Unit 6: Electrochemistry

Unit 6.1: Redox processes: electron transfer and changes in oxidation number (oxidation s

Topical Question No: 1

1 Which compound contains two different elements with identical oxidation states?

A $HClO$ **B** $Mg(OH)_2$ **C** Na_2SO_4 **D** NH_4Cl

Topical Question No: 2

8 $HOCl(aq)$ is the molecule that kills bacteria when chlorine is added to water.

The following reaction produces this molecule.

$$Cl_2(g) + H_2O(l) \rightleftharpoons HOCl(aq) + H^+(aq) + Cl^-(aq)$$

Which statement about this reaction is correct?

A Chlorine is both oxidised and reduced.

B Chlorine is oxidised but not reduced.

C Hydrogen is both oxidised and reduced.

D Hydrogen is oxidised but not reduced.

Topical Question No: 3

33 Which of these statements are always correct?

1 The sum of the oxidation numbers of all the atoms in a compound is zero.

2 The oxidation number of sodium in a salt is positive.

3 The oxidation number of chlorine in a compound is negative.

Topical Question No: 4

10 Which reaction is **not** a redox reaction?

A $Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

B $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$

C $SO_2 + NO_2 \rightarrow SO_3 + NO$

D $SO_3 + H_2O \rightarrow H_2SO_4$

Topical Question No: 5

17 Bromine is extracted from sea-water.

In the final stages of the process two redox reactions take place.

$$Br_2(aq) + SO_2(g) + 2H_2O(l) \rightarrow 2HBr(aq) + H_2SO_4(aq)$$

$$2HBr(aq) + Cl_2(g) \rightarrow Br_2(g) + 2HCl(aq)$$

Which row is correct?

	strongest oxidising agent	⟶	weakest oxidising agent
A	Br_2	SO_2	Cl_2
B	Cl_2	Br_2	SO_2
C	Cl_2	SO_2	Br_2
D	SO_2	Br_2	Cl_2

Topical Question No: 6

18 When burned, sulfur forms a gaseous product X which can be oxidised to produce a gas Y.

Gas Y reacts with water to produce a product Z.

Which row correctly shows the oxidation states of sulfur in X, Y and Z?

	X	Y	Z
A	–2	+4	+4
B	–2	+4	+6
C	+4	+6	+4
D	+4	+6	+6

Topical Question No: 7

33 In which reactions is the underlined element or compound reduced?

1 $NaC\underline{l}O + H_2O_2 \rightarrow O_2 + NaCl + H_2O$

2 $2\underline{N}H_3 + 2Li \rightarrow 2LiNH_2 + H_2$

3 $3\underline{CH_3CH_2OH} + K_2Cr_2O_7 + 4H_2SO_4 \rightarrow 3CH_3CHO + Cr_2(SO_4)_3 + K_2SO_4 + 7H_2O$

Topical Question No: 8

17 In the treatment of domestic water supplies, chlorine is added to the water to form HC*l*O.

$$Cl_2(aq) + H_2O(l) \rightarrow H^+(aq) + Cl^-(aq) + HClO(aq)$$

The HC*l*O reacts further to give C*l*O$^-$ ions.

$$HClO(aq) + H_2O(l) \rightarrow H_3O^+(aq) + ClO^-(aq)$$

Both HC*l*O and C*l*O$^-$ kill bacteria by oxidation.

What is the overall change in oxidation number of chlorine when forming the C*l*O$^-$ ion from the aqueous chlorine?

A –1 **B** 0 **C** +1 **D** +2

Topical Question No: 9

20 Carbon monoxide, CO, nitrogen monoxide, NO, and sulfur dioxide, SO_2, may all be present in the exhaust fumes from a car engine.

Which reaction concerning these compounds occurs in the atmosphere?

