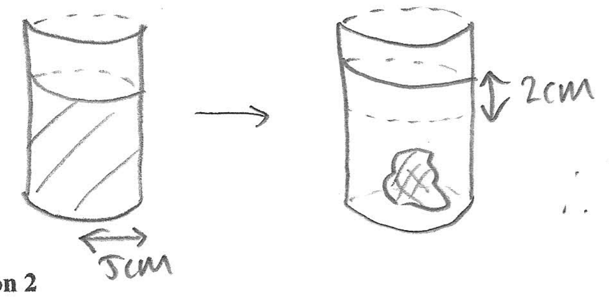
WRITE ON THIS PAPER UNLESS TOLD OTHERWISE. **CLEARLY SHOW ALL WORKINGS!** PAY ATTENTION TO NEATNESS AND ORGANIZATION. HAND IT IN ON TIME. HAVE A GO EVEN IF AT FIRST YOU CAN'T SPOT THE ANSWER!

NAME: Dr French SET: .... DATE: ....

Measurement/Density/Units

Question 1

A meteorite is placed in a cylinder of water. The radius of the cylinder is 5cm. When immersed the height of the water rises by 2cm. Meteorites are known to have densities between 3 and 8 g/cm^3. Calculate the range of masses you expect the meteorite to have.



Density $\rho = M/V$

$\therefore$ $\boxed{M = \rho V}$

$V = \pi \times 5^2 \times 2$

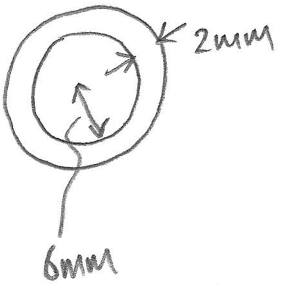
$V = 50\pi \text{ cm}^3$

$\therefore$ $150\pi\,g < M < 400\pi\,g$

$\boxed{471g < M < 1260g}$

Question 2

Samples of a rare meteorite can be bought for £500 per gram. A ring is to be fashioned. The inner radius is 6mm, the ring thickness is 2mm and the height of the ring is 5mm. If the density is $7g/cm^3$, calculate (i) the mass of the ring and (ii) the cost of materials



Volume of ring is $(\pi \times 8^2 - \pi \times 6^2) \times 5$

$= \boxed{140\pi \text{ mm}^3}$

$\therefore$ $1 \text{ mm} = 10^{-1} \text{ cm}$ $\therefore$ $1 \text{ mm}^3 = 10^{-3} \text{ cm}^3$

So $140\pi \text{ mm}^3 = \frac{140\pi}{1000} \text{ cm}^3$ $\therefore$ $M = \rho V$

$= \frac{980\pi}{1000} = \boxed{3.08g}$

So cost is $\boxed{£1539}$

Question 3

An electrical signal is to be transmitted along a 100km cable between Winchester and London. The signal travels at one fifth of the speed of light in a vacuum, which is $c = 2.998 \times 10^8 \text{ms}^{-1}$. Calculate the travel time in micro-seconds (μs)

At constant speed: $\frac{1}{5}c = \frac{100 \times 10^3 \text{ m}}{t}$ $\therefore$ $t = \frac{100 \times 10^3}{2.998 \times 10^8} \times 5$

$t = 1.668 \times 10^{-3} s = \boxed{1668 \mu s}$

Question 4

1 inch = 2.54cm, 1 month = 365/12 days

A nerve can re-grow at a rate of about 1 inch per month. Calculate this speed in ms^{-1}, writing your answer in standard form to 2.s.f.

$v = \frac{1 \times 2.54 \times 10^{-2} \text{ m}}{\frac{365}{12} \times 24 \times 3600 \text{ s}} = \boxed{9.7 \times 10^{-9} \text{ ms}^{-1}}$

(ie about 1000 atoms per second)

↑ 10^{-10} m