CHEMISTRY

PHYSICAL, INORGANIC, AND ORGANIC CHEMISTRY

D BLOCK ELEMENTS

Solved Example

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. The element with the electronic configuration $[Ze]^{54}4f^{14}5d^{1}6S^{2}$ is a

A. representative element

B. d-block element

C. lanthanoid

D. actinoid

Answer:

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3. The number of transition series is:

A. two

B. three

C. four

D. five

Answer:

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4. Why do the transition element have higher boiling & melting points?

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5. The atomic radii of transition elements in a period are.

A. smaller than those of s-block as well as p-block elements.

B. larger than those of s-block as well as p-block elements

C. smaller than those of s-block but larger than those of p-block element

D. larger than those of s-block but smaller than those of p-block elements

Answer:

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6. Zn form only Zn^{2+} and not Zn^{3+}, why?

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7. 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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8. 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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9. 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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10. Zinc does not show variable valency Because of:

A. Complete 'd' sub-shell

B. inert pair effect

C. $4s^2$ sub-shell

D. none

Answer:

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11. Explain the blue colour of $CuSO_4.5H_2O$

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

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13. How iron (III) catalyses the reaction between iodide & persulphate ?

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14. Which of the following form an alloy?

A. $Ag + Pb$

B. $Fe + Hg$

C. $Pt + Hg$

D. $Fe + C$

Answer:

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15. $Zn(OH)_2 \underset{\rightarrow}{\Delta} [X]$

Select the correct statement (s) for the compound X.

A. X on heating with cobalt nitrate gives green mass

B. X on heating alone, becomess yellow but turns white on cooling

C. Solution of X in dilute HCl gives bluish white// white precipitate with excees potassium ferrocyanide.

D. None Of These

Answer:

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16. Anhydrous white solid (A) on addition of potassium iodine solution gave a brown precipitate which turned white (B) on addition of excees of hypo solution. When potasium cyanide is added to an aqeous Solution of (A)a white precipitate is formed which then dissolved in excess forming (C) A Solution $(\%)$ of (A) on adding to a solution of white portion of egg produced violet colouration in alkaline medium $(i.e)$ in presence of $NaOH)$ identify compound (A) and explain the reactions.

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17. $CuSO_4.5H_2O \underset{\longrightarrow}{100^0} C[X](S) \underset{\longrightarrow}{250^0} C[Y](S)$

A. X and Y are $CuSO_4.3H_2O$ and $CUSO_4$

B. X and Y are $CuSO_4.3H_2O$ and $CUSO_4.\ H_2O$

C. $X$and Y are $CuSO_4.\ H_2O$ and $CuSO_4$

D. X and Y are $CuSO_4$ and CuO

Answer:

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18. Pottassium permanganate acts as an oxidant in neutral, alkaline as well as acidic media. The final product obtained from it in three condition are respectively:

A. MnO_4^{2-}, Mn^{3+} and Mn^{2+}

B. MnO_2, MnO_2 and Mn^{2+}

C. MnO_2, MnO_2^+ and Mn^{3+}

D. MnO_2, MnO_2^+ and Mn^{2+}

Answer:

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19. An inorganic Compound (A) has garnet red prismatic crystals. (A) is modertely soluble in water and dissolved in cold concentrated H_2SO_4 to yield red crystal (B) . In presence of dilute H_2SO_4 it converts a pungent

gas (C) into yellow turbidity (D) and converts a Suffocating gas (E) into a green solution (F). the gas (C) and (E) also combine to produced the yellow turbidity (D) . With KI and starch in presence of dilute. H_2SO_4 (A) and $concentrated$H_(2)SO_(4) $Mixtureusedasac \leq an \sin ga \geq ntf$ or $glassware \in thelab$ or $a \to ry.$ (A)` and explain the reactions.

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20. Name the member of the lanthanoids series which exibit+4 oxidation states and those which exhibit+2 oxidation state. Try to correlate this types of behaviour with the electronic configuration of these elements.

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21. 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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Miscellaneous Solved Problem Msps

1. Among the following statement choose the true or false statements(s).

$K_2Cr_2O_7$on heating with charcoal gives mettalic potassium and Cr_2O_3 on heating in current of H_2 the crystalline $KMnO_4$ is converted into KOH and Mn_3O_4

Hydrated ferric chloride on treatment with $2-$ 2-dimethoxypropane gives anhydrous ferric chloride.

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2. A compound (A) is used in paints instead of salts of lead. . Compound(A) is obtained when a white compound (B) is strongly heated . Compound (B) is insoluble in water but dissolves in sodium hydroxide forming a solution of compound (C) the compounds (A) on heating with coke gives a metal (D) and a gas (E) which burns with blue flame .

(B) also dissolves in ammonium sulphate solution mixed with ammonium hydroxide. solution of compound (A) in dilute HCl gives a bluish white//white precipitate (F) with excess of (F) with excees of $K_4\left[Fe(CN)_6\right]$ identify (A) to (F) and explain the reactions.

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3. An unknown inorganic compound (X) gave the following reactions:

(i) The compound (X) on heating gave a residue, oxygen and oxide of nitrogen.

An aqueous solution of compound (X) on addition to tap water gave a turbidity which did not dissolve in HO_{3+}

(iii) The turbidity dissolved in NH_4OH .

Identify the compound (X) and gives equation for the reaction (i),(ii) & (iii)`

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4. Among $[TiF_6]^{2-}, [COF_6]^{3-}, CU_2Cl_2$ and $[NiCl_4]^{2-}$ [Atomic number, $Ti = 22, Co = 27, Cu = 29, Ni = 28$] the Colourless species are:

A. $[TiF_6]^{2-}$ and $[Cu_2Cl_2]$

B. $[Cu_2Cl_2]$ and $[NiCl_4]^{2-}$

C. $[TiF_6]^{3-}$ and $[CoF_6]^{3-}$

D. $[CoF_6]^{3-}$ and $[NiCl_4]^{2-}$

Answer: A

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5. On the basis of trends in the properties of the $3d$-series elements , suggested possible M^{2+} aqua ions for use as reducing agents , and write a balanced chemical equation for the reaction of one of those ions with O_2 in acidic solution.

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6. Which of the following is true for the speical having $3d^4$ configuration ?

A. Cr^{2+} is reducing in nature.

B. Mn^{3+} is oxidising in nature.

C. Both (A) and (B)

D. None of those

Answer:

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7. Which of the following increasing order of oxidising power is correct for the following species?

$VO_2^+, MnO_4^-, Cr_2O_7^{2-}$

A. $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

B. $VO_2^+ < MnO_4^- < Cr_2O_7^{2-}$

C. $Cr_2O_7^{2-} < VO_2^+ < MnO_4^-$

D. $Cr_2O_7^{2-} < MnO_4^- < VO_2^+$

Answer:

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8. Which of the following Statement(s) is//are correct?

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 generally form coloured compounds

D. Transition metals and their many compounds act as good catalyst.

Answer:

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9. When cO_2 is passed into aqueous:

A. Na_2CrO_4 solution , its yellow colour change to orange

B. K_2MnO_4 Solution,it disproportionate to $KMnO_4$ and MnO_2

C. $Na_2Cr_2O_7$ Solution,its orange colour change to green

D. $KmnO_4$ Solution ,its pink colour change to green.

Answer:

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10. Which of the following statements (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.

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

B. Fe^{3+} gives blue precipitate with potassium ferricyanide

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

D. Fe^{2+} gives brown olour with potassium sulphocyanide

Answer:

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11. Assertion : Ammoniacal silver nitrate converts glucose to gluconic acid and metallic is precipitated.

Reason : Glucose acts as a week reducing is precipitated.

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

B. Statement-1 is True, Statement -2 is True , Statement-2 is Not a correct explanation for statement-1.

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

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

Answer:

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12. The number of unpaired electrons in the following gaseous ion:

Mn^{3+}, Cr^{3+}, V^{3+} and Ti^{3+} and Ti^{3+} are 4, 3, 2 and 1 respectively

Statement: Cr^{3+} is most stable in aqeous solution among these ions.

A. Statement-1 is true, Statement-2 is True, Statement-2 is a correct explanation for statement-1

B. Statement-1 is true, Statement-2 is True, Statement-2 is Not a correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer:

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13. S_1 interstitial compound have high melting points, higher than those of pure metals.

S_2 Permanganate titration in presence of hydrochloric acid are unsatisfactory

S_3: $KmnO_4$ does not act as an oxidising agent in strong alkaline medium.

S_4 : $KMnO_4$ On heating in a current of H_2 gives MnO

A. TTFT

B. $TFFT$

C. TFTT

D. $FFTF$

Answer:

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14. What is the composition of mischmetal alloy and what are it's uses?

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Board Level Exercise

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

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

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

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

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

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10. 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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11. 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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12. 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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13. What are alloys? Name an important alloy which contains some of the lanthanoid metals . Mention its uses.

