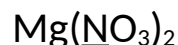


NAME: \_\_\_\_\_

TIME ALLOWED: 50 MINUTES

**Part A: Multiple Choice Questions. (10 marks)**

Q1. The sum of the Oxidation Numbers of the underlined elements of the following species is

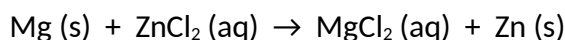


- A) 11+
- B) 13+
- C) 15+
- D) 16+

Q2. An Oxidising agent is one which

- A) Contains Hydrogen atoms
- B) Can donate electrons
- C) Can accept electrons
- D) Must contain an Oxygen atom

Q3. In the reaction below, which is true of Zinc ions?



- A) It is oxidised by losing electrons
- B) It is oxidised by gaining electrons
- C) It is reduced by losing electrons
- D) It is reduced by gaining electrons

Q4. Acidified Potassium Permanganate solution is a strong Oxidising agent because

- A) the Mn in the compound has a high oxidation number which can be lowered by a reducing agent.
- B) the  $\text{K}^+$  ion in the compound can easily be reduced.
- C) the compound has 4 Oxygen atoms.
- D) the solution forms a precipitate of  $\text{MnO}_2$  with a reducing agent.

Q5. Which one of the following is not a redox reaction?

- A)  $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$
- B)  $\text{Mg} + \text{CuSO}_4 \rightarrow \text{MgSO}_4 + \text{Cu}$
- C)  $\text{CuSO}_4 + \text{H}_2\text{S} \rightarrow \text{CuS} + \text{H}_2\text{SO}_4$
- D)  $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$

- Q6. Which of the following statements about oxidation numbers is false?
- A) The oxidation number of a free element is Zero.
  - B) The oxidation number of a compound is Zero.
  - C) Cations always have positive oxidation numbers.
  - D) Non-metals always have negative oxidation numbers.
- Q7. If a metal is found in its elemental form in nature, we expect that the metal
- A) Is very reactive
  - B) Is very electropositive
  - C) Will form very stable compounds
  - D) To be completely pure
- Q8. The Oxidation Numbers of element M in  $\text{Na}_2\text{H}_2\text{M}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$  is
- A) 0
  - B) +7
  - C) +5
  - D) +3
- Q9. In the compound magnesium hydride, the oxidation numbers of the magnesium and the hydrogen are
- |           | Oxidation number |    |    |    |
|-----------|------------------|----|----|----|
|           | A.               | B. | C. | D. |
| <b>Mg</b> | +2               | -2 | -2 | +2 |
| <b>H</b>  | -2               | +2 | +1 | -1 |
- Q10. Which of the following reactions shows that Hydrogen Peroxide is a reducing agent?
- A)  $\text{H}_2\text{S} + \text{H}_2\text{O}_2 \rightarrow \text{S} + 2\text{H}_2\text{O}$
  - B)  $\text{PbO}_2 + \text{H}_2\text{O}_2 \rightarrow \text{PbO} + \text{H}_2\text{O} + \text{O}_2$
  - C)  $\text{H}_2\text{O}_2 + \text{dye} \rightarrow \text{H}_2\text{O} + (\text{dye} + \text{O})$
  - D)  $\text{H}_2\text{SO}_3 + 4\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$

**END OF PART A**

## PART B : SHORT ANSWER QUESTIONS (10 marks)

Q11. Several Redox reactions were carried out in the lab and some of the observations were recorded. From the information provided write one complete half equation for each experiment.

- A) An unknown halogen was added to a colourless solution of iodide ions to form a brown solution.

Half-equation: \_\_\_\_\_

- B) Aluminium metal was added to an unknown solution. The Aluminium dissolved producing a clear colourless solution.

Half-equation: \_\_\_\_\_

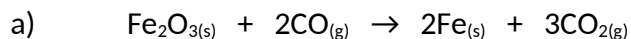
- C) A metal was added to an unknown acid solution and a colourless gas was produced.

