

Name of the Student: _____

Max. Marks : 19 Marks

Time : 19 Minutes

Q1.

Use the standard electrode potential data in the table below to answer the questions which follow.

		$E^\ominus / \text{V}$
$\text{Ce}^{4+}(\text{aq}) + \text{e}^-$	$\rightleftharpoons$	$\text{Ce}^{3+}(\text{aq})$ +1.70
$\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^-$	$\rightleftharpoons$	$\text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$ +1.51
$\text{Cl}_2(\text{g}) + 2\text{e}^-$	$\rightleftharpoons$	$2\text{Cl}^-(\text{aq})$ +1.36
$\text{VO}_2^+(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{e}^-$	$\rightleftharpoons$	$\text{VO}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ +1.00
$\text{Fe}^{3+}(\text{aq}) + \text{e}^-$	$\rightleftharpoons$	$\text{Fe}^{2+}(\text{aq})$ +0.77
$\text{SO}_4^{2-}(\text{aq}) + 4\text{H}^+(\text{aq}) + 2\text{e}^-$	$\rightleftharpoons$	$\text{H}_2\text{SO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$ +0.17

- (a) Name the standard reference electrode against which all other electrode potentials are measured.

(1)

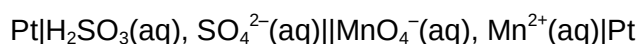
- (b) When the standard electrode potential for $\text{Fe}^{3+}(\text{aq}) / \text{Fe}^{2+}(\text{aq})$ is measured, a platinum electrode is required.

- (i) What is the function of the platinum electrode?

- (ii) What are the standard conditions which apply to $\text{Fe}^{3+}(\text{aq})/\text{Fe}^{2+}(\text{aq})$ when measuring this potential?

(3)

- (c) The cell represented below was set up under standard conditions.



Calculate the e.m.f. of this cell and write an equation for the spontaneous cell reaction.

Cell e.m.f. _____

Equation _____

(3)

- (d) (i) Which one of the species given in the table is the strongest oxidising agent?

- (ii) Which of the species in the table could convert $\text{Fe}^{2+}(\text{aq})$ into $\text{Fe}^{3+}(\text{aq})$ but could not convert $\text{Mn}^{2+}(\text{aq})$ into $\text{MnO}_4^{-}(\text{aq})$?

(3)

- (e) Use data from the table of standard electrode potentials to deduce the cell which would have a standard e.m.f. of 0.93 V. Represent this cell using the convention shown in part (c).

(2)

(Total 12 marks)

Q2.

Large blocks of magnesium are bolted onto the hulls of iron ships in an attempt to prevent the iron being converted into iron(II), one of the steps in the rusting process.

Use the data below, where appropriate, to answer the questions which follow.

		$E^\ominus / \text{V}$
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^-$		$\text{Mg}(\text{s})$ -2.37
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$		$\text{Fe}(\text{s})$ -0.44
$\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^-$		$4\text{OH}^-(\text{aq})$ $+0.40$

- (a) Calculate the e.m.f. of the cell represented by $\text{Mg}(\text{s})|\text{Mg}^{2+}(\text{aq})||\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$ under standard conditions. Write a half-equation for the reaction occurring at the negative electrode of this cell when a current is drawn.

Cell e.m.f. _____

Half-equation _____

(2)

- (b) Deduce how the e.m.f. of the cell $\text{Mg}(\text{s})|\text{Mg}^{2+}(\text{aq})||\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$ changes when the concentration of Mg^{2+} is decreased. Explain your answer.

Change in e.m.f. _____

Explanation _____

(3)

- (c) Calculate a value for the e.m.f. of the cell represented by $\text{Pt}(\text{s})|\text{OH}^-(\text{aq})|\text{O}_2(\text{g})||\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$ and use it to explain why iron corrodes when in contact with water which contains dissolved oxygen.

Cell e.m.f. _____

Explanation _____

(2)

(Total 7 marks)