statement-2 is false

D. Statement-1 is False, Statement-2is True

Answer:

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Assertion Reason Tyep Questions Type Ii

1. Assertion: Mercury is not considered as a transition element.

Reason: Mercury is liquid.

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2. Assertion: Cu, Ag and Au lie in Group 11 of the periodic table. Hence their atomic radii are in the order $\mathrm{Cu} < Ag < Au$

Reason: In any group iof the transition elements, the atomic radii increase as we move down the group.

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3. Assertion: The second ionisation energies of V, Cr and Mn are in the order $V < Cr < Mn$.

Reason: Ionisation energies show a regular increase along a period with increase of atomic number.

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4. Assertion: Tungsten has very high melting point.

Reason: Tungsten is a covalent compound.

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5. Assertion: Mn atom loses ns electrons first during ionisation as compared to $(n-1)$ d electrons

Reason: The effective nuclear charge experienced by $(n-1)$d electrons is greater than that by ns electrons.

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6. Assertion: $E^{\ominus}$ for $\frac{Mn^{3+}}{Mn^{2+}}$ is more positive than for $\frac{Cr^{3+}}{Cr^{2+}}$.

Reason: The third ionisation energy of Mn is larger than that of Cr.

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7. Assertion : Mercury vapour is shining silvery in appearance.

Reason : Mercury is a metal with shining silvery appearance.

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8. Statement : Aufbau rule is violated in writing electronic configurations of Pd.

Explanation: Pd show diamagnetic nature.

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9. Assertion: Equivalent mass of $KMnO_4$ is same in the neutral as well as alkaline medium.

Reason: The product formed in both cases in MnO_2

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10. Assertion: In $Cr_2O_7^{2-}$ ion, all the $Cr-O$ bond lengths are equal.

Reason: In $Cr_2O_7^{2-}$ ion all the $O-Cr-O$ bond angles are equal.

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11. Assertion: $K_2Cr_2O_7$ is used as primary standard in volumetric analysis.

Reason: It has a good solubility in water.

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12. Assertion : Change in colour of the acidic solution of breath is used as a test for drunken driver.

Reason : Change in colour is due to complexation of alcohol with potassium dichromate.

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13. Assertion: The purple colour of $KMnO_4$ is due to the charge transfer transition.

Reason: Manganese in $KMnO_4$ has +7 oxidation state

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14. Assertion (A) $Cu(II)$ iodide is not known.

Reason (R) Cu^{2+} oxidises I^- to iodine.

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15. Assertion.Atomic size of silver is almost the same as that of gold.

Reason. d-subshell has low penetration power and produces poor shielding.

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16. Assertion (A) Separation of Zr and Hf is difficult.

Reason (R) Because Zr and Hf lie in the same group of the Periodic Table.

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17. Assertion. Actinoids show larger number of oxidation states than lanthanoids.

Reason. Highest oxidation state showsn by lanthanoids is $+4$ while that of actinoids is $+7$

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Important Questions

1. Silver atom has completely filled d orbitals $\left(4d^{10}\right)$ in its ground state. How can you say it is a transition element?

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2. Explain why transition elements have many irregularties in their electronic configuration.

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3. Chromium is a typical hard metal while mercury is a liquid.

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

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5. (a) Why do transition elements show variable oxidation states ?

(b) The paramagnetic character in 3d transition series elements increases upto Mn and then decreases.Explain why .

(c) Why doe transition metals exhibit higher enthalpies of atomisation ?

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6. Name a trasition element wihich does not exhibit variable oxidation states.

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

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

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9. Explain giving reason:

(a) Transition metals and many of their compounds show paramagnetic behaviour.

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

(c). The transition metals gnerally form coloured compounds.

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10. Why is $+2$ oxidation state of manganese quite stable while the same is not true for iron?$[Mn = 25, Fe = 26]$.

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

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

$Ti^{3+}, V^{3+}, Sc^{3+}, Mn^{2+}, Fe^{3+}, Co^{2+}$ and MnO_4^-

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13. How will you account for the following :

(i) Cobalt (II) is stable in aqueous solution but in the presence of a complexing agent, it is easily oxidized.

(ii) Out of d^4 species, Cr^{2+} is strongly reducing while Mn^{2+} is strongly oxidising .

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14. Which of the two is paramagnetic : V (IV) or V (V) and why ?

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15. Copper (I) compounds are white and diamagnetic while copper(II) compounds are coloured and paramagnetic. Explain.

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16. Which divalent metal ion has maximum paramagnetic character among the first transition metals? Why?

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17. Transition elements have greater tendency to form complexes because

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18. In the titratin of Fe^{2+} ions with $KMnO_4$ in acidic medium, why dilute H_2SO_4 is used and not dilute HCl ?

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

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20. 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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21. 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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22. 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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23. When a white crystalline compound X is heated with $K_2Cr_2O_7$ and concentrated H_2SO_4 a, a reddish brown gas A is evolved. On passing A into caustic soda solutions, a yelow coloured solution of B is obtained. Neutralizing the solution B with acetic acid and on subsequent addition

of lead acetate, a yellow precipitate C is obtained.When X is heated with NaOH solution, a colourless gas is evolved and on passing this gas into K_2HgI_4 solution, a reddish brown precipitate D is formed. Identify A,B,C,D and X. Write the equation of the reaction involved.

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24. The $+3$ oxidation states of langthanum $(Z = 57)$, gadolinium $(Z = 64)$ and lutetium $(Z = 71)$ are especially stable. Why ?

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25. Why Sm^{2+}, Eu^{2+} and Yb^{2+} ions in solutions are good reducing agents but an aqueous solution of Ce^{4+} is a good oxidizing agent ?

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26. What is lanthanoid contraction? What are the consequences of lanthanold contraction?

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

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

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29. Comparethe chemistry of actinoids with that of lanthanoids with special reference to (i) electronic configuration (ii) oxidation state (iii)

atomic and ionic sizes (iv) chemical reactivity .

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30. Name the elements of 3d series. Give their electronic configuration. Explain why transition metals exhibit variable oxidation states.

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