Half-equation: \_\_\_\_\_

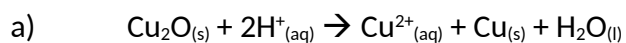
[3 marks]

Q12. Identify the oxidising and reducing agents in each of the following:

[2 marks]

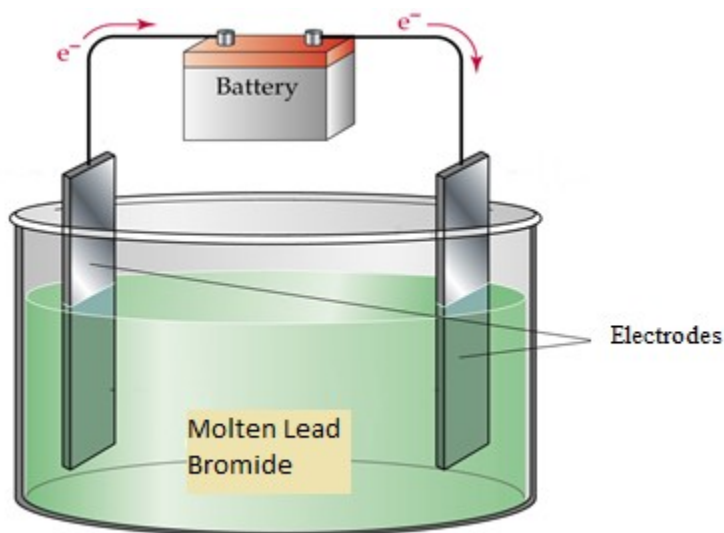


Oxidising agent: \_\_\_\_\_ Reducing agent: \_\_\_\_\_



Oxidising agent: \_\_\_\_\_ Reducing agent: \_\_\_\_\_

Q13. Molten Lead II Bromide is electrolysed as the diagram below.



a) What observation would you record for the reaction at the Anode?

---

[1 mark]

b) Write the half reaction at the Cathode.

---

[1 mark]

c) Where do the electrons come from?

---

[1 mark]

d) Describe and explain how an electric current is conducted in an electrolytic cell.

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---

e) Is this reaction spontaneous or non-spontaneous? Justify your answer

[2 marks]

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---

[3 marks]

**END OF PART B**

**PART C : EXTENDED ANSWER QUESTIONS (15 marks)**

Q14. A solution of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) is unstable and decomposes to produce water and oxygen.

The heat of reaction for the decomposition of 1 mole of Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ ) is  $-107 \text{ kJ mol}^{-1}$ .

36mls of a  $0.25 \text{ mol.L}^{-1}$  hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) solution is decomposed to produce oxygen gas at S.T.P. **[8 marks]**

a) Write a balanced equation for this reaction.

[1 mark]

b) One of the atoms in  $\text{H}_2\text{O}_2$  undergoes oxidation, and the other oxygen atom undergoes reduction. What **term** is used to describe a species which undergoes both oxidation and reduction? [1 mark]

c) How much heat energy is released from this quantity of hydrogen peroxide? [2 marks]

d) What volume of oxygen is produced in the above decomposition? [2 marks]  
**Please provide your answer to 3.s.f**

e) What mass of water was produced in this same reaction? [2 marks]



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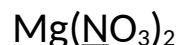
**END OF TEST**

NAME: \_\_\_\_\_

TIME ALLOWED: 50 MINUTES

**Part A: Multiple Choice Questions. (10 marks)**

Q1. The sum of the Oxidation Numbers of the underlined elements of the following species is

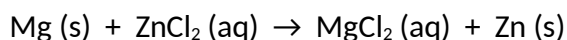


- E) 11+
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- G) 15+
- H) 16+

Q2. An Oxidising agent is one which

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- H) Must contain an Oxygen atom

Q3. In the reaction below, which is true of Zinc ions?



