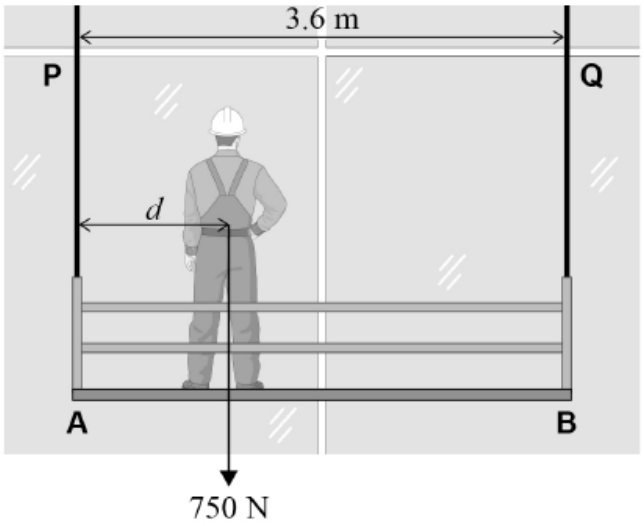
Materials – 2022 AS Physics

1. June /2022/Paper_ 7407/1/No.6

0 6 **Figure 5** shows a worker of weight 750 N on a uniform platform. The weight of the worker is acting at a horizontal distance d from end **A**.

Throughout this question, assume that the platform is horizontal and that all cables obey Hooke's law.

Figure 5



The platform weighs 1800 N and is suspended by vertical cables **P** and **Q**.
Each cable has an unstretched length of 3.0 m.
The horizontal distance between **P** and **Q** is 3.6 m.

0 6 . 1 The worker moves to a position where the tension in the left-hand cable **P** is 1150 N.

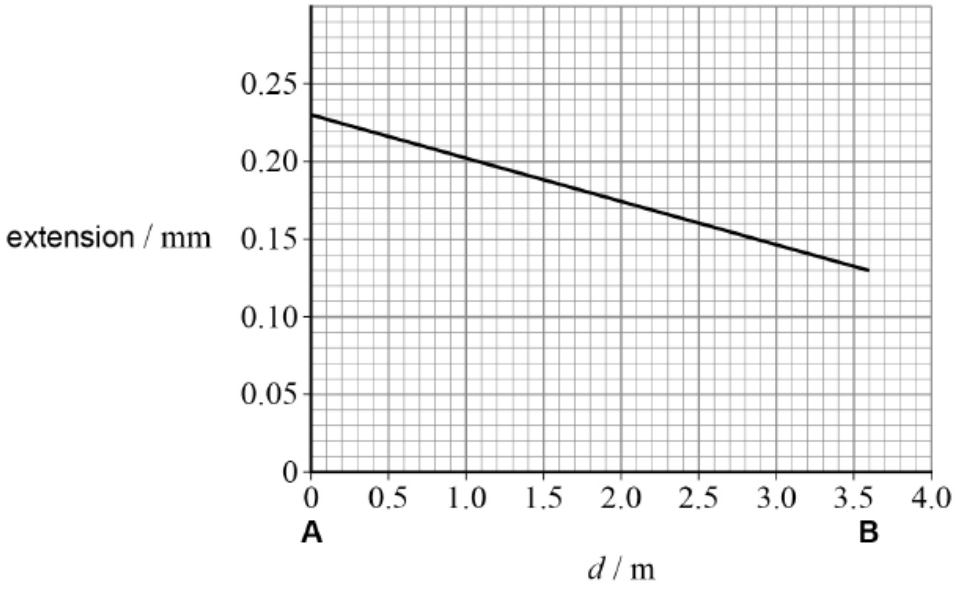
Calculate d for this position.

[3 marks]

$d =$ _____ m

Figure 6 shows how the extension of **P** varies with d as the worker walks slowly along the platform from **A** to **B**.

Figure 6



The worker moves to a position **X** where the strain in **P** is 6.0×10^{-5}.

0 6 . 2 Determine d for position **X**.

[2 marks]

$d =$ _____ m

0 6 . 3 The cable material has a Young modulus of 1.9×10^{11} N m^{-2}.

Calculate the tensile stress in **P** when the worker is at **X**.

[1 mark]

tensile stress = _____ N m^{-2}

0 6 . 4 The original cables **P** and **Q** are replaced.

Table 2 shows how the properties of the original cables compare with the replacement cables.

