**Activity 3: Calibration practical**

**Station 1 – Calibrating a balance**

**Equipment**

* A mass balance, minimum of 2 d.p but 4 d.p is preferred
* A set of masses that can be used as calibration masses

You may have to add into the worksheet (or demonstrate to students) how to calibrate the pieces of equipment used.

**Safety**

None.

**Method**

If your balance has a draught shield with doors built in, ensure they are closed whenever you zero the balance or take a mass reading!

1. Place the balance away from draughts and on a stable, flat surface.
2. Enter calibration mode on the balance.
3. Zero the balance by pressing ‘Tare’ or ‘Zero’ and leave it for a short time to zero. You may need to repeat this step.
4. Ensure the calibration mass is clean, dry and not damaged.
5. Gently place the calibration mass on the centre of the balance and leave it to stabilise.
6. If the reading on the balance does not equal the mass of the calibration mass, adjust the balance accordingly.
7. Repeat steps 3 to 5 with different calibration masses to check accuracy.
8. Repeat with the original calibration mass once the balance is calibrated to double-check that calibration has been successful.

**Discussion questions**

* Why did the balances need to be placed on a stable surface?
* Why can there not be a breeze during calibration?

**Station 2 – Calibrating a pH meter**

**Equipment**

* pH meter
* pH meter calibration buffer solutions (pH 4.0, pH 7.0, pH 10.0) in small beakers
* Distilled or deionised water
* Lint-free tissue
* Beakers for rinsing

**Safety**

Check with your teacher.

**Method**

1. Rinse the electrode of the pH meter with distilled or deionised water and gently blot dry.
2. Turn on the pH meter.
3. Submerge the electrode into the beaker of pH 7.0 buffer solution.
4. Press the ‘Calibrate’ button and wait for the reading to stabilise. The display should read 7.0. If it does not, adjust the meter to display the correct value.
5. Remove the pH meter from the buffer solution and rinse with distilled or deionised water, then blot dry.
6. Repeat steps 3 to 5 with buffer solutions of pH 4.0 and then pH 10.0.

**Discussion questions**

* Why does a range of buffer solutions need to be used when calibrating a pH meter?
* Do you think the buffer solutions you used were appropriate?

**Station 3 – Calibrating a pipette**

**Equipment**

* Mechanical (variable volume) pipette
* Calibrated high-sensitivity balance (or at least 0.0001 g)
* Weighing boats or small containers
* Distilled or deionised water in clean flasks/beakers
* Thermometer

**Safety**

None.

**Method**

1. Dispense some (~50 ml) distilled water into a beaker and insert a thermometer to monitor the water temperature.
2. Set the pipette to the desired volume and attach a clean, dry tip to the pipette.
3. Turn on the high-sensitivity balance and allow it to stabilise (with the balance doors closed if present).
4. Place a small, clean and dry weighing boat or container on the balance and tare (zero) the balance.
5. Draw water from the beaker into the tip and dispense it again to wet the tip. Repeat this process two or three times.
6. Holding the pipette vertically above the beaker of water, slowly and steadily, to avoid creating bubbles or splashes, draw the set volume of water into the tip.
7. Slowly and steadily dispense the water into the weighing boat or small container on the balance. Leave to stabilise (with the doors closed if present). Record the mass displayed on the balance.
8. Press ‘Tare’ to zero the balance and then repeat steps 5 to 7 with the same set volume of water.
9. Calculate the mean volume of water dispensed using the equation below and adjusting for the room temperature if required.

Volume (mL) = Mass (g) / density of water at the measured temperature (g/mL)

1. If the calculated volume does not match the set volume, adjust the draw volume on the pipette using the calibration screws and repeat steps 5 to 9 with the adjusted pipette. If the pipette is calibrated at that set volume, move on to step 11.
2. Repeat steps 2 to 9 for a different set volume. Ensure the volumes at the top and bottom end of the range are calibrated.

**Discussion questions**

* What potential sources of error could have influenced your calibration results?
* How could environmental factors (e.g. temperature or humidity) influence the results?

**Station 4 – Calibrating a conductivity meter**

**Equipment**

* Conductivity meter
* Standard conductivity calibration solution(s) (150 µS/cm conductivity standard,   
  1413 µS/cm conductivity standard and 2880 µS/cm conductivity standard)
* Distilled or deionised water
* Clean beaker(s) for the standard solution(s)
* Lint-free tissue

**Safety**

Refer to solution manufacturer’s safety instructions.

**Method**

1. Turn on the conductivity meter and allow it to stabilise.
2. Rinse the probe with distilled or deionised water and gently blot dry.
3. Select an appropriate conductivity calibration solution and immerse the probe in the calibration solution. Allow the reading to stabilise, then record the reading. Adjust the reading on the meter if required using the calibration settings.
4. Rinse the probe with distilled or deionised water and blot dry.
5. Repeat steps 3 to 4 two or three times, with the same calibration solution to ensure calibration.
6. Repeat steps 2 to 5 with a different conductivity calibration solution, if required.

**Discussion question**

* How are the conductivity solutions chosen when calibrating a conductivity meter?