1.5 Answers

1.5.1 Solution to 1.2 Example

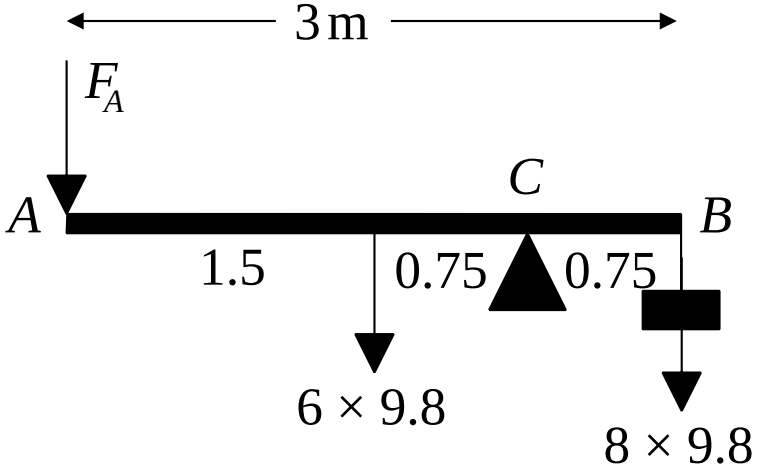
$$Moment_{ROBERT} = 0.6 \times 50 \qquad Moment_{GEORGE} = 0.4 \times 70$$
$$= 30 \text{ Nm} \qquad = 28 \text{ Nm}$$

$\therefore$ As $30 > 28$, Robert wins the pushing battle

1.5.2 Solution to 1.3 Example

To begin with questions involving moments will feature a single long, straight beam. It might be made out of wood, metal or plastic and may be described as a rod, a plank, a pipe or a pole, for example.
It will be assumed that it does not bend or break under load.
A key idea, used repeatedly, is that when the beam is described as *uniform* all of its mass can be considered to act half way along its length.

In this question you could think of the uniform steel rod as being a see-saw, with its pivot at C, offset from the centre by 0.75 m.



Take moments about C

$$6 \times 9.8 \times 0.75 + F_A \times 2.25 = 8 \times 9.8 \times 0.75$$
$$44.1 + 2.25 F_A = 58.8$$
$$F_A = \frac{14.7}{2.25}$$
$$= 6.53 \text{ N}$$

1.5.3 Solutions to 1.4 Exercise

Answer 1

(i) Emma wins because,

$$Moment_{EMMA} > Moment_{LUCY} + Moment_{TRACY}$$

$$0.7 \times 70 > 0.8 \times 60 + 50 \times 0$$

$$49 > 48$$

(ii) Let x be the distance from the pivot at which Tracy applies her force,

$$0.7 \times 70 = 0.8 \times 60 + 50 \times x$$

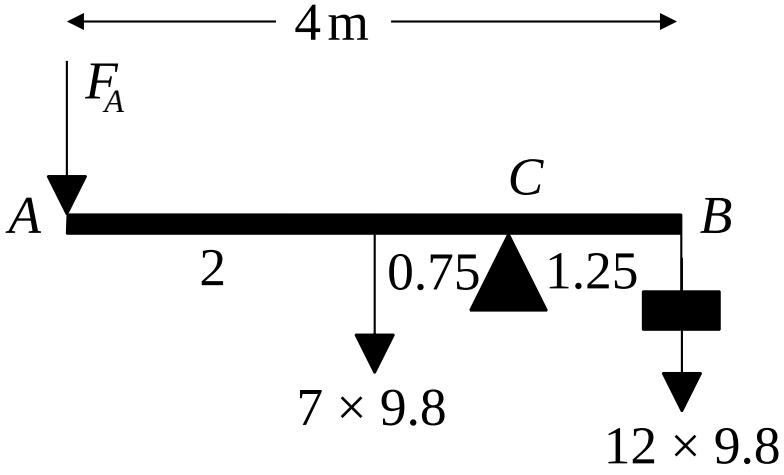
$$49 = 48 + 50x$$

$$50x = 1$$

$$x = 0.02 \text{ metres}$$

i.e 2 cm in from the pivot (Hinge)

