**Chapter 7**

1. In which of the following compounds is sulfur in its highest oxidation state?
   - A. CuSO$_4$
   - B. Na$_2$SO$_3$
   - C. H$_2$S
   - D. SO$_2$

2. Iodide ions react with iodate(V) ions in acidic solution:

   \[ 5\text{I}^- (aq) + \text{IO}_3^- (aq) + 6\text{H}^+ (aq) \rightarrow 3\text{I}_2 (aq) + 3\text{H}_2\text{O}(l) \]

   Which one of the following statements about this reaction is correct?
   - A. The I$^-$ ions act as an oxidising agent
   - B. The iodine in the IO$_3^-$ ions changes in oxidation number from −5 to 0
   - C. The IO$_3^-$ ions act as an oxidising agent
   - D. The oxidation number of the hydrogen changes from 0 to +1
3 Manganate(VII) ions react with bromide ions in acidic solution:

\[ 2\text{MnO}_4^- (aq) + 10\text{Br}^- (aq) + 16\text{H}^+ (aq) \rightarrow 2\text{Mn}^{2+} (aq) + 5\text{Br}_2 (aq) + 8\text{H}_2\text{O}(l) \]

Which one of the following half-equations relating to this reaction is correct?

A \[ 2\text{MnO}_4^- (aq) + 8\text{H}^+ (aq) \rightarrow 2\text{Mn}^{2+} (aq) + 4\text{H}_2\text{O}(l) + 5e^- \]

B \[ \text{MnO}_4^- (aq) + 8\text{H}^+ (aq) + 5e^- \rightarrow \text{Mn}^{2+} (aq) + 4\text{H}_2\text{O}(l) \]

C \[ 5\text{Br}^- (aq) \rightarrow 5\text{Br}_2 (aq) + 5e^- \]

D \[ 2\text{MnO}_4^- (aq) + 8\text{H}^+ (aq) + 2e^- \rightarrow 2\text{Mn}^{2+} (aq) + 4\text{H}_2\text{O}(l) \]

4 When a car battery is charged, the following reaction occurs:

\[ 2\text{Pb}^{2+} (aq) + 2\text{H}_2\text{O}(l) \rightarrow \text{Pb}(s) + \text{PbO}_2 (s) + 4\text{H}^+ (aq) \]

Which one of the following statements about this reaction is correct?

A Water is acting as an oxidising agent

B The oxidation number of each oxygen atom changes from −2 to −1

C The hydrogen atoms in the water lose electrons to become \( \text{H}^+ \) ions

D \( \text{Pb}^{2+} \) ions are both oxidised and reduced during the reaction
5 Which one of the following is named **incorrectly**?

A $\text{Cl}_2\text{O}_7$, chlorine(VII) oxide  
B $\text{CuCl}$, copper(I) chloride  
C $\text{VO}^{2+}$, vanadate(IV) ion  
D $\text{MnO}_4^{2-}$, manganate(VII) ion

6 Which one of the following statements about the redox reactions taking place during the electrolysis of molten sodium chloride is correct?

A When the cations reach the cathode they gain electrons  
B Anions are reduced at the anode  
C Cations are oxidised at the cathode  
D When anions reach the anode they gain electrons

7 Which one of the following statements about the extraction of aluminium by electrolysis is correct?

A At the cathode, oxide ions are reduced to oxygen  
B Aluminium metal is removed from the surface of the electrolyte  
C Aluminium ions gain electrons at the cathode  
D The electrolyte is pure molten aluminium oxide
The diagram shows a diaphragm cell used to electrolyse concentrated brine. The letters A, B and C show the places where the products of electrolysis are removed.

Which one of the following statements about the products of this electrolysis is completely correct?

A  Oxygen is removed at A, hydrogen is removed at B and sodium hydroxide is removed at C

B  Hydrogen is removed at A, chlorine is removed at B and sodium hydroxide is removed at C

C  Chlorine is removed at A, hydrogen is removed at B and sodium is removed at C

D  Chlorine is removed at A, hydrogen is removed at B and sodium hydroxide is removed at C
9 Four half-reactions (1–4) are shown below.

1 \[ 2\text{Cl}^- \rightarrow \text{Cl}_2 + 2e^- \]

2 \[ 4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4e^- \]

3 \[ 2\text{O}^{2-} \rightarrow \text{O}_2 + 4e^- \]

4 \[ 2\text{H}^+ + 2e^- \rightarrow \text{H}_2 \]

Which two of these reactions are most likely to occur when concentrated brine is electrolysed?

A 1 and 2  
B 1 and 4  
C 2 and 3  
D 2 and 4  

10 Copper is purified by electrolysis of copper(II) sulfate solution using copper electrodes. Which one of these statements about this electrolysis is correct?

A At the anode, Cu$^{2+}$ ions lose electrons  
B At the cathode, Cu atoms lose electrons  
C At the anode, Cu atoms lose electrons  
D At the anode Cu$^{2+}$ ions gain electrons