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14. How is the variablility in oxidation states of transition metals different from that of the non transition metals gt illustrate with example

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15. Decribes the oxidising action of potassium dichromate and write the ionic equation for its reaction with:

A. iodide

B. iron solution

C. H_2S

D. H_2S

Answer: $\begin{matrix} Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O \\ 2I_2 \rightarrow I_2 + 2e^- \times [3] \\ \hline Cr_2O_7^{2-}, + 14H^+ + 6I^-, \rightarrow , 2Cr^{3+} + 3I_2 + 7H_2O \end{matrix}$ **(ii)**

Ferrous salts are oxidised to ferric salts:

$6Fe^{2+} + Cr_2O_7^{2-} + 14H^+ \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$

(iii) H_2S**is oxidised to sulphur:**

$Cr_2O_7^{2-} + 3H_2S + 8H^+ \rightarrow 2Cr^{3+} + 7H_2O + 3S$

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16. 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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17. How would you account for the irregular of ionisation enthalpies (first) in the first series of the transition elements?

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18. How would you account for the following:

of the d^4 species Cr^{2+} is strongly reducing while manganese(III) is strongly oxiding.

Cobalt(II) is stable in aqueous solution but in the presence of complexing

reagents it is easily oxidised.

The D^1 configuration is very unstable in ions.

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

A. electronic configuration

B. atomic and ionic sizes

C. oxidation state and

D. chemical reactivity.

Answer:

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20. 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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21. (a) why is the E^{Θ} value for the Mn^{3+}/Mn^{2+} couple much more positivethan that for Cr^{3+}/Cr^{2+} or $Fe^{3+}//Fe^{2+}$? Explain.

(b) What is meant by 'disproportionation' of an oxidation state? Give example.

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Exercise I Part I

1. What is the general electronic configuration of transition elements

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2. Write the electronic configuration of the following ions.

A. Mn^{2+}

B. Fe^{3+}

C. Ni^{2+}

D. Cr^{3+}

Answer: (i) $[Ar]3d^5 4s^0$**, (ii)** $[Ar]3d^5 4s^0$**;(iii)**$[Ar]3d^8 4s^0$ **(iv)** $[Ar]3d^3 4s^0$

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3. Name the d-block elment which do not have partially filled d-orbitals in their or in their simple ions

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4. What is meant by the 'lanthanide contraction'? Mention one important fact that can be consisdered as a consequence of the lanthanide contraction.

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5. Name the (i) lightest and the (ii) heaviest element (in terms of density)among the transition elements.

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6. Which element among d-block element has(i) the lowest melting point and (ii) the highest melting point

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7. Why Zinc has lowest melting point in $3d$ series?

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

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

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10. Why do transition elements show variable oxidation state?

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11. What is the most common oxidation state of first transition series?

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

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13. Name the three factors which determine the stability of a particular oxidation state in solution.

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

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15. Most of transition , metals can display hydrogen from dilute acid. Why?

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16.

$(\text{Element}, Cr, Mn, Fe), \left(E^0\left(M^{2+}/M\right), -0.90V, -1.18V, -0.4V\right), (E$

Use this data to comment upon

(i) The stability of Fe^{3+} and Mn^{2+} in acid solution.

(ii) The ease with which iron can be oxidised as compared to the similar process for either Cror Mn Metals.

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17. Which of the following ions would form (i) coloured and (ii) colourless complexes in water?

$CU^{2+}, Zn^{2+}, Ti^{3+}, Ti^{+4}, Cd^{2+}, Mn^{2+}$

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18. Why Ti^4 complex are diamagnetic?

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

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20. Why do $Mn(II)$ show maximum paramagnetic character amongst the bivalent ion of the I^{ST} transition series?

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21. Explain gives reason.

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

behaviour.

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

© The transition metals generally from coloured compounds.

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22. Explain why transition metals and their many compounds act as goodd catalyst.

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23. A transition metal form alloys with other transition elements . Explain

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24. Describe The general characteristics of transition elements with special reference to the following:

Catalyst

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25. What happen when $CuSO_4$ solution is treated with

(excess of ammonia solution and (ii) KI solution?

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26. What happen when silver nitrate solution is added to $Na_2S_2O_3$ solution and then content is allowed to keep for a longer period?

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27. What reaction will take place if a silver coin is put in dilute HNO_3 ?

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28. Which type of reaction MnO_4^{2-} show with acid , dilute -alkali or water.

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29. Why KMO_4 is stored in dark bottle and what happens to it's acidic solution?

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30. Why does $AgNO_3$ produced a black stain on the skin?

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31. Why is $AgBr$ used in photography ?

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32. Why it is not advisable to dissolve $KMnO_4$ in cold and concentrated H_2SO_4

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33. What happen when:

(a) Green Vitriol is strongly heated. , (b) $FeSO_4$ reacts with potassium ferricyanide.

(c) Fe_2O_3 is fused with soda ash. , (d) Salts of iron (III) reacts with NH_4SCN.

(e) Zinc oxide and cobalt oxide is fused. ,(f) Malachite is made to react with dilute H_2SO_4

(g) copper sulphate is exposed to air for longer period

Lunar caustic is made to react with sodium hydroxide and then product is dried.

(i) Silver nitrate reacts with excess iodine.

Potassium dichromate reacts with cold and concentrated H_2SO_4

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34. Complete and balance the following reactions:

(a) $FeSO_4 + H_2O + O_2 \rightarrow$, (b)

$$FeCl_3.6H_2O + CH_3 - \underset{OCH_3}{\overset{OCH_3}{\underset{|}{\overset{|}{C}}}} - CH_3 \rightarrow$$

(C) $CU(OH)_2 + (NH_4)_2SO_4 \rightarrow$,(d)$CuCl_2.2H_2O \underset{Strong}{\overset{\Delta}{\rightarrow}}$

(e) $AgNO_3(excess) + I_2 + H_2O \rightarrow$, (f)

$KMnO_4 + Na_2S_2O + H_2O \rightarrow$

(g) $K_2Cr_2O_7 + H_2SO_4 + SO_2 + H_2O \underset{Tempt < 70^\circ C}{\longrightarrow}$

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35. $CrO(O_2)_2$ is stable in pyridine. Explain?

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36. Write the formula of the compound formed by $K_2Cr_2O_7$ in alkaline solution with $30\ \%\ H_2O_2$:

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37. 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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38. 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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39. 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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40. Why Sm^{2+}, Eu^{2+} and yb^{2+} ions in solution are good reducing agent but an aqeius solution of Ce^{4+} is a good oxidising agent?

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Exercise I Part Ii

1. The transition elements have a general electronic configuration:

A. $ns^2np^6nd^{1-10}$

B. $(n-1)d^{1-10}ns^{0-2}np^{0-6}$

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

D. none

Answer: C

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2. The atomic volume of the transition elements are low compared with elements in neighboring group 1 and 2 because:

A. The number charge is poorly screened and so attract all the electrons more strongly

B. the extra electrons added inner orbitals

C. (A) and (B) both

D. none

Answer: C

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3. The wrong statement regarding transition metals among the following is:

A. $4s$ electrons penetrate toward the nucleus more than $3d$ electrons

B. atomic radii of transition metals increase rapidly with increase in atomic number because of poor shielding of nuclear attraction by $(n-1)$ of electrons

C. second and third transition series elements have nearly the same size

D. their densities are higher and densities of the $5d$ series element are higher than those of $4d$ series elements.

Answer: B

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4. The melting point of Zn is lower as compared to those of the other elements of $3d$ series because:

A. The orbitals are completely filled.

B. the d-orbitals are partially filled

C. d-electrons do not participate in metallic bonding

D. size of Zn atoms is smaller

Answer: AC

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5. First IE of $5d$ seties element are higher than those of $3d$ and $4d$ series elements. This is due to:

A. bigger size of atoms of $5d$ -series elements than $3d$ series elements

B. Greater effective nuclear charge is experienced by valence electrons because of the weak shielding of the nuclear by $4f$-electrons in $5d$ series.

C. (A) and (B) both

D. None of these

Answer: B

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6. which of the following statement is correct?

A. The lesser number of oxidation state in $3d$-series in the beginning of the series is due to the presence of too few electrons to loose or share

B. The lesser number of oxidation states in $3d - series$ towards the end of the series is due to the presence of too many electrons and thus fewer empty orbital to share electrons with the ligands

C. (A) and (B) both

D. None is correct

Answer: C

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7. ionisation energies of Ni and Pt in $Kjmol^{-1}$ are given below

	$\underbrace{(IE)_1 + (IE)_2}$	$\underbrace{(IE)_3 + (IE)_4}$
Ni	2.49	8.80
Pt	2.60	6.70

So, (select the correct statement)

A. (A) nickle (II) compounds tend to be thermodynamically more stable than platinum(II)

B. Platinum (IV) compounds tend to be more stable than nickel (IV)

C. (A) & (B) both

D. None is correct

Answer: C

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8. Maximum oxidation state is shown by:

A. Os

B. Mn

C. Cr

D. Co

Answer: AC

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9. The less stable oxidation state of Cr are:

A. Cr^{2+}

B. Cr^{3+}

C. Cr^{4+}

D. Cr^{6+}

Answer: ACD

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10. Which of the following statement is false?

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

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

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

D. None of these

Answer: A

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11. Whih of the followin statement are correct?

