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VCE Chemistry ¾
Spontaneous Redox Reactions [1.7]
Homework Solutions

Homework Outline:

Compulsory Questions	Pg 02 - Pg 15
Supplementary Questions	Pg 16 - Pg 26

Section A: Compulsory Questions (42 Marks)

Sub-Section [1.7.1]: Apply the ECS to Predict Spontaneous Reactions

Question 1 (3 marks)

Write the (i) oxidation and (ii) half equations for each of the following spontaneous reactions.

a. John reacts zinc metal (Zn) with copper (II) sulphate ($CuSO_4$) in aqueous solution.

i. Oxidation half equation. (0.5 marks)

Oxidation Half Equation:

$$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$$

ii. Reduction half equation. (0.5 marks)

Reduction Half Equation:

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$$

b. Maggie reacts copper metal (Cu) with silver nitrate ($AgNO_3$) in aqueous solution.

i. Oxidation half equation. (0.5 marks)

$$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$$

ii. Reduction half equation. (0.5 marks)

$$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$$

c. Ivy reacts nickel sulphate ($NiSO_4$) with hydrogen gas (H_2).

i. Oxidation half equation. (0.5 marks)

Oxidation Half Equation:

$$H_2(g) \rightarrow 2H^+(aq) + 2e^-$$

ii. Reduction half equation. (0.5 marks)

Reduction Half Equation:

$$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$$

Question 2 (3 marks)

Write the (i) oxidation and (ii) half equations for each of the following spontaneous reactions.

a. Esther reacts tin (II) sulphate ($SnSO_4$) with iron (III) phosphate ($FePO_4$) in an aqueous solution.

i. Oxidation half equation. (0.5 marks)

$$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-$$

ii. Reduction half equation. (0.5 marks)

$$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$$

b. Angel reacts hydrogen peroxide (H_2O_2) with iodide ions (KI) in an aqueous solution.

i. Oxidation half equation. (0.5 marks)

$$2I^-(aq) \rightarrow I_2(s) + 2e^-$$

ii. Reduction half equation. (0.5 marks)

$$H_2O_2(aq) + 2H^+(aq) + 2e^- \rightarrow 2H_2O(l)$$

c. Cherry reacts hydrogen gas (H_2) with tin (II) sulphate ($SnSO_4$) in an aqueous environment.

i. Oxidation half equation. (0.5 marks)

$$H_2(g) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e^-$$

ii. Reduction half equation. (0.5 marks)

$$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$$

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Question 3 (6 marks)

Write the (i) oxidation and (ii) half equations for each of the following spontaneous reactions.

a. Ethan reacts a solution of potassium permanganate ($KMnO_4$), iron (II) sulphate ($FeSO_4$), and hydrogen peroxide (H_2O_2) in aqueous medium.

i. Oxidation half equation. (1 mark)

1. **Reduction (Strongest Oxidant):**

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$$

(Potassium permanganate is reduced.)

2. **Oxidation (Strongest Reductant):**

$$H_2O_2(aq) \rightarrow O_2(g) + 2H^+(aq) + 2e^-$$

(Hydrogen peroxide is oxidized.)

ii. Reduction half equa

b. Olivia reacts tin (II) chloride ($SnCl_2$) with a mixture of iron (III) nitrate ($Fe(NO_3)_3$) and copper (II) iodide (CuI_2) in an aqueous solution.

i. Oxidation half equation. (1 mark)

ii. Reducti

Oxidation Half Equation (Reductant $Sn^{2+}(aq)$):

$$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-$$

Reduction Half Equation (Oxidant $Fe^{3+}(aq)$):

$$2Fe^{3+}(aq) + 2e^- \rightarrow 2Fe^{2+}(aq)$$

c. Lucas reacts copper (II) nitrate ($Cu(NO_3)_2$) with zinc (Zn), silver nitrate ($AgNO_3$), and hydrochloric acid (HCl) in solution.

i. Oxidation half equation. (1 mark)

1. **Reduction (Strongest Oxidant):**
   $Ag^+(aq) + e^- \rightarrow Ag(s)$
   (Silver ion is reduced to silver metal.)
2. **Oxidation (Strongest Reductant):**
   $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$
   (Zinc metal is oxidized to zinc ions.)

ii. Reduction half equation.

