

4. A garden centre has commissioned a design for the shade structure shown in Figure Q4. Titanium-alloy supporting cables hold the main columns in position.

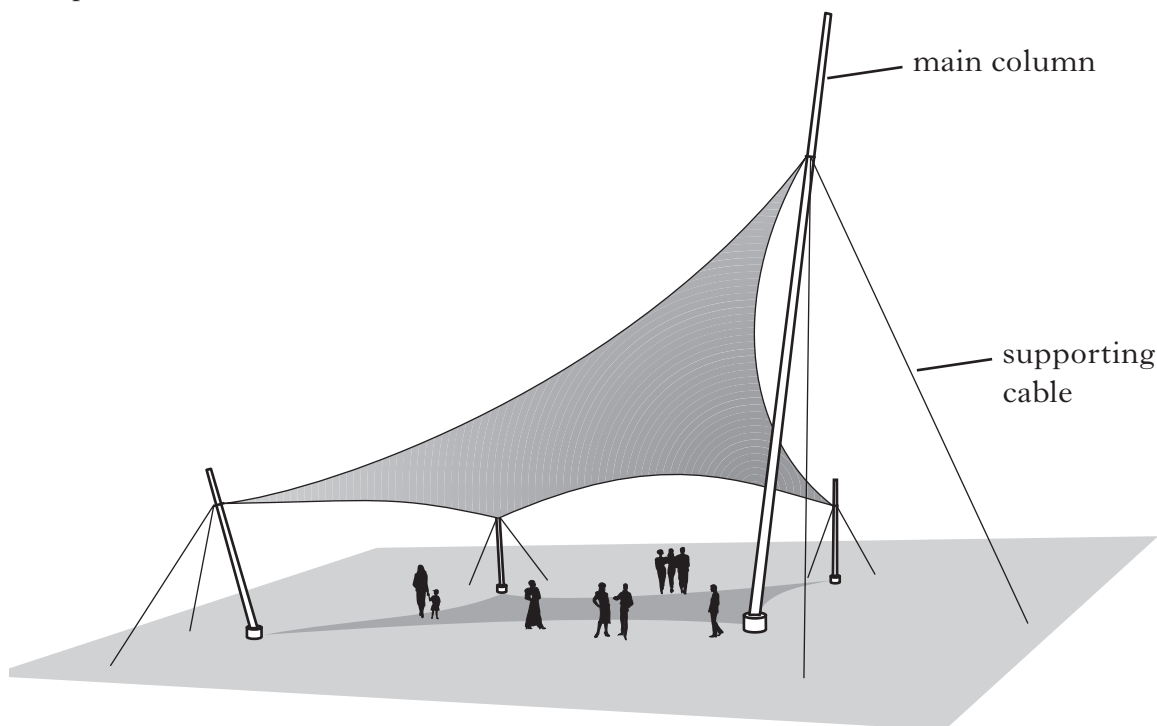


Figure Q4

The supporting cables have an effective diameter of 10 mm and the safe working strain is 0.0009.

- (a) State why a high factor of safety would be appropriate for this design. 1
- (b) (i) Calculate the safe working stress. 3
- (ii) Calculate the factor of safety. 2
- (c) Determine the maximum permissible load that can be applied to a supporting cable. (6)

4. Figure Q4 shows a load-extension graph for a tensile test on a sample of a special type of steel.

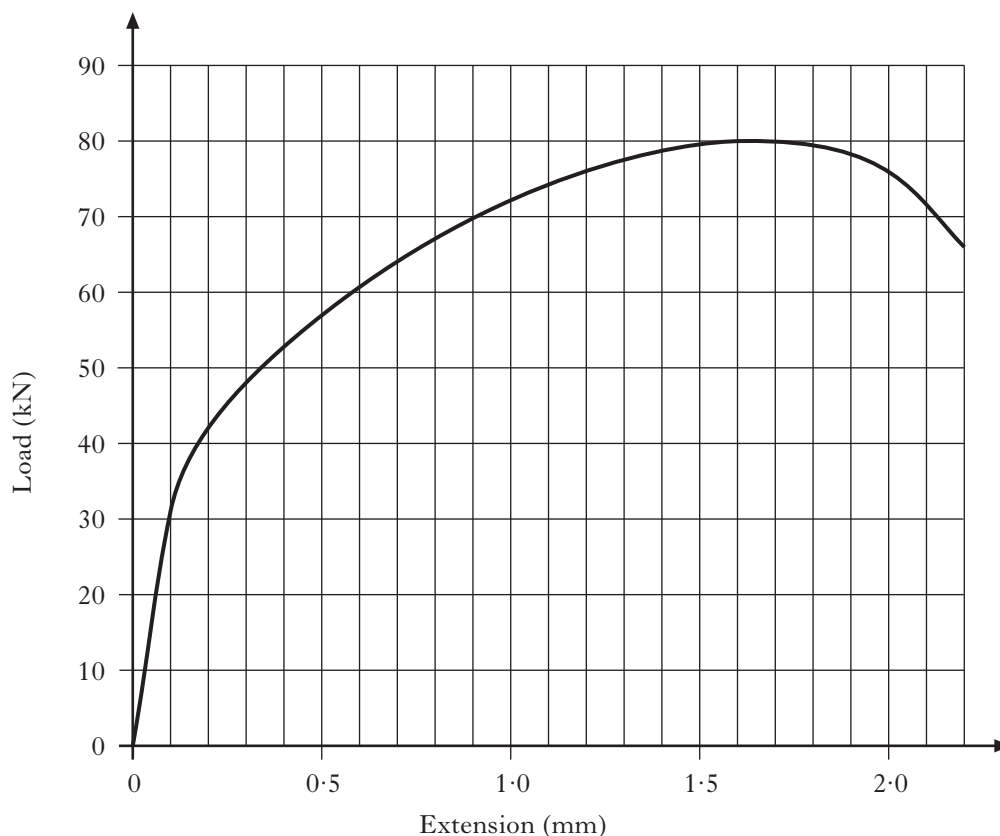


Figure Q4

- (a) State whether this material is brittle or ductile. 1

The test specimen was 50 mm long with a cross-sectional area of  $80 \text{ mm}^2$ .

- (b) Calculate Young's Modulus for the material. 3

- (c) Calculate the **ultimate** tensile stress for the material. 1

A bar with a rectangular cross-section of  $30 \text{ mm} \times 10 \text{ mm}$  is manufactured from the material. The bar is to be loaded in tension with a Factor of Safety of 6.

- (d) (i) Calculate the safe working stress for the bar. 1

- (ii) Calculate the safe working load for the bar. 1

(7)

[Turn over