



# Moments, Turning and Balancing 7

GCSE

P

P

P

A Level

P

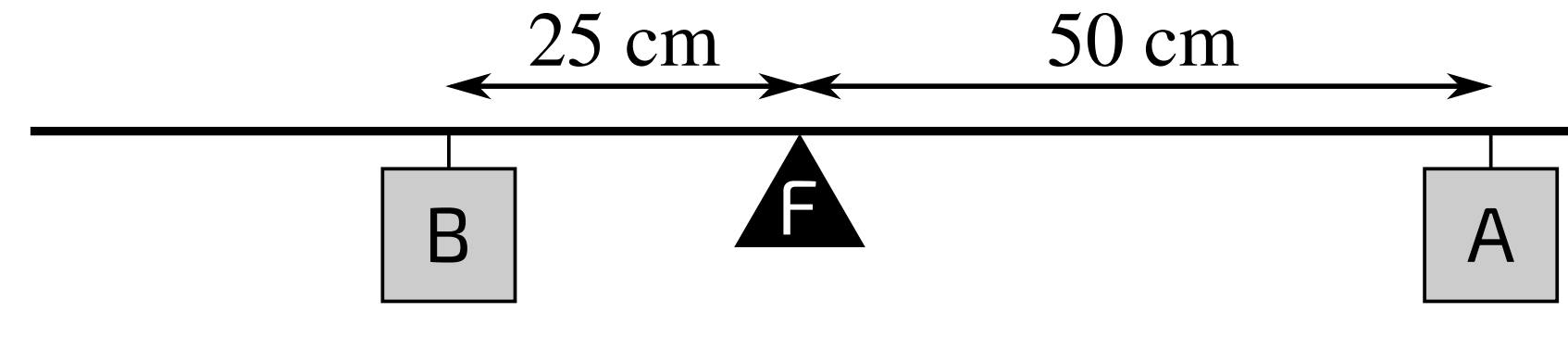
P

P

## Essential GCSE Physics 16.7

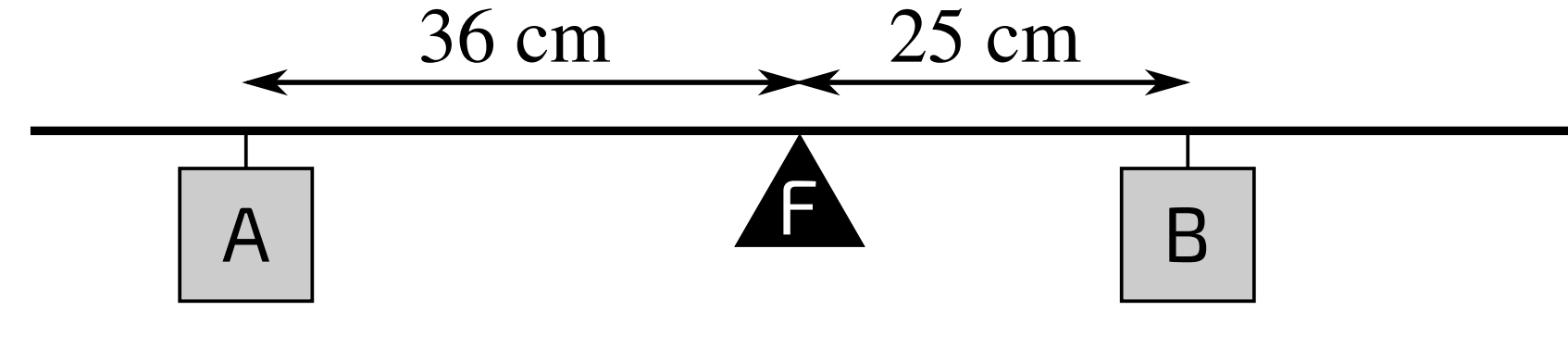
Calculate the weight of the block stated in each situation below where the uniform lever arm is balanced about the fulcrum 'F'.

