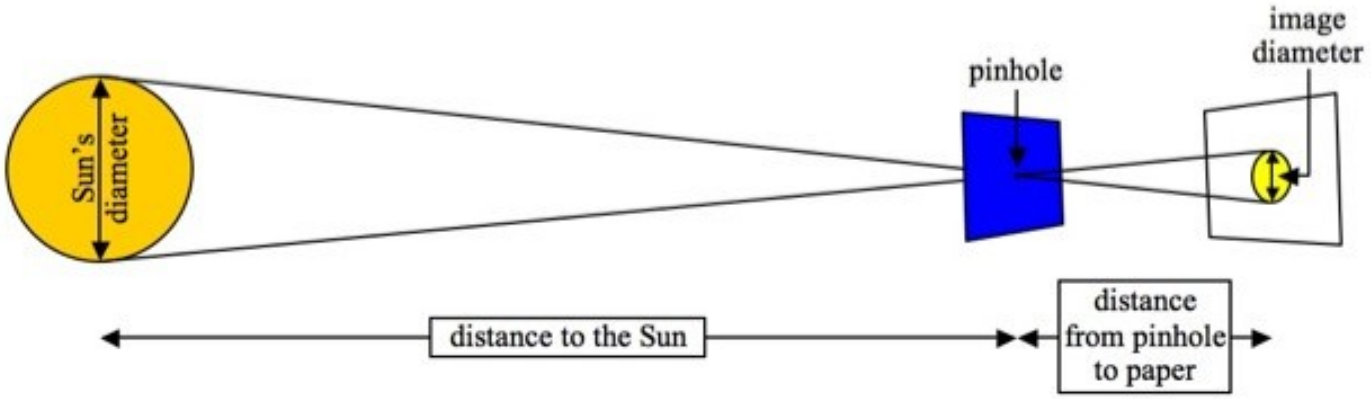
Measure the diameter of the Sun



$$\frac{\text{Sun's diameter}}{\text{distance to the Sun}} = \frac{\text{image diameter}}{\text{distance from pinhole to paper}}$$

$$\text{Sun's diameter} = \frac{\text{image diameter} \times \text{distance to the Sun}}{\text{distance from pinhole to paper}}$$

The distance from Earth to the Sun is 1.496×10^{11}m and has an absolute uncertainty of 1m Measurement of image diameter	The ruler has an absolute uncertainty of 1mm Percentage uncertainty in image diameter
Measurement of distance from pinhole to paper	Percentage uncertainty in distance from pinhole to paper
Calculated value of the Sun's diameter	Percentage uncertainty in distance from Earth to the Sun
Absolute uncertainty of the Sun's diameter	Percentage uncertainty of the diameter of the Sun

The Sun's actual diameter is 1.3927×10^{9}m

Is this within the absolute uncertainty of your calculated value?