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Sub-Section [1.7.2]: Identify Differences Between Direct & Indirect Redox Reactions, & Features of ECS

Question 4 (3 marks)

Michelle adds hydrogen peroxide (H_2O_2) into water (H_2O). She observes no physical signs of a chemical reaction occurring.

a. Predict two physical indicators that Michelle may be looking for to suggest that a reaction is occurring. (2 marks)

- Bubbling
- Warming of reaction vessel

b. Justify why no chemical reaction is occurring. (1 mark)

The rate of reaction is extremely slow, meaning no physical evidence of a reaction occurring is present (1).

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Question 5 (2 marks)

Melody adds a strip of lead (Pb) to a beaker containing a 1.0 *M* aqueous solution of silver sulphate (Ag_2SO_4).

a. Predict the half-reactions occurring in the beaker.

i. Oxidation reaction. (0.5 marks)

Oxidation Half-Reaction (at the surface of lead):

Lead (Pb) loses electrons to form lead ions (Pb^{2+}).

$$Pb\ (s) \rightarrow Pb^{2+}(aq) + 2e^-$$

ii. Reduction reaction.

Reduction Half-Reaction (at the Ag^+ ions in solution):

Silver ions (Ag^+) gain electrons to form solid silver (Ag).

$$Ag^+(aq) + e^- \rightarrow Ag\ (s)$$

b. State the type of energy conversion occurring in this chemical reaction. (1 mark)

Chemical energy → Heat/thermal energy

Question 6 (2 marks)

State the primary difference between direct contact and indirect contact spontaneous redox reactions.

In **direct contact redox reactions**, the oxidising and reducing agents are in physical contact with each other, allowing direct electron transfer between the substances. (1)
In **indirect contact redox reactions**, the oxidising and reducing agents are not in direct contact, and the electron transfer occurs through an external circuit, as seen in electrochemical cells like galvanic cells. (2)

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Sub-Section [1.7.3]: Find the Strongest Oxidants/Reductants by Constructing Your Own ECS

Question 7 (4 marks)

a. Three unknown substances P, Q, and R are present. The half equations are provided without $E°$ values.

Reaction
$P^{2+}(aq) + 2e^- \rightleftharpoons P(s)$
$Q^{2+}(aq) + 2e^- \rightleftharpoons Q(s)$
$R^{2+}(aq) + 2e^- \rightleftharpoons R(s)$

The following facts are known:

- When P reacts with a solution of R^{2+}, a reaction occurs.
- When Q interacts with a solution of P^{2+}, the beaker containing the solution becomes warmer.

Rank the three metals in decreasing oxidant strength. (2 marks)

R^{2+}, P^{2+}, Q^{2+}

b. Three unknown substances X, Y, and Z are present. The half equations are provided without $E°$ values.

$$X^{2+}(aq) + 2e^- \rightarrow X(s)$$

$$Y^{2+}(aq) + 2e^- \rightarrow Y(s)$$

$$Z^{2+}(aq) + 2e^- \rightarrow Z(g)$$

The following observations are recorded:

- When Z^{2+} is added to Y, no bubbles are produced.
- When Z^{2+} is added to X, the beaker containing the solutions becomes warmer.

Rank the substances in increasing reductant strength. (2 marks)

X, Z, Y

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Question 8 (2 marks)

a. Four unknown substances A, B, C, and D are present. The half-equations are provided without $E°$ values.

$$A^{2+}(aq) + 2e^- \rightarrow A(s)$$

$$B^{+}(aq) + e^- \rightarrow B(s)$$

$$C^{3+}(aq) + 3e^- \rightarrow C(g)$$

$$D^{+}(aq) + e^- \rightarrow D(l)$$

The following observations are recorded:

- When C^{3+} is added to A, the reaction mixture fizzes (produces gas bubbles).
- When D^{+} is added to A^{2+}, no reaction occurs.
- When C^{3+} is added to B, the solution releases heat.