A. Transition elements higher enthalpies of atomization as they have stronger interatomic interaction

B. IE_2 of $._{23} V < ._{24} Cr > ._{25} Mn$ and $._{28} Ni < ._{29} Cu > ._{30} Zn$

C. $Ni(II)$ compounds are more stable than pt(II) where as Pt(IV) compounds are stable than nickel(IV).

D. The element which gives the greatest number of oxidation state does not occur in or near the middle of the series.

Answer: ABC

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12. Which of the following has the maximum number of unpaired d-electron?

A. Zn^{2+}

B. Fe^{2+}

C. Ni^{2+}

D. Cu^{2+}

Answer: B

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13. The highest magnetic moments is shown by the transition metal ion with the outermost electronic configuration is:

A. $3d^5$

B. $3d^2$

C. $3d^7$

D. $3d^9$

Answer: A

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14. A metal ion from the first transition series has a magnitic moment (calculated) or $3.87B.M.$ How man unparied electrons are expected to

be present in the ion?

A. 1

B. 2`

C. 3

D. 4

Answer: C

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15. Magnetic moment of $Cr^{+2}(Z=24), Mn^{+2}(Z=25)$ and $Fe^{2+}(Z=26)$ are x,y,z. they are in order

A. $x < y < z$

B. $x > y > z$

C. $z < x = y$

D. $x = z < y$

Answer: D

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16. The magnetic moment of $._{25}Mn$ in ionic state is $\sqrt{15}B.M$, then Mn is in:

A. $+2$ state

B. $+3$ state

C. $+4$ state

D. $+5$ state

Answer: C

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17. which of the following group of ion is paramagnetic in nature:

A. $Cu^{+}, Zn^{2+} Sc^{2+}$

B. $Mn^{2+}, Fe^{3+}, Ni^{2+}$

C. $Cr^{2+}, Mn^{3+}, Sc^{3+}$

D. $Cu^{2+}, Ni^{2+}, Ti^{4+}$

Answer: B

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18. The colour of transition metal ion is attributed to:

A. exceptionally small size of cations

B. absorption of ultraviolet rays

C. incomplete(n-1)d-subshell

D. absorption of infrared radiation

Answer: C

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19. Which one of the ionic species will impart colour to an aqueous solution?

A. Ti^{4+}

B. Cu^{+}

C. Zn^{2+}

D. Cr^{3+}

Answer: D

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20. MnO_4^- is of intense pink colour, though Mn is in$(+7)$ oxidation state.It is due to:

A. Oxygen gives colour to it

B. charge transfer when Mn gives its electrons to oxygen

C. charge transfer when oxygen its electron to Mn making it $Mn(+VI)$ hence coloured

D. None is correct

Answer: C

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21. The yellow colour of chromates changes to orange on acidification due to formation of:

A. Cr^{3+}

B. $Cr_2(CO_3)_3$

C. $Cr_2O_7^{2-}$

D. CrO_4^-

Answer: C

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22. $CuSO_4.5H_2O$ is blue in colour because

A. It contains water of crystallization.

B. SO_4^{2-} ions absorbs red light.

C. Cu^{2+} ion absorb red light

D. Cu^{2+} ions absorbs all colours except red from the white light.

Answer: C

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23. whih of the following ions gives(s) coloured aqeous solution?

A. Ni^{2+}

B. Fe^{2+}

C. Cu^{2+}

D. Cu^{+}

Answer: ABC

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24. The catalytic activity of the transition metals and their compound is ascribed to:

A. Their chemical reactivity

B. their magnetic behaviour

C. their filled d-orbitals

D. their ability to adopt multiple oxidation state and their complexing ability.

Answer: D

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25. Cementite is:

A. interstitial compound of iron and carbon

B. an alloy of Fe and Cr

C. a compound resembling cement

D. an ore of iron

Answer: A

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26. which forms interstitial compounds?

A. Fe

B. Co

C. Ni

D. All

Answer: D

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27. Which of the following statement is/are correct?

A. transition metals and their many compounds act as good catalyst.

B. The enthalpies of atomisation of the transition metals are high

C. The transition metals generally form interstitial compounds with small atoms like C, B, H etc.

D. All transition metal compounds are not paramagnetic.

Answer: ABCD

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28. $KmnO_4$ is the oxo salt of :

A. MnO_2

B. Mn_2O_7

C. MnO_3

D. Mn_2O_3

Answer: B

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29. When $K_4\left[Fe(CN)_6\right]$ is added to $FeCl_3$, the complex compound formed is:

A. $Fe_3\left[Fe(CN_6\right]_4$

B. $Fe_4\left[Fe(CN)_6\right]_3$

C. $K_2\left[Fe(CN)_6\right]$

D. $K_2Fe_3\left[Fe(CN)_6\right]_2$

Answer: B

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30. $FeCl_3.6H_2O$ is actually:

A. $\left[Fe(H_2O)_6\right]Cl_3$

B. $\left[Fe(H_2O)_5\right]Cl]Cl_2.\ H_2O$

C. $\left[Fe(H_2O)_4\right]Cl_2.2H_2O$

D. $\left[Fe(H_2O)_3\right]Cl_3.3H_2O$

Answer: C

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31. A compound is yellow when hot and white when cold. The compound is:

A. Al_2O_3

B. PbO

C. CaO

D. ZnO

Answer: D

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32. On heating $ZnXl_2.2H_2O$, the compounds obtained is:

A. $ZnCl_2$

B. $Zn(OH)Cl$

C. $Zn(OH)_2$

D. Zn

Answer: B

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33. When copper is placed in the atmosphere for sufficient time, a green crust is formed on its surface. The composition of the green crust is:

A. $CU(OH)_2$

B. CuO

C. $CuCO_3$

D. $CuCO_3.Cu(OH)_2$

Answer: D

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34. The solubility of silver bromide in hypo solution (excess) is due to the formation of:

A. Ag_2SO_3

B. $Ag_2S_2O_3$

C. $[Ag(S_2O_3)]^-$

D. $\left[Ag(S_2O_3)_2\right]^{3-}$

Answer: D

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35. In dilute alkaline solution, MnO_4^- changes to:

A. $KMnO_4^{2-}$

B. MnO_2

C. Mn_2O_3

D. MnO

Answer: B

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36. Cl_2 gas is obtained by various reactions select the reactions from the following (s):

A. $KMnO_4(s) + ConcHcl \underset{\rightarrow}{\Delta}$

B. $KCl(s) + K_2CR_2O_7(s) + ConcH_2SO_4 \underset{\rightarrow}{\Delta}$

C. $MnO_2(s) + ConcHcl \underset{\rightarrow}{\Delta}$

D. $Kcl(s) + f_2(l) \rightarrow$

Answer: B

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37. $CuSO_4$ solution + lime is called:

A. Lucas reagent

B. Fenton's reagent

C. Fehling solution A`

D. Bordeaux mixture

Answer: D

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38. The developer used in photography is an alkaline solution of:

A. hydroquinone

B. glycerol

C. phenol

D. picric acid

Answer: A

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39. When acidified solution of $K_2Cr_2O_7$ is shaken with aqeous solution of $FeSO_4$, Then:

A. $Cr_2O_7^{2-}$ ions is reduced to Cr^{3+} ions

B. $Cr_2O_7^{2-}$ ion is converted to CrO_4^{2-} ion

C. $Cr_2O_7^{2-}$ ions is reduced to Cr

D. $Cr_2O_7^{2-}$ ions is converted to CrO_3

Answer: A

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40. $FeCl_3$ dissolves in:

A. water

B. ether

C. ammonia

D. A and B both

Answer: D

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41. Which of the following compounds is used as the startingn material for the preparation of potassium dichromate?

A. $K_2SO_4.Cr(SO_4)_3.24H_2O$ (chrome alum)

B. $PbCrO_4$ (Chrome yellow)

C. $FeCr_2O_4$(chromite)

D. $PbCrO_4.PbO$(chrome red)

Answer: C

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42. $Cr)_3$ dissolved in aqueous $NaOH$ to give:

A. CrO_4^{2-}

B. $Cr(OH)_3$

C. $Cr_2O_7^{2-}$ ions is reduced to Cr

D. $Cr(OH)_2$

Answer: A

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43. The final product obtained for the following reaction is:

$KMnO_4(\text{excess}) + H_2SO_4(\text{concentrated and cold}) \rightarrow$

A. Mn_2O_7

B. MnO

C. Mn_3O_4

D. MnO_3^+

Answer: A

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44. When $AgNo_3$(aq)` reacts with excess of iodine, we get:

A. $AgIO_3$

B. HIO_3

C. AgO

D. HI

Answer: B

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45. $ZnO + CoO \underset{\rightarrow}{\Delta} X$,Product X colour is:

A. Green

B. Blue

C. Pink

D. Bluish green

Answer: A

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46. The compound that gets oxidised even on exposure to atmosphere is:

A. $Co_2(SO_4)_3$

B. $NiSO_4$

C. $KMnO_4$

D. $FeSO_4$

Answer: D

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47. Select correct statement(s).

