UNIT 3 Sample Test

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REDOX TEST
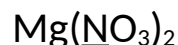
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/35 marks

NAME:_____   **TIME ALLOWED: 50 MINUTES**

Part A: Multiple Choice Questions. (10 marks)

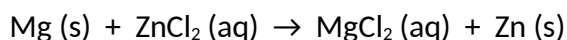Q1.   The sum of the Oxidation Numbers of the underlined elements of the following species is

$\underline{C}O_3^{2-}$ $\underline{K}H$ $H_2\underline{S}O_4$ $Mg(\underline{N}O_3)_2$

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?

$$Mg\ (s)\ +\ ZnCl_2\ (aq)\ \rightarrow\ MgCl_2\ (aq)\ +\ Zn\ (s)$$

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 K^+ ion in the compound can easily be reduced.
C)   the compound has 4 Oxygen atoms.
D)   the solution forms a precipitate of MnO_2 with a reducing agent.

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

A) $Cl_2\ +\ 2KBr\ \rightarrow\ 2KCl\ +\ Br_2$
B) $Mg\ +\ CuSO_4\ \rightarrow\ MgSO_4\ +\ Cu$
C) $CuSO_4\ +\ H_2S\ \rightarrow\ CuS\ +\ H_2SO_4$
D) $PbS\ +\ 4H_2O_2\ \rightarrow\ PbSO_4\ +\ 4H_2O$

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 $Na_2H_2M_2O_7.6H_2O$ 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?

    A) $H_2S + H_2O_2 \rightarrow S + 2H_2O$
    B) $PbO_2 + H_2O_2 \rightarrow PbO + H_2O + O_2$
    C) $H_2O_2 + dye \rightarrow H_2O + (dye + O)$
    D) $H_2SO_3 + 4H_2O_2 \rightarrow H_2SO_4 + H_2O$

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.
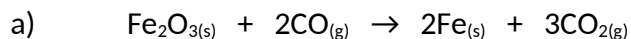
Half-equation: _____

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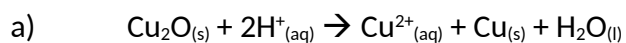
Half-equation: _____

[3 marks]

Q12. Identify the oxidising and reducing agents in each of the following:
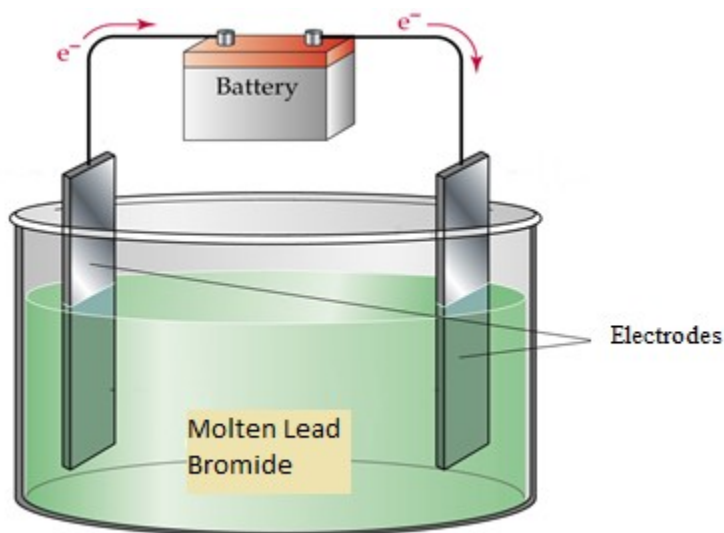
[2 marks]

a) $Fe_2O_{3(s)}$ + $2CO_{(g)}$ → $2Fe_{(s)}$ + $3CO_{2(g)}$

Oxidising agent: _____ Reducing agent: _____

a) $Cu_2O_{(s)}$ + $2H^+_{(aq)}$ → $Cu^{2+}_{(aq)}$ + $Cu_{(s)}$ + $H_2O_{(l)}$

Oxidising agent: _____ Reducing agent: _____

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

Battery

Electrodes

Molten Lead Bromide

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.

_____

_____

_____

[2 marks]

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

_____

_____

_____ [3 marks]

END OF PART B

PART C : EXTENDED ANSWER QUESTIONS (15 marks)

Q14. A solution of hydrogen peroxide (H_2O_2) is unstable and decomposes to produce water and oxygen.
The heat of reaction for the decomposition of 1 mole of Hydrogen Peroxide (H_2O_2) is -107 kJ mol^{-1}.

36mls of a 0.25 mol.L^{-1} hydrogen peroxide (H_2O_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 H_2O_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]

_____

_____

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. **Density of water 1.00g/ml**

[7 marks]

The electrode processes in the fuel cell are:

$$H_2 \rightarrow 2H^+ + 2e^-$$

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$$

A. Write the Equation for the Anode: _____

Write the Equation for the Cathode: _____ [1 for both]

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

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

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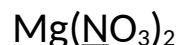_____

END OF TEST

REDOX TEST

/35 marks

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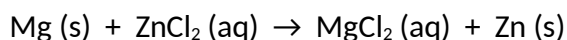Q1.   The sum of the Oxidation Numbers of the underlined elements of the following species is

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E) $H_2S + H_2O_2 \rightarrow S + 2H_2O$
F) $PbO_2 + H_2O_2 \rightarrow PbO + H_2O + O_2$
G) $H_2O_2 + dye \rightarrow H_2O + (dye + O)$
H) $H_2SO_3 + 4H_2O_2 \rightarrow H_2SO_4 + 4H_2O$

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

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

Half-equation: $Al_{(s)} \rightarrow Al^{3+}_{(aq)} + 3e^-$
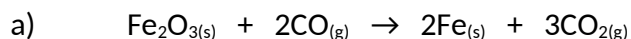
F)   A metal was added to an unknown acid solution and a colourless gas was produced.

