

A level Chemistry A

H432/01 Periodic table, elements and physical chemistry

Question Set 14

1. (a) This question is about some reactions of d block elements and their ions.

Table 1.1 shows standard electrode potentials which will be needed within this question.

$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^{-}$	\rightleftharpoons	$\text{Zn}(\text{s})$	$E^{\ominus} = -0.76 \text{ V}$
$\text{Cr}^{3+}(\text{aq}) + \text{e}^{-}$	\rightleftharpoons	$\text{Cr}^{2+}(\text{aq})$	$E^{\ominus} = -0.42 \text{ V}$
$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^{-}$	\rightleftharpoons	$\text{Ni}(\text{s})$	$E^{\ominus} = -0.25 \text{ V}$
$\text{I}_2(\text{aq}) + 2\text{e}^{-}$	\rightleftharpoons	$2\text{I}^{-}(\text{aq})$	$E^{\ominus} = +0.54 \text{ V}$
$\text{Fe}^{3+}(\text{aq}) + \text{e}^{-}$	\rightleftharpoons	$\text{Fe}^{2+}(\text{aq})$	$E^{\ominus} = +0.77 \text{ V}$
$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^{+}(\text{aq}) + 6\text{e}^{-}$	\rightleftharpoons	$2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	$E^{\ominus} = +1.33 \text{ V}$
$\text{H}_2\text{O}_2(\text{aq}) + 2\text{H}^{+}(\text{aq}) + 2\text{e}^{-}$	\rightleftharpoons	$2\text{H}_2\text{O}(\text{l})$	$E^{\ominus} = +1.78 \text{ V}$

Table 1.1

Complete the electron configuration of

a Ni atom: $1s^2$

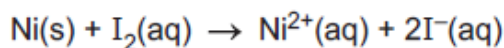
.....

a Ni^{2+} ion: $1s^2$

.....

[2]

(b) (i) A standard cell is set up in the laboratory with the cell reaction shown below.



Draw a labelled diagram to show how this cell could be set up to measure its standard cell potential.

Include details of apparatus, solutions and the standard conditions required.

Standard conditions

.....

[4]

(ii) Predict the standard cell potential of this cell.

standard cell potential = V

[1]

- (c) (i) Use the information in **Table 1.1** to help you answer both parts of this question.

Write the overall equation for the oxidation of Fe^{2+} by acidified H_2O_2 .

[1]

- (ii) Zinc reacts with acidified $\text{Cr}_2\text{O}_7^{2-}$ ions to form Cr^{2+} ions in two stages.

Explain why this happens in terms of electrode potentials and equilibria.

Include overall equations for the reactions which occur.

[4]

- (d)* Three different reactions of copper compounds are described below.

Reaction 1: Aqueous copper(II) sulfate reacts with excess aqueous ammonia in a ligand substitution reaction. A deep-blue solution is formed, containing an octahedral complex ion, **C**, which is a *trans* isomer.

Reaction 2: Copper(I) oxide reacts with hot dilute sulfuric acid in a disproportionation reaction. A blue solution, **D**, and a brown solid, **E** are formed.

Reaction 3: Copper(II) oxide reacts with warm dilute nitric acid in a neutralisation reaction, to form a blue solution. Unreacted copper(II) oxide is filtered off, and the solution is left overnight in an evaporating basin.

A hydrated salt, **F**, crystallises, with the percentage composition by mass: Cu, 26.29%; H, 2.48%; N, 11.59%; O, 59.63%.

Identify **C–F** by formulae or structures, as appropriate.

Include equations, any changes in oxidation number, and working.

[6]

Total Marks for Question Set 14: 18

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