A. PH_3 reduce $AgNO_3$ to metallic Ag

B. Organic tissues turn $AgNO_3$ black by reducing it to Ag

C. $AgCN$ is soluble in KCN.

D. Zr and Ta have almost similar size due to lanthanide contraction

Answer: ABC

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48. The f-block elements of the periodic table contains those element in which

A. Only $4f$ orbitals are progressively filled in $6th$ period.

B. Only $5f$ orbitals are progressively filled in $7th$ period.

C. $4f$ and $5f$ orbitals are progressivley filled in $6th$ and $7th$ period respectively.

D. none

Answer: C

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49. Among the lanthanides the one obtained by synthetic method is

A. Lu

B. Pm

C. Pr

D. Gd

Answer: B

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50. The most common lanthanoide is :

A. Lanthanum

B. Cerium

C. Samarium

D. Plutonium

Answer: B

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51. Across the lanthanide series , the basicity of the lanthanoide hydroxides:

A. increases

B. decreases

C. first increases and then decreases

D. does not change

Answer: B

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52. The $+3$ ion of which one of the following has half filled $4f$ subshell?

A. La

B. Lu

C. Gd

D. Ac

Answer: C

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53. Actinides

A. Are all synthetic elements

B. includes element 104

C. Have only short lived isotopes

D. have variable valency

Answer: D

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54. The lanthanide contraction is responsible for the fact that

A. Zr and Y have about the same radius

B. Zr and Nb have similar oxidation state

C. Zr and Hf have about the same radius

D. Zr and Ce have the same oxidation state.

Answer: C

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55. Lanthanides and actinides resemble in

A. electronic configuration

B. oxidation state

C. ionization energy

D. formation of complexes

Answer: A

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56. The speration of lanthanides by ion exchanges method is based on

A. Size of the ions

B. Oxidation state of the ions

C. The solubility of their nitrates

D. basicity of hydroxides of lanthanides

Answer: A

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Exercise I Part Iii

1. Assertion : The order of atomic radii of Cu, Ag and Au is $Cu < Ag \approx Au.$

Reason : The atomic radii of $4d$ series elements are larger than those of $3d$ series elements but generally the radii of $4d$ and $5d$ series elements are almost identical.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: B

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2. Assertion : $4d$ and $5d$ series elements have nearly same atomic radius.

Reason : Lanthanoid contraction.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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3. Assertion: Tungsten has very high melting point.

Reason: Tungsten is a covalent compound.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: C

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4. 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.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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5. Assertion : $CuSO_4.5H_2O$ on heating to $250^\circ C$ losses all the five H_2O molecules and becomes anhydrous.

Reason : All five H_2O molecules are coordinated to the central Cu^{2+} ion.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: C

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6. Assertion : Silver chloride dissolves in execss ammonia.

Reason : $AgCl$ forms a soluble complex, $\left[Ag(NH_3)_2\right]Cl$ with ammonia.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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7. Assertion : CrO_3 is an acid anhydride.

Reason: CrO_3 is obtained as bright orange crystals by the reaction of $K_2Cr_2O_7$ with cold concentrated H_2SO_4.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: B

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8. Assertion : Solid potassium dichromate gives greenish yellow vapour with concentrated H_2SO_4 and solid ammonium chloride.

Reason : The reaction of ammonium chloride with solide $K_2Cr_2O_7$ and concentrated H_2XO_4 produces chromyl chloride.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: D

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9. Assetion : Permanganate titrations is not carried out in presence of hydrochloric acid.

Reason : Hydrochloric acid is oxidised to chlorine.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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10. The free gaseous Cr atom has six unpaired electrons.

Half-filled s-orbital has greater stability.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: C

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11. Assertion : K_2CrO_4 has yellow colour due to charge transfer.

Reason : CrO_4^{2-} ion is tetrahedral in shape.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: B

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12. Assetion : The green manganate is paramagnetic but the pruple permanganate is diamagnetic in nature.

Reason : MnO_4^{2-} contains on upaired electron while in MnO_4^- all electrons are paried.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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13. Assertion : Copper metal is turned green when exposed to atmospheric CO_2 and moisture.

Reason: Copper gets covered with a green layer of basic copper carbonate.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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14. Assertion : Ammoniacal silver nitrate converts glucose to gluconic acid and metallic is precipitated.

Reason : Glucose acts as a week reducing is precipitated.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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15. Assertion : $4d$ and $5d$ series elements have nearly same atomic radius.

Reason : Lanthanoid contraction.

A. Statement-1 is true , Statement-2 is true and Statement-2 is correct explanation for Statement-1

B. Statement-1 is true, Statement-2 is True and Statement-2 is Not correct explanation for statement-1

C. Statement-1 is true, Statement-2 is False

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

Answer: A

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Exercise 2 Part I

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

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2. Why the highest oxidations state of a metal is exhibited in its or fluoride only?

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

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

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

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7. The $E(\Theta)\left(M^{2+}/M\right)$ Value for copper is positive $(+0.34V)$. What is possibly the statement-2 for this?

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8. Why is the E^{Θ} value for the Mn^{3+}/Mn^{2+} couple much postive than for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+}? Example

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

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10. Why is Cu^+ ion not stable in aqueous solution ?

or

Why is Cu^+ is not known in aqueous solution ?

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11. The aqueous solution of $FeCl_3$ is acidic . Why?

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12. Ferric iodide is very unstable but ferric chloride is not

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13. Copper dissolves in dilute nitrate acid but not in dilute HCl. Why?

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14. Blue colour of $CUSO_4$ solution is discharge slowly when an iron rod is dipped into it. Why?

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15. Copper (I) Salts are not known in aueous solution.

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

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18. Copper sulphate dissolves in Nh_4OH solution but $FesO_4$ does not.

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19. An aqueous solution of inorganic compounds (X) gives following reactions.

(i) With an aqueous solution of barium chloride a precipitate insoluble in dilute HCl is obtained.

(ii) Addition of excess of Kl gives a brown precipitate which turns white on additon of excess of hyposolution.

(iii) With an aqueous solution of $K_4\left[Fe(CN)_6\right.$, a brown coloured precipitate is obtained.

Identity (X) and gives equation for the reaction for (i),(ii) and (iii) observations.

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20. H_2S gas is passed through an acidic solution of $K_2Cr_2O_7$. The solution turns milky, why?

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21. What happen when(i) a small amount of $Kmno_4$ is added to concentrated H_2SO_4 (ii) an excess amount of $KMnO_4$ is added to concentrated H_2SO_4 solution.

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22. A hydrated mettalic salt(A). Light green in colour , on careful heating gives a white anhydrates residue (B),(B) is soluble in water and its aqueous gives a dark blue precipitate (C) with potassium hexacyanidoferrate (III) . (B) on strong heating gives a brown residue(D) and a mixture of two gases(E) and (F). The gaseous mixture when passed through acidified potassium dichromate , produce green colour solution and when passed through lead acetate solution gave a white precipitate.

Out of two gase(E) can act as both reducing as well as oxidising agent.

Identify (A) ,(B) ,(C),(D) , and (F) and gives the reaction involved.

Explain why salt(A) become white on heating .

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23. A white substance (A) reacts with dilute H_2SO_4 to produce a colourless suffocating gas (B) and a colourless solution (C)/ The reaction of gas (B) with potassium iodate and starch solution produce a blue colour solution. Aqueous Solution of (A) gives a white precipitate with $BaCl_2$ solution which is soluble in dilute HCl. Addition of aqueous NH_3 or $NaOH$ to (C) produced first a precipitate which dissolves in excess of the respective reagent to poduced a clear solution. Similarly addition of excess of potassium ferrocyanide to (C) produced a precipitate (D) which also dissolves in aqeous $NaOH$ giving a clear solution. Identify (A),(B),(C) and (D). Write the equation of the reactions involved.

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24. Write the balanced chemical equation for the following reaction:- Nitrrogen is obtained in the reaction of aqueous ammonia with potassium permanganate

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25. Complete and //balance the following equation:

$Ag_2S + CuCl_2 + Hg. \ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + S + 2Ag$

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

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27. One among the lanthanoides, $Ce(III)$, can be easily oxidized to Ce(IV) (At.No. of ce=58) explain why?

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Exercise 2 Part Ii

1. The correct ground state electronic configuration of chromium atom(Z=24) is :

A. $[Ar]4d^5 4s^1$

B. $[Ar]3d^4 4s^2$

C. $[Ar]3d^6 4s^0$

D. $[Ar]3d^5 4s^1$

Answer: D

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2. Transition metals:

A. exhibit only diamagnetism

B. undergo inert pair effect

C. do not form alloys

D. show variable oxidation states.

Answer: D

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3. The radii (metallic) of $Fe, CO \text{ and } Ni$ are nearly same.

This is due to:

A. Lanthanide contraction

B. The fact that successive addition of d-electrons screens (4s) from the inward pull of the nucleus.

C. increase in radii due to increase in n is compensated by decrease in radii due to increase in effctive nulcear charge(Z).

D. Atomic radii do not remain constant but increase in a normal gradation.

Answer: B

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4. Atomic of the transition elements than those of the s-block elements because:

A. there is increase in the nuclear charge along the period.

B. orbital electrons are added to the penultimate d-subshell rather than to the outer shell of the atom.

C. the shielding effect of d-electrons is small.

D. All of these.

Answer: D

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

A. Poor shielding of 4 f-electrons in compare to other electrons in the sub-shell.

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

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

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

Answer: A

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6. Which of the following transition metal ions has the lowest density?

