



# **A-Level Chemistry**

## **Electrochemical Cells (Multiple Choice)**

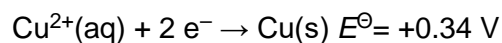
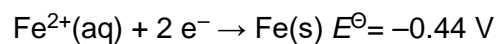
### **Question Paper**

**Time available: 11 minutes**

**Marks available: 11 marks**

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



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

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 ( $\text{I}^-$ ) and peroxodisulfate ( $\text{S}_2\text{O}_8^{2-}$ )?

Use the data below to help you answer this question.

Half-equation	$E^\ominus / \text{V}$
$\text{S}_2\text{O}_8^{2-} + 2\text{e}^- \rightarrow 2\text{SO}_4^{2-}$	+2.01
$\text{Co}^{3+} + \text{e}^- \rightarrow \text{Co}^{2+}$	+1.82
$\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}$	+0.77
$\text{I}_2 + 2\text{e}^- \rightarrow 2\text{I}^-$	+0.54
$\text{Cr}^{3+} + \text{e}^- \rightarrow \text{Cr}^{2+}$	-0.41

A  $\text{Co}^{2+}$

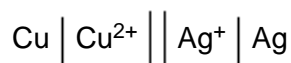
B  $\text{Cr}^{2+}$

C  $\text{Fe}^{2+}$

D  $\text{Fe}^{3+}$

(Total 1 mark)

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



Which statement is correct about the operation of the cell?

- A Metallic copper is oxidised by  $\text{Ag}^+$  ions.
- B The silver electrode has a negative polarity.
- C The silver electrode gradually dissolves to form  $\text{Ag}^+$  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.

	$E^\ominus / \text{V}$
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.80
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	0.00
$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Pb}(\text{s})$	-0.13

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

	$E^{\ominus} / \text{V}$
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.80
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	0.00
$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Pb}(\text{s})$	-0.13

The e.m.f. of the cell  $\text{Pt}(\text{s}) | \text{H}_2(\text{g}) | \text{H}^+(\text{aq}) || \text{Ag}^+(\text{aq}) | \text{Ag}(\text{s})$  would be increased by

- A increasing the concentration of  $\text{H}^+(\text{aq})$ .
- B increasing the surface area of the Pt electrode.
- C increasing the concentration of  $\text{Ag}^+(\text{aq})$ .
- D decreasing the pressure of  $\text{H}_2(\text{g})$ .

(Total 1 mark)

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



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

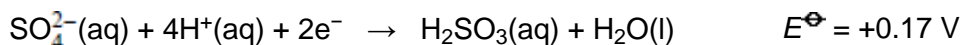
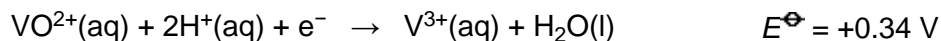
	$E^{\ominus} / \text{V}$
$\text{Cu}^{2+}(\text{aq}) + \text{e}^- \rightarrow \text{Cu}^+(\text{aq})$	+ 0.15
$\text{Cu}^+(\text{aq}) + \text{e}^- \rightarrow \text{Cu}(\text{s})$	+ 0.52
$\text{Hg}^{2+}(\text{aq}) + \text{e}^- \rightarrow \text{Hg}^+(\text{aq})$	+ 0.91
$\text{Hg}^+(\text{aq}) + \text{e}^-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

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

- A Both  $\text{Cu}(\text{l})$  and  $\text{Hg}(\text{l})$  undergo disproportionation.
- B Only  $\text{Cu}(\text{l})$  undergoes disproportionation.
- C Only  $\text{Hg}(\text{l})$  undergoes disproportionation.
- D Neither  $\text{Cu}(\text{l})$  nor  $\text{Hg}(\text{l})$  undergoes disproportionation.

(Total 1 mark)

7.



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

- A 40 cm<sup>3</sup> of a 0.10 mol dm<sup>-3</sup> solution of Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup>(aq)
- B 80 cm<sup>3</sup> of a 0.30 mol dm<sup>-3</sup> solution of Fe<sup>3+</sup>(aq)
- C 50 cm<sup>3</sup> of a 0.24 mol dm<sup>-3</sup> solution of V<sup>3+</sup>(aq)
- D 50 cm<sup>3</sup> of a 0.24 mol dm<sup>-3</sup> solution of H<sub>2</sub>SO<sub>3</sub>(aq)

(Total 1 mark)

8.

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

	$E^\ominus / \text{V}$
$\text{MnO}_4^- (\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \rightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	+ 1.52
$\text{Cr}_2\text{O}_7^{2-} (\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	+ 1.33
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+ 0.77
$\text{Cr}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Cr}^{2+}(\text{aq})$	- 0.41
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$	- 0.76

The most powerful oxidising agent in the table is

- A Mn<sup>2+</sup>(aq)
- B Zn(s)
- C MnO<sub>4</sub><sup>-</sup>(aq)
- D Zn<sup>2+</sup>(aq)

(Total 1 mark)

**9.**

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

	$E^\ominus / \text{V}$
$\text{MnO}_4^- (\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \rightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	+ 1.52
$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	+ 1.33
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+ 0.77
$\text{Cr}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Cr}^{2+}(\text{aq})$	- 0.41
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn}(\text{s})$	- 0.76

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

- A**  $\text{Fe}^{2+}(\text{aq})$  can reduce acidified  $\text{MnO}_4^- (\text{aq})$  to  $\text{Mn}^{2+}(\text{aq})$
- B**  $\text{CrO}_7^{2-}(\text{aq})$  can oxidise acidified  $\text{Fe}^{2+}(\text{aq})$  to  $\text{Fe}^{3+}(\text{aq})$
- C**  $\text{Zn}(\text{s})$  can reduce acidified  $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$  to  $\text{Cr}^{2+}(\text{aq})$
- D**  $\text{Fe}^{2+}(\text{aq})$  can reduce acidified  $\text{Cr}^{3+}(\text{aq})$  to  $\text{Cr}^{2+}(\text{aq})$

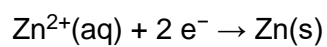
**(Total 1 mark)****10.**Which change to a hydrogen electrode has **no** effect on the electrode potential?

- 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

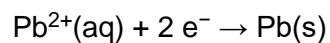
**(Total 1 mark)**

**11.**

Some electrode potential data are shown.

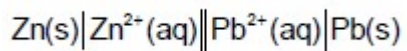


$$E^{\ominus} = -0.76 \text{ V}$$



$$E^{\ominus} = -0.13 \text{ V}$$

Which is a correct statement about this cell?

**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)**