Redox Reactions JEE Main PYQ - 1

Total Time: 1 Hour **Total Marks:** 100

Instructions

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1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Redox Reactions

1. Oxidation state of central metal of Z and Q are: (+4, -1)

$$Na_2B_4O_7.10H_2O \xrightarrow[-10\,H_2O]{\Delta} 2X + Y$$

$$CuSO_4 + X \xrightarrow[\text{Non-Luminous Flame}]{\Delta} Z$$

$$Z \xrightarrow[\text{Luminous Flame}]{\Delta} Q$$

a. $+2$ and $+1$

b. $+1$ and $+2$

c. $+2$ and $+2$

d. $+1$ and $+1$

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2. 500 ml, 1.2M KI is completely react with 0.2M, 500 ml $\mathrm{KMnO_4}$ solution in basic medium. $\mathrm{I^-}$ is oxidised to $\mathrm{I_2}$. The liberated $\mathrm{I_2}$ react with 0.1 M $\mathrm{Na_2S_2O_3}$ solution. Then find volume (in L) of $\mathrm{Na_2S_2O_3}$ solution required to completely react with liberated $\mathrm{I_2}$. (+4, -1)

a. 1 L

b. 2 L

c. 3 L

d. 4 L

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3. For the reaction: (+4, -1)

$$Cl_2 + KOH \rightarrow KCl + KClO + H_2O$$

1 mole of Cl_2 is passed into 2 litre, 2 M KOH solution. Determine the molarity of Cl^-, ClO^- and OH^- respectively.

a. 1 M, 0.5 M, 0.5 M

b. 0.5 M, 0.5 M, 1 M

c. 1 M, 1 M, 0.5 M

d. 0.5 M, 1 M, 0.5 M

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4. Consider the reaction: **(+4, -1)**
Mg + 2HCl $\rightarrow$ $MgCl_2$ + H_2
If 12 g of Mg reacts with excess HCl, choose the incorrect statement.

a. Moles of Mg used = 0.5 mol

b. Moles of H_2 produced = 0.5 mol

c. Volume of H_2 at STP = 11.2 L

d. Mass of $MgCl_2$ formed = 47.5 g

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5. $x & y$ are the number of moles of electrons involved respectively during oxidation of I^- to I_2 & S^{2-} to S by acidified $K_2Cr_2O_7$. The value of $x+y$ is ? **(+4, -1)**

a. 12

b. 6

c. 18

d. 9

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6. The oxidation state of 'Cr' in the final product formed by reaction between KI and acidified $K_2Cr_2O_7$ is : **(+4, -1)**

a. $+2$

b. $+6$

c. $+4$

d. $+3$

7. **If** $K_2Cr_2O_7$ **(**$200\ \text{cm}^3$**,** $x \times 10^{-3}\ \text{M}$**) reacts with** $0.6\ \text{M}$**,** $750\ \text{cm}^3$ **Mohr's salt then find value of x?** **(+4, -1)**

a. 375

b. 750

c. 150

d. 500

8. **In the following reaction:** **(+4, -1)**

$$\text{MnO}_4^- \xrightarrow{\text{H}^+} \text{MnO}_2 + \text{MnO}_4^{2-}$$

Mangante ion undergoes disproportionation in acidic medium to form:

a. $\text{MnO}_2, \text{MnO}_4^{2-}$

b. $\text{MnO}_4, \text{MnO}_2$

c. $\text{MnO}_2, \text{Mn}_2\text{O}_3$

d. MnO_4, MnO

9. $\text{K}_2\text{Cr}_2\text{O}_7$ is heated with KCl in pressure of H_2SO_4. Find the correct match of product with their oxidation state. **(+4, -1)**

a. CrO_2Cl_2, +6

b. $\text{Cr}_2\text{O}_2\text{Cl}_2$, +6

c. $\text{Cr}_2\text{O}_2\text{Cl}_2$, +5

d. CrO_2Cl_2, +5

10. When 8.74 g MnO_2 is treated with HCl, then what will be the weight of $\text{Cl}_2(g)$ obtained? Molar mass of $\text{MnO}_2 = 87.4\,\text{g/mol}$. **(+4, -1)**

a. 7.1 g

b. 17.1 g

c. 14.2 g

d. 3.55 g

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11. Match the following and choose the correct option. **(+4, -1)**

List-I:
(a) $[Ag(NH_3)_2]^+$ (b) Zn-Hg/HCl (c) NH_2-NH/KOH (d) Cu^{2+}/OH^-

List-II:
(i) Fehling solution (ii) Clemmensen reduction (iii) Tollen's reagent (iv) Wolff-Kishner reduction

r reduction

a. a → (i), b → (ii), c → (iii), d → (iv)

b. a → (iv), b → (iii), c → (ii), d → (i)

c. a → (iii), b → (ii), c → (iv), d → (i)

d. a → (i), b → (ii), c → (iv), d → (iii)

