HL Paper 1

A reaction takes place when a rechargeable battery is used:

 $Pb(s) + PbO_2(s) + 4H^+(aq) + 2SO_4^{2-}(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

Which statements are correct?

- I. H⁺ is reduced
 - II. The oxidation state of Pb metal changes from 0 to +2
 - III. PbO₂ is the oxidising agent
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Which statement is correct for a voltaic but not for an electrolytic cell?

- A. An electrolyte is required.
- B. The anode is where oxidation occurs.
- C. Ions move in the electrolyte.
- D. Electrons flow from the negative electrode to the positive electrode.

Which element is reduced in the following decomposition?

A.	Ν
В.	н
C.	Cr
D.	0

Which change represents oxidation?

- A. HCIO₄ to HCIO₃
- B. N₂ to NH₃
- C. N₂O to NO
- D. SO_4^{2-} to SO_3^{2-}

What is the correct order of reaction types in the following sequence?

$C_{3}H_{7}Br \xrightarrow{\mathbf{I}} C_{3}H_{7}OH \xrightarrow{\mathbf{II}} C_{2}H_{5}COOH \xrightarrow{\mathbf{III}} C_{2}H_{5}COOC_{2}H_{5}$

	I	п	III
A.	substitution	oxidation	condensation
B.	addition	substitution	condensation
C.	oxidation	substitution	condensation
D.	substitution	oxidation	substitution

What is the name of MnO_2 ?

- A. Manganese(II) oxide
- B. Magnesium(II) oxide
- C. Manganese(IV) oxide
- D. Magnesium(IV) oxide

The following equations indicate reactions that occur spontaneously.

Which is the increasing order of the reactivity of the metals?

- $\label{eq:A.Fe} \mathsf{A.} \quad \mathrm{Fe} < \mathrm{Ni} < \mathrm{Zn} < \mathrm{Pb}$
- $\mathsf{B}. \quad \mathsf{Pb} < \mathsf{Ni} < \mathsf{Fe} < \mathsf{Zn}$
- $\label{eq:classical_constraint} \textbf{C}. \quad Ni < Zn < Pb < Fe$
- $\mathsf{D.} \quad \mathrm{Zn} < \mathrm{Fe} < \mathrm{Ni} < \mathrm{Pb}$

Consider the following half-equations:

 $\begin{array}{ll} \mathsf{I}_2 \left(\mathsf{s} \right) + 2\mathsf{e}^- \rightleftharpoons 2\mathsf{I}^- \left(\mathsf{aq} \right) & E^\theta = +0.54 \text{ V} \\ (\mathsf{brown}) & (\mathsf{colourless}) \\ \\ \mathsf{MnO}_4^- \left(\mathsf{aq} \right) + 8\mathsf{H}^+ \left(\mathsf{aq} \right) + 5\mathsf{e}^- \rightleftharpoons \mathsf{Mn}^{2+} \left(\mathsf{aq} \right) + 4\mathsf{H}_2\mathsf{O} \left(\mathsf{I} \right) & E^\theta = +1.51 \text{ V} \\ (\mathsf{purple}) & (\mathsf{colourless}) \end{array}$

Which statement is correct for the reaction between KMnO₄ (aq) and KI (aq) in acidic conditions?

A. MnO_4^- reduces I^- to I_2 .

- B. I⁻ reduces MnO_4^- to Mn^{2+} .
- C. The colour changes from brown to purple.
- D. MnO_4^- is oxidized to Mn^{2+} .

Which is a redox reaction?

- $\label{eq:cucl_state} \text{A.} \quad \left[\mathrm{Cu}(\mathrm{H}_2\mathrm{O})_4\right]^{2+}(\mathrm{aq}) + 4\mathrm{Cl}^-(\mathrm{aq}) \rightarrow \left[\mathrm{Cu}\mathrm{Cl}_4\right]^{2-}(\mathrm{aq}) + 4\mathrm{H}_2\mathrm{O}(\mathrm{l})$
- ${\sf B}. \quad {\rm Ag}^+({\rm aq}) + {\rm Cl}^-({\rm aq}) \to {\rm AgCl}(s)$
- $\text{C.} \quad \operatorname{Zn}(s) + 2 \mathrm{HCl}(\mathrm{aq}) \to \operatorname{ZnCl}_2(\mathrm{aq}) + \mathrm{H}_2(g)$
- $\label{eq:cross} \text{D.} \quad 2\mathrm{K}_2\mathrm{CrO}_4(\mathrm{aq}) + 2\mathrm{HCl}(\mathrm{aq}) \rightarrow \mathrm{K}_2\mathrm{Cr}_2\mathrm{O}_7(\mathrm{aq}) + \mathrm{H}_2\mathrm{O}(\mathrm{l}) + 2\mathrm{KCl}(\mathrm{aq})$

Applying IUPAC rules, what is the name of MnO₂?

