O

10 Oxidation and Reduction

For each question, choose the most suitable option and write the letter (**A**, **B**, **C** or **D**) in the brackets provided.

Level 1

1. Sulfur dioxide is a reducing agent. Which of the following can be used to identify sulfur dioxide?

   A Acidified potassium iodide

   B Acidified potassium manganate(VII)

   C Dilute sodium hydroxide solution

   D Hydrogen peroxide ( )

Level 2

2. What are the oxidation states of hydrogen and oxygen in hydrogen peroxide, H_2O_2?

	Oxidation State of Hydrogen	Oxidation State of Oxygen
A	+1	–1
B	+1	–2
C	–1	–1
D	–1	–2

( )

3. Which of the following is an example of a redox reaction?

   A $AgNO_3 + KBr \longrightarrow KNO_3 + AgBr$

   B $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

   C $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$

   D $HCl + NaOH \longrightarrow NaCl + H_2O$ ( )

4. Determine the oxidation state of vanadium in $K_2V_2O_5$.

   A +1 **B** +2

   C +4 **D** +5 ( )

5. In which reaction are I^- ions acting as the **reducing agent**?

   A $Ag^+ + I^- \longrightarrow AgI$ **B** $Cl_2 + 2I^- \longrightarrow I_2 + 2Cl^-$

   C $I_2 + 2Na \longrightarrow 2NaI$ **D** $2I^- + 2H^+ \longrightarrow 2HI$ ( )

6. The formation of water from its elements can be represented by the following equation.

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$$

Which of the following is **true** of this redox reaction?

A Hydrogen gains electrons to form water.

B Oxygen loses electrons to form water.

C The oxidation state of hydrogen increases from hydrogen gas to water.

D The oxidation state of oxygen increases from oxygen gas to water. ( )

7. Which of the following reactions shows the greatest **decrease** in oxidation state of the underlined element?

A $\underline{Cl}_2 + H_2O \longrightarrow H\underline{Cl} + H\underline{O}Cl$

B $2\underline{Mn}O_4^- + 8H^+ + 5Fe^{2+} \longrightarrow \underline{Mn}^{2+} + 4H_2O + 5Fe^{3+}$

C $2NaC\underline{l}O \longrightarrow NaC\underline{l}O_2 + NaC\underline{l}$

D $\underline{S} + O_2 \longrightarrow \underline{S}O_2$ ( )

8. Hydrogen peroxide is added to separate solutions of acidified potassium manganate(VII) and acidified potassium iodide.

Which of the following would be observed?

	Acidified Potassium Manganate(VII)	Acidified Potassium Iodide
A	Colourless solution turns purple.	Colourless solution turns brown.
B	No change is observed.	Brown solution decolourises.
C	Purple solution decolourises.	Brown solution decolourises.
D	Purple solution decolourises.	Colourless solution turns brown.

( )

9. When some iron filings are added into a solution of iron(III) chloride, the iron filings dissolved and the yellow solution turned green.

Which of the following are **true** of the reaction?

	Equation	Oxidised Species	Reduced Species
A	$Fe + 2Fe^{3+} \longrightarrow 3Fe^{2+}$	Fe^{2+}	Fe^{2+}
B	$Fe + 2Cl^- \longrightarrow FeCl_2$	Cl^-	Fe
C	$Fe + 2Fe^{3+} \longrightarrow 3Fe^{2+}$	Fe	Fe^{3+}
D	$Fe + Cl_2 \longrightarrow FeCl_2$	Fe	Cl_2

( )

Level 3

10. Chromium compounds can undergo the several stages of changes in a reaction.

$$CrO \longrightarrow CrO_2 \longrightarrow Cr_2O_3 \longrightarrow CrO_3 \longrightarrow Cr$$

In how many stages was chromium **oxidised** and what is the greatest **increase** in the oxidation state of chromium?

	Number of Stages Where Chromium was Oxidised	Greatest Increase in Oxidation State of Chromium
A	1	2
B	2	3
C	2	6
D	3	2

( )

11. The following equation shows the decomposition of hydrogen peroxide.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

Which of the following statements about the reaction is **correct**?

A Hydrogen is oxidised to form water.

B Oxygen is only oxidised to form oxygen gas.

C Oxygen is oxidised to form oxygen gas and reduced to form water.

D The decomposition of hydrogen peroxide is not a redox reaction. ( )

12. Potassium iodide reacts with sodium iodate(V) according to the following ionic equation.

$$5I^-(aq) + 6H^+(aq) + IO_3^-(aq) \longrightarrow 3I_2(aq) + 3H_2O(l)$$

Which of the following statements are **true**?

1 H^+ is reduced.

2 I^- is oxidised.

3 IO_3^- is the reducing agent.

4 The oxidation state of iodine decreases from +5 in IO_3^- to 0 in I_2.

5 The pH of the solution increases after some time.

A 1, 2 and 4 only

B 1, 3 and 5 only

C 2, 3 and 5 only

D 2, 4 and 5 only ( )

13. Iron(II) sulfate can be oxidised by acidified potassium manganate(VII).

The half-equations involved in this reaction are as follows.

$$5Fe^{2+}(aq) \longrightarrow 5Fe^{3+}(aq) + 5e^-$$

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$$

Which of the following statements is **incorrect** about the reaction?

A The colour of acidified potassium manganate(VII) changes from colourless to purple.

B The number of moles of electrons lost during oxidation is the same as the number of moles of electrons gained during reduction.

C The final colour of the reaction mixture is yellow.

D The overall ionic equation is
$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \longrightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$. ( )

14. When oxygen combines with Group 1 metals, oxides of different formulae can be formed.

Arrange the following oxides of rubidium in **ascending** order of the oxidation state of oxygen.

A RbO_2, Rb_2O, Rb_2O_2

B RbO_2, Rb_2O_2, Rb_2O

C Rb_2O, Rb_2O_2, RbO_2

D Rb_2O, RbO_2, Rb_2O_2 ( )

15. The following equations below represent the reactions between different Group 17 gases and their compounds.

$$Cl_2 + 2KBr \longrightarrow 2KCl + Br_2$$

$$Br_2 + 2KI \longrightarrow 2KBr + I_2$$

$$Br_2 + 2KCl \longrightarrow \text{no reaction}$$

$$I_2 + 2KBr \longrightarrow \text{no reaction}$$

Which of the following statements is **correct**?

A Bromine is a stronger oxidising agent than chlorine.

B Chlorine acts as a reducing agent when it forms KCl.

C Chlorine is a stronger oxidising agent than bromine.

D Potassium iodide cannot be oxidised by chlorine. ( )