

- 11 A tensile force of 4.5 N is applied to a spring. The spring extends elastically by 3.2 cm.

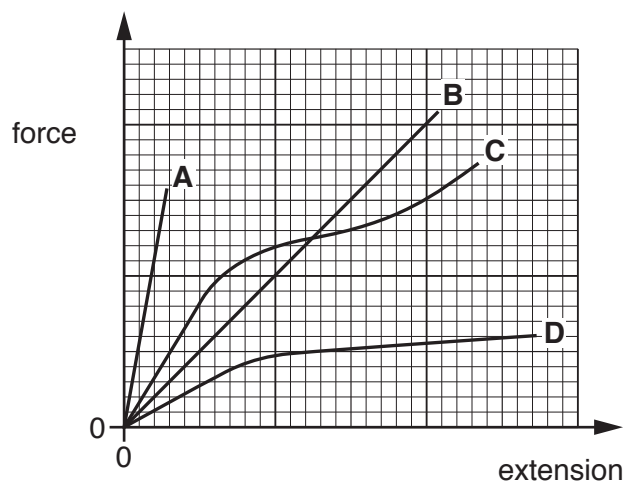
What is the elastic potential energy of the spring?

- A 0.072 J
- B 0.14 J
- C 2.4 J
- D 14 J

Your answer

[1]

- 2 Four materials **A**, **B**, **C** and **D** have the same length and cross-sectional area. The force against extension graph for each material up to the breaking point is shown below.

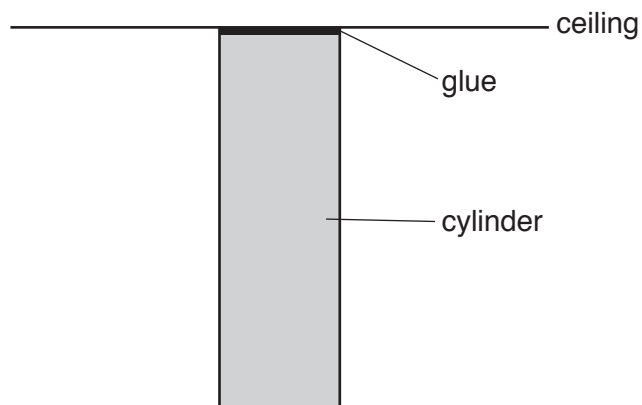


Which material is brittle and has the greatest ultimate tensile strength?

Your answer

[1]

- 6 The flat end of a uniform steel cylinder of weight 7.8 N is glued to a horizontal ceiling. The cylinder hangs vertically. The breaking stress for the glue is 130 kPa.



The glue only just holds the cylinder to the ceiling.

What is the cross-sectional area of the cylinder?

- A  $6.0 \times 10^{-2} \text{m}^2$
- B  $6.0 \times 10^{-5} \text{m}^2$
- C  $1.7 \times 10^{-2} \text{m}^2$
- D  $1.7 \times 10^1 \text{m}^2$

Your answer

[1]

- 11 The table below shows some data on two wires **X** and **Y**.

Wire	Young modulus of material / GPa	Cross-sectional area of wire / mm <sup>2</sup>
<b>X</b>	120	1.0
<b>Y</b>	200	2.0

The wires **X** and **Y** have the same original length. The tension in each wire is the same. Both wires obey Hooke's law.

What is the value of the ratio  $\frac{\text{extension of X}}{\text{extension of Y}}$ ?

- A 0.30
- B 1.7
- C 2.0
- D 3.3

Your answer

[1]

- 7 One end of a spring is fixed and a force  $F$  is applied to its other end. The elastic potential energy in the extended spring is  $E$ . The spring obeys Hooke's law.

What is the extension  $x$  of the spring?

A  $x = \frac{E}{F}$

B  $x = \frac{F}{E}$

C  $x = \frac{2E}{F}$

D  $x = \frac{F}{2E}$

Your answer

[1]

**10**  
**SECTION B**

Answer **all** the questions.

- 16 (a)** Explain what is meant by the **ultimate tensile strength** of a material.