A. Copper

B. Nickel

C. Scandium

D. Zinc

Answer: C

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7. Of the ions Zn^{2+}, Ni^{2+} and Cr^{3+} (atomic number Zn=30,Ni=28,Cr=24):

A. Only Zn^{2+} is colourless and Ni^{2+} and Cr^{3+} are coloured.

B. all three are colourless.

C. all three are coloured

D. only Ni^{2+} is coloured and Zn^{2+} and Cr^{3+} are colourless.

Answer: A

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

A. Zn^{2+}, Zn^{3+}

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

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

D. V^{3+}, V^{5+}

Answer: A

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9. VO_2 is an amphoteric oxide and in acidic medium it form:

A. VO^{2+}

B. VO_2^{+}

C. V^{3+}

D. VO_2^{2+}

Answer: A

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10. Which of the following transition metal shows the highest oxidation state:

A. Mn

B. Fe

C. V

D. Cr

Answer: A

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11. Standard reduction electrode potential of Zn^{2+}/Zn is -0.76V`. This means:

A. ZnO is reduced to Zn by H_2

B. Zn can't liberates H_2 with conentrated acid

C. Zn is generally the anode in an electrochemical cell

D. Zn is generally the cathode in an electrochemical cell.

Answer: C

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12. E^{Θ} value for the couple Cr^{3+}/Cr^{2+} and Mn^{3+}/Mn^{2+} are -0.41 and $+1.51$ volts respectively. Considering these value select the correct option from the following statements.

A. Cr^{2+} act as a reducing agent and Mn^{3+} act as an oxidising agent in their aqueous solutions.

B. Cr^{2+} (aq) is more stable than Cr^{3+} (aq).

C. Mn^{3+} (aq) is more stable than Mn^{2+} (aq).

D. None of these

Answer: A

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13. Which one of the following show highest magnetic moment?

A. V^{3+}

B. Cr^{3+}

C. Fe^{3+}

D. CO^{3+}

Answer: C

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14. Amongest the following the lowest degree of paramagnetism per mole of the compound at $298K$ will be shown by:

A. $MnSO_4.4H_2O$

B. $CuSO_4.5H_2O$

C. $FeSO_4.6H_2O$

D. $NiSO_4.6H_2O$

Answer: B

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15. Which one of the transittion metal ions is coloured in aqueous solution?

A. $Cu^{+()}$

B. Zn^{2+}

C. Sc^{3+}

D. V^{4+}

Answer: D

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16. 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: C

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17. Which of the following is expected to be coloured?

A. Ag_2SO_4

B. CuF_2

C. MgF_2

D. $CuCl$

Answer: B

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18. Most transition metals:(I) Form sets of compounds which display different oxidation states of the metal.

(II) form coloured ion in solution

(III)burn vigorously in oxygen

(IV) form complex compound of these

A. I,II,III are correct

B. II,III,IV are correct

C. I,II are correct

D. all the correct

Answer: C

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19. The aqueous solution of the following salts will be coloured in the case of :

A. $Zn(NO_3)_2$

B. $LiNO_3$

C. $Co(NO_3)_2$

D. potash alum

Answer: C

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20. Which one of the following characteristics of the transition metals is associated with their catalytic activity?

A. Colour of hydrated ions.

B. Variable oxidation states.

C. High enthalpy of atomization.

D. paramagnetic behaviour.

Answer: B

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21. German silver is an alloy of copper and:

A. $Zn + Ni$

B. $Al + Ag$

C. $Zn + Ag$

D. $Sn + Zn$

Answer: A

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22. Ferric sulphate on heating gives:

A. SO_2 and SO_3

B. SO_2 only

C. SO_3 only

D. S

Answer: C

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23. Anhydrous ferric chloride is prepared by:

A. dissolving ferric hydroxide in dilute HCl

B. dissolving ferric hydroxide in concentrated HCl

C. by passing dry Cl_2 gas over heated scrap iron

D. by dissolving iron(III) oxide in concentrated HCl.

Answer: C

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24. At $3000^\circ C FeCl_3$:

A. decompose into $FeCl_2$ and Cl_2

B. decompose into Fe and Cl_2

C. sublimes to give liquid $FeCl_3$

D. sublimes to give gaseous dimer $(FeCl_3)_2$

Answer: D

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25. Iron is rendered passive by treatment with concentrated :

A. HCl

B. H_2SO_4

C. Cu

D. Ag

Answer: D

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26. Lucas reagent is:

A. Anhydrous $ZnCl_2 + HCl(conc.)$

B. $MnO_2 + H_2O$

C. $H_2SO_4 + HCl$

D. $NO + H_2O$

Answer: A

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27. Which one of the following dissolves in hot concentrated $NaOH$?

A. Fe

B. Zn

C. Cu

D. Ag

Answer: B

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28. The compound used for gravimetric estimation of `Cu(II) is:

A. $Cu_2(SCN)_2$

B. CU_2O

C. Cu_2I_2

D. Cu_2CO_3

Answer: A

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29. In the reaction, $2CuCl_2 + 2H_2O + SO_2 \rightarrow A + H_2SO_4 + 2HCl$, A is

A. Cu_2Cl_2

B. Cu

C. $CuSO_4$

D. $CuSO_4$

Answer: A

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30. Sodium thiosulphate is used in photography because of its:

A. oxidising behaviour

B. reducing behaviour

C. complexing behaviour

D. photochemical behaviour

Answer: C

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31. MnO_4^{2-} (1 mole) in neutral aqueous medium is disproportionate to

A. $2/3$ mole of MnO_4^- and $1/3$ mole of MnO_2

B. $1/3$ mole of MnO_4^- and $2/3$ moles of MnO_2

C. $1/3$ mole of Mn_2O_7 and $1/3$ mole of MnO_2

D. $2/3$ mole of Mn_2O_7 and $1/3$ moles of MnO_2

Answer: A

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32. When H_2O_2 is added to an acidified solution of $K_2Cr_2O_7$:

A. Solution turns green due to formation of Cr_2O_3

B. Solution turns yellow due to formation of K_2CrO_4

C. Solution gives green ppt of $Cr(OH)_3$

D.

Answer: C

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33. The number of moles of KMn_4 that will be needed to react with one mole of sulphite ion in acidic medium is

A. $2/5$

B. $3/5$

C. $4/5$

D. 1

Answer: A

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34. Ammonium dichromate is used in some fireworks. The green-coloured powder blown in the air is

A. CrO_3

B. Cr_2O_3

C. Cr

D. $CrO(O_2)$

Answer: B

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

A. $3/5$

B. $2/5$

C. $4/5$

D. 1

Answer: A

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36. Super conductors are derived from compound of:

A. p-block elements

B. lanthanoides

C. actinoides

D. transition elements

Answer: A

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37. In photography , quinol is used as developer accoding to following reaction.

Which of the following describes(s) the role of quinol in this reaction?

A. it acts as an acid

B. It acts as a weak base.

C. It acts as an oxidising agent

D. It act as a reducing agent

Answer: AD

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38. Which of the following statement(s) is/are correct?

A. $S_2O_8^{2-}$ oxidised Ag^+ in presence of pyridine and give red colour compound

B. MnO_4^{2-} disproportionates to yield MnO_4^- in presence of H^+ ions.

C. In $Cr_2O_7^{2-}$ each Cr is linked to four oxygen atoms.

D. Ti^{3+} is purple while Ti^{4+} is colourless.

Answer: ABCD

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39. Following reaction (s) is /are involved in the iodometric estimation

A.

$$Cr_2O_7^{2-} + H^+ + I^- \rightarrow 2Cr^{3+} + I_2, I_2 + S_2O_3^{2-} \rightarrow S_4O_6^{2-} + I^-$$

B.

$$MnO_4^- + H^+ + I^- \rightarrow Mn^{2+} + I_2, I_2 + S_2O_3^{2-} \rightarrow S_4O_6^{2-} + I^-$$

C.

$$MnO_4^- + OH^- + I^- \rightarrow MnO^2 + I_2, I_2 + S_2O_3^{2-} \rightarrow S_4O_6^{2-} + I^-$$

D.

$$Cr_2O_7^{2-} + OH^- + I^- \rightarrow 2Cr^{3+} + I_2, I_2 + S_2O_3^{2-} \rightarrow S_4O_6^{2-} + I^-$$

Answer: AB

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40. The colour of the transition metal ions is//are due to:

A. d-d transition of electrons in presence of ligands

B. charge transfer from ligand to metal ion.

C. change in the geometry

D. Polarisation of anion by cation

Answer: ABD

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41. Which of the following statement(s) is/are not correct.

A. The blue colour of aqueous $CuCl_2$ is due to $\left[Cu(H_2O)_4\right]^{2+}$

B. The yellow colour of aqueous $CuCl_2$ is due to $[CuCl_4)]^{2-}$

C. The green colour of aqueous $CuCl_2$ is due to $[CuCl_2$ is due to presence of both $[Cu(H_2O_4)]^{2+}$ and $[CuCl_4]^{2-}$

D. The blue colour of aqueous$CuCl_2$ is due to $[CuCl_4]^{2-}$

Answer: D

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42. Select correct statement(s).

