**Q1.** The following cell has an EMF of +0.46 V.

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

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)**

**Q2.** 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)**

**Q3.** 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 $Pt(s) \mid H_2(g) \mid H^+(aq) \mid\mid Ag^+(aq) \mid Ag(s)$ 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)**

**Q4.** A disproportionation reaction occurs when a species $M^+$ 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)**

**Q5.**

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

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

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

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

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

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 $V^{3+}(aq)$

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

**(Total 1 mark)**

**Q6.** 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)**

**Q7.** 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)**