## **Stage 2 Chemistry**

## **Birdwood**

HIGH SCHOOL **Topic 2: Analytical Chemistry**

**Chemists Calculating and Measuring**

**Review Paper 6**

**DUE DATE:** Ref: ESSENTIALS pages 77 - 86

**Question 1**

i In the following equation, *use oxidation numbers* to state which reactant is being *oxidised*.

2MnO4- + 3SO32- + H2O 2MnO 2 + 3SO42- + 2OH-

Mn + 4 x -2 = -1 Mn + 2 x -2 = 0

Mn – 8 = -1 Mn – 4 = 0

Mn = +7 Mn = +4 Mn reduced

S + 3 x -2 = -2 S + 4 x -2 = -2

S – 6 = -2 S – 8 = -2

S = +4 S = +6 S oxidised

ii The following equation shows how zinc oxide can be converted into zinc.

ZnO(s) + C(s) Zn(s) + CO(g)

Identify the *oxidising agent* in this reaction.

Zn is reduced, therefore is the oxidizing agent (alternatively donates O)

iii Calculate the volume in mL of a 20.00 mol L-1 solution of acetic acid that must be diluted to make

1.00 L of 0.20 mol L-1 acetic acid. C1V1 = C2V2 (6 marks)

20 x V = 0.2 x 1

20V = 0.2

V = 0.01L

**Question 2**

Copper (II) oxide can be reduced to copper metal using hydrogen as a reducing agent according to the

following equation:

CuO + H2 Cu + H2O

The company making copper using this method needs to produce 10 tonne (10 000 kg) of copper each day to

remain economically viable.

Calculate the mass of copper oxide the company must process to produce this amount of copper each day.

n = m/M mole ratio 1:1

n = 10 000 000 / 63.55 n = 157356.4

n = 157356.4 m = 12 517 702 g

(3 marks)

**Question 3**

The half-equations for a common redox reaction are partially completed below:

Cr2O72- + 14H+ + 6e 2Cr3+ + 7H2O

SO32- + H2O SO42- + 2H+ + 2e

i Complete the equations by filling in the appropriate spaces in each half-equation.

ii Write a balanced equation for the overall reaction between acidified dichromate and sulfite ions.

Cr2O72- + 14H+ + 3SO32- + 3H2O 2Cr3+ + 7H2O + 3SO42- + 6H+

Cr2O72- + 8H+ + 3SO32- 2Cr3+ + 4H2O + 3SO42-

iii Use oxidation numbers to identify the substance being *reduced*.

s + 3 x -2 = -2 s + 4 x -2 = -2

s - 6 = -2 s - 8 = -2

s = +4 s = +6 (8 marks)

oxidation number is increased, therefore is oxidised

Cr x 2 + 7 x -2 = -2 Cr = +3

2Cr - 14 = -2

2Cr = +12

Cr = +6 Oxidation number is decreased, therefore reduced

**Question 4**

Convert the following to mol L-1:

i sodium chloride, (NaCl) 3 ppm.

3ppm = 0.003 gL-1

0.003 gL-1 / (22.99 + 35.45)

0.0000513 mol L-1

ii sodium hydroxide, (NaOH) 1.55 g L-1.

1.55 gL-1 / (22.99 + 16 +1.008)

0.0387 mol L

iii sodium carbonate, (Na2CO3) 6.5 % w/v.

6.5% w/v = 65 gL-1

65 / (22.99 x 2 + 12.01 + 16 x 3)

0.613 mol L-1 (6 marks)

**Question 5**

The label on a bottle of spring water states that the water contains magnesium (Mg) at a

concentration of 8 mg L-1.

Convert this concentration to %w/v.

8 mgL-1 = 0.008 gL-1

0.008 / 10 = 0.0008 %w/v

(2 marks)

*Credit will be given for the correct use of significant figures in calculations in answers to Question 6*. (1 mark)

**Question 6**

2.70 g of aluminium metal was added to 300 mL of 0.10 mol L-1 copper nitrate solution.

The mixture was left to stand for some time. The following reaction took place:

Al(s) + 3CuNO3(aq) Al(NO3)3(aq) + 3Cu(s)

i State the reacting mole ratio of aluminium to copper nitrate solution.

1:3

ii a) Calculate the number of moles of *each reactant* that was *mixed* together in the reaction.

n(Al) = m/M n(CuNO3) = C V

= 2.7 / (26.98) n = 0.1 x 0.3

= 0.100 mol n = 0.030 mol

1. Using the mole ratio, determine *which reactant is in excess* and by how many mole.

using n of CuNO3

n = 0.03

mole ratio is 1:3

n (Al) should be 0.01

n (Al) is 0.1

n(Al) is in excess by 0.1 - 0.01

n(Al) = 0.09

1. Hence determine the amount of reactant (Al or CuNO3) that would be left unreacted,

(in mL or grams), whichever is the most appropriate unit.

m = n M

m = 0.09 x 26.98

m = 2.43g

iii Hence calculate the mass of copper metal formed. (9 marks)

n (Cu) = n(CuNO3)

n = 0.030

m = n M

m = 0.030 x 63.55

m = 1.91g

**TOTAL MARK = 35**