Rank the four substances in decreasing oxidant strength. (2 marks)

$C^{3+} > A^{2+} > B^{+} > D^{+}$

b. Four unknown substances A, B, C, and D are present. The half-equations are provided without $E°$ values.

$$A^{2+}(aq) + 2e^- \rightarrow A(s)$$

$$B^{+}(aq) + e^- \rightarrow B(s)$$

$$C^{3+}(aq) + 3e^- \rightarrow C(s)$$

$$D^{+}(aq) + e^- \rightarrow D(g)$$

The following observations are recorded:

- When B^+ is added to A^{2+}, no reaction occurs.
- When C^{3+} is added to A, the temperature of the beaker increases.
- When D^+ is added to B, gas bubbles are observed.

Rank the four substances in increasing reductant strength. (2 marks)

$B > D > A > C$

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Question 9 (6 marks)

a. A scientist is given five metals and 1 *M* solution of nitrates of the metals.

The metals are labelled M, N, O, P and Q and the solutions are labelled M^{2+}, N^{2+}, O^{2+}, P^{2+}, and Q^{2+}.

The student carries out a number of experiments and the results obtained are listed below:

i. Metal O began to be coated in different metals when placed in solutions of M^{2}, N^{2+}, and P^{2+} but not Q^{2+}.

ii. A solution of P^{2+} underwent a reaction when metal M was dipped in it.

iii. Metal N is known to be the weakest reductant.

Rank each of the 5 metals in order of decreasing $E°$ values. (3 marks)

N, M, P, O, Q

b. A scientist is given five metals and 1 *M* solution of nitrates of the metals.

The metals are labelled M, N, O, P, and Q and the solutions are labelled M^{2+}, N^{2+}, O^{2+}, P^{2+}, and Q^{2+}.

The student carries out a number of experiments and the results obtained are listed below:

i. When metal Q is dipped in all solutions, it reacts vigorously with all of them.

ii. When a metal rod of N is dipped in all solutions, it only begins to degrade in M^{2+} and O^{2+} solutions.

iii. M^{2+} reacts vigorously when reacted with metal O.

Rank each of the 5 metals in order of decreasing $E°$ values. (3 marks)

M, O, N, P, Q

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Sub-Section: The 'Final Boss'

Question 10 (9 marks)

Ivy is investigating the following reactions shown below.

1. $ClO_2^-(aq) + 2H^+(aq) + e^- \rightarrow ClO(g) + H_2O(l)$
2. $Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$
3. $BrO_3^-(aq) + 6H^+(aq) + 6e^- \rightarrow Br_2(l) + 3H_2O(l)$
4. $NO_3^-(aq) + 4H^+(aq) + 3e^- \rightarrow NO_2(g) + 2H_2O(l)$

She notes down the following observations:

- When BrO_3^- is mixed with $ClO(g)$, a reaction occurs, and bubbles are produced.
- NO_3^- reacts with Sn^{2+}, generating heat but no gas.
- When ClO_2^- is added to Sn^{2+}, no observable reaction occurs.
- Br_2 reacts with NO_2, releasing a small amount of heat.

a. Rank the 4 substances in increasing oxidant strength. (2 marks)

$$Sn^{4+} < NO_3^- < ClO_2^- < BrO_3^-$$

b. Using **part a.**, predict whether a reaction will occur when $BrO_3^-(aq)$ is mixed with $Sn^{2+}(aq)$. Justify your answer. (2 marks)

Yes, a reaction will occur.

- BrO_3^- is the strongest oxidant in the ECS and Sn^{2+} is the weakest reductant.
- A reaction occurs because BrO_3^- has a higher reduction potential than Sn^{2+}, allowing BrO_3^- to be reduced while Sn^{2+} is oxidized.

c. Explain why no observable reaction takes place when $ClO_2^-(aq)$ is mixed with $NO_2(g)$. (2 marks)

No reaction occurs.