### Part A   Weight of B



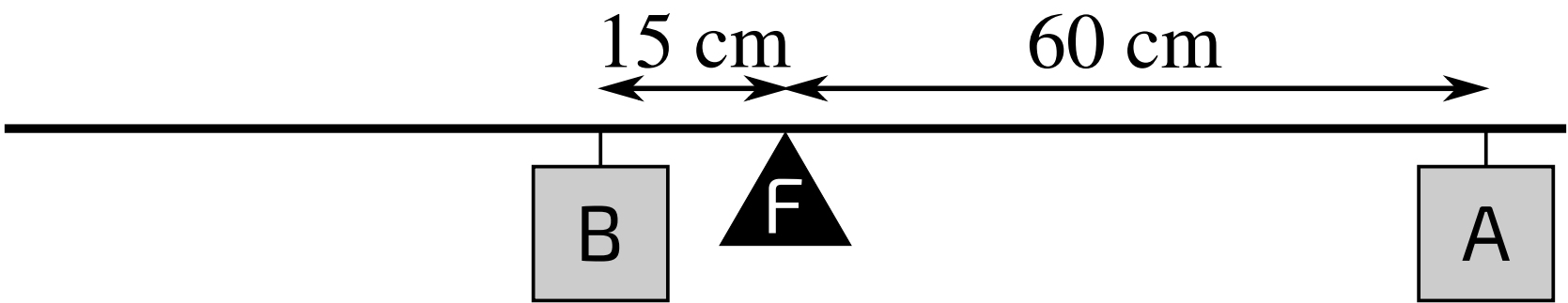
If A weighs 5.0 N, what is the weight of B?

### Part B   Weight of B



If A weighs 10 N, what is the weight of B?

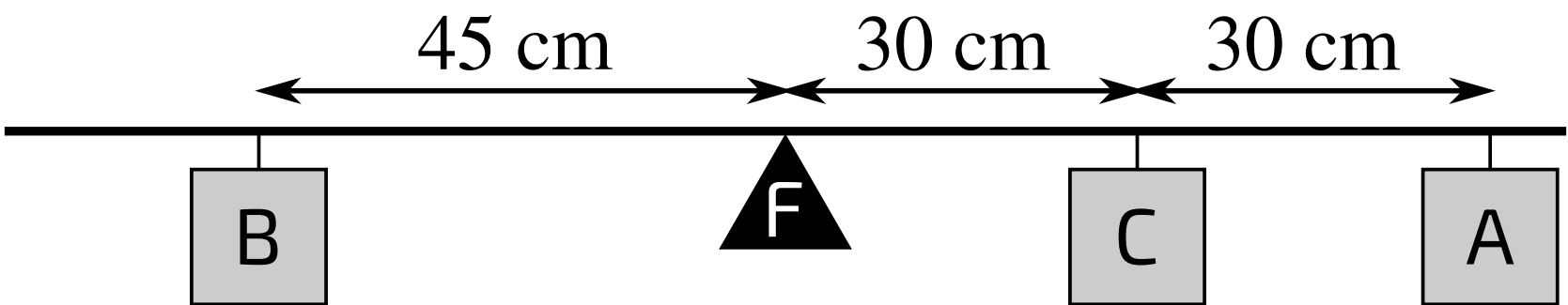
Part C    Weight of B



If A weighs 10 N, what is the weight of B?

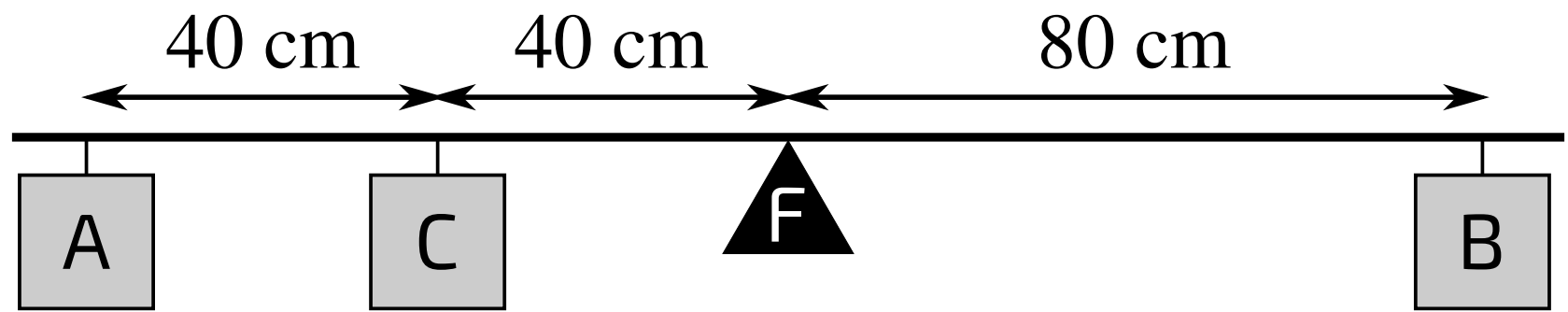
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Part D    Weight of C