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Q8. The Oxidation Numbers of element M in  $\text{Na}_2\text{H}_2\text{M}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$  is

- A) 0
- B) +7
- C) +5
- D) +3

Q9. In the compound magnesium hydride, the oxidation numbers of the magnesium and the hydrogen are

	Oxidation number			
	A.	B.	C.	#D.
Mg	+2	-2	-2	+2
H	-2	+2	+1	-1

Q10. Which of the following reactions shows that Hydrogen Peroxide is a reducing agent?

- E)  $\text{H}_2\text{S} + \text{H}_2\text{O}_2 \rightarrow \text{S} + 2\text{H}_2\text{O}$
- F)  $\text{PbO}_2 + \text{H}_2\text{O}_2 \rightarrow \text{PbO} + \text{H}_2\text{O} + \text{O}_2$
- G)  $\text{H}_2\text{O}_2 + \text{dye} \rightarrow \text{H}_2\text{O} + (\text{dye} + \text{O})$
- H)  $\text{H}_2\text{SO}_3 + 4\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{SO}_4 + 4\text{H}_2\text{O}$

**END OF PART A**

1	2	3	4	5	6	7	8	9	10
D	C	D	A	C	D	D	C	D	B

## PART B : SHORT ANSWER QUESTIONS (10 marks)

Q11. Several Redox reactions were carried out in the lab and some of the observations were recorded. From the information provided write one complete half equation for each experiment.

- D) An unknown halogen was added to a colourless solution of iodide ions to form a brown solution.

Half-equation:  $2\text{I}^-_{(\text{aq})} \rightarrow \text{I}_{2(\text{aq})} + 2\text{e}^-_{(\text{g})}$

- E) Aluminium metal was added to an unknown solution. The Aluminium dissolved producing a clear colourless solution.

Half-equation:  $\text{Al}_{(\text{s})} \rightarrow \text{Al}^{3+}_{(\text{aq})} + 3\text{e}^-$

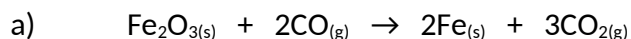
- F) A metal was added to an unknown acid solution and a colourless gas was produced.

Half-equation:  $2\text{H}^+_{(\text{aq})} + 2\text{e}^- \rightarrow \text{H}_{2(\text{g})}$

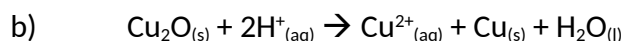
[3 marks]

Q12. Identify the oxidising and reducing agents in each of the following:

[2 marks]

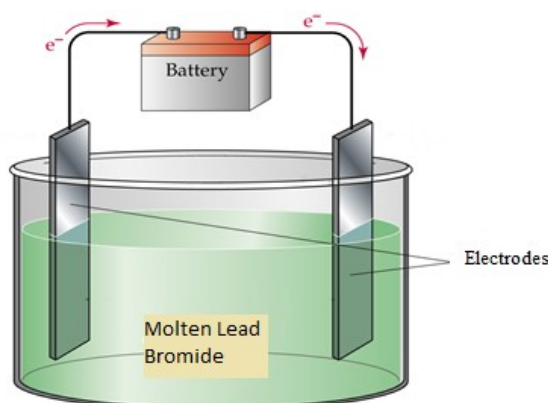


Oxidising agent:  $\text{Fe}_2\text{O}_3$  Reducing agent:  $\text{CO}$



Oxidising agent:  $\text{Cu}_2\text{O}$  Reducing agent:  $\text{Cu}_2\text{O}$

Q13. Molten Lead II Bromide is electrolysed as the diagram below.



- a) What observation would you record for the reaction at the Anode?

Brownish red vapour bubbles from the molten liquid

[1 mark]

- b) Write the half reaction at the Cathode.



[1 mark]

- c) Where do the electrons come from?

The Battery cells.

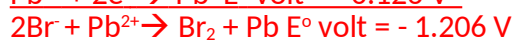
[1 mark]

- d) Describe and explain how an electric current is conducted in an electrolytic cell.

