

## 1.2 Measuring molecules

For these problems, review Appendix A and B on the main document. You may also need to read up on Indices in the *Foundation Maths support Pack*.

### 1.2.1 More converting units and geometry

1. The volume of a cuboid is  $4 \text{ cm}^3$ . If the cuboid is placed on a flat table its height is 10 cm. What is the area of the side in contact with the table in square metres?
2. What is the volume of a spherical shell (an 'onion shell') that is 1 cm thick and has an outer radius of 10 cm (in cubic metres)?
3. The volume of a sphere is  $10 \text{ m}^3$ . What is its surface area in square metres?
4. The volume of a cylindrical cup is  $400 \text{ cm}^3$ . If the height of the cup is 10 cm, what is the radius of the cylinder in cm?

### 1.2.2 Density, volume and mass

The basic concept here is that  $mass = density \times volume$ . In these questions you are given two of the three variables and asked to calculate a third. The difficulty is often converting units though!

1. A cube has the length of all sides equal to 10 cm. The density of the material it is made of is  $\rho = 3000 \text{ kg m}^{-3}$ . What is the mass of the cube in kg?
2. A cube has a mass of 4500 grams. What is the length of all three sides (in cm) if the density of the cube is  $\rho = 2000 \text{ kg m}^{-3}$ ?
3. A sphere has density,  $\rho = 1.5 \text{ g cm}^{-3}$  and a radius of 20 cm. What is its mass in kg?
4. A spherical rain drop has mass of  $5 \times 10^{-4} \text{ kg}$  and a density of  $\rho = 1 \text{ g cm}^{-3}$ . What is its diameter in cm?

### 1.2.3 Distances between things

These problems follow on from the problem in class about distance between water molecules.

1. Manchester city centre has an area of  $\sim 5.7 \text{ km}^2$  and a population of 11,689<sup>1</sup>. What is the average distance between people within the Centre?
2. Walking down Oxford Road for  $\sim 1500 \text{ m}$  you count that there are 10 bars / pubs. What is the average distance between pubs?
3. Within a lake of volume  $1 \times 10^6 \text{ m}^3$  there are 1000 fish. What is the average spacing between the fish?

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<sup>1</sup>[http://en.wikipedia.org/wiki/Manchester\\_city\\_centre](http://en.wikipedia.org/wiki/Manchester_city_centre)

Answers to: More converting units and geometry:

1.  $4 \times 10^{-5} \text{ m}^2$ .
2.  $0.0011 \text{ m}^3$ .
3. 1.3365 m is the radius and  $22.4466 \text{ m}^2$  is the surface area.
4. 3.57 cm.

Answers to: Density, volume and mass:

1. 3 kg.
2. 13.1 cm.
3. 50.27 kg.
4. 0.98 cm.

Answers to: Distances between things:

1. 22 m.
2. 150 m.
3. 10 m.