1. (a) Define the *density* of a material.

.....

(1)

(b) Brass, an alloy of copper and zinc, consists of 70% **by volume** of copper and 30% **by volume** of zinc.

density of copper $= 8.9 \times 10^3$ kg m^{-3}
density of zinc $= 7.1 \times 10^3$ kg m^{-3}

(i) Determine the mass of copper and the mass of zinc required to make a rod of brass of volume 0.80×10^{-3} m^3.

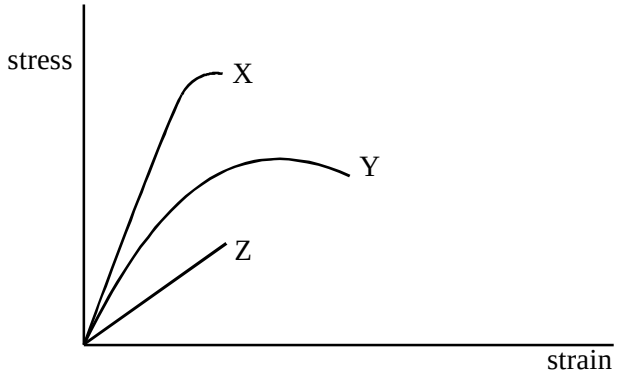
.....

(ii) Calculate the density of brass.

.....

(4)
(Total 5 marks)

2. The diagram shows tensile stress-strain curves for three different materials X, Y and Z.



For each material named below, state which curve is typical of the material, giving the reasoning behind your choice.

(a) copper .....

reasoning .....

(b) glass .....

reasoning .....

(c) hard steel .....

reasoning .....

(Total 6 marks)

3. (a) Describe an experiment to determine the Young modulus for a material in the form of a wire. Draw a labelled diagram and explain how you would make the necessary measurements. Show how you would use your measurements to calculate the result.

.....

(8)

(b)

A copper wire and an aluminium wire, each of diameter 0.72 mm, are joined end to end as shown in the diagram with the aluminium wire fixed at right angles to a rigid support. A steadily increasing force, *F*, is applied. Use data from the Data Sheet to

(i) explain which wire will yield,

.....

(ii) determine the value of F at which yield should occur.

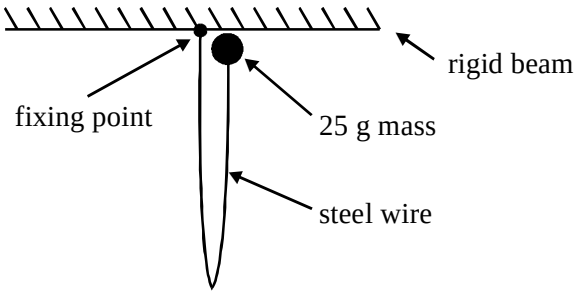
.....

.....

(4)

(Total 12 marks)

4. One end of a steel wire of length 1.2 m and 2.0 mm diameter is attached to a rigid beam. A 25 g mass is attached to the free end of the steel wire and placed against the underside of the beam as shown.



The 25 g mass is released and falls freely until the wire becomes taut. The kinetic energy of the falling mass is converted to elastic potential energy in the wire as the wire extends to a maximum of 1.0 mm. Energy converted to other forms is negligible.

For **maximum** extension of the wire, complete parts (i) to (v).

(i) Show that the elastic potential energy stored by the extended wire is 0.29 J.

.....

(ii) Calculate the tension in the wire.

.....

(iii) Calculate the stress in the wire.

.....

(iv) Calculate the strain of the wire.

.....

(v) Hence, calculate the Young modulus for the steel of the wire.

.....

(Total 9 marks)

5. (a) When determining the Young modulus for the material of a wire, a *tensile stress* is applied to the wire and the *tensile strain* produced is measured.

(i) State the meaning of

tensile stress .....