Measure the diameter of an oil molecule

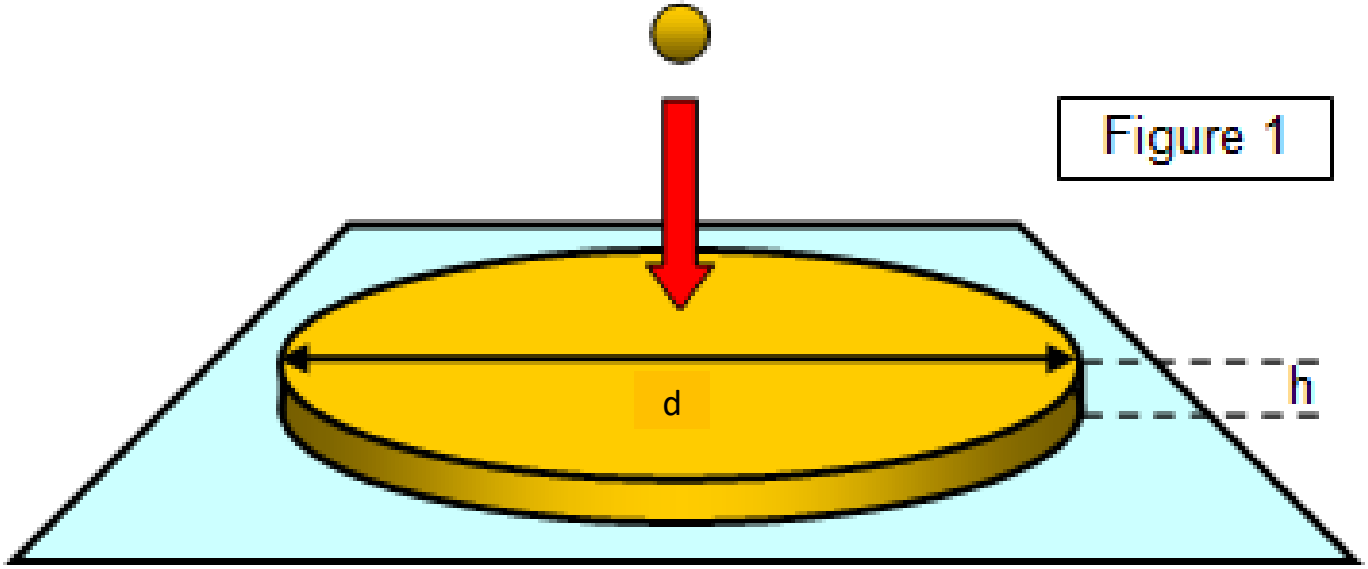


Figure 1

The volume of a cylinder $V = h \times \pi \times d^2/4$ where d is the diameter and h is the height of the cylinder.

The oil spreads out one molecule thick so h = the diameter of the oil molecule.

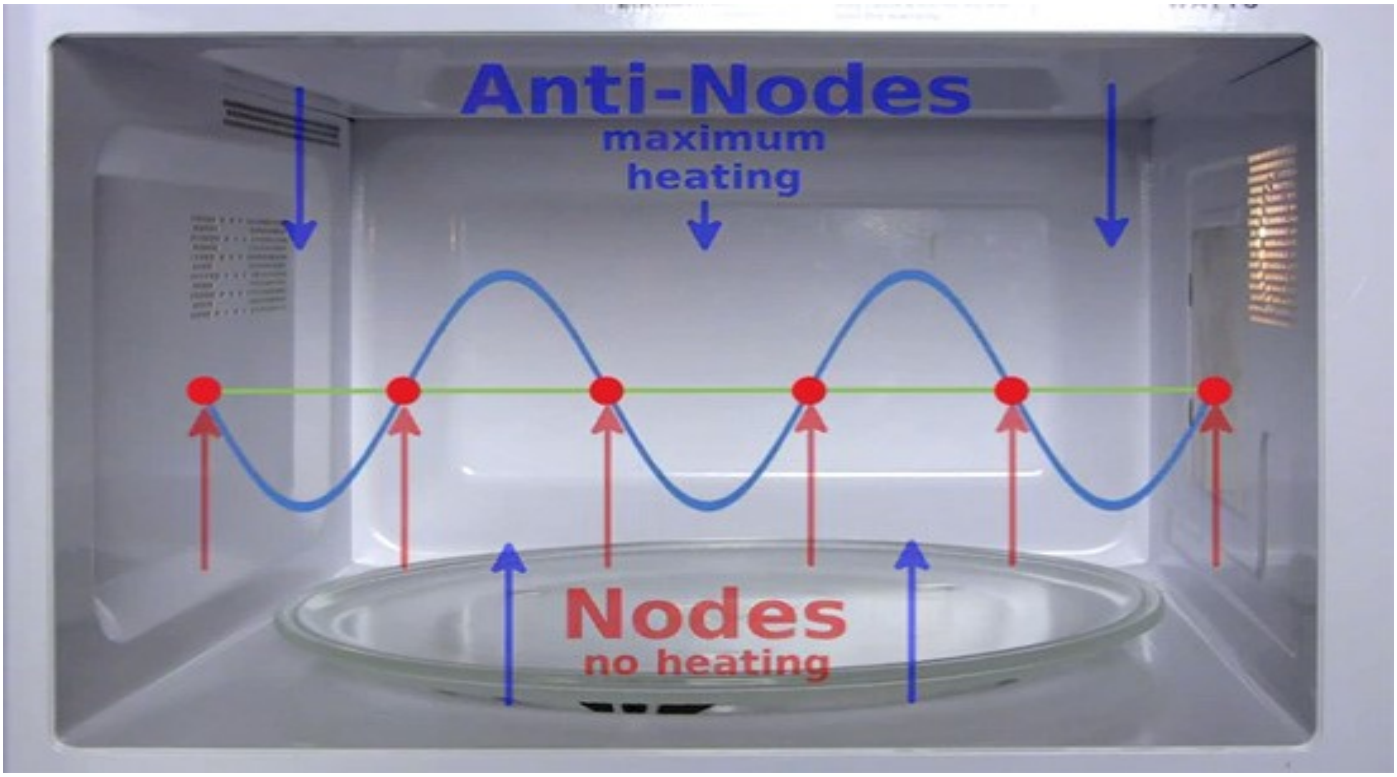
$$h = 4V/\pi \times d^2$$

Measurement of volume of oil droplet	The ruler has an absolute uncertainty of 1mm The pipette has an absolute uncertainty of $0.01cm^3$ Percentage uncertainty in the volume of the oil droplet
Measurement of diameter of oil cylinder	Percentage uncertainty in diameter of the oil cylinder
Calculated value of height of oil cylinder	Percentage uncertainty in the height of the oil cylinder
Absolute uncertainty of height of oil cylinder	

The oil molecule's actual diameter is 1×10^{-9}m

Is this within the absolute uncertainty of your calculated value?