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12. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing Fe^{2+} ions is $x \times 10^{-2}$ M. The value of x is ________. (Nearest integer) **(+4, -1)**

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13. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is ________ $\times 10^{-2}$ g/L. (Round off to the Nearest Integer). **(+4, -1)**

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14. The oxidation states of nitrogen in NO, NO_2, N_2O and NO_3^- are in the order of : **(+4, -1)**

a. $NO > NO_2 > N_2O > NO_3^-$

b. $N_2O > NO_2 > NO > NO_3$

c. $NO_2 > NO_3 > NO > N_2O$

d. $NO_3 > NO_2 > NO > N_2O$

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15. (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$ | (+4, -1)
(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$.
Choose the correct option.

a. H_2O_2 acts as oxidising agent in (A) and (B).

b. H_2O_2 acts as reducing agent in (A) and (B).

c. H_2O_2 acts as oxidizing and reducing agent respectively.

d. H_2O_2 acts as reducing and oxidising agent respectively.

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16. In basic medium CrO_4^{2-} oxidises $S_2O_3^{2-}$ to form SO_4^{2-} and itself changes into $Cr(OH)_4^-$. The volume of 0.154 M CrO_4^{2-} required to react with 40 mL of 0.25 M $S_2O_3^{2-}$ is __________ mL. (+4, -1)

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17. In which one of the following sets all species show disproportionation reaction ? (+4, -1)

a. ClO_2^-, F_2, MnO_4^- and $Cr_2O_7^{2-}$

b. $Cr_2O_7^{2-}, MnO_4^-, ClO_2^-$ and Cl_2

c. $ClO_4^-, MnO_4^-, ClO_2^-$ and F_2

d. $MnO_4^{2-}, ClO_2^-, Cl_2$ and Mn^{3+}

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18. When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is __________ $\times 10^{-2}$. (Nearest integer) (+4, -1)
[Atomic mass of $K = 39, Mn = 55, O = 16$]

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19. $\mathrm{KMnO_4}$ acts as an oxidising agent in acidic medium. ' X ' is the difference between the oxidation states of Mn in reactant and product. ' Y ' is the number of ' d ' electrons present in the brown red precipitate formed at the end of the acetate ion test with neutral ferric chloride. The value of $\mathrm{X+Y}$ is _______ . (+4, -1)

20. See the following chemical reaction: (+4, -1)

$\mathrm{Cr_2O_7^{2-} + XH^+ + 6Fe^{2+} \rightarrow YCr^{3+} + 6Fe^{3+} + ZH_2O}$.

The sum of X, Y, and Z is _____.

21. The standard reduction potential values of some of the p-block ions are given below. Predict the one with the strongest oxidizing capacity. (+4, -1)

a. $E^\circ_{\mathrm{I^-/I_2}} = +1.26\,\mathrm{V}$

b. $E^\circ_{\mathrm{Al^{3+}/Al}} = -1.66\,\mathrm{V}$

c. $E^\circ_{\mathrm{Pb^{4+}/Pb^{2+}}} = +1.67\,\mathrm{V}$

d. $E^\circ_{\mathrm{Sn^{4+}/Sn^{2+}}} = +1.15\,\mathrm{V}$

22. The heat of formation of $\mathrm{SO_2}(g)$ is given by: (+4, -1)

$$S(g) + \frac{3}{2}O_2(g) \rightarrow SO_3(g) + 2x\,\mathrm{kcal}$$

$$SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g) + y\,\mathrm{kcal}$$

a. $\frac{2x}{y}\,\mathrm{kcal}$

b. $x + y\,\mathrm{kcal}$

c. $y - 2x\,\mathrm{kcal}$

d. $2x + y\,\mathrm{kcal}$

23. **Given below are two statements:** **(+4, -1)**

Statement (I): The first ionization energy of Pb is greater than that of Sn.
Statement (II): The first ionization energy of Ge is greater than that of Si.

In light of the above statements, choose the correct answer from the options given below:

a. Statement I is true but Statement II is false

b. Both Statement I and Statement II are false

c. Statement I is false but Statement II is true

d. Both Statement I and Statement II are true

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24. **Match the LIST-I with LIST-II (Redox Reactions).** **(+4, -1)**

	LIST-I (Redox Reaction)		LIST-II (Type of Redox Reaction)
A.	$CH_{4(g)} + 2O_{2(g)} \xrightarrow{\Delta} CO_{2(g)} + 2H_2O_{(l)}$	I.	Disproportionation reaction
B.	$2NaH_{(s)} \xrightarrow{\Delta} 2Na_{(s)} + H_{2(g)}$	II.	Combination reaction
C.	$V_2O_{5(s)} + 5Ca_{(s)} \xrightarrow{\Delta} 2V_{(s)} + 5CaO_{(s)}$	III.	Decomposition reaction
D.	$2H_2O_{2(aq)} \xrightarrow{\Delta} 2H_2O_{(l)} + O_{2(g)}$	IV.	Displacement reaction

