## **Stage 2 Chemistry**

## **Birdwood**

HIGH SCHOOL **Topic 2: Analytical Chemistry**

**Chemists Calculating and Volumetric Analysis**

**Review Paper 8**

**DUE DATE:**

**Question 1**

Three students A, B and C, made three weighings of the same sodium hydroxide sample using three different balances. The correct mass of the sodium hydroxide sample was known to be 22.70 grams.

The student results are shown in the table below:

**Mass of sodium hydroxide (g)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Weighing** | **Student A** | **Student B** | **Student C** |
| 1 | 26.1 | 22.70 | 25.30 |
| 2 | 23.2 | 22.75 | 25.35 |
| 3 | 24.7 | 22.75 | 25.30 |

i Define the term *precision*.

Precision is how close the values are to each other. A high precision will mean closely grouped data.

ii Compare the *accuracy* of students A and B.

averages are 24.7 and 22.7. Correct mass is 22.7 grams, therefore student B is the more accurate.

iii State and explain which student’s results (**A**, **B** or **C**) may be affected by a systematic error.

C is likely to be affected by a systematic error as the precision is high, but the result is not accurate. Student A has low precision so systematic errors are not obvious.

(5 marks)

**Question 2**

The pipette used in a volumetric analysis experiment was prepared carefully, to ensure that the results were

accurate.

State two steps that should be followed in *the delivery of the solution from the pipette*, and state why each step

is necessary to ensure accuracy.

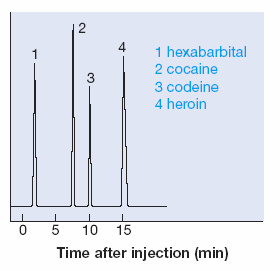
Pipette should be held vertical against the side of the glassware the solution is being delivered to. This is done so that none of the solution in the pipette goes above the line and the solution exits the pipette correctly. The pipette is held for 15 seconds after delivering the solution and not shaken to ensure that the correct amount of solution is delivered. These steps are followed to ensure that the pipette delivers exactly the amount that it is calibrated for, this ensures the accuracy of the delivery.

(4 marks)

**Question 3**

A blood sample taken from a truck-driver was analysed using thin layer chromatography.

The sample produced the retention time graph shown below. A non-polar stationary phase was used.



i Estimate the retention time of cocaine

to 1 significant figure.

8 mins

ii State the polarity of the mobile phase used.

Polar mobile phase, due to the non polar stationary phase used.

iii How many drugs were identified in

the drivers blood sample?

4

iv Use the graph to state which drug codeine

or heroin is more polar.

Codeine is more polar than heroin

v Explain how this retention time graph indicates that

hexabarbital is more polar than cocaine.

Hexabarbital has a lower retention time than cocaine. This indicates a stronger adsorbtion to the polar mobile phase. As polar compounds show greater attraction for polar phases, due to the stronger secondary interactions formed, this indicates that hexabarbital is the more polar compound.

(6 marks)

**Question 4**

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

The iron content of a steel razor blade was analysed as follows:

**Step 1**: The razor blade, weighing 2.857 g, was dissolved in dilute sulfuric acid in a beaker to produce a solution of iron (II) ions, (Fe2+).

**Step 2**: The entire iron (II) solution was transferred to a volumetric flask and made up to 200.0 mL.

**Step 3**: 20.00 mL samples of the iron (II) solution were transferred to conical flasks and titrated with permanganate solution with a concentration of 0.0500 mol L-1.

i Write an *ionic equation* for the reaction between the iron and the acid in Step 1 to produce the Fe2+ ions.

[The *other product* is hydrogen.]

Fe + 2H+ -> Fe2+ + H2 (in an ionic equation you can write acid as H+ rather than H2SO4)

ii State how the chemist would ensure the transfer of all of the iron (II) solution into the volumetric flask in

Step 2.

Rinsing from the beaker into the volumetric flask using a funnel. Both beaker and funnel are thoroughly rinsed with distilled water, with rinsings going into the volumetric flask.

iii State the name of the best piece of apparatus used to transfer the 20.00 mL samples of the iron (II)

solution to the conical flasks.

Volumetric pipette

iv Mark on a diagram *similar to the one below*, to show the liquid level at the calibration mark of the

volumetric flask,

 if it was filled correctly.

Bottom of meniscus should

Be touching the line

v The results of the titration are shown in the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Titration No. | 1 | 2 | 3 | 4 |
| **Final** V mL | 18.10 | 35.75 | 18.35 | 36.25 |
| **Initial** V mL | 0 | 17.90 | 0.450 | 18.35 |
| **Titre value mL** | 18.1 | 17.85 | 17.9 | 17.9 |

1. Use the table to calculate the average titre. [*Show your working*.]

(17.85 + 17.9 + 17.9) / 3 (ignore 1st titre)

= 17.88

1. Hence find the number of moles of permanganate used in the titration.

n = C V

n = 0.05 x 0.01783

n = 0.000894 mol

vi The equation for the reaction between permanganate ions and iron (II) ions is:

MnO4- + 8H+ + 5Fe2+ Mn2+ + 4H2O + 5Fe3+

Use the equation to determine the number of moles of iron (II) present in each 20.00 mL sample.

n(Fe) / n(MnO4) = 5 / 1

n(MnO4) = 0.894 x 5

n = 0.00447 mol

vii The 20.00 mL samples were obtained from the 200 mL solution prepared in **Step 2**.

Hence, determine the number of moles of iron present in the original razor blade.

n(undiluted) = n(diluted) x 10

n = 0.00447 x 10

n = 0.0447 mol

viii Convert this number of moles of iron to a mass and hence determine the percentage of iron in the

original razor blade.

m = n M

m = 0.0447 x 55.85

m = 2.50 g

%w/w = 2.50 / 2.857 x 100

%w/w = 87.4 %

87.4% of the razor blade was iron

(17 marks)

**TOTAL MARK = 33**