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VCE Chemistry $\frac{3}{4}$
Introduction to Redox [1.6]
Homework

Homework Outline:

Compulsory Questions	Pg 2 – Pg 11
Supplementary Questions	Pg 12 – Pg 21



Section A: Compulsory Questions (47 Marks)

Sub-Section [1.6.1]: Apply Oxidation Numbers to Find Oxidant & Reductant



Question 1 (4 marks)

Find the oxidation number for all elements in each of the following molecules:

a. $\text{C}_2\text{H}_5\text{COOH}$. (1 mark)

b. H_2O . (1 mark)

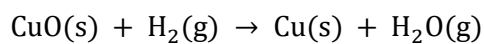
c. O_2 . (1 mark)

d. CH_4 . (1 mark)

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Question 2 (4 marks)

Preesha is investigating the following chemical reaction:



a. Find the oxidation numbers for all atoms in the following molecules:

i. CuO. (1 mark)

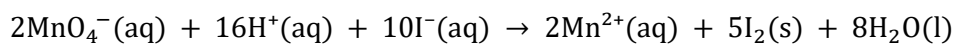
ii. Cu. (1 mark)

b. Hence, determine and justify whether CuO is an oxidant or a reductant. (2 marks)

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Question 3 (4 marks)

Micah is observing the following reaction occurring at school.



His friend explains that the oxidising agent in this reaction is MnO_4^- . Evaluate Micah's friend's statement, using calculations as justification.

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Sub-Section [1.6.2]: Apply KOHES to Write Balanced Half-Equations in Acidic & Basic Conditions

Question 4 (2 marks)



Nitrate ions (NO_3^-) turn into nitrogen gas (N_2) in a laboratory.

- a. Write the half-equation in acidic conditions. (1 mark)

- b. Write the half-equation in alkaline conditions. (1 mark)

Question 5 (4 marks)



Complete the balanced half-equation for each of the following, and state whether it is a reduction or oxidation reaction.

- a. Iron (II) ions turning into iron solid. (1 mark)

- b. AgNO_3 turning into silver solid. (1 mark)

c. Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) turning into ethanoic acid (CH_3COOH). (1 mark)

d. Nitrogen dioxide (NO_2) turning into nitrogen gas (N_2). (1 mark)

Question 6 (4 marks)



In acidic conditions, dichromate ($\text{Cr}_2\text{O}_7^{2-}$) can react and turn into chromium ions (Cr^{3+}).

a. Write a balanced half-equation for this process. (1 mark)

b. State whether this is an oxidation or reduction reaction and justify why. (2 marks)

c. Hence or otherwise, is Cr^{3+} an oxidant or reductant? (1 mark)

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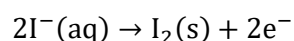
Sub-Section [1.6.3]: Apply KOHES to Write Balanced Half-Equations and Overall Equations in Acidic & Basic Conditions

Question 7 (6 marks)

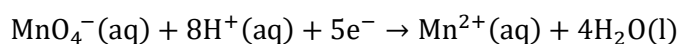


Express the overall equation using the half equations provided.

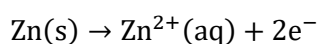
a. Oxidation half-equation: (2 marks)



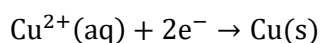
Reduction half-equation:



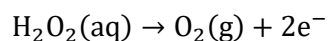
b. Oxidation half-equation: (2 marks)



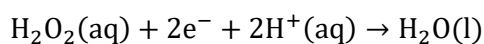
Reduction half-equation:



c. **Oxidation half-equation:** (2 marks)



Reduction half-equation:



Question 8 (3 marks)



Lead (II) Pb^{2+} can be formed from Lead solid, Pb, when reacted with permanganate ions (MnO_4^-). Mn^{2+} ions are formed in the process.

Write the balanced equation for:

a. The oxidation reaction. (1 mark)

b. The reduction reaction. (1 mark)

c. The overall reaction. (1 mark)


Question 9 (4 marks)

Magnesium (Mg) can react with water (H_2O) in an alkaline environment to form magnesium hydroxide ($\text{Mg}(\text{OH})_2$) and hydrogen gas (H_2).

Write the balanced equation for:

a. The oxidation reaction. (1 mark)

b. The reduction reaction. (1 mark)

c. The overall reaction. (2 marks)

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Sub-Section: The 'Final Boss'

Question 10 (12 marks)



Liam is experimenting with Potassium dichromate ($K_2Cr_2O_7$) reacting with ethanol (C_2H_5OH), forming chromium (III) ions and acetic acid (CH_3COOH) in a reaction vessel with a pH of 8.2.

- a.** His friend explains that the reducing agent in this reaction is $K_2Cr_2O_7$. Evaluate Liam's friend's statement, using calculations as justification. (4 marks)

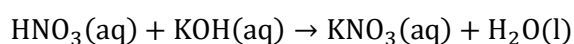
- b.** Express the half-equations involving the following and state the type of reaction occurring.