Choose the correct answer from the options given below:

a. A-IV, B-I, C-II, D-III

b. A-II, B-III, C-I, D-IV

c. A-II, B-III, C-IV, D-I

d. A-III, B-IV, C-I, D-II

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25. Which of the following oxidation reactions are carried out by both $K_2Cr_2O_7$ and $KMnO_4$ in acidic medium? **(+4, -1)**

A. $I^- \rightarrow I_2$

B. $S^{2-} \rightarrow S$

C. $Fe^{2+} \rightarrow Fe^{3+}$

D. $I^- \rightarrow IO_3^-$

E. $S_2O_3^{2-} \rightarrow SO_4^{2-}$

Choose the correct answer from the options given below:

a. A, B and C Only

b. A, D and E Only

c. B, C and D Only

d. C, D and E Only

Answers

1. Answer: a

Explanation:

Concept:
Borax bead test is used to identify metal ions based on color changes and oxidation states in different flames.

Heating borax produces boric oxide and sodium metaborate.
Transition metal salts form colored metaborates.
Oxidation state of metal depends on flame conditions.

Step 1: Decomposition of Borax

$$Na_2B_4O_7 \cdot 10H_2O \xrightarrow{\Delta} 2\,NaBO_2 + B_2O_3$$

Thus:

$$X = NaBO_2, \quad Y = B_2O_3$$

Step 2: Reaction with Copper Sulphate

$$CuSO_4 + NaBO_2 \xrightarrow{\text{non-luminous flame}} Cu(BO_2)_2\ (Z)$$

In Z, copper exists as Cu^{2+}.
Step 3: Heating in Luminous Flame

$$Z \xrightarrow{\text{luminous flame}} Cu_2O\ (Q)$$

In $Q = Cu_2O$, copper is in $+1$ oxidation state.
Final Conclusion:

$$\boxed{\text{Oxidation state in } Z = +2, \quad \text{Oxidation state in } Q = +1}$$

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2. Answer: c

Explanation:

Step 1: Reaction of $KMnO_4$ with KI.

In basic medium, $KMnO_4$ is generally reduced to MnO_2. Change in oxidation state of Mn: $+7 \to +4$.

n-factor for $KMnO_4 = 3$.

Moles of $KMnO_4 = M \times V = 0.2 \times 0.5 = 0.1$ mol.

Equivalents of $KMnO_4 = 0.1 \times 3 = 0.3$ Eq.

The problem states KI "completely reacts", implying KI is in excess or sufficient.

However, usually the oxidant determines the yield of I_2.

According to the principle of equivalence: Equivalents of Oxidant = Equivalents of Reductant (I^-) oxidized = Equivalents of I_2 formed.

So, Equivalents of I_2 liberated = 0.3 Eq.

Step 2: Titration of I_2 with $Na_2S_2O_3$.

Reaction: $I_2 + 2S_2O_3^{2-} \to 2I^- + S_4O_6^{2-}$.

n-factor for Hypo $(S_2O_3^{2-})$ is 1 (avg oxidation state change $+2 \to +2.5$, change per molecule is 1 electron).

Equivalents of $Na_2S_2O_3$ required = Equivalents of I_2.

$M_{hypo} \times V_{hypo} \times n_{hypo} = 0.3$.

$0.1 \times V \times 1 = 0.3$.

$V = 3$ L.

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3. **Answer: b**

Explanation:

Step 1: Balanced reaction in cold KOH.

$$Cl_2 + 2KOH \to KCl + KClO + H_2O$$

Step 2: Initial moles of reactants.

Moles of Cl_2 = 1

Moles of KOH = $2 \times 2 = 4$

Step 3: Stoichiometric consumption.

1 mole Cl_2 consumes 2 moles KOH

Remaining KOH = $4 - 2 = 2$ moles

Step 4: Calculation of molarity.

Moles of Cl^- formed = 1
Moles of ClO^- formed = 1
Volume = 2 L

$$[\mathrm{Cl^-}] = \frac{1}{2} = 0.5\ \mathrm{M}$$

$$[\mathrm{ClO^-}] = \frac{1}{2} = 0.5\ \mathrm{M}$$

$$[\mathrm{OH^-}] = \frac{2}{2} = 1\ \mathrm{M}$$

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4. Answer: d

Explanation:

Step 1: Understanding the Question:
We are given a chemical reaction and the mass of one reactant (Magnesium). We need to analyze four statements related to the stoichiometry of this reaction and identify the one that is incorrect. For such problems, it's important to decide whether to use approximate or more precise atomic masses. Using precise values is generally safer.
Approximate Molar Masses: Mg = 24 g/mol, H = 1 g/mol, Cl = 35.5 g/mol.
More Precise Molar Masses: Mg = 24.3 g/mol, Cl = 35.45 g/mol.
Step 2: Key Formula or Approach:
1. Calculate the moles of the reactant (Mg) using Moles = Mass / Molar Mass.
2. Use the stoichiometric coefficients from the balanced equation to find the moles of products (H_2 and $MgCl_2$).
3. Calculate the volume of H_2 gas at STP (1 mole = 22.4 L).
4. Calculate the mass of $MgCl_2$ produced (Mass = Moles $\times$ Molar Mass).
5. Compare the calculated values with each statement.
Step 3: Detailed Explanation using approximate masses (often intended for such questions):
Let's use M(Mg) = 24 g/mol and M(Cl) = 35.5 g/mol.
- **Statement (A): Moles of Mg used = 0.5 mol**
Moles of Mg = $\frac{12\ \mathrm{g}}{24\ \mathrm{g/mol}} = 0.5$ mol. This statement is correct.
- **Statement (B): Moles of H$_{2$ produced = 0.5 mol}**
From the reaction, 1 mole of Mg produces 1 mole of H_2. So, 0.5 mol of Mg produces 0.5

mol of H_2. This statement is correct.
- **Statement (C): Volume of H$_{2$** at STP = 11.2 L}
Volume of H_2 = Moles × Molar Volume at STP = $0.5 \text{ mol} \times 22.4 \text{ L/mol} = 11.2$ L. This statement is correct.
- **Statement (D): Mass of MgCl$_{2$** formed = 47.5 g}
Molar mass of $MgCl_2$ = M(Mg) + 2 × M(Cl) = $24 + 2 \times 35.5 = 24 + 71 = 95$ g/mol.
From the reaction, 1 mole of Mg produces 1 mole of $MgCl_2$. So, 0.5 mol of Mg produces 0.5 mol of $MgCl_2$.
Mass of $MgCl_2$ = Moles × Molar Mass = $0.5 \text{ mol} \times 95 \text{ g/mol} = 47.5$ g. This statement is also correct.
Analysis of Discrepancy:
With standard approximate molar masses, all statements appear correct. This usually implies that the question requires using more precise molar masses, and the "incorrect" statement is the one that deviates most from the precise calculation.
Step 3 (Re-evaluation with precise masses):
M(Mg) = 24.305 g/mol. M(Cl) = 35.453 g/mol.
- Moles of Mg = $\frac{12}{24.305} = 0.4937$ mol. Statement (A) has a slight error.
- Moles of H_2 produced = 0.4937 mol. Statement (B) has a slight error.
- Volume of H_2 at STP = $0.4937 \times 22.414 = 11.066$ L. Statement (C) has a slight error.
- Molar mass of $MgCl_2 = 24.305 + 2(35.453) = 95.211$ g/mol.
- Mass of $MgCl_2$ formed = $0.4937 \times 95.211 = 47.00$ g.
The value given in statement (D) is 47.5 g. The difference is $47.5 - 47.0 = 0.5$ g. This represents a significant deviation compared to the precision of the input data. Thus, statement (D) is the most incorrect.
Step 4: Final Answer:
Statement (D) is the incorrect statement when calculated with precise atomic masses.

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5. Answer: a

Explanation:

The reduction of $1 \text{ mole of } Cr_2O_7^{2-}$ requires $6 \text{ moles of electrons.}$
x: Moles of electrons involved during oxidation of $I^- \rightarrow I_2$.
$3 \times (2I^- \rightarrow I_2 + 2e^-) \implies 6e^-. \; x = 6.$
y: Moles of electrons involved during oxidation of $S^{2-} \rightarrow S$.

$3 \times (S^{2-} \rightarrow S + 2e^-) \implies 6e^-$. $y = 6$.
Sum of $x + y = 6 + 6 = 12$.

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6. Answer: d

Explanation:

Step 1: Acidified potassium dichromate $(K_2Cr_2O_7)$ acts as a strong oxidizing agent.
Step 2: In acidic medium, iodide ions (I^-) are oxidized to iodine (I_2), while dichromate ions are reduced.
Step 3: Oxidation states:

$$Cr \text{ in } Cr_2O_7^{2-} = +6$$

Step 4: During the reaction, chromium gets reduced to Cr^{3+}.
Step 5: Balanced ionic equation:

$$Cr_2O_7^{2-} + 6I^- + 14H^+ \rightarrow 2Cr^{3+} + 3I_2 + 7H_2O$$

Step 6: Hence, chromium in the final product exists as Cr^{3+}.
Therefore, oxidation state of chromium is $+3$.