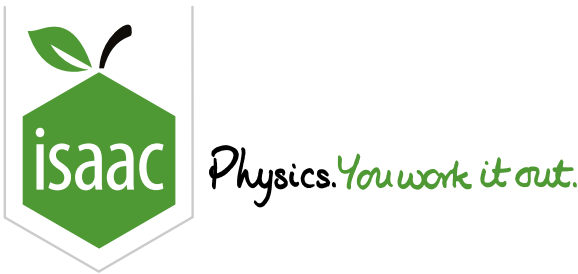
If A weighs 10 N and B weighs 20 N, what is the weight of C?

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**Part E**    **Weight of C**

If A weighs 2.0 N and B weighs 4.0 N, what is the weight of C?

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# Moments 1

## Essential Pre-Uni Physics B5.1

GCSE

P

P

P

A Level

P

P

P

The strength of Earth's gravity at ground level =  $9.8 \text{ N kg}^{-1}$ . 1 tonne = 1000 kg.

Numeric answers should contain units. Where forces are asked for, ensure that the direction is in the answer (e.g. up/down). Assume that the mass is evenly distributed in the rulers, poles, planks, bridge spans mentioned in the questions.

A metre rule is pivoted about the '50 cm' mark (which is the position of its centre of mass). In each part, find the direction and magnitude of force  $F$  needed to balance the rule. Assume the upwards direction is positive.

### Part A   The 70 cm mark

a) There is a 3.0 N upwards force at the 20 cm mark. Force  $F$  acts at the 70 cm mark.

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### Part B   The 60 cm mark

There is a 5.0 N upwards force at the 10 cm mark. Force  $F$  acts at the 60 cm mark.

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### Part C   The 75 cm mark

There is a 2.0 N upwards force at the 5.0 cm mark, and a 12 N downwards force at the 40 cm mark. Force  $F$  acts at the 75 cm mark.

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**Part D    The 30 cm mark**

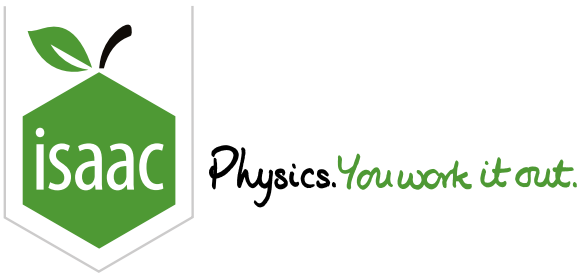
There is a 100 g mass sitting on the 10 cm mark, and a 50 g mass sitting on the 60 cm mark. Force  $F$  acts at the 30 cm mark.

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# Moments 2

## Essential Pre-Uni Physics B5.2

GCSE

C

C

C

A Level

P

P

P

The strength of Earth's gravity at ground level =  $9.8 \text{ N kg}^{-1}$ . 1 tonne = 1000 kg.

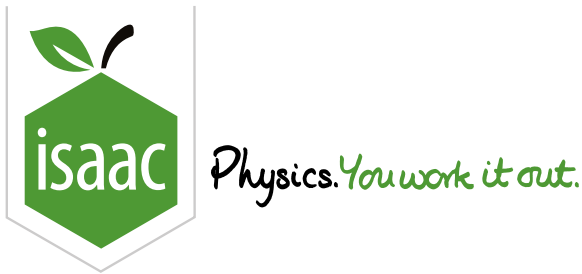
Numeric answers should contain units. Where forces are asked for, ensure that the direction is in the answer (e.g. up/down). Assume that the mass is evenly distributed in the ruler.

A metre stick has its centre of mass at the 50 cm mark, and weighs 0.92 N. A 2.00 N weight is stuck to the 10 cm mark with massless glue. About which point will the ruler balance?

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# Moments 3



## Essential Pre-Uni Physics B5.3

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The strength of Earth's gravity at ground level =  $9.8 \text{ N kg}^{-1}$ . 1 tonne = 1000 kg.

Where forces are asked for, ensure that the direction is in the answer (e.g. up/down). Assume that the mass is evenly distributed in the rulers, poles, planks, bridge spans mentioned in the questions.