A. MnO_4^- is intensive pink colour due to d-d electron.

B. $Cu(I)$ is diamagnetic while $Cu(II)$ is paramagnetic .

C. CrO_3 is amphoteric oxide.

D. $\left[Ti(H_2O)_6\right]^{3+}$ and $\left[Sc(H_2O)_6\right]^{3+}$ both are coloured in aqueous soloution.

Answer: B

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43. Correct statements about transition metals are that they:

A. form complex

B. show variable oxidation states

C. show magnetic properties

D. do not from coloured compounds

Answer: ABC

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44. Transition elements have greater tendency to form complex because they have:

A. vacant d-orbitals

B. small size

C. higher nuclear charge

D. variable oxidation states.

Answer: ABC

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45. Which of the following statement are correct when a mixture of $Nacl$ and $K_2Cr_2O_7$ is gently warmed with conc.H_2SO_4?

A. Deep red vapours are liberated

B. Deep red vapours dissolved in $NaOH(aq)$ forming a yellow solution.

C. Greenish yellow gas is liberated

D. Deep red vapour dissolve in water forming yellow solution.

Answer: ABD

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46. Which of the following reaction(s) is/are incorrect for silver nitrate?

A. $6AgNO_3 + 3l_2(\text{excees}) + 3H_2O \rightarrow AglO_3 + 5Agl + 6HNO_3$

B. $AgNO_3(\text{excess}) + 2KCN \rightarrow K\left[Ag(CN)_2\right] + KNO_3$

C. $2AgNO_3 + 4Na_2S_2O_3(\text{excess}) \rightarrow 2Na_3\left[Ag(S_2O_3)_2\right] + 2NaNO_3$

D. $PH_3 + 6AgNO_3 + 3H_2O \rightarrow Ag + 6HNO_3 + H_3PO_3$

Answer: AB

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47. Which of the following reaction(s) is /are used for the preparation of anhydrous $FeCl_3$?

A. $FeCl_3.6H_2O + 6SOCl_2 \rightarrow FeCl_3 + 12HCl + 6SO_2$

B. $Fe(OH)_3 \downarrow + 3HCl \rightarrow FeCl_3 + 3H_2O$

C. $2Fe + 4HCl(aq) + Cl_2 \rightarrow 2FeCl_3 + 2H_2$

D. $2Fe + 3Cl_2(dry) \rightarrow 2FeCl_3$

Answer: AD

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48. Which of the following is//are false?

A. $Na_2Cr_2O_7$ is used as a primary standard in volumetric analysis.

B. Potassium permanganate in excess on treatment with conc. H_2SO_4 form manganese heptoxide

C. phosphine, arsine and stibine all precipitates silver from silver nitrate.

D. From Kipp's apparatus waste ferric sulphate and ferrous sulphate mixture is obtained when air or oxygen is passed for longer time.

Answer: A

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49. Which of the following chemical reaction(s) is//are involved in developing of photographic plate?

A. $C_6H_4(OH)_2 + 2AgBr \rightarrow 2Ag + C_6H_4O_2 + 2HBr$

B. $AgBr + 2Na_2S_2O_3 \rightarrow Na_3\left[Ag(S_2O_3)_2\right] + NaBr$

C. $2AgNO_3 + Na_2S_2O_3 \rightarrow Ag_2S_2O_3 + 2NaNO_3$

D. $AgNO_3 + KCN \rightarrow AgCN + KNO_3$

Answer: AB

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50. Pyrolusite is MnO_2 used to prepare $KMnO_4$ step are:

$$MnO_2 \underset{\rightarrow}{I} MnO_4^{2-} \underset{\rightarrow}{II} MnO_4^-$$

Step I and II are respectively:

A. Fuse with KOH/air, electrolytic oxidation

B. fuse with $KOH\,/\,KNO_3$, electrolytic reduction

C. fuse with concentrated HNO_3/ air , electrolytic reduction

D. dissolve in H_2O. oxidation

Answer: AB

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51. Which are correct statement?

A. In less acidic solution $K_2Cr_2O_7$ and H_2O_2 gives violet coloured diamagnetic $[CrO(O_2)(OH)]^- ion.$

B. In alkaline H_2O_2. K_3CrO_8(with tetraperoxo species $\left[Cr(O_2)_4\right]^{3-}$ is formed with $K_2Cr_2O_7$.

C. In ammonical solution of H_2O_2, $(NH_3)_3CrO_4$ is formed with $K_2Cr_2O_7$.

D. CrO_4^{2-} change to $Cr_2O_7^{2-}$ by oxidation.

Answer: ABC

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52. When CO_2 is passed into aqueous:

A. Na_2CrO_4 solution, its yellow colour change to orange

B. K_2CrO_4 solution,it disproportionates to MnO_4 and MnO_2

C. $Na_2Cr_2O_7$ solution its orange colour changes to green

D. $KMnO_4$ solution, its pink colour chanhe to green

Answer: AB

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Exercise 2 Part Iv

1. Paramagnetism is a property due to the presence of unpaired electrons. In case of transition metals, as they contain unpaired contain unpaired electrons in the $(n-1)$ d orbitals , most of the transition metal ions and their compounds are paramagnetic . Paramagnetism increases with increases in number of unpaired electrons. Magnetic moment is calculated from spin only formula' Vz

$\mu = \sqrt{n(n+2)}B.\ Mn = \text{number of unpaired electrons}$

Similarly the colour of the compounds of transition metals may be attributed to the presence of incomplete $(n-1)$ d sub-shell. When an electron from a lower energy of d-orbitals is excited to a higher energy d-orbital, the energy of excitation corresponds to the frequency of light absorbed. This frequency generally lies in the visible region. The colour observed corresponds to complementry colour of the light obserbed. The frequency of the light absorbed is determined by the nature of the ligand.

Which of the following pair of Compounds is expected to exhibit same colour in aqueous solution

A. $FeCl_2, CuCl_2$

B. $VOCl_2, CuCl_2$

C. $VOCl_2, FeCl_2$

D. $FeCl_2, MnCl_2$

Answer: B

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2. Paramagnetism is a property due to the presence of unpaired electrons. In case of transition metals, as they contain unpaired contain unpaired electrons in the $(n-1)$ d orbitals , most of the transition metal ions and their compounds are paramagnetic . Paramagnetism increases with increases in number of unpaired electrons. Magnetic moment is calculated from 'spin only formula' Vz

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Titanium shows magnetic moments of $1.73BM$ in its compound. What is the oxidation state of titanium in the compound?

A. $+2$

B. $+1$

C. $+3$

D. $+4$

Answer: C

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3. Paramagnetism is a property due to the presence of unpaired electrons. In case of transition metals, as they contain unpaired contain unpaired electrons in the $(n-1)$ d orbitals , most of the transition metal ions and their compounds are paramagnetic . Paramagnetism increases with increases in number of unpaired electrons. Magnetic moment is calculated from 'spin only formula' Vz

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orbital, the energy of excitation corresponds to the frequency of light absorbed. This frequency generally lies in the visible region. The colour observed corresponds to complementry colour of the light obserbed. The frequency of the light absorbed is determined by the nature of the ligand.

The colourless species is:

A. VCl_3

B. $VOSO_4$

C. Na_3VO_4

D. $[V(H_2O_6)SO_4]$

Answer: C

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4. Paramagnetism is a property due to the presence of unpaired electrons. In case of transition metals, as they contain unpaired contain unpaired electrons in the $(n-1)$ d orbitals , most of the transition metal

ions and their compounds are paramagnetic . Paramagnetism increases with increases in number of unpaired electrons. Magnetic moment is calculated from 'spin only formula' Vz

$\mu = \sqrt{n(n+2)}B$. $Mn = \text{number of unpaired electrons}$

Similarly the colour of the compounds of transition metals may be attributed to the presence of incomplete $(n-1)$ d sub-shell. When an electron from a lower energy of d-orbitals is excited to a higher energy d-orbital, the energy of excitation corresponds to the frequency of light absorbed. This frequency generally lies in the visible region. The colour observed corresponds to complementry colour of the light obserbed. The frequency of the light absorbed is determined by the nature of the ligand.

Identify the correct statement.

A. Mn^{2+} has the highest paramagnetism amongst the bivalentcation of the I^{st} transition series.

B. The coloured ions or compounds of transition elements are due to d-d transition and charge transfer spectrum.

C. In $3d$ series the paramagnetic character first increase to maximum & then start decreasing.

D. None of these

Answer: D

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5. (i) A powdered substance (A) on treatment with fusion mixture gives a green coloured compound (B).

(ii) The solution of (B) in boiling water on acidification with dilute H_2SO_4 gives a pink coloured compound (C).

(iii) The aqueous solution of (A) on treatment with NaOH and Br_2 – water gives a compound (D).

(iv) A solution of (D) in conc. HNO_3 on treatment with lead peroxide at boiling temperature produced a compound (E) which was of the same colour at that of (C).

(v) A solutionof (A) on treatment with a solution of barium chloride gas

a white precipitate of compound (F) which was insoluble in conc. HNO_3 and conc. HCl.

Which of the following is true for compound (C).