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7. Answer: a

Explanation:

The reaction is between $K_2Cr_2O_7$ (oxidant) and Mohr's salt $(Fe^{2+}$, reductant) in acidic medium.
For $K_2Cr_2O_7$: $Cr(+6) \rightarrow Cr(+3)$, n-factor (n_1) is $2 \times 3 = 6$.
For Mohr's salt (Fe^{2+}): $Fe^{2+} \rightarrow Fe^{3+}$, n-factor (n_2) is 1.
At equivalence point: Milli-equivalents of $K_2Cr_2O_7$ = Milli-equivalents of Fe^{2+}.
$M_1V_1n_1 = M_2V_2n_2$.
$(x \times 10^{-3}) \times (200) \times 6 = (0.6) \times (750) \times 1$.
$x \times 10^{-3} \times 1200 = 450$.
$x \times 1.2 = 450$.
$x = \frac{450}{1.2} = 375$.

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8. **Answer: a**

Explanation:

Step 1: Understanding the reaction.
The manganate ion MnO_4^- undergoes a disproportionation reaction in acidic medium, meaning it breaks into two different species: MnO_2 and MnO_4^{2-}.
Step 2: Conclusion.
The correct answer is **(1)** MnO_2, MnO_4^{2-} as per the given reaction sequence.

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9. **Answer: a**

Explanation:

Step 1: Understand the reaction.
When potassium dichromate $(K_2Cr_2O_7)$ is heated with potassium chloride (KCl) in the presence of sulfuric acid (H_2SO_4), the reaction forms CrO_2Cl_2 (chromyl chloride). The chromium in CrO_2Cl_2 is in the +6 oxidation state. The reaction can be summarized as:

$$K_2Cr_2O_7 + 6\,KCl + 3\,H_2SO_4 \rightarrow 2\,CrO_2Cl_2 + 3\,K_2SO_4 + 3\,H_2O$$

Step 2: Identify the oxidation states.
In the product CrO_2Cl_2, the oxidation state of chromium is +6, which matches the given option. Thus, the correct answer is CrO_2Cl_2, with chromium in the +6 oxidation state.

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10. **Answer: a**

Explanation:

Step 1: Write the chemical reaction.
The reaction between manganese dioxide (MnO_2) and hydrochloric acid (HCl) produces chlorine gas (Cl_2) according to the following balanced equation:

$$MnO_2 + 4\,HCl \rightarrow MnCl_2 + 2\,H_2O + Cl_2$$

Step 2: Use stoichiometry.
From the balanced equation, 1 mole of $\mathrm{MnO_2}$ produces 1 mole of $\mathrm{Cl_2}$.
Step 3: Calculate the moles of $\mathrm{MnO_2}$.
The molar mass of $\mathrm{MnO_2}$ is 87.4 g/mol. So, the moles of $\mathrm{MnO_2}$ in 8.74 g is:

$$\text{moles of } \mathrm{MnO_2} = \frac{8.74\,\mathrm{g}}{87.4\,\mathrm{g/mol}} = 0.1\,\mathrm{mol}$$

Step 4: Calculate the moles of $\mathrm{Cl_2}$.
Since 1 mole of $\mathrm{MnO_2}$ produces 1 mole of $\mathrm{Cl_2}$, the moles of $\mathrm{Cl_2}$ produced is also 0.1 mol.
Step 5: Calculate the mass of $\mathrm{Cl_2}$.
The molar mass of chlorine gas ($\mathrm{Cl_2}$) is 70.9 g/mol. Therefore, the mass of $\mathrm{Cl_2}$ produced is:

$$\text{mass of } \mathrm{Cl_2} = 0.1\,\mathrm{mol} \times 70.9\,\mathrm{g/mol} = 7.1\,\mathrm{g}$$

Thus, the weight of $\mathrm{Cl_2}$ obtained is 7.1 g.

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11. **Answer: c**

Explanation:

Step 1: Analyzing the reactions.
- (a) $[Ag(NH_3)_2]^+$ is the Tollen's reagent, which is used for the detection of aldehydes.
- (b) Zn-Hg/HCl is used in the Clemmensen reduction, a reduction method for carbonyl compounds.
- (c) NH_2-NH/KOH is used in the Wolff-Kishner reduction, which reduces aldehydes and ketones to hydrocarbons.
- (d) Cu^{2+}/OH^- forms Fehling solution, used to test for reducing sugars.

Step 2: Conclusion.
Matching the items correctly gives the answer: (3) a → (iii), b → (ii), c → (iv), d → (i).

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12. **Answer: 18 - 18**

Explanation:

Step 1: Understanding the Concept:
Titration between Fe^{2+} and $K_2Cr_2O_7$ is a redox titration where Fe^{2+} is oxidized to Fe^{3+} and $Cr_2O_7^{2-}$ is reduced to Cr^{3+} in acidic medium.
At the equivalence point, the number of equivalents of the reducing agent (Fe^{2+}) is equal to the number of equivalents of the oxidizing agent $(K_2Cr_2O_7)$.
Step 2: Key Formula or Approach:
Equivalents of Reducing Agent = Equivalents of Oxidizing Agent

$$(M_1 \times n_1) \times V_1 = (M_2 \times n_2) \times V_2$$

Where n is the n-factor (change in oxidation state per molecule).
Step 3: Detailed Explanation:
1. **Determine n-factors:**
For $Fe^{2+} \rightarrow Fe^{3+} + e^-$, n-factor (n_1) = 1.
For $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$, the oxidation state of Cr changes from $+6$ to $+3$.
Since there are 2 Cr atoms in $K_2Cr_2O_7$, n-factor (n_2) = $2 \times (6-3) = 6$.