.....  
..... [1]

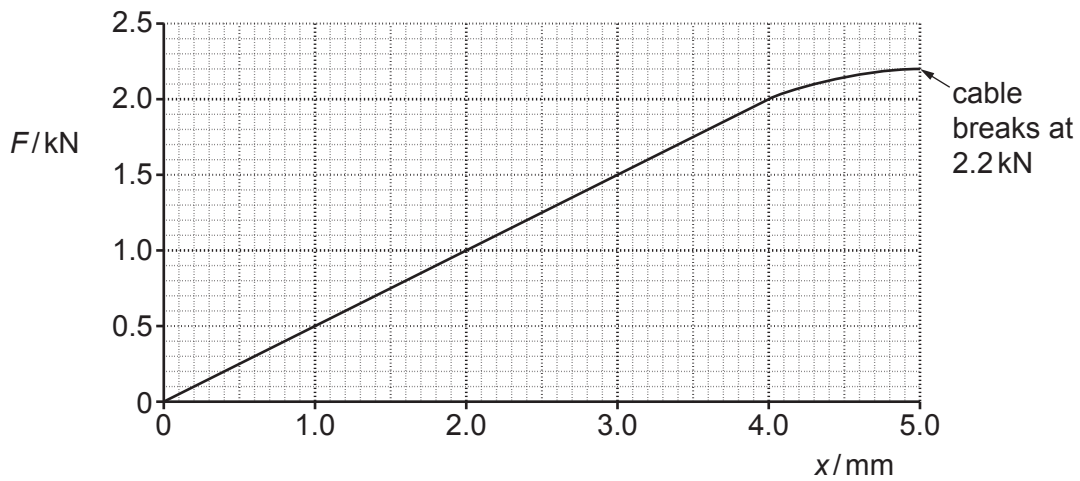
- (b)** A footbridge is supported by a number of metal cables of the same length. Each cable has uniform cross-section and diameter 4.20 mm as shown in Fig. 16.1.



**Fig. 16.1 (not to scale)**

A group of engineers investigate how the extension  $x$  varies with applied force  $F$  for one of the cables.

The results of the investigation are shown in Fig. 16.2.



**Fig. 16.2**

The cable breaks when the force is 2.2 kN.

- (i)** Describe how a suitable measuring device may have been used by the engineers to demonstrate that the cable had uniform cross-section.

.....  
.....  
..... [2]

(ii) State any value of  $F$  when the cable behaves

1. elastically

$F = \dots\dots\dots$  kN

2. plastically.

$F = \dots\dots\dots$  kN  
[2]

(iii) Use Fig. 16.2 to determine the force constant  $k$  in  $\text{Nm}^{-1}$  of the cable.

$k = \dots\dots\dots$   $\text{Nm}^{-1}$  [2]

(c) Determine the breaking stress  $\sigma$  of the cable.

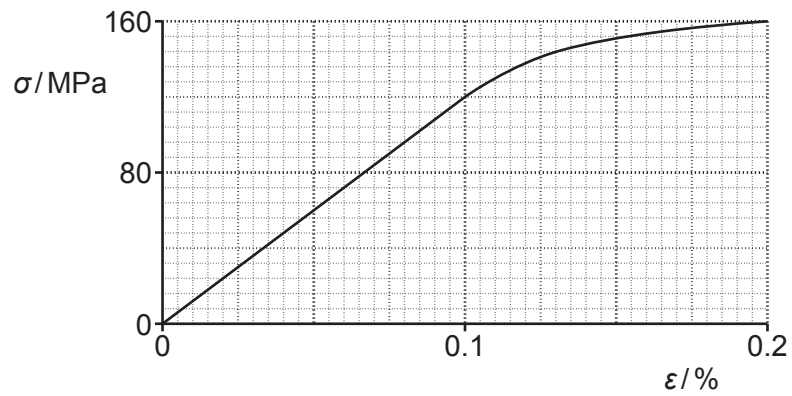
Assume that the cross-sectional area of the cable remains constant during the test.

$\sigma = \dots\dots\dots$  Pa [2]

(d) Explain why the work done on the cable when its extension changes from 3.0 mm to 4.0 mm is greater than when its extension changes from 1.0 mm to 2.0 mm.

.....  
.....  
..... [2]

12 A graph showing the variation of the stress  $\sigma$  with strain  $\epsilon$  for a material is shown below.



What is the Young modulus of the material?

- A  $6.0 \times 10^4$  Pa
- B  $1.2 \times 10^9$  Pa
- C  $8.0 \times 10^{10}$  Pa
- D  $1.2 \times 10^{11}$  Pa

Your answer

[1]