- A. Magnesium(II) oxide
- B. Manganese(II) oxide
- C. Magnesium(IV) oxide
- D. Manganese(IV) oxide

Consider the following reaction.

$${
m MnO}_4^-({
m aq}) + 8{
m H}^+({
m aq}) + 5{
m Fe}^{2+}({
m aq}) o {
m Mn}^{2+}({
m aq}) + 5{
m Fe}^{3+}({
m aq}) + 4{
m H}_2{
m O}({
m l})$$

Which statement is correct?

- A. MnO_4^- is the oxidizing agent and it loses electrons.
- B. MnO_4^- is the reducing agent and it loses electrons.
- C. MnO_4^- is the oxidizing agent and it gains electrons.
- D. MnO_4^- is the reducing agent and it gains electrons.

Which species are the oxidizing and reducing agents in the following reaction?

$$\mathrm{SO}_3^{2-}(\mathrm{aq}) + \mathrm{PbO}_2(\mathrm{s}) + \mathrm{H}_2\mathrm{O}(\mathrm{l}) o \mathrm{SO}_4^{2-}(\mathrm{aq}) + \mathrm{Pb}(\mathrm{OH})_2(\mathrm{s})$$

	Oxidizing agent	Reducing agent
A.	PbO ₂	H_2O
B.	SO ₃ ²⁻	PbO ₂
C.	H ₂ O	SO3 ²⁻
D.	PbO ₂	SO3 ²⁻

Which compounds can be reduced?

- I. C₂H₄
- II. CH₃COOH
- III. CH₃CHO
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Which species are produced at each electrode during the electrolysis of molten lead(II) bromide, $PbBr_2(l)$?

	Negative electrode (cathode)	Positive electrode (anode)
Α.	Br ⁻ (1)	Pb ²⁺ (1)
B.	Pb ²⁺ (1)	Br ⁻ (1)
C.	$Br_2(g)$	Pb (1)
D.	Pb (1)	Br ₂ (g)

Which are correct statements about a voltaic cell?

- I. A spontaneous redox reaction occurs which converts chemical energy to electrical energy.
- II. Oxidation occurs at the negative electrode (anode).
- III. Electricity is conducted by the movement of electrons through the salt bridge.
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Consider the following reaction.

$$2\mathrm{Cr(OH)}_3(\mathrm{s}) + 6\mathrm{ClO}^-(\mathrm{aq}) \rightarrow 2\mathrm{CrO}_4^{2-}(\mathrm{aq}) + 3\mathrm{Cl}_2(\mathrm{g}) + 2\mathrm{OH}^-(\mathrm{aq}) + 2\mathrm{H}_2\mathrm{O}(\mathrm{l})$$

Which statement is correct?

A. $Cr(OH)_3$ is the oxidizing agent and the oxidation number of chromium changes from +3 to +6.

- B. $Cr(OH)_3$ is the reducing agent and undergoes reduction.
- C. ${\rm ClO}^-$ is the oxidizing agent and the oxidation number of chlorine changes from +1 to 0.
- D. $\rm ClO^-$ is the reducing agent and the oxidation number of chlorine changes from –1 to 0.

Which represents a redox reaction?

- ${\sf B}.\quad {\rm CaCO}_3(s)\to {\rm CaO}(s)+{\rm CO}_2(g)$

In the electrolytic cell shown, at which electrode will chlorine form, and what is the process taking place there?



	Electrode	Process
Α.	Р	reduction
В.	Q	reduction
C.	Р	oxidation
D.	Q	oxidation

Which compound contains nitrogen with an oxidation number of +3?

- A. NH₄Cl
- B. HNO₃
- C. N₂O₄
- D. KNO₂