2. **Calculate Molarity of Fe^{2+}:**
Given: $V_1 = 10 \text{ mL}$, $V_2 = 15 \text{ mL}$, $M_2 = 0.02 \text{ M}$.

$$M_1 \times 1 \times 10 = 0.02 \times 6 \times 15$$

$$10 \times M_1 = 1.8$$

$$M_1 = 0.18 \text{ M}$$

3. **Convert to requested format:**
The molarity is $x \times 10^{-2}$ M.

$$0.18 = 18 \times 10^{-2} \text{ M}$$

So, $x = 18$.

Step 4: Final Answer:

The value of x is 18.

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13. Answer: 1575 - 1575

Explanation:

Step 1: Write the balanced redox reaction.

In acidic medium, permanganate ion (MnO_4^-) is reduced and oxalate ion ($C_2O_4^{2-}$) is oxidized.

Reduction half-reaction: MnO_4^- + $8H^+$ + $5e^-$ $\rightarrow$ Mn^{2+} + $4H_2O$ (n-factor for $KMnO_4$ is 5)

Oxidation half-reaction: $C_2O_4^{2-}$ $\rightarrow$ $2CO_2$ + $2e^-$ (n-factor for oxalic acid is 2)

The balanced overall reaction is: $2MnO_4^-$ + $5C_2O_4^{2-}$ + $16H^+$ $\rightarrow$ $2Mn^{2+}$ + $10CO_2$ + $8H_2O$.

The stoichiometric ratio is 2 moles of $KMnO_4$ to 5 moles of oxalic acid.

Step 2: Use the titration equivalence formula.

At the equivalence point, $M_1V_1n_1$ ($KMnO_4$) = $M_2V_2n_2$ (Oxalic Acid).

Let M_{ox} be the molarity of the oxalic acid solution.

(0.05 M)(10.0 mL)(5) = (M_{ox})(10.0 mL)(2).

$0.05 \times 5 = M_{ox} \times 2$.

$0.25 = 2 \times M_{ox}$.

$M_{ox} = \frac{0.25}{2} = 0.125$ M.

Step 3: Calculate the strength in g/L.

Strength (g/L) = Molarity (mol/L) $\times$ Molar Mass (g/mol).

The solute is oxalic acid dihydrate, $H_2C_2O_4 \cdot 2H_2O$.

Molar Mass = (2$\times$1.01) + (2$\times$12.01) + (4$\times$16.00) + 2$\times$(18.02) = 2.02 + 24.02 + 64.00 + 36.04 = 126.08 g/mol. We can approximate it as 126 g/mol.

Strength = 0.125 mol/L $\times$ 126 g/mol = 15.75 g/L.

Step 4: Express the answer in the required format.

The question asks for the strength in units of $\times 10^{-2}$ g/L.

Strength = 15.75 g/L = 1575 $\times 10^{-2}$ g/L.

The integer value is 1575.

---

14. Answer: d

Explanation:

Step 1: Calculate the oxidation state (x) for Nitrogen in each:
$NO_3^-: x + 3(-2) = -1 \implies x = +5$
$NO_2: x + 2(-2) = 0 \implies x = +4$
$NO: x + (-2) = 0 \implies x = +2$
$N_2O: 2x + (-2) = 0 \implies x = +1$

Step 2: Arrange in descending order: $+5 > +4 > +2 > +1$. The order is $NO_3^- > NO_2 > NO > N_2O$.

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15. **Answer: b**

Explanation:

Step 1: In (A), Chlorine in HOCl (+1) is reduced to Cl^- (-1). Thus H_2O_2 is the reducing agent.
Step 2: In (B), Iodine (I_2) in oxidation state 0 is reduced to I^- (-1). Thus H_2O_2 is the reducing agent.
Step 3: In both cases, H_2O_2 is oxidized to O_2 (0).

---

16. **Answer: 173 - 173**

Explanation:

Step 1: n-factor for $CrO_4^{2-} \to Cr(OH)_4^-$: $Cr(+6) \to Cr(+3)$, change = 3.
Step 2: n-factor for $S_2O_3^{2-} \to 2SO_4^{2-}$: Average $S(+2) \to S(+6)$, change $= 2 \times (6-2) = 8$.
Step 3: Equivalents of Oxidant = Equivalents of Reductant.
Step 4: $(M_1 \times n_1 \times V_1) = (M_2 \times n_2 \times V_2)$.
Step 5: $0.154 \times 3 \times V_1 = 0.25 \times 8 \times 40$.
Step 6: $0.462V_1 = 80 \Rightarrow V_1 = 80/0.462 \approx 173.16$ mL.