A 200 m bridge span is supported at both ends. The span has a mass of 100 tonnes. A 30 tonne bus is 50 m from one end of the span. Calculate the supporting force holding the bridge up at the end nearer the bus. Please give your answer to 2 significant figures.

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# Moments 4

A Level  
P P P

## Essential Pre-Uni Physics B5.4 & B5.5

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Two workers are moving a 20 kg, 10 m scaffolding pole. One stands at the end, the other stands 2.0 m from the other end.

**Note:** The strength of Earth's gravity at ground level =  $9.8 \text{ N kg}^{-1}$ .

Numeric answers should contain units. Where forces are asked for, ensure that the direction is in the answer (e.g. up/down). Assume that the mass is evenly distributed in the pole.

### Part A B5.4 Scaffolding pole

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Calculate the force exerted by the worker standing at the end, in holding the pole.

### Part B B5.5 Force exerted by the other worker

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Calculate the weight of the pole 'carried' by the other worker.

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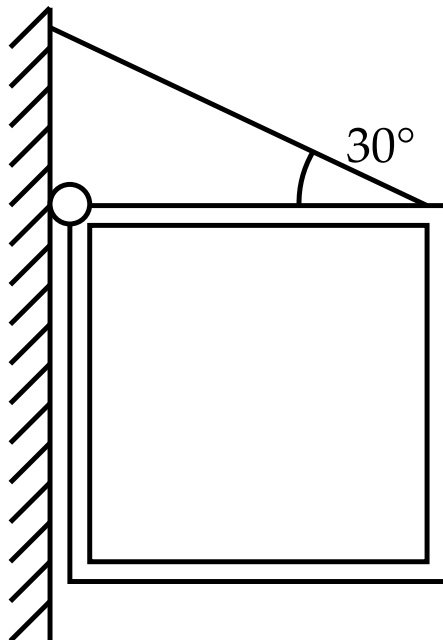
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# Moments 7

Essential Pre-Uni Physics B5.7

A Level



**Figure 1:** Diagram showing the pub sign.

The pub sign shown above is supported by a hinge and by a metal rod.

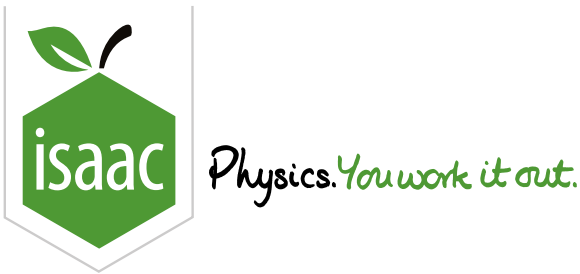
**Note:** The strength of Earth's gravity at ground level =  $9.8 \text{ N kg}^{-1}$ .

Calculate the tension in the rod if the pub sign is an 80 cm square of mass 30 kg. Ignore the mass of the rod, assume that the hinge is well-oiled, and assume that the mass is evenly distributed in the sign. Give your answer to 2 significant figures.

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# Moments 6

A Level

## Essential Pre-Uni Physics B5.6

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Two pupils who don't like each other are made to carry a  $1.0\text{ m} \times 2.0\text{ m}$  whiteboard down some stairs. Each takes their share of the weight by holding the bottom corner at their end.

Assuming that they each want the easier job, and that the mass is evenly distributed in the whiteboard, which end should they fight over?

- ☐ Upper end
- ☐ Lower end

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# Weight of a Lorry

A Level



*This problem involves centre of mass calculation by moments, which is not covered in some Physics A Levels. For more information please check with your teacher.*

A haulage company wants to determine the weight of a lorry with four identical wheels, which is too large to stand with all four wheels on a single weighing platform.

The lorry is placed so that the two front wheels are on one weighing platform and the two back wheels on another; the masses recorded are 1350 kg and 1450 kg respectively. The axles are 3.00 m apart and at the same height.

## Part A Mass of the lorry

Find the mass of the lorry.

## Part B Position of centre of mass

Find the distance of the centre of mass from the front axle.

## Part C Additional mass

What additional mass  $m$  would have to be placed 50.0 cm in front of the front axle to make the weights borne by the axles equal?

Adapted with permission from UCLES, Higher School Certificate Mathematics, June 1930, Paper 3, Question 5.

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