OCR
Oxford Cambridge and RSA

A Level Chemistry B (Salters)

H433/01 Fundamentals of chemistry

Question Set 20

1 (a) A company was investigating the corrosion of metal parts used in oil rigs in the North Sea.

Chemists took two identical bolts.
One was unused and the other had been exposed to the seawater for several weeks. They reacted each bolt with dilute sulfuric acid. All the unreacted ironwas converted to $Fe^{2+}(aq)$ ions and the rust reacted to form $Fe^{3+}(aq)$.

Describe how the chemists would dissolve one bolt and make the solution up to 1.00 dm^3. **[2]**

(b) The chemists then titrated 10.0 cm^3 portions of their solutions with a solution of 0.200 mol dm^{-3} potassium manganate(VII).

The MnO_4^- ions oxidise the Fe^{2+} to Fe^{3+} and the Fe^{3+} ions do not react.The equation for the reaction is given below.

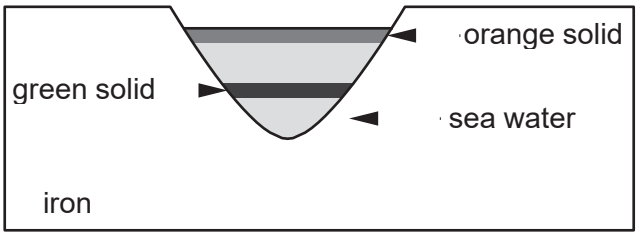
$MnO_4^- + 5\ Fe^{2+} + \ 8H^+ \rightarrow Mn^{2+} + 5\ Fe^{3+} + 4H_2O$

Use the titration results below to find the mass of the bolt that had rusted away.

Type of bolt	**Average volume of 0.200 mol dm^{-3} $KMnO_4$ used in the titration / cm^3**
Unused bolt	17.92
Rusted bolt	9.75

mass of bolt that had rusted away = …….. g **[3]**

(c) (i) The iron rusted in small dips in the surface. The chemists noticed a green solid that turned orange at the surface of the water.



Give the half-equations for the processes occurring during the rusting. **[2]**

(ii) What are the **formulae** of the green and orange solids?

Green solid .....

Orange solid .....

[1]

(iii) Suggest why rusting takes place faster in seawater than in rainwater. **[1]**

(d) Give the electron configuration of the Fe^{2+} ion.

[1]

(e) The chemists investigated making the bolts from a nickel-copper alloy that has high strength andresistance to corrosion.

They reacted the alloy with sulfuric acid and filtered off the unreacted solid, which they found was copper.

Use the electrode potentials in the table below to explain why only the nickel reacts.

Half reaction	$E^{\ominus}$ / V
$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	– 0.25
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.00
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+ 0.34

[2]

(f) (i) The solution they obtained was green due to $[Ni(H_2O)_6]^{2+}$. The chemists added some $EDTA^{4-}$solution and the colour changed to blue. $EDTA^{4-}$ is a polydentate ligand.

Suggest why the colour changes as the $EDTA^{4-}$ is added and name the type of reactiontaking place.

[1]

(f) (ii) In a separate experiment, 25.0 cm^3 of a 0.250 mol dm^{-3} $[Ni(H_2O)_6]^{2+}$ solution is found to react exactly with 41.7 cm^3 of 0.150 mol dm^{-3} $EDTA^{4-}$ solution.

Calculate the formula of the complex ion that nickel forms with $EDTA^{4-}$.

formula of the complex ion: **[2]**

Total Marks for Question Set 20: 15