---

17. **Answer: d**

Explanation:

Step 1: Understanding the Concept:
A disproportionation reaction is a redox reaction in which the same element undergoes both oxidation and reduction simultaneously. This is only possible if the element is in an intermediate oxidation state and can move to both a higher and a lower oxidation state.
Step 2: Detailed Explanation:
- Species in their highest oxidation state (like $\mathrm{Mn^{+7}}$ in $\mathrm{MnO_4^-}$, $\mathrm{Cr^{+6}}$ in $\mathrm{Cr_2O_7^{2-}}$, $\mathrm{Cl^{+7}}$ in $\mathrm{ClO_4^-}$) cannot be further oxidized, so they cannot disproportionate.
- $\mathrm{F_2}$ is the most electronegative element and can only have an oxidation state of 0 or -1. It cannot be oxidized, so it doesn't disproportionate.
- **Let's check Option (D):**
1. **$\mathrm{MnO_4^{2-}}$:** Mn is in $+6$. It can disproportionate to $\mathrm{MnO_4^-}$ $(+7)$ and $\mathrm{MnO_2}$ $(+4)$ in acidic medium.
2. **$\mathrm{ClO_2^-}$:** Cl is in $+3$. It can go up to $\mathrm{ClO_3^-}$ $(+5)$ and down to $\mathrm{Cl^-}$ (-1).
3. **$\mathrm{Cl_2}$:** Cl is in 0. In alkaline solution, it disproportionates to $\mathrm{Cl^-}$ (-1) and $\mathrm{ClO^-}$ $(+1)$.
4. **$\mathrm{Mn^{3+}}$:** In aqueous solution, it disproportionates to $\mathrm{Mn^{2+}}$ and $\mathrm{MnO_2}$ $(+4)$.
Step 3: Final Answer:
The set in option (D) contains species that all undergo disproportionation.

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18. **Answer: 316 - 316**

Explanation:

Step 1: Understanding the Concept:
In a redox titration, the total equivalents of the oxidizing agent must equal the total equivalents of the reducing agent.
Step 2: Detailed Explanation:
In acidic medium:
n-factor for $KMnO_4$ $(Mn^{+7} \rightarrow Mn^{2+})$ is 5.
n-factor for $FeSO_4$ $(Fe^{2+} \rightarrow Fe^{3+})$ is 1.
Equivalents of $KMnO_4 = \text{Equivalents of } FeSO_4$

$$N_1V_1 = N_2V_2$$

$$(M_1 \times 5) \times 10 = (0.1 \times 1) \times 10$$

$$5M_1 = 0.1 \implies M_1 = \frac{0.1}{5} = 0.02\,M$$

Molar mass of $KMnO_4 = 39 + 55 + (4 \times 16) = 158\,\text{g/mol}.$
Strength in g/L $= \text{Molarity} \times \text{Molar mass}$

$$\text{Strength} = 0.02 \times 158 = 3.16\,\text{g/L}$$

Given Strength $= x \times 10^{-2}$:

$$3.16 = 316 \times 10^{-2}$$

Step 3: Final Answer:
The value of x is 316.

---

19. **Answer: 10 - 10**

Explanation:

To solve the given problem, we need to determine variables **X** and **Y**, and then compute **X + Y**.

Firstly, let's address the compound KMnO_4 acting as an oxidizing agent in acidic medium. In this scenario, **Mn** is reduced from +7 oxidation state to +2:

- **Initial oxidation state of Mn** = +7
- **Final oxidation state of Mn** = +2

The difference **X** is the change in oxidation state:

X = 7 - 2 = 5

Next, we consider the number of 'd' electrons in the brown-red precipitate at the end of the acetate ion test with neutral ferric chloride (typically **$Fe(OH)_3$** which is red-brown).

The oxidation state of iron in **$Fe(OH)_3$** is +3. In this state, the electron configuration of Fe is:

- **Atomic number of Fe** = 26: Configuration for Fe (neutral) = [Ar] $4s^2\ 3d^6$
- For Fe^{3+}: $3d^5$ (since 2 electrons are removed from 4s and 1 from 3d)

Thus, the number of 'd' electrons, **Y = 5**.

Therefore, the computed value:

X + Y = 5 + 5 = 10

This value is within the provided range 10, 10.

---

20. Answer: 23 - 23

Explanation:

1. Balancing the Reaction: To balance the given reaction in an acidic medium:

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

2. Identify X, Y, and Z: - $X = 14$ (moles of H^+), - $Y = 2$ (moles of Cr^3+), - $Z = 7$ (moles of H_2O). 3. Sum of $X + Y + Z$:

$$X + Y + Z = 14 + 2 + 7 = 23.$$

Final Answer: $\boxed{23}$.