A. It oxidises ammonia to nitrogen dioxide in neutral medium.

B. it's pink colour is due to d-d transition.

C. it can be oxidised by ozone

D. it is obtained by alkaline fusion of pyrolusite followed by electrolytic oxidation.

Answer: D

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6. (i) A powdered substance (A) on treatment with fusion mixture gives a green coloured compound (B). (ii) The solution of (B) in boiling water on acidification with dilute H_2SO_4 gives a pink coloured compound (C). (iii) The aqueous solution of (A) on treatment with NaOH and Br_2 – water gives a compound (D).

(iv) A solution of (D) in conc. HNO_3 on treatment with lead peroxide at boiling temperature produced a compound (E) which was of the same coloure at that of (C).

(v) A solution of (A) on treatment with a solution of barium chloride gave a white precipitate of compound (F) Which was insoluble in conc. HNO_3 and conc. HCl.

The oxidation state of central metal ions of (A), (B) and (C) compounds are respectively :

A. $+II,\ +VI$ and VII

B. $+II,\ +VI$ and $+VI$

C. $+II,\ +VII$ and $+VII$

D. $+VI,\ +VII$ and $+VII$

Answer: A

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7. (i) A powdered substance (A) on treatment with fusion mixture gives a green coloured compound (B). (ii) The solution of (B) in boiling water on acidification with dilute H_2SO_4 gives a pink coloured compound (C).

(iii) The aqueous solution of (A) on treatment with NaOH and Br_2 – water gives a compound (D).

(iv) A solution of (D) in conc. HNO_3 on treatment with lead peroxide at boiling temperature produced a compound (E) which was of the same color at that of (C).

(v) A solution of (A) on treatment with a solution of barium chloride gave a white precipitate of compound (F) Which was insoluble in conc. HNO_3 and conc. HCl.

Consider the following statement :

(I) Anions of both (B) and (C) are diamagnetic and have tetradhedral geometray.

(II) Anions of both (B) and (C) are paramagnetic and have tetrahedral geometry.

(III) Anions of (B) is paramagnetic and that of (C) is diamagnetic but both have same tetrahedral geometry.

(IV) Green coloured compound (B) in a neutral of acidic medium disproportionates to give (C) and (D).

Of these select the correct one from the code given :

A. I and $IIIonly$

B. II and $IIIonly$

C. II and $IVonly$

D. III and $IVonly$

Answer: D

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Exercise 3 Part I

1. Among the following, identify the species with an atom in $+6$ oxidation state.

A. MnO_4^-

B. $Cr(CN)_6^{3-}$

C. iF_6^{2-}

D. CrO_2Cl_2

Answer: D

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2. Write the balanced chemical equation for developing photographic films.

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3. In the standardization of $Na_2S_2O_3$ using $K_2Cr_2O_7$ by iodometry, th equivalent weight of K_2Cr_2O is

A. $(\text{molecular weight})/2$

B. $(\text{molecular weight})/6$

C. $(\text{molecular weight})/3$

D. Same as molecular weight

Answer: B

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4. Anhydrous feric chloride is prepared by:

A. Heating hydrated ferrric chloride at a high temperature in a stream of air

B. heating metallic iron in a stream of dry chlorine.

C. Reaction of ferric oxide with HCl

D. reaction of metallic iron with hydrochloric acid

Answer: B

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5. When MnO_2 fused with KOH, a coloured compound is formed . The product and its colour is:

A. K_2MnO_4, green

B. Mn_2O_3brown

C. Mn_2O_4, black

D. $KMnO_4$, purple

Answer: A

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6. The product of oxidation of I^- with MnO_4^- in alkaline medium is:

A. IO_3^-

B. I_2

C. IO^-

D. IO_4^-

Answer: A

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7. The pair of compounds having metals in their highest oxidation state is:

A. $MnO_2, FeCl_3$

B. $[MnO_4]^-, CrO_2Cl_2$

C. $\left[Fe(CN)_6\right\}^{4-}, \left[Co(CN)_6\right]^{3-}$

D. $[NiCl_4]^{2-}, \left[Ni(CO)_4\right]$

Answer: B

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8. Which of the following pair of compounds is expected to exhibit same colour in aqueous solution?

A. $FeCl_3, CuCl_2$

B. $VOCl_2, CuCl_2$

C. $CoCl_2, FeCl_2$

D. $FeCl_2, MnCl_2$

Answer: B

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9. Give equation and describe the process for the developing of black and white photographic film. When sodium thiosulphate solution is treated with acidic solution turns milky white. Give the half reaction of the above described process.

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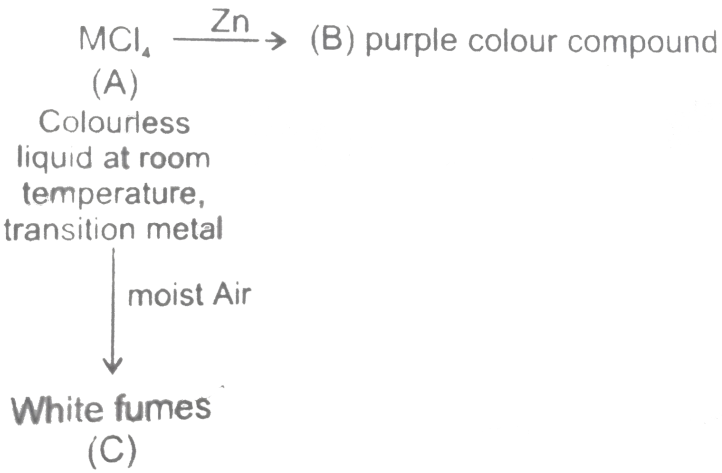

10.

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

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11. Among the following the coloured compound is .

A. $CuCl$

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

C. CuF_2

D. $\left[Cu(CH_3CN)_4\right]BF_4$

Answer: C

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12. Find the oxidation number of Mn in the product of alkaline oxidative fusion of MnO_2.

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

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: ACD

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14. The colour of light absobed by an aqueous solution of $CuSO_4$ is

A. orange-red

B. blue-green

C. yellow

D. violet

Answer: A

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15. Which of the following halides react(s) with $AgNO_{3(aq)}$ to give a precipitate that dissolves in $Na_2S_2O_{3(aq)}$

A. HCl

B. HF

C. HBr

D. Hl

Answer: ACD

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Exercise 3 Part Ii

1. Number of electrons transferred in each case when $KMnO_4$ acts as an oxidising agent to give $MnO_2, Mn^2, Mn(OH)_3$ and MnO_4^{2-} are respectively:

A. $3, 5, 4$ and 1

B. $4, 3, 1$ and 5

C. $1, 3, 4$ and 5

D. $5, 4, 3$ and 1

Answer: 1

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2. Which of the following ion has the maximum magnetic moment?

A. Mn^{2+}

B. Fe^{2+}

C. Ti^{2+}

D. Cr^{2+}

Answer: 1

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3. The most common oxidation states of cerium are

A. $+3,\ +4$

B. $+2, +3$

C. $+2, +4$

D. $+3, +5$

Answer: 1

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4. What happen when a solution of potassium chromate is treated with an excess of dil. Nitic acid?

A. $Cr_2O_7^{2-}$ and H_2O are formed

B. CrO_4^{2-} is reduced to $+3$ state of Cr

C. CrO_4^{2-} is oxidised to 0 state of Cr

D. Cr^{3+} and $Cr_2O_7^{2-}$ are formed

Answer: 1

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5. Which one of the following nitrates will leaves behind a metal on strong heating?

A. Copper nitrate

B. Manganese nitrate

C. Silver nitrate

D. Ferric nitrate

Answer: 3

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6. The atomic number of V, Cr, Mn and Fe are respectively $23, 24, 25$ and 26. Which one of these may be expected to have the highest second ionization enthalpy?

A. Cr

B. Mn

C. Fe

D. V

Answer: 1

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7. Which of the following group of transition metals is called coinage metals?

A. Cu, Ag, Au

B. Ru, Rh, Pb

C. Fe, Co, Ni

D. Os, Ir, Pt

Answer: 1

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8. The number of d-electrons retained in Fe^{2+} (At. No. Fe=26)` ions are:

A. 3

B. 4

C. 5

D. 6

Answer: 4

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9. Ammonia form the complex ion $\left[Cu(NH_3)_4\right]^{2+}$ with copper ions in the alkaline solution but not In acidic solution. What is the statement-2 for it?

A. In acidic solution hydration protect copper ions

B. In acidic solution protons co-ordinate with ammonia molecules forming NH_4^+ ion and NH_3 molecules are not available

C. In alkaline solution insolution $Cu(OH)_2$ is precipitated which is soluble in excess of any alkali

D. Copper hydroxide is an amphoteric substance.

Answer: 2

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10. The radius of $La^{3+}(Z = 57)$ is 106 pm. Which one of the following given values will be closest to the radius of $Lu^{3+}(Z = 71)$?

A. 1.60Å

B. 1.40Å

C. 1.06Å

D. 0.85Å

Answer: 4

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

A. The common oxidation state 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 oxidising agent.

Answer: 3

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12. The lanthanide contraction is responsible for the fact that

A. Zr and Y have about the same radius

B. Zr and Nb have similar oxidation state

C. Zr and Hf have about the same radius

D. Zr and Ce have same oxidation state.

Answer: 3

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13. Which of the following factors may be regarded as the main cause of lanthanide contraction?