- ClO_2^- is a weaker oxidant than NO_2 is as a reductant.
- Additionally, even if thermodynamically feasible, the rate of reaction between ClO_2^- and NO_2 is too slow for an observable reaction.

d. All the oxidants and reductants from the above reactions are added to a reaction vessel.

i. Write the overall equation for the reaction occurring immediately, as soon as the reagents are added to the vessel. (2 marks)

$$BrO_3^-(aq) + 6H^+(aq) + 6Sn^{2+}(aq) \rightarrow Br_2(l) + 3H_2O(l) + 6Sn^{4+}(aq)$$

ii. State the energy conversions occurring during this reaction. (1 mark)

Chemical energy → Heat energy

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Section B: Supplementary Questions (34 Marks)

Sub-Section [1.7.1]: Apply the ECS to Predict Spontaneous Reactions

Question 11 (3 marks)

Write the (i) oxidation and (ii) half equations for each of the following spontaneous reactions.

a. Sarah reacts magnesium metal (Mg) with hydrochloric acid (HCl) in an aqueous solution.

i. Oxidation half equation. (0.5 marks)

i) **Oxidation Half Equation:**

$$Mg \rightarrow Mg^{2+} + 2e^-$$

ii. Reduction half equation. (0.

ii) **Reduction Half Equation:**

$$2H^+ + 2e^- \rightarrow H_2$$

b. Liam reacts aluminium metal (Al) with iron (III) chloride ($FeCl_3$) in aqueous solution.

i. Oxidation half equation. (0.

i) **Oxidation Half Equation:**

$$Al \rightarrow Al^{3+} + 3e^-$$

ii. Reduction half equation. (0

ii) **Reduction Half Equation:**

$$Fe^{3+} + 3e^- \rightarrow Fe$$

c. Emma reacts lead (II) nitrate ($Pb(NO_3)_2$) with solid zinc (Zn).

i. Oxidation half equation. (

i) **Oxidation Half Equation:**

$$Zn \rightarrow Zn^{2+} + 2e^-$$

ii. Reduction half equation. (

ii) **Reduction Half Equation:**

$$Pb^{2+} + 2e^- \rightarrow Pb$$

Question 12 (3 marks)

Write the (i) oxidation and (ii) half equations for each of the following spontaneous reactions.

a. Rebecca reacts tin (II) chloride ($SnCl_2$) with iron (III) nitrate ($Fe(NO_3)_3$) in an aqueous solution.

i. Oxidatic

i) **Oxidation Half Equation:**

$$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-$$

ii) **Reduction Half Equation:**

$$2Fe^{3+}(aq) + 2e^- \rightarrow 2Fe^{2+}(aq)$$

ii. Reductic

b. Kevin reacts hydrogen peroxide (H_2O_2) with permanganate ions (MnO_4^-) in an aqueous solution.

i. Oxidation half equation. (0.5 marks)

i) **Oxidation Half Equation:**

$$H_2O_2(aq) \rightarrow O_2(g) + 2H^+(aq) + 2e^-$$

ii. Red

ii) **Reduction Half Equation:**

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$$

c. Chloe reacts hydrogen gas (H_2) with tin (II) nitrate ($Sn(NO_3)_2$) in an aqueous environment.

i. Oxidation half equation. (0.5 marks)

Oxidation Half Equation:

$$H_2(g) \rightarrow 2H^+(aq) + 2e^-$$

ii. Reduction hal

Reduction Half Equation:

$$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$$

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Question 13 (4 marks)

Write the (i) oxidation and (ii) half equations for each of the following spontaneous reactions.

a. Sophia adds tin (II) chloride ($SnCl_2$) to a solution containing potassium dichromate ($K_2Cr_2O_7$) and hydrogen peroxide (H_2O_2) in aqueous conditions.

i. Oxidatio

ii. Reductio

Reduction Half-Reaction (Strongest Oxidant):

