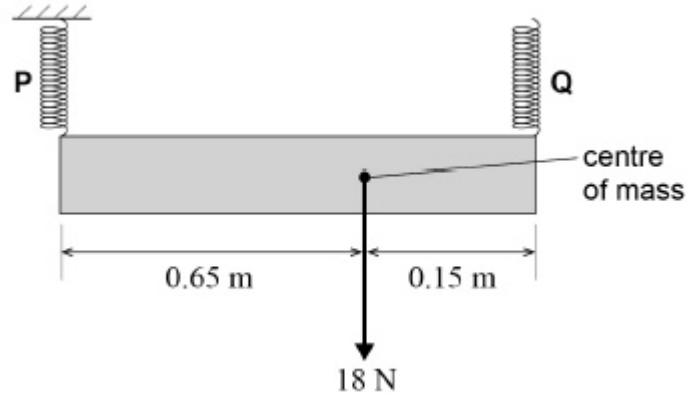


- 7 A non-uniform sign is 0.80 m long and has a weight of 18 N. It is suspended from two vertical springs **P** and **Q**. The springs obey Hooke's law and the spring constant of each spring is 240 N m^{-1} .



The top end of spring **P** is fixed and the top end of spring **Q** is adjusted until the sign is horizontal and in equilibrium.

What is the extension of spring **Q**?

- A** 0.014 m
- B** 0.038 m
- C** 0.049 m
- D** 0.061 m

Take moments at P to find the force on Q.

$$0.65 \times 18 = F_q \times (0.15 + 0.65) \Rightarrow F_q = 14.625 \text{ N}$$

$$F = Kx \text{ so } x = 78 / 240 = 0.061 \text{ m (2sf)}$$

(Total 1 mark)

8

A steel wire **W** has a length l and a circular cross-section of radius r . When **W** hangs vertically and a load is attached to the bottom end, it extends by e .

Another wire **X** made from the same material has the same load attached to it.

Which length and radius for **X** will produce an extension of $\frac{e}{4}$?

	Length of X	Radius of X	
A	$0.5l$	$2r$	<input type="checkbox"/>
B	l	$4r$	<input type="checkbox"/>
C	$2l$	$2r$	<input type="checkbox"/>
D	$4l$	$4r$	<input checked="" type="checkbox"/>

$E = \text{stress/strain}$

l/r^2
 $0.5/2^2 = 1/8$
 $1/4^2 = 1/16$
 $2/2^2 = 1/2$
 $4/4^2 = 1/4$

(Total 1 mark)

$$E = \frac{Fl}{\Delta l A} \rightarrow \Delta l = \frac{Fl}{EA}$$

Both wires have the same load and are of the same material, so same F and E

$\therefore \Delta l \propto \frac{l}{A}$ and we know that $A = \pi r^2$ so we can say $\Delta l \propto \frac{l}{r^2}$ and we know Δl for wire x is $\frac{1}{4}$ that for wire w
 So the $\frac{l}{r^2}$ must change by a factor $= \frac{1}{4}$ as well

Now we need to look at the ratios of l/r^2 from the table of answers and see which one has a ratio of $1/4$

9

What **cannot** be used as a unit for the Young modulus?

A N m^{-2}

B Pa

C $\text{kg m}^{-2} \text{s}^{-2}$

D $\text{kg m}^{-1} \text{s}^{-2}$

Units come down to F/A

A and B are just N/m^2 so both right

$$\text{Sub } F = ma \rightarrow E = \frac{ma}{A} \rightarrow \frac{\text{kgms}^{-2}}{\text{m}^2} \text{ ie } \text{kgm}^{-1}\text{s}^{-2}$$

Which is D.

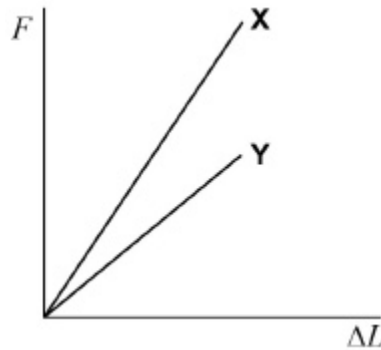
So C is wrong (ie its the answer_)

(Total 1 mark)

10

Two separate wires **X** and **Y** have the same original length and cross-sectional area.

The graph shows the extension ΔL produced in **X** and **Y** when the tensile force F applied to the wires is increased up to the point where they break.



Which statement is **incorrect**?

- A** For a given extension more energy is stored in **X** than in **Y**.
- B** The Young modulus of the material of wire **Y** is greater than that of wire **X**.
- C** Both wire **X** and wire **Y** obey Hooke's law.
- D** Wire **X** has a greater breaking stress than wire **Y**.