Mention two things... 1. Molten Ions are mobile 2. Ions can carry the charge.

[2 marks]

- e) Is this reaction spontaneous or non-spontaneous? Justify your answer



Reaction is **non-spontaneous**

**END OF PART B**

### PART C : EXTENDED ANSWER QUESTIONS (15 marks)

Q14. A solution of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) is unstable and decomposes to produce water and oxygen.

The heat of reaction for the decomposition of 1 mole of Hydrogen Peroxide ( $\text{H}_2\text{O}_2$ ) is  $-107 \text{ kJ mol}^{-1}$ .

36mls of a  $0.25 \text{ mol.L}^{-1}$  hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) solution is decomposed to produce oxygen gas at S.T.P. [8 marks]

f) Write a balanced equation for this reaction.

[1 mark]



g) One of the atoms in  $\text{H}_2\text{O}_2$  undergoes oxidation, and the other oxygen atom undergoes reduction. What **term** is used to describe a species which undergoes both oxidation and reduction? [1 mark]

Disproportionation

---

h) How much heat energy is released from this quantity of hydrogen peroxide? [2 marks]

---

$$n(\text{H}_2\text{O}_2) = cV = 0.036 \times 0.25 = 0.009 \text{ moles}$$

---

---

$$\Delta H(\text{H}_2\text{O}_2) = 0.009 \text{ mol} \times 107 \text{ kJ/mol} = 0.963 \text{ kJ released (exothermic)}$$

---

i) What volume of oxygen is produced in the above decomposition? [2 marks]  
Please provide your answer to 3.s.f

---

$$n(\text{H}_2\text{O}_2) = 0.009 \text{ moles} = 2 n(\text{O}_2)$$

---

---

$$n(\text{O}_2) = 0.0045$$

---

---

$$V(\text{O}_2) = 0.0045 \times 22.71 = 0.102195 \text{ L or } 102.195 \text{ mLs.}$$

---

j) What mass of water was produced in this same reaction? [2 marks]

---

$$n(\text{H}_2\text{O}_2) = 0.009 \text{ moles} = n(\text{H}_2\text{O})$$

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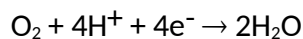
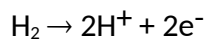
$$m(\text{H}_2\text{O}) = M \times n = 18.016 \times 0.009 = 0.162144 \text{ g}$$

---

- Q15. A hydrogen - oxygen fuel cell for use in a spacecraft is required to supply a current of electricity and water for the duration of the flight 24.0 hours. The passengers need 8 litres of water each per day and there are 4 astronauts.

[7 marks]

The electrode processes in the fuel cell are:



- C. Write the Equation for the Anode:  $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$

Write the Equation for the Cathode:  $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$  [1 for both]

- D. Calculate the number of moles of hydrogen gas required to supply spacecraft with the water required for the short trip. [4]

---

$$8\text{L} \times 4 \text{ passengers} = 32\text{L required over 24 hours}$$

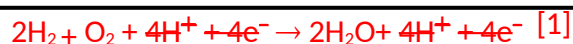
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$$\text{Density of water } 1.00\text{g/ml } m(\text{H}_2\text{O}) = 32,000\text{ml} \times 1.00 = 36000 \text{ g [1]}$$

---

$$n(\text{H}_2\text{O}) = 32000/18.016 = 1776.20 \text{ [1]}$$

---



$$n(\text{H}_2) = n(\text{H}_2\text{O}) = 1776.2 \text{ moles [1]}$$

---

- E. What volume of hydrogen gas would be required if it was stored STP? [2]

$$n(\text{H}_2) = 1776.2 \text{ [1]}$$

---

$$V(\text{H}_2) = n(\text{H}_2) \times \text{STP (22.71)}$$

---

$$= 1776.2 \times 22.71 = 40337.48 \text{ L [1]}$$

---

$$= 40300 \text{ L (3s.f)}$$

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END OF TEST