- i.** Oxidant. (2 marks)

- ii.** Reductant. (2 marks)

- c. Write the complete reaction that Liam is observing. (2 marks)

- d. Liam is also curious about the following reaction:



State and explain whether the above reaction is a redox reaction. (2 marks)

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Section B: Supplementary Questions (43 Marks)

Sub-Section [1.6.1]: Apply Oxidation Numbers to Find Oxidant & Reductant

Question 11 (4 marks)



State the oxidation number for the element specified in the molecule/ion provided.

a. Oxidation number of Chromium in CrO_4^{2-} . (1 mark)

b. Oxidation number of Sulphur in SO_3^{2-} . (1 mark)

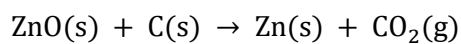
c. Oxidation number of Phosphorus in H_2PO_4^- . (1 mark)

d. Oxidation number of Nitrogen in NO_3^- . (1 mark)

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Question 12 (4 marks)

Natalie is investigating the following chemical reaction:



a. Find the oxidation numbers for all atoms in the following molecules:

i. C. (1 mark)

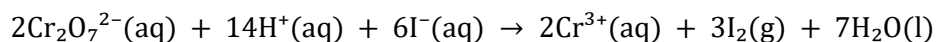
ii. CO₂. (1 mark)

b. Hence, determine and justify whether C (carbon) is a reductant or an oxidant. (2 marks)

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Question 13 (4 marks)

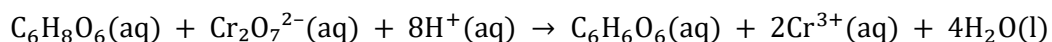

Kanta is observing the following reaction occurring at school:



His friend explains that the reducing agent in this reaction is $\text{Cr}_2\text{O}_7^{2-}$. Evaluate Kanta's friend's statement, using calculations as justification.

Question 14


In an acidic solution, ascorbic acid ($\text{C}_6\text{H}_8\text{O}_6$) reacts with dichromate ions ($\text{Cr}_2\text{O}_7^{2-}$), resulting in the formation of chromium(III) ions (Cr^{3+}) and dehydroascorbic acid ($\text{C}_6\text{H}_6\text{O}_6$).



A friend claims that $\text{C}_6\text{H}_8\text{O}_6$ is the reducing agent in this reaction. Evaluate this claim, justify your response with the relevant calculations.



Sub-Section [1.6.2]: Apply KOHES to Write Balanced Half-Equations in Acidic & Basic Conditions

Question 15 (2 marks)



Perchlorate ions (ClO_4^-) turn into chlorine gas (Cl_2) in a laboratory.

- a. Write the half-equation in acidic conditions. (1 mark)

- b. Write the half-equation in alkaline conditions. (1 mark)

Question 16 (4 marks)



Complete the balanced half-equation for each of the following, and state whether it is a reduction or oxidation reaction.

- a. Copper (II) ions turning into copper solid. (1 mark)

- b. Silver oxide (Ag_2O) turning into silver solid. (1 mark)

c. Butanol (C_4H_9OH) turning into butanoic acid ($C_4H_8O_2$). (1 mark)

d. Nitrous oxide (N_2O) turning into nitrogen gas (N_2). (1 mark)

Question 17 (4 marks)



In acidic conditions, potassium permanganate ($KMnO_4$) can react and turn into manganese ions (Mn^{2+}).

a. Write a balanced half-equation for this process. (1 mark)

b. State whether this is an oxidation or reduction reaction and justify why. (2 marks)

c. Hence or otherwise, is Mn^{2+} an oxidant or reductant? (1 mark)


Question 18 (4 marks)

In acidic conditions, potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) reacts and turns into chromium(III) ions (Cr^{3+}).

- a. Write a balanced half-equation for the reduction of potassium dichromate to chromium(III) ions in acidic conditions. (1 mark)

- b. State whether this is an oxidation or reduction reaction and justify why. (2 marks)

- c. Hence or otherwise, is Cr^{3+} an oxidant or reductant? (1 mark)

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Sub-Section [1.6.3]: Apply KOHES to Write Balanced Half-Equations and Overall Equations in Acidic & Basic Conditions

Question 19 (4 marks)

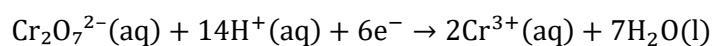


Express the overall equation using the half-equations provided.

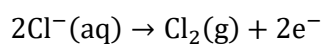
a. Oxidation half-equation: (2 marks)



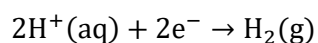
Reduction half-equation:



b. Oxidation half-equation: (2 marks)



Reduction half-equation:



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Question 20 (4 marks)

Zinc(II) Zn^{2+} can be formed from Zinc solid, Zn, when reacted with dichromate ions ($\text{Cr}_2\text{O}_7^{2-}$). Cr^{3+} ions are formed in the process.

Write the balanced equation for:

a. The oxidation reaction. (1 mark)

b. The reduction reaction. (1 mark)

c. The overall reaction. (2 marks)

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Question 21 (4 marks)

Sodium (Na) reacts with water in an alkaline environment to form sodium hydroxide and hydrogen gas.

Write the balanced equation for:

a. The oxidation reaction. (1 mark)

b. The reduction reaction. (1 mark)

c. The overall reaction. (2 marks)

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Question 22 (5 marks)

In the paper industry, bleaching is a crucial process to eliminate colour from pulp, ensuring the production of high-quality paper. Chlorine or chlorine compounds are commonly used in redox reactions to oxidise and remove impurities, enhancing the paper's brightness and quality.

- a.** Chlorine gas is used in a reaction with water. This purifies pulp and produces oxygen gas (O_2) and hypochlorous acid ($HOCl$).

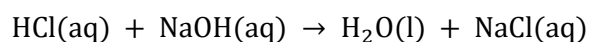
Write a balanced equation for the:

- i.** Oxidation reaction. (1 mark)

- ii.** Reduction reaction. (1 mark)

- iii.** Overall reaction. (1 mark)

- b.** Hydrochloric acid (HCl) is also often used as an alternative to using chlorine gas. HCl can undergo the following reaction:



State and explain whether the above reaction is a redox reaction. (2 marks)

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