9.1 Redox Processes

Question Paper

Course	DP IB Chemistry
Section	9. Redox Processes
Topic	9.1 Redox Processes
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

Question 1

When heated ammonium nitrate, NH_4NO_3, can decompose explosively.

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

The nitrogen atoms in NH_4NO_3 have different oxidation numbers.

What are the oxidation numbers for each of the N atoms when this reaction proceeds?

A +4, –4 **B** –2, –4 **C** +4, –6 **D** +2, +6

[1 mark]

Question 2

In winemaking, to prevent the oxidation of ethanol by air, sulfur dioxide (SO_2) is added. In order to calculate the amount of SO_2, a sample is titrated with iodine (I_2). The reaction is a one to one ratio for SO_2 and I_2 to produce H_2SO_4 as well as another product.

What is the change in the oxidation number of sulfur in this reaction?

A +2 to +6 **B** +4 to +6 **C** +2 to +4 **D** +4 to +5

[1 mark]

Question 3

20 cm^3 of a 0.60 mol dm^{-3} solution of thallium nitrate ($TlNO_3$) requires 40 cm^3 of 0.20 mol dm^{-3} acidified ammonium metavanadate (NH_4VO_3) to produce $Tl^{3+}_{(aq)}$ ions.

Vanadium is the only element reduced in this reaction. What is the oxidation number of the reduced vanadium?

A +1 **B** +2 **C** +3 **D** +4

[1 mark]

Question 4

If a solution contains both bromine and chlorine, BrO_3^- ions are produced.

The reactions leading to the production of BrO_3^- ions are shown below:

Reaction 1: $Br_2 + H_2O \rightarrow HBr + HBrO$

Reaction 2: $3HBrO + Cl_2 \rightarrow 2Cl^- + BrO_3^- + Br_2 + 3H^+$

1 Chlorine is reduced in reaction 2

2 Bromine is reduced in both reaction 1 and reaction 2

3 Bromine is oxidised in both reaction 1 and reaction 2

Which statements about these reactions are correct?

A 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3

[1 mark]

Question 5

If a dilute acid is added to an aqueous solution containing nitrite ions, NO_2^-, two different nitrogen compounds are released as gases.

$$2H^+(aq) + 2NO_2^-(aq) \rightarrow H_2O(l) + NO(g) + NO_2(g)$$

Which of the three statements below correctly describe the process?

1 The $H^+(aq)$ ion is oxidised by $NO_2^-(aq)$.

2 Some nitrogen atoms are oxidised, and some nitrogen atoms are reduced

3 The $H^+(aq)$ ion acts as a catalyst.

A 1 and 2 only **B** 2 only **C** 2 and 3 only **D** 1, 2 and 3

[1 mark]

Question 6

A voltaic cell consisting of zinc and silver is set up. The following overall reaction takes place:

$$Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$$

What are the correct half-equations at each electrode?

	Anode (negative electrode)	Cathode (positive electrode)
A	$Ag(s) \rightarrow Ag^{+}(aq) + e^{-}$	$Zn^{2+}(aq) + 2e^{-} \rightarrow Zn(s)$
B	$Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$	$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^{-}$
C	$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^{-}$	$Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$
D	$Zn^{2+}(aq) + 2e^{-} \rightarrow Zn(s)$	$Ag(s) \rightarrow Ag^{+}(aq) + e^{-}$

[1 mark]

Question 7

Below are four descriptions about the movements of electrons in voltaic cells.

Which is the correct statement?

A Electrons flow through the external wire from the cathode (positive electrode) to the anode (negative electrode)

B Electrons flow through the external wire from the anode (negative electrode) to the cathode (positive electrode)

C Electrons flow through the salt bridge from the oxidizing agent to the reducing agent

D Electrons flow through the salt bridge from the reducing agent to the oxidizing agent

[1 mark]

Question 8

When molten magnesium chloride is electrolysed using graphite electrodes what are the products?

	Product at cathode (negative electrode)	Product at anode (positive electrode)
A	magnesium	chlorine
B	chlorine	magnesium
C	magnesium ions	chloride ions
D	chloride ions	magnesium ions

[1 mark]

Question 9

Use the information given about four reactions of metals to determine the order of reactivity from most reactive to least reactive

$$W(s) + X^{2+}(aq) \rightarrow W^{2+}(aq) + X(s)$$

$$Y(s) + W^{2+}(aq) \rightarrow \text{No Reaction}$$

$$X(s) + Y^{2+}(aq) \rightarrow X^{2+}(aq) + Y(s)$$

$$Z(s) + Y^{2+}(aq) \rightarrow \text{No Reaction}$$

A W > Y > X > Z

B X > W > Z > Y

C Z > Y > W > X

D W > X > Y > Z

[1 mark]

Question 10

Below are three statements about voltaic cells.

I. A redox reaction takes place which produces electrical energy

II. At the cathode an oxidation reaction occurs

III. Electrons move from the anode to the cathode

The correct statements are

A I and II only

B I and III only

C II and III only

D I, II and III

[1 mark]