Measure the speed of microwaves



Chocolate will melt at the points of maximum heating (anti-nodes)

The distance between consecutive anti-nodes is half a wavelength $d = 0.5\lambda$

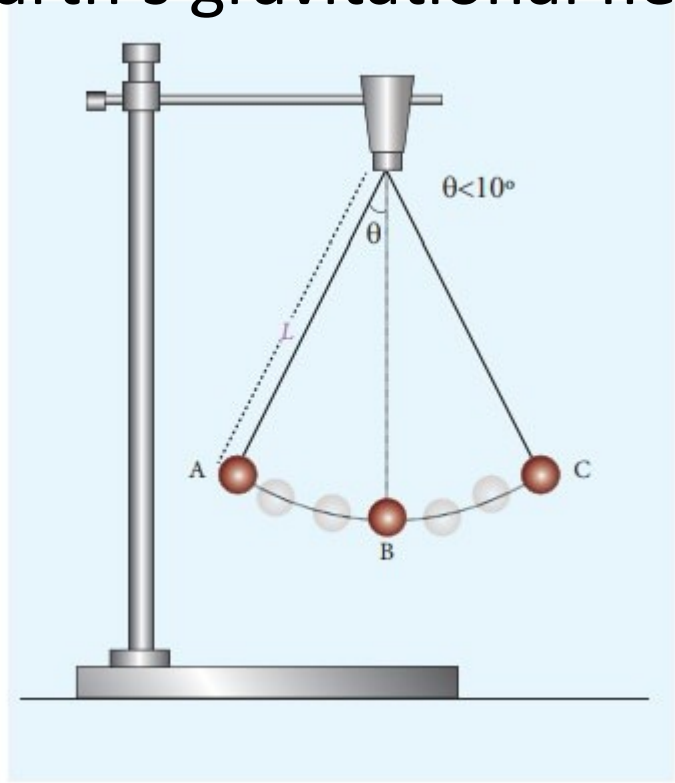
Speed of microwaves is frequency x wavelength $v = f \times \lambda$

The frequency of the microwaves are 2450 $\times 10^6$ Hz and have an absolute uncertainty of 1×10^6 Hz Measurement of distance between anti-nodes	The ruler has an absolute uncertainty of 1mm Percentage uncertainty in the distance between anti-nodes
Calculated value of Wavelength	Percentage uncertainty in speed of microwaves
Calculated value of speed of microwaves	Absolute uncertainty of speed of microwaves

The speed of microwaves is 3.00×10^8 m/s

Is this within the absolute uncertainty of your calculated value?

Measure Earth's gravitational field strength



The square of the time period of a pendulum $T^2 = 4\pi^2 \times L/g$ Where L is the length of the pendulum and g is the gravitational field strength. Timing 20 oscillations will reduce the % uncertainty in our measurement.

$$g = 4\pi^2 \times L / T^2$$

Measurement of the length of the pendulum Measurement of the time for 20 oscillations T for 1 oscillation = Calculated value of g Absolute uncertainty of g	The ruler has an absolute uncertainty of 1mm The timer has an absolute uncertainty of the reaction time of the user (roughly 0.25s) Percentage uncertainty in the length of the pendulum Percentage uncertainty in the time for 20 oscillations Percentage uncertainty in the gravitational field strength

The gravitational field strength of Earth is actually 9.81 m/s^2

Is this within the absolute uncertainty of your calculated value?

Calculating Percentage Uncertainties

Reading on meter = 25.2 V

Finest division = 0.1 V

This is the absolute uncertainty **± 0.1 V**

$$\%\text{Uncertainty} = \frac{\text{Absolute Uncertainty}}{\text{Reading Taken}} \times 100$$

$$\%\ \text{Uncertainty} = (0.1/25.2) \times 100 = 0.4\ \%$$

Combining % Uncertainties

What happens in the formula	What to do to calculate uncertainties
A x B or A ÷ B	Add percentage uncertainty of A with percentage uncertainty in B
A^2	Double the percentage uncertainty of A
A^n	Multiply the percentage uncertainty by n

$A_1 + A_2$ or $A_1 - A_2$ Combine the absolute uncertainties before calculating the % uncertainty