Answer 2



Take moments about C

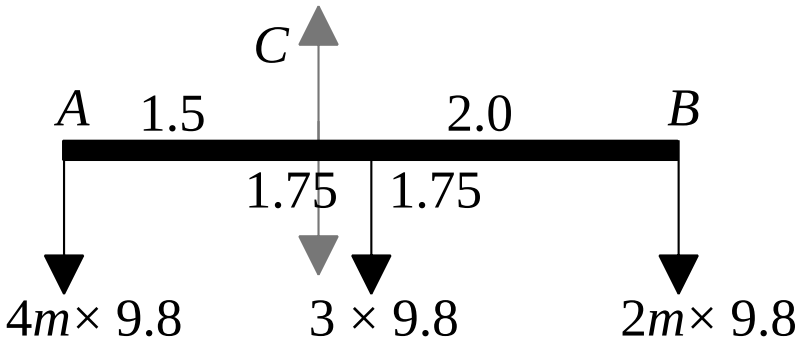
$$12 \times 9.8 \times 1.25 = 7 \times 9.8 \times 0.75 + F_A \times 2.75$$

$$147 = 51.45 + 2.75 F_A$$

$$F_A = \frac{95.55}{2.75}$$

$$= 34.7 \text{ N}$$

Answer 3



Take moments about C
The star hanging from C can be ignored as it is 0 m from C
The force in the string attached at C can be ignored for the same reason

$$4m \times 9.8 \times 1.5 = 3 \times 9.8 \times 0.25 + 2m \times 9.8 \times 2.0$$

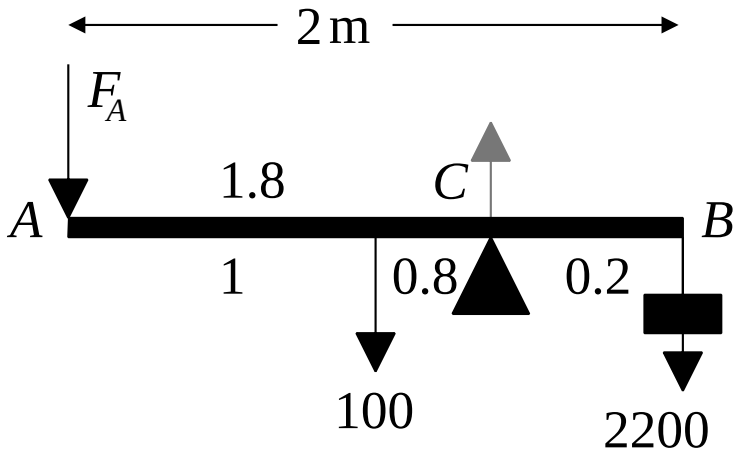
$$58.8m = 7.35 + 39.2m$$

$$19.6m = 7.35$$

$$m = \frac{7.35}{19.6}$$

$$= 0.375 \text{ kg}$$

Answer 4
(a)



Take moments about C
The force acting on the pivot at C can be ignored as it is 0 m from C

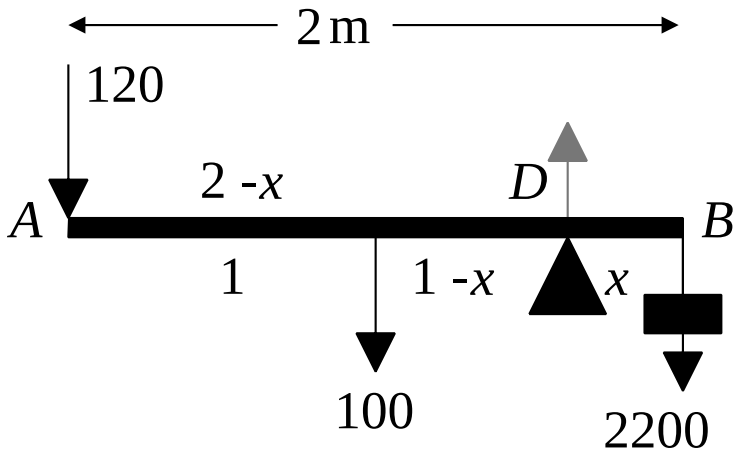
$$2200 \times 0.2 = 100 \times 0.8 + F_A \times 1.8$$

$$440 = 80 + 1.8\,F_A$$

$$F_A = \frac{360}{1.8}$$

$$= 200 \text{ N}$$

(b)



Let D be the new location of the pivot at a distance x from B,

$$2200 \times x = 100\,(1 - x) + 120\,(2 - x)$$

$$2200x = 100 - 100x + 240 - 120x$$

$$2420x = 340$$

$$x = \frac{340}{2420}$$

$$= 0.14 \text{ metres}$$

i.e. 14 cm