A. Greater shielding of $5d$ electrons by $4f$ electrons

B. Poorer shielding of $5d$ electron by $4f$ electrons

C. Effective shielding of one of $4f$ electrons by another in the sub-shell.

D. Poor shielding of one $4f$ electrons by another in the sub -shell.

Answer: 4

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14. The spin-only magnetic moment [in units of Bohr magneton, $(\mu_B$ of Ni^{2+} in aqueous solution would be (atomic number of $Ni = 28)$

A. 2.84

B. 4.90

C. 0

D. 1.73

Answer: 1

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15. Lanthanoid contraction is caused due to:

A. The appreciable on outer electrons by $4f$ electrons from the nulcear charge

B. The appreciable on outer electrons by $5f$ electrons from the nulcear charge

C. the same effective nuclear charge from Ce to Lu

D. The imperfect shielding on outer electrons by $4f$ electrons from the nulcear charge.

Answer: 4

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16. Identify the incorrect statement among the following.

A. The chemistry of varius lanthanoids is very similar.

B. $4f$ and $5f$ orbitals are equally shielded

C. d-block element show irregular and erratic chemical properties among themselves.

D. La and Lu have partially filled d orbitals and no other partially filled orbitals.

Answer: 2

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

A. The actinoids are more reactive than the lanthanoids

B. The $5f$ orbitals exhibit farther from the lanthanoids.

C. The $5f$ orbital are more buried than $4f$ orbitals

D. There is a similarity between $4f$ and $5f$ orbitals in their angular part of the wave function

Answer: 2

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

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

B. More energy difference between $5f$ and $6d$ than between $4f$ and $5d$ orbitals.

C. more reactive nature of the actionoids than the lanthanoids

D. 4 orbitals more diffused than the $5f$ orbitals

Answer: 1

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19. In context with the transition element, which of the following statement is incorrect?

A. In the highest oxidation states, the transition metal show basic character and form cationic complexes.

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

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

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

Answer: 1

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20. 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 of the bonding in its compounds is predominently ionic in chracter.

Answer: 2

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21. 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. $Mn > Cr > Fe > Co$

B. $Cr > Fe > Mn > Co$

C. $Fe > Mn > Cr > Co$

D. $Cr > Mn > Fe > Co$

Answer: 1

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22. In context of the lanthanoids , which of the following statement is not correct?

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

B. All the member exhibit $+3$ oxidation state

C. Availability of $4f$ electrons result in the formation of compounds in $+4$ state for all member of the series

D.

Answer: 4

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23. The outer electrons configuration of Lu (Atomic No.,71)` is :

A. $4F^3 5d^5 6s^2$

B. $4f^8 5d^0 6s^2$

C. $4f^4 5d^4 s^2$

D. $4f^{14} 5d^1 6s^2$

Answer: 4

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24. Iron exhibits $+2$ and $+3$ oxidation states. Which of the following statements about iron is incorrect?

A. Ferrous oxide is more basic in nature than the ferric oxide.

B. Ferrous compounds are relatively more ionic than the corresponding ferric compounds

C. Ferous compounds are less volatile than the corresponding ferric compounds

D. Ferrous compounds are more easily hydrolysed than the corresponding feric compounds.

Answer: 4

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

A. $Vn^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$, Paramagnetic behaviour

B. $Ni^{2+} < CO^{2+} < Fe^{2+} Mn^{2+}$: ionic size

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

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

Answer: 1

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26. Four successive members of first row transition element are listed belw. Which one of them is expected to have highest $E_{\frac{M^{3+}}{\left(M^{2+}\right)^{\ominus}}}$ value?

A. $Cr(Z=24)$

B. $Mn(Z=25)$

C. $Fe(Z=26)$

D. $Co(Z=27)$

Answer: 4

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Exercise 3 Part Iii

1. (a) of the ions A^+, 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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2. Name one ore each of manganese and chromium.

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

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

Or Zirconium (atomic number40) and hafnium number 72) occur together in minerals and they exhibit similar properties. Give reasons.

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5. Why among the lanthanides Ce,(III), can be easily oxidised to $Ce(IV)$ (At. No. of Ce=58). Explain why?

Or of the lanthanides , cerium (At.Nos.58) forms a tetrapositive ion Ce^{4+} in aqueous solution. Why?

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6. Wxplain 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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7. What is the effect of increasing pH on $K_2Cr_2O_7$ solution?

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

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9. Why do transition elements show variable oxidation state?

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10. 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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11. 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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12. The outer electronic configuration of two members of the lanthanoid series are as follows:

$4f^{1}5d^{1}6s^{2}$ and $4f^{7}5d^{0}6s^{2}$

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

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

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

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

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18. (a) Describe the general trends in the following properties of the first series of the transition elements:

(i) Stability of $+2$ oxidation state " "(ii) Formation of oxometal ions

(b) Assign reason for each of the following:

(i) Transition elements exhibit variable oxidation states.

Transition metal ions are usually coloured

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19. 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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20. 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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21. How would you account for the fact that actinoids exhibit a larger number of oxidation state than the corresponding lanthanoids?

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22. (a) Complete the following chemical reaction equation :

$(i) MnO^{-}_{4(aq)} + C_2O^{2-}_{4(aq)} + H^{+}_{aq} \rightarrow$

(ii) $Cr_2O^{2-}_{7(aq)} + Fe_{(aq)} + H^{+}_{(aq)} \rightarrow$

(b) Explain the following observation about the transition /inner transition elements:

(i) There is in general an increase in density of element from titanium $(Z = 22)$ to copper $(Z = 29)$

(ii) there occurs much more frequent metal bonding in compounds of heavy transition elements $\left(3^{rd}\right.$ series)

(iii) The members of the actinoid series exhibit a larger number of oxidation states than the corresponding members of the lanthanoid series

(a) Complete the following chemical equation for reaction:

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

(ii) $Cr_2O_7^{2-} + 3H_2S + 8H^+ \rightarrow$

(b) Give an explanation for each of the following observations:

(i) The gradual decrease in size (actinoid contractions) from element to element is greater among the actinoids than 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 $\left(d^4 Cr^{2+}\right)$ ion is a reducing agent but Mn^{3+} ion is an oxidising agent.

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23. Explain the following observation:

(i) Generally there is an increase in density of elements from titanium

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

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

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24. 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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25. Explain the following cases giving appropriate reason:

(i) Nickel does not from low spin octahedral complexes:

(ii) The πe-Complexes are known for the transition metals only.

(iii) CO^{2+} is easily oxidised to Co^{3+} in the presence of a strong ligand.

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26. (a) Complete the following chemical equation:

(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 oxoanion are in the order $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.

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

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

Or

(a) Complete the following chemical equation:

(i) $MnO_4^-(aq) + s_2O_3^{2-}(aq) + H_2O(I) \rightarrow$

(ii) $Cr_2O_7^{2-}(aq) + Fe^{2+}(aq) + H^+(aq) \rightarrow$

(b) Explain the following observation:

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

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

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

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27. 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) Because oxygen and fluorine are highly electronegative elements and small in size.

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28. Explain the following observation:

(i) Transiton elements generally from colourd compounds.

(ii) Zinc is not regarded as a transition element.

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29. What is meant by the 'lanthanide contraction'? Mention one important fact that can be considered as a consequence of the lanthanide contraction.

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30. How would you account for the following:

(i) Cr^{2+} is reducing in nature while with the same d-orbital configuration $(d^4)Mn^{3+}$ is an oxidising agent

(ii) In a transition series of metals, the metal which exhibits the greatest number of oxidation state occurs in the middle of the series.

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31. Complete the following chemical equation:

(i) $MnO_4^-(aq) + s_2O_3^{2-}(aq) + H_2O(I)$to (ii) $MnO_4^- + NO_2^- + H^+$to

State reason for the following :

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

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

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32. Assign reasons for the following :

(i) Copper (I) ion is not known in aqueous solution.

(ii) Actinoids exhibit greater range of oxidation states than lanthanoids.

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33. Complete the following chemical equation:

(i) $MnO_4^-(aq) + s_2O_3^{2-}(aq) + H_2O(I)$to (ii) $MnO_4^- + NO_2^- + H^+$to

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34. How would you account for the following :

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

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

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

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35. How would you account for the following ?

(i) Many of the transition elements are known to form interstitial compounds.

(ii) The metallic radii of the third $(5d)$ series of transition metals are

virtually the same as those of the corresponding group members of the second $(4d)$ series

(iii) Lanthanoids from primarily +3 ions, while the actinoids +1 usually have higher oxidation state in their compounds ,`+4 or even +6being typical.

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36. (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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37. How would you account for the following?

(i) Transition metals exhibits variable oxidation state.

(ii) $Zr(Z = 40)$ and $Hf(Z = 72)$ have almost identical radii.

(iii) Transition metals and their compounds act as catalyst.

OR

Complete the following chemical equation:

(i)$Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow$

(ii) $CrO_4^{2-} + 2H^+ \rightarrow$

(iii) $2MnO_4^{2-} + 5C_2O_4^{2-} + 16H^+ \rightarrow$

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