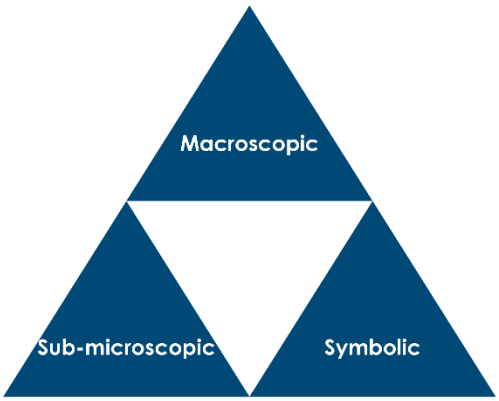
F6 Recording data and uncertainty

Scale

Subatomic	Atom	Molecule	Giant structure



Uncertainty and percentage uncertainty

1. Explain why every measurement you make has a degree of uncertainty.

2. Explain the difference between volumetric glassware (pipettes, flasks etc.) and qualitative glassware.

3. State the equation needed to calculate the % uncertainty for a measurement, explaining each of the quantities.

4. Use the equation in Q3 to calculate the percentage uncertainty for each of the following measurements.

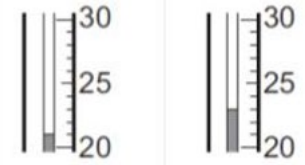
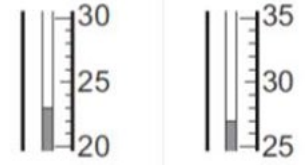
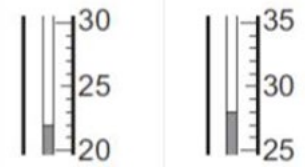
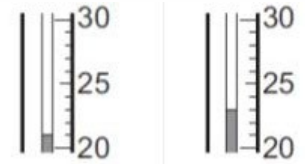
Measurement	Instrument	Uncertainty	Number of times scale used in measurement	% Uncertainty
25 cm^3	volumetric pipette	0.06 cm^3		
25 cm^3	measuring cylinder with 1 cm^3 division			

Measurement	Instrument	Uncertainty	Number of times scale used in measurement	% Uncertainty
25 cm^3	beaker, division 25 cm^3			
25 cm^3	burette, division 0.1cm^3			
250cm^3	volumetric flask (250 cm^3)	0.24 cm^3		
12.22 g	balance (2 decimal places) mass measured by difference			
12.220 g	balance (3 decimal places) mass measured by difference			
temperature change of 22.5 °C	thermometer (1°C division)			

5. A chemist measures 25.0 cm^3 of solution using a pipette with uncertainty 0.06 cm^3. Calculate the % uncertainty.

6. A chemistry student measures 12 cm^3 of solution using a measuring cylinder. The percentage uncertainty of this measurement is 0.833%. What was the smallest division on the scale?

7. A student measured the temperature change in a series of reactions by recording the initial and final temperature measurements. The diagrams below show the appearance of the thermometer scale at each reading. In each experiment, the thermometer on the left shows the initial reading, the thermometer on the right the final reading.

Experiment	Thermometer diagrams
1	
2	
3	
4	

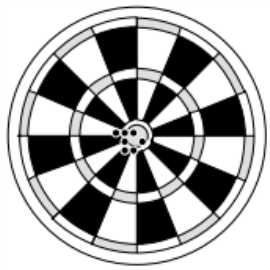
(a) Draw a table that displays the initial and final temperature measurements for each experiment and the temperature change. Don't forget to add headings and units.

(b) Calculate the mean average temperature change for the four experiments and show your working. Give your answer to one decimal place.

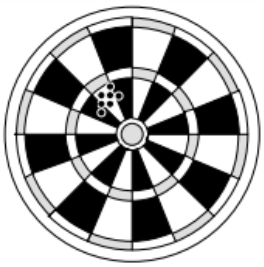
(c) Calculate the percentage uncertainty in the average temperature change.

(d) Would an average result always be more accurate than a single measurement?

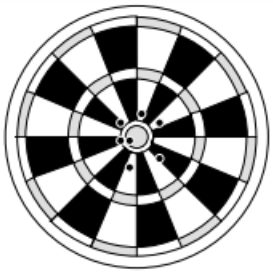
Multiple/repeated measurements



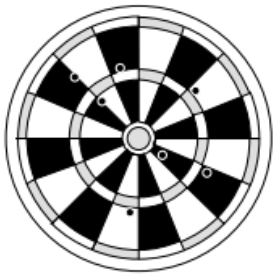
Accurate
Precise



Not accurate
Precise



Accurate
Not precise



Not accurate
Not precise

8. Use the target diagrams above to explain the difference between an accurate measurement and a precise measurement.

9. Why is it important to take repeat measurements?