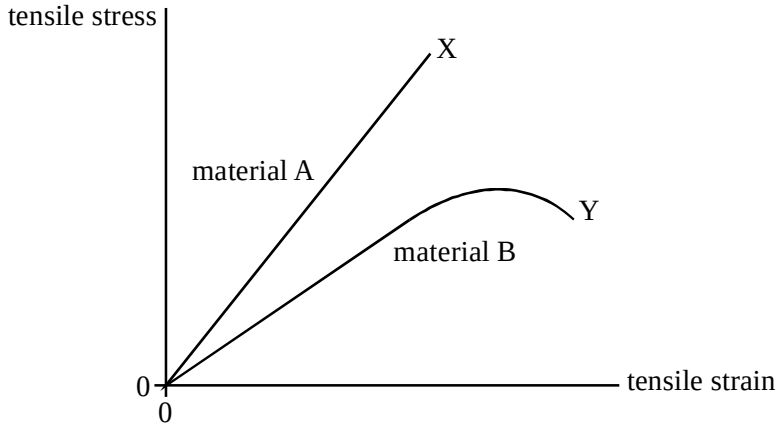
tensile strain .....

(ii) Define the Young modulus.

.....

(3)

(b) The graph represents tensile stress-tensile strain curves for two different materials A and B. X and Y are the respective points at which each material fractures.



(i) One of the materials is brittle, the other ductile. State which material is brittle.

.....

(ii) Making use of the curves in the graph, describe the behaviour of each material as it is stretched from its original state to breaking point.

material A .....

material B .....

(iii) State, giving a reason, which material has the greater value of the Young modulus.

.....

.....

(5)

(c) A vertical steel piano wire of length 1.5 m and cross-sectional area 1.3×10^{-6} m^2 supports a load of 80N.

Given that the Young modulus for steel = 2.10×10^{11} Pa, calculate the extension in the wire produced by this load.

.....

.....

(2)

(Total 10 marks)

6. A uniform wooden beam of mass 35.0 kg and length 5.52 m is supported by two identical vertical steel cables **A** and **B** attached at either end, as shown in **Figure 1**.

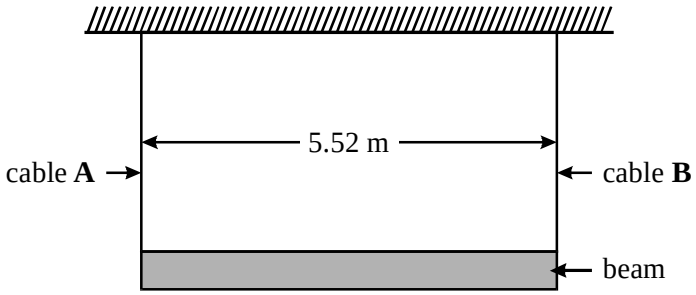


Figure 1

(a) Calculate

(i) the weight of the beam,

.....

(ii) the tension in each cable.

.....

(2)

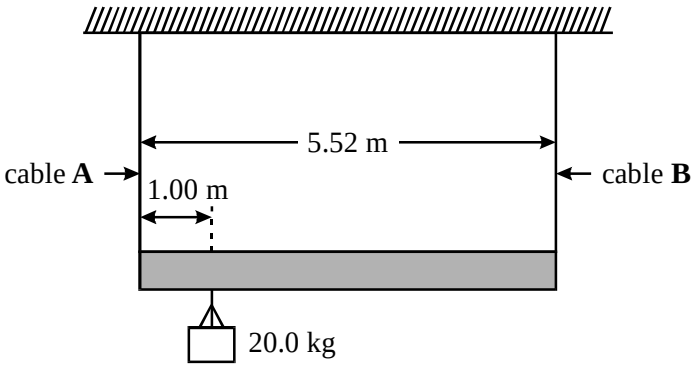
(b) Each unstretched cable has a diameter of 8.26 mm and a length 2.50 m. Calculate the extension of each cable when supporting the beam.

the Young modulus for steel = 2.10×10^{11} Pa

.....

(4)

(c) An object of mass 20.0 kg is hung from the beam 1.00 m from cable **A**, as shown in **Figure 2**.



(i) Show that the new tension in cable **A** is 332 N.

.....

(ii) Calculate the new tension in cable **B**.

.....

.....

(6)

(Total 12 marks)