Table 2

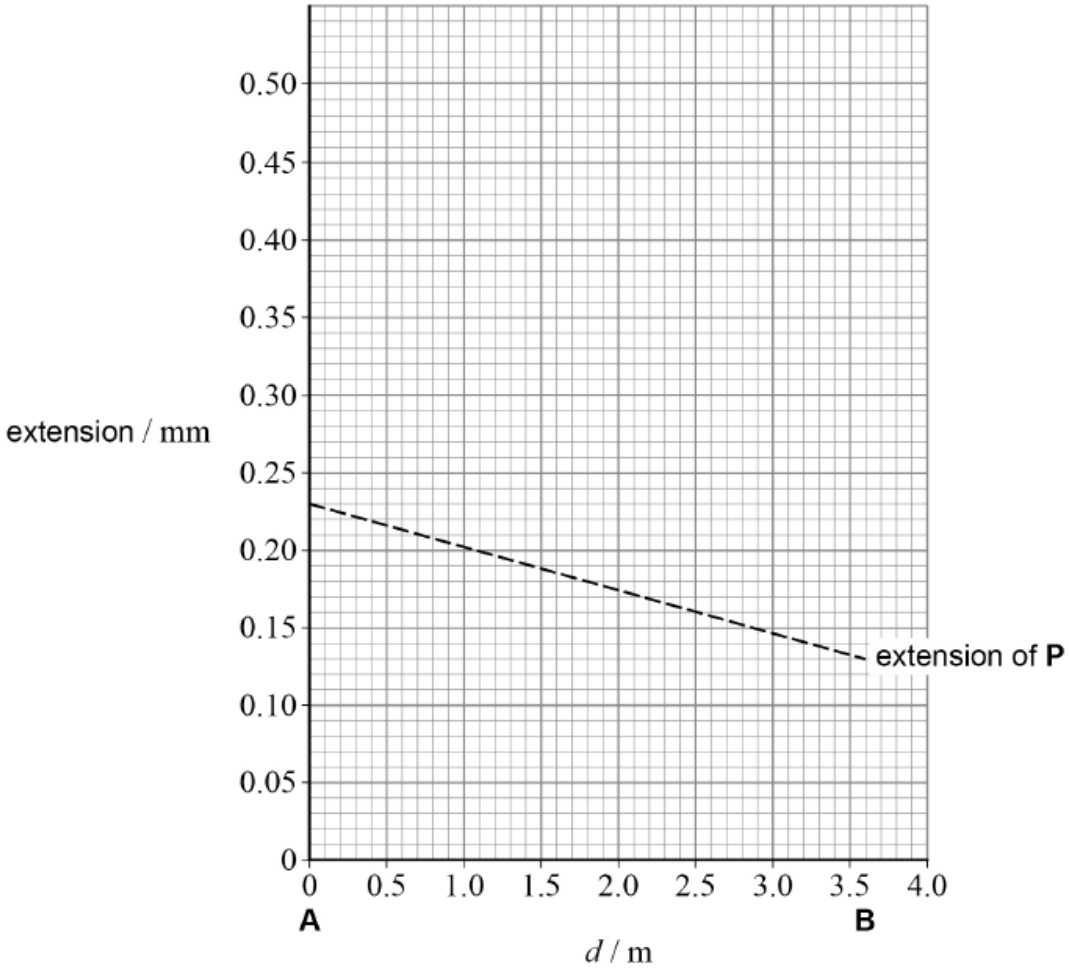
	Unstretched length	**Radius**	**Young modulus of cable material**
Original cables	L	r	E
Replacement cables	L	$\frac{r}{2}$	$2E$

After the cables have been replaced, the worker walks slowly from **A** to **B**.

Draw on **Figure 7** a line to show the variation of the extension of the replacement left-hand cable with d.
The original line from **Figure 6** is shown on **Figure 7** as a dashed line to help you.