---

21. Answer: c

Explanation:

In order to determine which of the given chemical species has the strongest oxidizing capacity, we need to examine their standard reduction potential values. The species with the highest standard reduction potential will have the strongest oxidizing capacity, as a higher reduction potential indicates a greater tendency to gain electrons and thereby oxidize other substances.

Here are the given standard reduction potentials:

- $E^\circ_{\mathrm{I^-/I_2}} = +1.26\ \mathrm{V}$

- $E^\circ_{Al^{3+}/Al} = -1.66\,V$
- $E^\circ_{Pb^{4+}/Pb^{2+}} = +1.67\,V$
- $E^\circ_{Sn^{4+}/Sn^{2+}} = +1.15\,V$

Comparing these values, $E^\circ_{Pb^{4+}/Pb^{2+}} = +1.67\,V$ is the highest. Therefore, the ion Pb^{4+} has the strongest oxidizing capacity because it more readily accepts electrons to be reduced.

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22. **Answer: c**

Explanation:

The heat of formation of SO_2 is the heat change when 1 mole of $SO_2(g)$ is formed from its elements in their standard states.
By using the given reactions, the heat of formation is found to be $y - 2x$.
Final Answer: $y - 2x\,\text{kcal}$.

---

23. **Answer: c**

Explanation:

- Statement (I) is false: The ionisation energy of Pb is lower than that of Sn because Pb is lower in the periodic table and has a higher atomic size.
- Statement (II) is true: Ge has a higher ionisation energy than Si because it is in the same group but higher in the periodic table, so its electrons are closer to the nucleus.
Final Answer: Statement I is false but Statement II is true.

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24. **Answer: c**

Explanation:

Let's analyze each reaction:

A. $CH_4(g) + 2O_2(g) \to CO_2(g) + 2H_2O(l)$:
This is a combustion reaction where methane reacts with oxygen to produce carbon dioxide and water.
The oxidation state of carbon changes from -4 to +4, and the oxidation state of oxygen changes from 0 to -2.
This is also a combination reaction.
So, A is matched with II.

B. $2NaH(s) \to 2Na(s) + H_2(g)$:
Sodium hydride decomposes into sodium and hydrogen.
The oxidation state of sodium changes from +1 to 0, and the oxidation state of hydrogen changes from -1 to 0.
This is a decomposition reaction.
So, B is matched with III.

C. $V_2O_5(s) + 5Ca(s) \to 2V(s) + 5CaO(s)$:
This is a displacement reaction, where calcium displaces vanadium from its oxide.
Calcium is oxidized from 0 to +2, and vanadium is reduced from +5 to 0.
So, C is matched with IV.

D. $2H_2O_2(aq) \to 2H_2O(l) + O_2(g)$:
Hydrogen peroxide decomposes into water and oxygen.
The oxidation state of oxygen in H_2O_2 is -1, in H_2O it is -2, and in O_2 it is 0.
This is a disproportionation reaction, where oxygen in H_2O_2 is both oxidized and reduced.
So, D is matched with I.

Final Matching:
A - II
B - III
C - IV
D - I

Final Answer:
The final answer is $A\text{-}II$, $B\text{-}III$, $C\text{-}IV$, $D\text{-}I$.

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25. Answer: a

Explanation:

Let's analyze each oxidation reaction:

A. $I^- \to I_2$**:**
Both $K_2Cr_2O_7$ and $KMnO_4$ can oxidize iodide to iodine in acidic medium.
This reaction is possible with both oxidizing agents.

B. $S^{2-} \to S$**:**
Both $K_2Cr_2O_7$ and $KMnO_4$ can oxidize sulfide to sulfur in acidic medium.
This reaction is possible with both oxidizing agents.

C. $Fe^{2+} \to Fe^{3+}$**:**
Both $K_2Cr_2O_7$ and $KMnO_4$ can oxidize Fe^{2+} to Fe^{3+} in acidic medium.
This reaction is possible with both oxidizing agents.

D. $I^- \to IO_3^-$**:**
Both $K_2Cr_2O_7$ and $KMnO_4$ can oxidize iodide to iodate in acidic medium, but it requires a stronger oxidizing power.
This reaction is possible under strong conditions, but not always consistent in standard acidic conditions.

E. $S_2O_3^{2-} \to SO_4^{2-}$**:**
Thiosulfate oxidation to sulfate is more complex and specific to certain oxidizing power and conditions. $KMnO_4$ typically does not oxidize thiosulfate to sulfate quantitatively in acidic medium, while $K_2Cr_2O_7$ may do so under vigorous conditions.
This reaction is not consistently carried out by both oxidizing agents.

Therefore, reactions A, B, and C are the only ones that are *consistently* carried out by both $K_2Cr_2O_7$ and $KMnO_4$ under standard acidic conditions.

Final Answer:
The final answer is $(3)\ A,\ B \text{ and } C \text{ only}.$