A-Level Chemistry

Electrochemical Cells (Multiple Choice)

Question Paper

Time available: 11 minutes
Marks available: 11 marks

1. The $E^{\ominus}$ values for two electrodes are shown.

$$Fe^{2+}(aq) + 2\ e^- \rightarrow Fe(s)\ E^{\ominus} = -0.44\ V$$

$$Cu^{2+}(aq) + 2\ e^- \rightarrow Cu(s)\ E^{\ominus} = +0.34\ V$$

What is the EMF of the cell $Fe(s)|Fe^{2+}(aq)||Cu^{2+}(aq)|Cu(s)$?

A +0.78 V ⬭

B +0.10 V ⬭

C −0.10 V ⬭

D −0.78 V ⬭

(Total 1 mark)

2. Which ion **cannot** catalyse the reaction between iodide (I^-) and peroxodisulfate ($S_2O_8^{2-}$)?

Use the data below to help you answer this question.

Half-equation	$E^{\ominus}$ **/ V**
$S_2O_8^{2-} + 2e^- \rightarrow 2SO_4^{2-}$	+2.01
$Co^{3+} + e^- \rightarrow Co^{2+}$	+1.82
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	+0.77
$I_2 + 2e^- \rightarrow 2I^-$	+0.54
$Cr^{3+} + e^- \rightarrow Cr^{2+}$	–0.41

A Co^{2+} ⬭

B Cr^{2+} ⬭

C Fe^{2+} ⬭

D Fe^{3+} ⬭

(Total 1 mark)

3. The following cell has an EMF of +0.46 V.

$$Cu \mid Cu^{2+} \mid\mid Ag^{+} \mid Ag$$

Which statement is correct about the operation of the cell?

A Metallic copper is oxidised by Ag^{+} ions. ⬭

B The silver electrode has a negative polarity. ⬭

C The silver electrode gradually dissolves to form Ag^{+} ions. ⬭

D Electrons flow from the silver electrode to the copper electrode via an external circuit. ⬭

(Total 1 mark)

4. In this question consider the data below.

	$E^{\ominus}$ / V
$Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$	+0.80
$2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$	0.00
$Pb^{2+}(aq) + 2e^{-} \rightarrow Pb(s)$	−0.13

The e.m.f. of the cell $Ag(s) \mid Ag^{+}(aq) \parallel Pb^{2+}(aq) \mid Pb(s)$ is

A 0.93 V

B 0.67 V

C −0.67 V

D −0.93 V

(Total 1 mark)

5. In this question consider the data below.

	$E^{\ominus}$ / V
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.80
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.00
$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	−0.13

The e.m.f. of the cell Pt(s) | $H_2(g)$ | $H^+(aq)$ || $Ag^+(aq)$ | Ag(s) would be increased by

A increasing the concentration of $H^+(aq)$.

B increasing the surface area of the Pt electrode.

C increasing the concentration of $Ag^+(aq)$.

D decreasing the pressure of $H_2(g)$.

(Total 1 mark)

6. A disproportionation reaction occurs when a species $\mathbf{M}^+$ spontaneously undergoes simultaneous oxidation and reduction.

$$2M^+(aq) \rightarrow M^{2+}(aq) + M(s)$$

The table below contains $E^{\ominus}$ data for copper and mercury species.

	$E^{\ominus}$ / V
$Cu^{2+}(aq) + e^- \rightarrow Cu^+(aq)$	+ 0.15
$Cu^+(aq) + e^- \rightarrow Cu(s)$	+ 0.52
$Hg^{2+}(aq) + e^- \rightarrow Hg^+(aq)$	+ 0.91
$Hg^+(aq) + e^- \rightarrow Hg(l)$	+ 0.80

Using these data, which one of the following can be predicted?

A Both Cu(I) and Hg(I) undergo disproportionation.

B Only Cu(I) undergoes disproportionation.

C Only Hg(I) undergoes disproportionation.

D Neither Cu(I) nor Hg(I) undergoes disproportionation.

(Total 1 mark)

7.

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ $E^\ominus = +1.33$ V

$Br_2(aq) + 2e^- \rightarrow 2Br^-(aq)$ $E^\ominus = +1.09$ V

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$ $E^\ominus = +0.77$ V

$VO^{2+}(aq) + 2H^+(aq) + e^- \rightarrow V^{3+}(aq) + H_2O(l)$ $E^\ominus = +0.34$ V

$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow H_2SO_3(aq) + H_2O(l)$ $E^\ominus = +0.17$ V

Based on the above data, which one of the following could reduce 0.012 mol of bromine to bromide ions?

A 40 cm^3 of a 0.10 mol dm^{-3} solution of $Cr_2O_7^{2-}(aq)$

B 80 cm^3 of a 0.30 mol dm^{-3} solution of $Fe^{3+}(aq)$

C 50 cm^3 of a 0.24 mol dm^{-3} solution of $V^{3+}(aq)$

D 50 cm^3 of a 0.24 mol dm^{-3} solution of $H_2SO_3(aq)$

(Total 1 mark)

8. Use the data in the table below to answer this question.

	$E^\ominus$ / V
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$	+ 1.52
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$	+ 1.33
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$	+ 0.77
$Cr^{3+}(aq) + e^- \rightarrow Cr^{2+}(aq)$	− 0.41
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	− 0.76

The most powerful oxidising agent in the table is

A $Mn^{2+}(aq)$

B Zn(s)

C $MnO_4^-(aq)$

D $Zn^{2+}(aq)$

(Total 1 mark)

9. Use the data in the table below to answer this question.

	$E^{\ominus}$ / V
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$	+ 1.52
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$	+ 1.33
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$	+ 0.77
$Cr^{3+}(aq) + e^- \rightarrow Cr^{2+}(aq)$	− 0.41
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	− 0.76

Which one of the following statements is **not** correct?

A $Fe^{2+}(aq)$ can reduce acidified $MnO_4^-(aq)$ to $Mn^{2+}(aq)$

B $CrO_7^{2-}(aq)$ can oxidise acidified $Fe^{2+}(aq)$ to $Fe^{3+}(aq)$

C Zn(s) can reduce acidified $Cr_2O_7^{2-}(aq)$ to $Cr^{2+}(aq)$

D $Fe^{2+}(aq)$ can reduce acidified $Cr^{3+}(aq)$ to $Cr^{2+}(aq)$

(Total 1 mark)

10. Which change to a hydrogen electrode has **no** effect on the electrode potential?

A the concentration of the hydrogen ions ⬭

B the pressure of the hydrogen ⬭

C the surface area of the platinum electrode ⬭

D the temperature of the acid ⬭

(Total 1 mark)

11. Some electrode potential data are shown.

$Zn^{2+}(aq) + 2\ e^- \rightarrow Zn(s)$ $\quad E^{\ominus} = -0.76$ V

$Pb^{2+}(aq) + 2\ e^- \rightarrow Pb(s)$ $\quad E^{\ominus} = -0.13$ V

Which is a correct statement about this cell?

$Zn(s)|Zn^{2+}(aq)\|Pb^{2+}(aq)|Pb(s)$

A Electrons travel in the external circuit from zinc to lead. ⬭

B The concentration of lead(II) ions increases. ⬭

C The maximum EMF of the cell is 0.89 V ⬭

D Zinc is deposited. ⬭

(Total 1 mark)