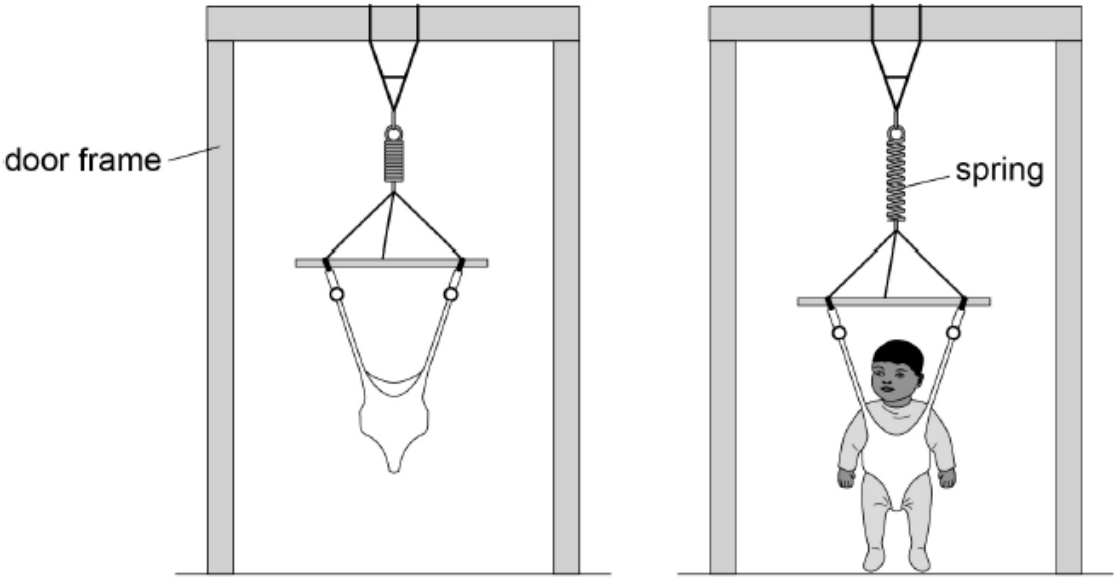
[3 marks]

Figure 7



2. June /2022/Paper_ 7407/2/No.6

A baby bouncer consists of an inextensible harness attached to a spring.



The stiffness of the spring is in the range:

[1 mark]

A 1–10 N m^{-1} ⬭

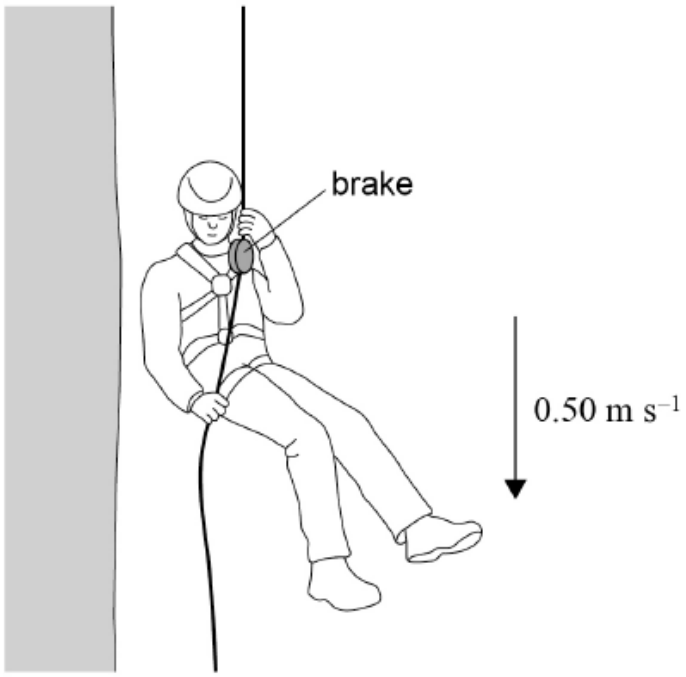
B 10–100 N m^{-1} ⬭

C 100–1000 N m^{-1} ⬭

D 1000–10 000 N m^{-1} ⬭

3. June /2022/Paper_ 7407/2/No.27

A climber wears a harness attached to a rope. The rope passes through a brake. There is friction between the rope and the brake.



The climber uses the brake to descend at a steady speed of $0.50\ \text{m s}^{-1}$.
The combined mass of the climber, the harness and the brake is $60\ \text{kg}$.

What is the rate of energy transfer to the brake and rope?

[1 mark]

A 15 W ⬭

B 29 W ⬭

C 150 W ⬭

D 290 W ⬭

4. June /2022/Paper_ 7407/2/No.29

A wire is made from a material of Young modulus E.
The wire obeys Hooke's law.
The wire has an unstretched length L and a cross-sectional area A.
When a force is applied to the wire, the extension of the wire is e.

What is the elastic strain energy stored in the wire?

[1 mark]

A $\frac{AEe^2}{2L}$ ⬭

B $\frac{L}{2Ae}$ ⬭

C $\frac{Ae^2}{2EL}$ ⬭

D $\frac{AEL}{2e}$ ⬭