

Exercise walk-through

5.4

Moments, levers and gears – physics only (4.5.4)

AQA · GCSE · Physics

Exercises 2.1·2.3

2.1 A 40 N force acts 0.50 m from a pivot. Calculate the moment. [2]

2.2 State the balance condition for an object that does not rotate about a pivot. [1]

2.3 A child applies 2.0 N on gear A's axle radius 0.10 m. Calculate the moment, and state the effect on gear B of twice the radius. [3]

3 Exam-style questions

Exercises 2.1·2.3

2.1 A 40 N force acts 0.50 m from a pivot. Calculate the moment. [2]

2.1

$$M = Fd = 40 \times 0.50 = \mathbf{20} \text{ N} \cdot \text{m}$$

(substitution 1, answer with unit 1)

2.2 State the balance condition for an object that does not rotate about a pivot. [1]

2.2 Total clockwise moment about the pivot = total anticlockwise moment.

2.3 A child applies 2.0 N on gear A's axle radius 0.10 m. Calculate the moment, and state the effect on gear B of twice the radius. [3]

3 Exam-style questions

2.3 Moment = $2.0 \times 0.10 = 0.20 \text{ N} \cdot \text{m}$. A gear of twice the radius turns with twice the moment at half the rate – force $\times$ distance trades off along the chain.

Exercise 3.1

3.1 A see-saw balances. A 400 N child sits 1.5 m left of the pivot.

- (a) Calculate the anticlockwise moment. [2]
- (b) A 600 N child sits right of the pivot. Calculate their distance for balance. [2]
- (c) The 400 N child moves 0.5 m further from the pivot. State and explain which way the see-saw tips. [2]

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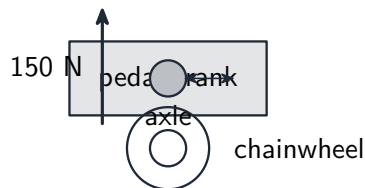
3.1 (a) $M = 400 \times 1.5 = \mathbf{600} \text{ N} \cdot \text{m}$ anticlockwise (C1, A1). (b) Balance: $600 \times d = 600$ so $d = \mathbf{1.0} \text{ m}$ (C1, A1). (c) It tips further left / down on the 400 N side: the left moment grows to $400 \times 2.0 = 800 \text{ N} \cdot \text{m}$ against $600 \text{ N} \cdot \text{m}$ right – unbalanced anticlockwise.

Exercise 3.2

3.2 A bicycle's pedal crank is 0.17 m long; the rider pushes down with 150 N perpendicular to the crank.

(a) Calculate the moment about the axle. [2]

(b) The chain transfers this turning effect to the rear wheel's gear. Explain how gears transmit rotational effects and why a lower gear helps on a hill. [3]

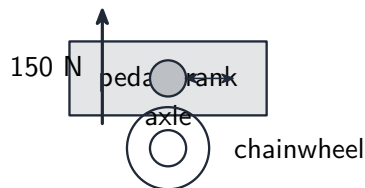


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3.2 (a) Force perpendicular to the crank, so $d = \text{crank length}$.

$$M = Fd = 150 \times 0.17 = 25.5 \approx \mathbf{26} \text{ N} \cdot \text{m} \text{ (2 s.f.)}$$

(C1, A1) (b) Meshed teeth push so the turning effect passes from one gear to the next; a lower (larger) rear gear multiplies the moment at the wheel; more moment at lower rotation rate suits climbing, where the rider needs force rather than speed.

Exercise 3.3

3.3 A uniform 6.0 m bridge of weight 3000 N rests on a support at its centre; a 1200 N car stands 1.5 m from the left end.

- (a) Explain why the bridge's own weight acts at its centre. [1]
- (b) Taking moments about the centre support, calculate the extra support force needed at the left end 3.0 m away. [3]
- (c) State one assumption in your calculation. [1]

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(c) State one assumption in your calculation. [1]

3.3 (a) A uniform object's weight acts at its centre of mass, the midpoint. (b) The car's moment about the centre: $1200 \times (3.0 - 1.5) = 1800 \text{ N} \cdot \text{m}$ anticlockwise (C1). The left support at 3.0 m must supply $1800 \text{ N} \cdot \text{m}$ clockwise (C1):

$$F = \frac{1800}{3.0} = \mathbf{600 \text{ N}}$$

(c) The car acts as a point load at its stated position / the bridge is uniform / the support is at the centre (any one, B1).