A CO is spontaneously oxidised to CO_2

B NO_2 is reduced to NO by CO

C NO_2 is reduced to NO by SO_2

D SO_2 is oxidised to SO_3 by CO_2

Topical Question No: 10

11 A solution of Sn^{2+} ions will reduce an acidified solution of MnO_4^- ions to Mn^{2+} ions. The Sn^{2+} ions are oxidised to Sn^{4+} ions in this reaction.

How many moles of Mn^{2+} ions are formed when a solution containing 9.5 g of $SnCl_2$ (M_r: 190) is added to an excess of acidified $KMnO_4$ solution?

A 0.010 **B** 0.020 **C** 0.050 **D** 0.125

Topical Question No: 11

14 What happens when iodine solution is added to a solution of sodium bromide?

A A reaction occurs without changes in oxidation state.

B Bromide ions are oxidised, iodine atoms are reduced.

C Bromide ions are reduced, iodine atoms are oxidised.

D No reaction occurs.

Topical Question No: 12

1 During the electrolysis of molten aluminium oxide to produce aluminium, using carbon electrodes, two consecutive reactions occur at the anode, each producing a different gas.

How does the oxidation number of oxygen change in these reactions?

A decreases by 2, then increases by 2

B increases by 2, then decreases by 2

C increases by 2, then decreases by 4

D no change, then decreases by 2

Topical Question No: 13

36 Sulfur dioxide is an atmospheric pollutant that causes acid rain. One of the reactions in this process is the oxidation of sulfur dioxide to sulfur trioxide.

This oxidation takes place by a two stage reaction involving oxygen and nitrogen monoxide, NO.

$$NO + \tfrac{1}{2}O_2 \rightarrow NO_2$$

$$NO_2 + SO_2 \rightarrow SO_3 + NO$$

Which statements are correct?

1 Nitrogen monoxide is acting as a catalyst for the oxidation.

2 Nitrogen atoms are oxidised in the second stage.

3 Oxygen atoms are first reduced and are then oxidised.

Topical Question No: 14

1 In the redox reaction shown, how do the oxidation states of vanadium and sulfur change?

$$VO_2^+ + SO_2 \rightarrow V^{3+} + SO_4^{2-}$$

	vanadium		sulfur	
	from	to	from	to
A	+1	+3	0	–2
B	+1	+3	+4	+6
C	+5	+3	0	–2
D	+5	+3	+4	+6

Topical Question No: 15

31 A space shuttle's upward thrust came from the following reaction between aluminium and ammonium perchlorate.

$$10Al + 6NH_4ClO_4 \rightarrow 4Al_2O_3 + 2AlCl_3 + 12H_2O + 3N_2$$

Which statements about this reaction are correct?

1 Aluminium is oxidised.

2 Chlorine is reduced.

3 Nitrogen is oxidised.

Topical Question No: 16

12 Redox reactions occur very frequently in the chemistry of Group VII.

Which statement is correct?

A Chlorine will oxidise bromide ions but not iodide ions.

B Fluorine is the weakest oxidising agent out of F_2, Cl_2, Br_2 and I_2.

C Iodide ions are the weakest reducing agent out of F^-, Cl^-, Br^- and I^-.

D When chlorine reacts with water, chlorine is both oxidised and reduced.

Topical Question No: 17

37 Which pairs of reagents will take part in a redox reaction?

1 CH_3COCH_3 + Tollens' reagent

2 CH_3CH_2CHO + Fehling's reagent

3 $CH_3CH{=}CH_2 + Br_2$

Topical Question No: 18

6 In which reaction is the species in **bold** acting as an oxidising agent?

A $\mathbf{2Ca} + O_2 \rightarrow 2CaO$

B $Cr_2O_7^{2-} + 8H^+ + \mathbf{3SO_3^{2-}} \rightarrow 2Cr^{3+} + 4H_2O + 3SO_4^{2-}$

C $Mg + \mathbf{Fe^{2+}} \rightarrow Mg^{2+} + Fe$

D $\mathbf{SO_2} + 2H_2O + 2Cu^{2+} + 2Cl^- \rightarrow H_2SO_4 + 2H^+ + 2CuCl$

Answer Key

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