U1 - Measurements and Their Errors

What are the 7 SI base units?	• Length - metres (m) • Mass - kilograms (kg) • Time - seconds (s) • Current - amperes (A) • Temperature - kelvin (K) • Amount of substance - mole (mol) • Luminous intensity - candela (cd)
What are the prefixes ≥ 1000?	• Kilo (K) - 10^3 • Mega (M) - 10^6 • Giga (G) - 10^9 • Tera (T) - 10^{12}
What are the prefixes ≤ 0.001?	• Milli (m) - 10^{-3} • Micro (μ) - 10^{-6} • Nano (n) - 10^{-9} • Pico (p) - 10^{-12} • Femto (f) - 10^{-15}
What are random and systematic errors?	• Random errors - statistical fluctuations in data due to experimeter's ability. • Systematic errors - inaccuracies present through the whole experiment.

What are readings and measurements and the absolute uncertainty of both? And to what decimal place should they be?	• Readings…
	  ○ Absolute uncertainty is ½ resolution.
	  ○ No zero error because you're not lining things up (e.g., thermometers, measuring cylinders).
	• Measurements…
	  ○ Absolute uncertainty is the resolution.
	  ○ Zero error because you're lining up with zero (e.g., ruler, stopwatch, micrometer, vernier callipers).
	• They should be to no greater no. of decimal places than the value it is for. E.g., if you calculate the uncertainty for 0.29mm to be 0.0081mm then it must be 0.01mm.

How would you infer the uncertainty from data?	Look at the lowest number of significant figures (e.g., a reading of e.g., 2.3×10^3 will have an uncertainty of $\pm 0.05 \times 10^3$).

What should be done if there is a zero-error?	Calibrate the device.
What is precision and accuracy?	● Precision is the smallest resolution. ● Accuracy is how close you are to the true value.
How do you find the uncertainty from a graph?	1. Draw a line of best fit and line of worst fit going through the error bars. 2. Choose the furthest gradient (yet, in most cases, they may appear symmetrical) and the difference between the best and worst is the uncertainty divided by the line of best fit will be it. E.g., if the m_{best} = 20 and m_{worst} = 18 then % uncertainty is (20 - 18) / 20 = 10%.
What should the uncertainty be taken as when calculating the mean from a set of data?	Half the range of values given to the same number of d.p. E.g., v_{mean} = 5.0 ms^{-1} and if the range were to be (5.3 - 4.6) / 2 = 0.35 then the uncertainty of the mean would be 0.4.
What should you do when adding or subtracting with uncertainties?	Add the **ABSOLUTE UNCERTAINTIES**.
What should you do when multiplying or dividing with uncertainties?	Add the **PERCENTAGE UNCERTAINTIES**.
What should you do when you have an uncertainty to a power?	Multiply the **PERCENTAGE UNCERTAINTY** by the power.
Describe what orders of magnitude are about with an example	● Making estimates to check answers. ● E.g., an apple of 1N (0.1kg) would have an order of magnitude of 10^{-2} kg.