

## Materials 2 Questions set 2

### Materials Properties

1. Define density and state its SI units.

*Note: when you define properties of materials give the defining equation and state what the symbols mean.*

2. Define stress, strain, Young's modulus, and Poisson's ratio and state the units where applicable.

3. Why do we use density, Young's modulus and stress when we define material properties rather than mass, stiffness and force?

4. Define thermal expansion and thermal conductivity and state the units where applicable.

5. Consider the following materials:

aluminium, brick, iron, polyethylene, rubber, silicon carbide (SiC), steel

(a) State which classification each belongs to, choose from metals, ceramics, and polymers.

(b) For each material give **approximate values**, and state the reference source you use to find the data, for the following properties: density, Young's modulus, strength, Poisson's ratio, thermal expansion, thermal conductivity, approximate maximum temperature of use. *Advice on which reference sources to use: Ashby 1989 and video slides, or pdf of video slides.*

(c) For consideration and discussion in the seminars: what can you sense or feel kinaesthetically in a metal, ceramic, and polymers in relation to these properties?

6. Imagine a pint glass that's filled with soft, fluffy, fresh snow. If you took the snow and made it into a snowball (a) estimate what diameter the snowball would be. If the snowball then melts, (b) what volume of water do you estimate it will be.

State any assumptions you make in answering this question.

7. Concrete comprises aggregate plus cement. Explain how the measurement of density is affected by the size of the concrete sample, and estimate approximately how large a sample you need, to get a reliable measurement. Explain your reasoning.

8. What can Ashby maps (sometimes called Ashby's materials selection charts) be used for?

9. What relationships, or patterns, can you find between density and other engineering material properties in Ashby's materials selection charts?

*For this question use Ashby's materials selection charts you can find these in the video slides, in the Library Resources (including M.F. Ashby, On the engineering properties of materials (Overview No. 80), Acta Metall, 37, 1273-1293, 1989).*