Potassium dichromate ($Cr_2O_7^{2-}$) is reduced:

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$$

Oxidation Half-Reactions (Strongest Reductants):

1. Tin(II) chloride ($SnCl_2$) is oxidized:

$$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-$$

b. Angela adds iron (III) chloride ($FeCl_3$), hydrogen peroxide (H_2O_2), and sulphuric acid (H_2SO_4) in aqueous medium.

i. Oxidation half equation. (1 mark)

ii. Reduc

Reduction Half-Reaction (Strongest Oxidant):

Iron(III) is reduced:

$$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$$

Oxidation Half-Reactions (Strongest Reductants):

1. Hydrogen peroxide is oxidized:

$$H_2O_2(aq) \rightarrow O_2(g) + 2H^+(aq) + 2e^-$$

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Question 14 (2 marks)

Vivek is given the following electrochemical series for some reactions that are not occurring at SLC.

$Sn^{4+}(aq) + 2e^- \rightleftharpoons Sn^{2+}(aq)$	$+0.1$
$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$	$+0.25$
$I_2(s) + 2e^- \rightleftharpoons 2I^-(aq)$	$+0.69$
$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$	-0.90

Vivek adds copper (II), iodide and tin (IV) ions to a beaker. Following this, he adds a strip of zinc metal.

Predict the half equations of the reaction occurring.

a. Oxidation reaction. (1 mark)

$$Zn\ (s) \rightarrow Zn^{2+}(aq) + 2e^-$$

b. Reduction reaction. (1 mark)

$$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$$

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Sub-Section [1.7.2]: Identify Differences Between Direct & Indirect Redox Reactions, & Features of ECS

Question 15 (4 marks)

Betty is analysing a reaction between oxygen gas (O_2) and iron metal (Fe).

a. State and justify using chemical equations whether the reaction is spontaneous. (2 marks)

Oxygen gas and iron metal can react spontaneous due to a transfer of electrons from the oxidation of Iron, producing electrons, which are consumed in the reduction of oxidation gas (1). This is shown in these half equations; (2)

Oxygen (O_2) in the presence of water (H_2O) gains electrons to form hydroxide ions (OH^-).

$$O_2(g) + 4e^- + 2H_2O\ (l) \rightarrow 4OH^-(aq)$$

These half-reactions combine to form iron(III) hydroxide (rust):

$$Fe\ (s) + O_2(g) + 2H_2O\ (l) \rightarrow Fe(OH)_3(aq)$$

b. When Betty sets up this reaction in the laboratory, she notices no reaction occurring. Provide a justification for this observation. (1 mark)

The rate of reaction is extremely slow, meaning no physical evidence of a reaction occurring is present (1).

c. Provide a physical application of this chemical reaction. (1 mark)

Iron metal rusting (1)

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Question 16 (2 marks)

Precious adds a strip of magnesium (Mg) to a beaker containing a 1.0 M aqueous solution of aluminium phosphate ($AlPO_4$).

a. Predict the half-reactions occurring in the beaker.

i. Oxidation reaction. (0.5 marks)

$$Mg\ (s) \rightarrow Mg^{2+}(aq) + 2e^-$$

ii. Reduction reaction. (0.5 marks)

$$2H_2O(l) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq)$$

b. State the type of energy conversion occurring in this chemical reaction. (1 mark)

Chemical energy → Heat/thermal energy

Question 17 (2 marks)

State the role of the Standard Hydrogen Electrode (SHE) in the electrochemical series.

The Standard Hydrogen Electrode (SHE) serves as the reference electrode in the electrochemical series. It is assigned a standard electrode potential of 0.00 V under standard conditions (1 M concentration, 1 atm pressure, and 25°C). (1) The SHE provides a consistent baseline for comparing the electrode potentials of other half-reactions, allowing the determination of the relative tendency of substances to gain or lose electrons, allowing other the construction of an ECS based on whether other reagents can spontaneously react with it (2).

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Question 18 (3 marks)

Discuss the limitations of the electrochemical series when applied to real-world chemical reactions.

