**Lab session 1 – Skills and key concepts**

We will use this lab to introduce key words, their application and general lab skills. In the beginning of the guide you will find information on how to complete the following activities.

**Task 1 – Significant figures and decimal places**

Complete the following questions to ensure your understanding.

1. How many significant figures are present in these numbers?
   1. 1.83
   2. 0.0009
   3. 1200008
   4. 50000
   5. 5 x 104
   6. 5 x 10-4
2. How many decimal places are present in these numbers?
   1. 0.1
   2. 98.273
   3. 25
   4. 66.6000
3. Write these numbers in scientific notation (A.B x 10-C).
   1. 160
   2. 52795
   3. 0.00042
4. Write the answers to these calculations (from quantitative data collected in the lab):
   1. 5.8 + 4.56 + 12 =
   2. 0.008 – 0.0456 + 0.9 =
   3. 11 x 222 x 333 =
   4. 19.30 / 182.3
   5. (4.5 x 103) x (18.93 + 2.07)
   6. What is the average of these data point – 42.66, 43.810, 43.0

**Task 2 – Qualitative and quantitative data**

Mr Canning carried out a titration experiment in which many different types of data were recorded. He has listed the data below. Highlight any qualitative data in red and any quantitative data in blue. (Do not worry about what the experiment is about)

***Objective – to calculate the concentration of a NaOH solution***

***Analysis section***

*Acid used: HCl, 0.0100 M*

*Base used: NaOH, unknown concentration*

*Indicator used: Phenolphthalein, 2 drops for each titration*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Titration Number*** | ***Volume of HCl (mL)*** | ***Initial NaOH burette Reading (mL)*** | ***Final NaOH burette Reading (mL)*** | ***Volume NaOH Added (mL)*** |
| *1* | *25.00* | *0.11* | *15.56* | *15.45* |
| *2* | *25.00* | *0.20* | *16.23* | *16.03* |
| *3* | *25.00* | *0.05* | *15.89* | *15.84* |

*The final burette reading was taken when the solution in the flask changed from colorless to pale pink. The first titration was the lightest in color of the three titrations and the second titration was the darkest.*

*Observation – also noted was a small amount of heat being produced in the conical flask.*

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When finished ask Mr Canning to check it. In a lab report you will always be required to record both types of data to support your analysis and conclusion.

**Task 3 – Accuracy and precision**

Consider the following results from an experiment to measure the boiling point of water:

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*Mr Canning used a standard mercury thermometer to measure the boiling point of water to be 99.5oC. He then used a data probe and recorded it as 98.15 oC. He also decided to guess that boiling point was 99.4160 oC.*

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What is the actual boiling point of water? –

Which result is the most accurate? –

Which result is the most precise? –

**Task 4 – Uncertainty and error**

**A – State the uncertainty for each piece of equipment then the % uncertainty for the measurements given:**

1. E.g. 25 mL measuring cylinder (has an uncertainty of ±0.5 mL); measurement = 16 mL (0.5 mL / 16 mL = 0.03125 = 0.03 (to 1 sig.fig) so the percentage uncertainty is ±0.03%)
2. 25 mL measuring cylinder; measurement = 16 mL
3. 25 mL pipette; measurement = 2.2 mL
4. 25 mL burette; measurement = 18.6 mL
5. The high-precision balance; measurement = 0.0763 g
6. 50 mL volumetric flask; measurement = 50 mL
7. 250 mL beaker; measurement = 150 mL

**B – Follow the procedure below and complete the following questions**

***Objective - produce 1 g of NaCl***

1. Precisely record the mass of an evaporating basin.
2. Measure 17 mL of NaOH (sodium hydroxide) solution and 17 mL of HCl (hydrochloric acid) solution into a beaker 50 mL.
3. Place the evaporating basin onto a pipe-clay triangle and place it on a tripod.
4. Using this solution, half-fill the evaporating basin and begin heating gently (to prevent the solution from “spitting” out of it.
5. As the level drops, continue to add the solution carefully until all of it has been added.
6. Continue to heat the solution until all the water has evaporated and you are left with only salt in the evaporating basin.
7. After it has cooled, record the mass of the evaporating basin and the salt on the scales.

Using the data (of the masses) you have collected complete the table below:

|  |  |  |
| --- | --- | --- |
|  | Mass (g) | Absolute uncertainty (g) |
| Mass of evaporating basin |  |  |
| Mass of basin and NaCl |  |  |
| Mass of NaCl |  |  |

Calculate the relative uncertainty of the mass of NaCl:

Calculate the percentage uncertainty of the mass of NaCl:

Calculate the absolute error between your mass and the theoretical mass (what you should have produced – 1 g):

Calculate the percentage error in your experiment:

List any areas where systematic errors *may* have occurred:

List any areas where random errors *may* have occurred and how could we reduced the effect of random errors?