## **Stage 2 Chemistry**

## **Birdwood**

HIGH SCHOOL **Topic 1: Analytical Chemistry**

**Chemists Calculating and Volumetric Analysis**

**Review Paper 7**

**DUE DATE:** Ref: ESSENTIALS pages 82 - 93

**Question 1**

Find the volume of 20.0 mol L-1 sodium oxalate, Na2C2O4 , solution needed to be *diluted* to make up

500 mL of concentration 0.40 mol L-1.

C1V1 = C2V2

20 x V = 0.4 x 0.5

20V = 0.2

V = 0.010 L

(3 marks)

**Question 2**

Volumetric analysis is described as a *quantitative method*.

Briefly explain the meaning of this term as it applies to volumetric analysis. (1 mark)

Gives a magnitude with units. Ie gives a quantity.

**Question 3**

*Credit will be given for the correct use of significant figures in calculations in answers to this question*.

Prior to checking the acetic acid, CH3COOH, concentration of some vinegar, a laboratory assistant prepared a standard solution of anhydrous sodium carbonate Na2CO3.

i Calculate the mass of anhydrous sodium carbonate required to prepare 250.0 mL of a solution with a

concentration of 0.0487 mol L-1.

n = C V

n = 0.0487 x 0.25

n = 0.0122 mol

m = n M

m = 0.0122 x (22.99 x 2 + 12.01 + 16 x 3)

m = 1.29g (3sf)

ii Write a balanced equation for the reaction between acetic acid and sodium carbonate, given the

products of the reaction are carbon dioxide, water and sodium acetate, NaCH3COO.

2CH3COOH + Na2CO3 CO2 + H2O + 2NaCH3COO

(5 marks)

**Question 4**

The concentration of hydrogen peroxide in a commercial hydrogen peroxide solution can be determined

by titration with potassium permanganate solution.

i State the oxidation number of oxygen in hydrogen peroxide, H2O2. [*Remember hydrogen is +1*]

O has an oxidation no. of -1

ii Balance the redox half-equation for the reaction of the permanganate ion.

5e- + MnO4- + 8H+ Mn2+ + 4H2O

iii The half-equation for the reaction of hydrogen peroxide in this titration is:

H2O2 O2 + 2H+ + 2e-

State why hydrogen peroxide is behaving as a *reducing agent* in this reaction. (5 marks)

Hydrogen peroxide has lost electrons; therefore it has been oxidized and therefore is the reducing agent.**Question 5**

*Credit will be given for the correct use of significant figures in calculations in answers to this question*.

The following experiment was performed to determine the concentration of a solution of sodium hydroxide.

**STEP 1**: A 0.050 mol L-1 standard solution of oxalic acid, H2C2O4 was prepared in an appropriate piece

of glassware.

**STEP 2**: 20.0 mL portions of a sodium hydroxide solution of unknown concentration were then

delivered into a suitable container.

**STEP 3**: 2 drops of phenolphthalein indicator was then added to the sample of sodium hydroxide.

**STEP 4**: A titration was then performed using these two solutions and the average titre obtained was

21.2 mL.

The equation for the reaction is:

H2C2O4 + 2NaOH 2H2O + Na2 C2O4

i State the number of significant figures that should be used for all numerical answers in this

question.

2, as the concentration of oxalic acid is 2 sf.

ii State the oxidation number of C (carbon), in H2C2O4.

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

2 + 2C – 8 = 0

2C – 6 = 0

2C = +6

C = +3

iii Name the best apparatus used to deliver the portions of sodium hydroxide in STEP 2.

Volumetric pipette

iv Name the best piece of apparatus used to prepare the standard solution of oxalic acid in STEP 1.

Volumetric flask

vi Describe the purpose of the phenolphthalein?

Used as an indicator. Phenolphthalein is pink in basic conditions and colourless in neutral/acidic

vii Calculate the number of moles of oxalic acid from the data given above.

n = C V

n = 0.05 x 0.0212

n = 0.0011 mol (2sf)

viii Use the reaction mole ratio to find the number of moles of NaOH used.

n(NaOH) = 0.00106 x 2

n(NaOH) = 0.0021mol (2sf)

ix Hence find the concentration of NaOH in mol L-1.

C = n / V

C = 0.00212 / 0.020

C = 0.11 mol L-1 (2sf)

x Convert your answer in part ix to % w/v.

C = 0.106 x (22.99 + 16 + 1.008)

C = 4.24 gL-1

C = 0.42 %w/v (2sf)

(13 marks)

**Question 6**

The burette used in Question 5 was prepared carefully, to ensure that the results were accurate.

State *two* steps that should be followed in the *filling* of the burette, and state why each step

is necessary to ensure accuracy.

With tap closed fill burette with a funnel, ensure that funnel is removed.

Allow some solution to run through the tap before closing again – ensures that section below tap is filled.

Ensure that no gas bubbles reside in burette

(4 marks)

**Question 7**

Assume the molar mass of ethanol is 46.068 g mol-1 for answers to this question.

i A particular brand of beer was found to contain ethanol, (C2H5OH), at a concentration of 0.046 g mL-1.

Convert this concentration to mol L-1.

C = 0.046 / 46.068

C = 0.0010 mol mL-1

C = 1.0 mol L-1

ii A person drank a different beverage containing ethanol. The concentration of ethanol in the blood

leaving this person’s liver 30 minutes later was 10.53 μmol L-1.

Convert this concentration of ethanol into ppm.

C = 10.53 x 46.068

C = 485 μg L-1 (ppb)

C = 0.490 ppm (2sf)

(5 marks)

**TOTAL MARK = 36**