The electrochemical series is a useful tool for predicting the relative reactivity of different substances, but it has several limitations when applied to real-world reactions:

1. **Conditions Dependence:** The electrochemical series is based on standard conditions (1 M concentration, 1 atm pressure, and 25℃). In real-world reactions, conditions may differ (e.g., varying concentrations, temperatures, or pressures), which can affect the actual electrode potentials and the feasibility of a reaction.
2. **Reaction Kinetics:** The series does not account for the rate of reaction. Even if a reaction is thermodynamically favourable (based on electrode potentials), it may occur very slowly or not at all due to high activation energy or other kinetic barriers.
3. **Complexity of Real-World Systems:** In real systems, multiple factors such as the presence of catalysts, the medium (e.g., acidic or basic solutions), and side reactions can influence the outcome. The electrochemical series only provides a simplified view and may not fully predict all the variables that impact the reaction in practice.

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Sub-Section [1.7.3]: Find the Strongest Oxidants/Reductants by Constructing Your Own ECS

Question 19 (4 marks)

a. There are three unknown substances J, K, and L. The following half-equations are given, but their $E°$ values are not given.

Reaction
$J^{2+}(aq) + 2e^- \rightarrow J(s)$
$K^{2+}(aq) + 2e^- \rightarrow K(s)$
$L^{2+}(aq) + 2e^- \rightarrow L(s)$

It is known that when J is mixed into a solution of L^{2+}, a reaction begins to occur.

It is also known that when K is mixed into a solution of L^{2+}, no reaction occurs.

Rank the three metals in terms of their decreasing oxidant strength. (2 marks)

K^{2+}, L^{2+}, J^{2+}

b. There are three unknown substances A, B, and C. The following half-equations are given, but their $E°$ values are not given.

Reaction
$A^{2+}(aq) + 2e^- \rightarrow A(s)$
$B^{2+}(aq) + 2e^- \rightarrow B(s)$
$C^{2+}(aq) + 2e^- \rightarrow C(s)$

i. A plastic rod coated in metal A reacts vigorously with a solution of $B(NO_3)_2$ and CSO_4.

ii. Metal C is able to react with B^{2+} but not with A^{2+}.

Rank the three metals in terms of their decreasing oxidant strength. (2 marks)

B, C, A

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Question 20 (3 marks)

Four unknown substances P, Q, R, and S are present. The half-equations are provided without $E°$ values.

$$P^{2+}(aq) + 2e^- \rightarrow P(s)$$

$$Q^{+}(aq) + e^- \rightarrow Q(g)$$

$$R^{3+}(aq) + 3e^- \rightarrow R(s)$$

$$S^{+}(aq) + e^- \rightarrow S(l)$$

The following observations are recorded:

1. When Q^+ is added to P^{2+}, no reaction occurs.
2. When R^{3+} is added to P, the beaker becomes warmer.
3. When S^+ is added to Q, gas bubbles are observed.

Rank the four substances in increasing reductant strength.

$R < P < S < Q$

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Question 21 (4 marks)

A scientist is given five metals and 1 *M* solutions of their nitrates.

The metals are labelled A, B, C, D, and E and the solutions are labelled A^{2+}, B^{2+}, C^{2+}, D^{2+}, and E^{2+}.

The scientist carries out several experiments, and the results obtained are as follows:

1. When metal A is dipped into all solutions, it reacts vigorously with D^{2+} and E^{2+}, but no reaction occurs with B^{2+} or C^{2+}.
2. When metal D is dipped into all solutions, it reacts only with E^{2+}.
3. Metal C, when dipped into solutions, reacts with B^{2+} but not with A^{2+}.
4. B^{2+} reacts with metal E, but no reaction occurs when B^{2+} is added to C.

a. State the strongest oxidant and reductant. (2 marks)

B^{2+} → Oxidant
E → Reductant

b. Rank the metals in terms of decreasing $E°$ values. (2 marks)

B > C > A > D > E

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