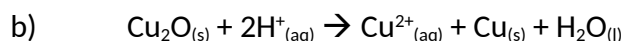Half-equation: $2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$

[3 marks]

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

[2 marks]

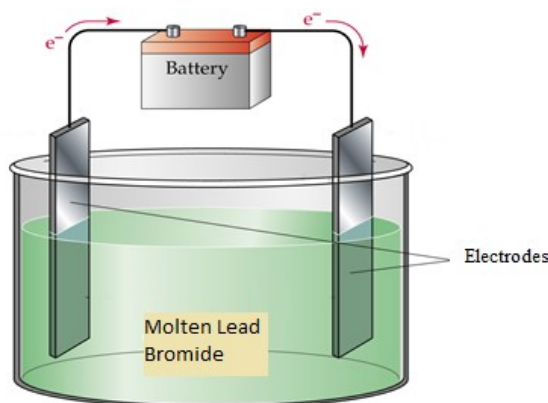a) $Fe_2O_{3(s)} + 2CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$

Oxidising agent: _____Fe_2O_3_____   Reducing agent: _____CO_____

b) $Cu_2O_{(s)} + 2H^+_{(aq)} \rightarrow Cu^{2+}_{(aq)} + Cu_{(s)} + H_2O_{(l)}$

Oxidising agent: _____Cu_2O_____   Reducing agent: _____ Cu_2O _____

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.

10

$Pb^{2+}_{(l)} + 2e^- \rightarrow Pb_{(s)}$

___

[1 mark]

      c)   Where do the electrons come from?
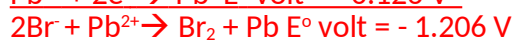
The Battery cells.

___

[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

$Br_2 + 2e^- \rightarrow 2Br^-$ E° volt = + 1.08 V

$2Br^- \rightarrow Br_2 + 2e^-$ E° volt = - 1.08 V
$Pb^{2+} + 2e^- \rightarrow Pb$ E° volt = - 0.126 V
$2Br^- + Pb^{2+} \rightarrow Br_2 + Pb$ E° volt = - 1.206 V

Reaction is **non-spontaneous**

END OF PART B

PART C : EXTENDED ANSWER QUESTIONS (15 marks)

Q14. A solution of hydrogen peroxide (H_2O_2) is unstable and decomposes to produce water and oxygen.

The heat of reaction for the decomposition of 1 mole of Hydrogen Peroxide (H_2O_2) is -107 kJ mol^{-1}.

36mls of a 0.25 mol.L^{-1} hydrogen peroxide (H_2O_2) solution is decomposed to produce oxygen gas at S.T.P. **[8 marks]**

f) Write a balanced equation for this reaction.

[1 mark]

$2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$

g) One of the atoms in H_2O_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]

$n(H_2O_2) = cV = 0.036*0.25 = 0.009$ moles

$\Delta H(H_2O_2) = 0.009$mol * 107 kJ/mol = 0.963 kJ released (exothermic)

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

$n(H_2O_2) = 0.009$ moles $= 2 n(O_2)$

$n(O_2) = 0.0045$

$V(O_2) = 0.0045*22.71 = 0.102195$ L or 102.195mLs.

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

$n(H_2O_2) = 0.009$ moles $= n(H_2O)$
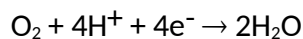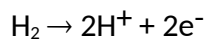
$m(H_2O) = M \times n = 18.016 * 0.009 = 0.162144$g

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 astronaughts.

[7 marks]

The electrode processes in the fuel cell are:

$$H_2 \rightarrow 2H^+ + 2e^-$$

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$$
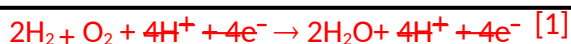
C. Write the Equation for the Anode: $\underline{H_2 \rightarrow 2H^+ + 2e^-}$

Write the Equation for the Cathode: $\underline{O_2 + 4H^+ + 4e^- \rightarrow 2H_2O}$ [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]

8L x 4 passengers = 32L required over 24 hours

Density of water 1.00g/ml m(H_2O) = 32,000ml x 1.00 = 36000 g [1]

n(H_2O) = 32000/18.016 = 1776.20 [1]

$$2H_2 + O_2 + \cancel{4H^+} + \cancel{4e^-} \rightarrow 2H_2O + \cancel{4H^+} + \cancel{4e^-} \; [1]$$

n(H_2) = n(H_2O) = 1776.2 moles [1]

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

n(H_2) = 1776.2 [1]

V(H_2) = n(H_2) x STP (22.71)

= 1776.2 x 22.71 = 40337.48 L [1]

= 40300 L (3s.f)

END OF TEST