

Exercise walk-through

5.8

Forces and braking (4.5.6.3)

AQA · GCSE · Physics

Exercises 2.1·2.3

2.1 State the two parts of the stopping distance and what the first part equals. [2]

2.2 A driver travels at 15 m/s with a 0.5 s reaction time. Calculate the thinking distance. [2]

2.3 Give two vehicle-condition factors and two road factors that lengthen the braking distance. [4]

3 Exam-style questions

Exercises 2.1·2.3

2.1 State the two parts of the stopping distance and what the first part equals. [2]

2.1 Thinking distance + braking distance; thinking distance = reaction time $\times$ speed.

2.2 A driver travels at 15 m/s with a 0.5 s reaction time. Calculate the thinking distance. [2]

2.2 $s = vt = 15 \times 0.5 = \mathbf{7.5}$ m (C1, A1).

2.3 Give two vehicle-condition factors and two road factors that lengthen the braking distance. [4]

3 Exam-style questions

2.3 Vehicle: worn brakes; worn tyres. Road: wet; icy.

Exercises 3.1·3.2

3.1 Speed cameras record a car's average speed over 500 m as 24 m/s.

- (a) Explain why an average-speed measurement may hide a dangerous moment. [1]
- (b) The speed limit is 20 m/s. Using $\text{thinking} = v \times t$ and the table of braking distances, at 20 m/s the braking distance is 12 m. Estimate the stopping distance with a 0.7 s reaction time. [3]
- (c) Give two factors that could have lengthened this driver's thinking distance. [2]

3.2 Explain why the brakes of a vehicle heat up during braking, and why heavier braking is more dangerous. [4]

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3.1 (a) Averaging hides short bursts of speeding above the limit between cameras. (b) Thinking: $20 \times 0.7 = 14$ m (C1); stopping = $14 + 12 = \mathbf{26}$ m (C1, A1). (c) Any two: tiredness, alcohol, drugs, distractions (phone, passengers).

3.2 Explain why the brakes of a vehicle heat up during braking, and why heavier braking is more dangerous. [4]

3.2 The friction force between brake pads and wheel does work; the kinetic store of the car empties into the thermal store of the brakes – temperature rises. Heavier braking means a larger deceleration ($F = ma$); the brakes can overheat – losing braking power – and the tyres may lose grip, causing loss of control.

Exercise 3.3

3.3 A 1200 kg car travelling at 25 m/s makes an emergency stop in 50 m.

- (a) Calculate the deceleration. [2]
- (b) Estimate the braking force. [2]
- (c) The same car at 50 m/s stops with the same braking force. Show that the braking distance is about four times larger. [3]
- (d) Explain one danger of this large deceleration. [2]

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3.3 (a)

$$a = \frac{v^2 - u^2}{2s} = \frac{0 - 25^2}{100} = -\mathbf{6.25} \text{ m/s}^2$$

(C1, A1) (b) $F = ma = 1200 \times 6.25 = \mathbf{7500} \text{ N}$ (C1, A1). (c) Same force $\rightarrow$ same deceleration; doubling u quadruples u^2 (C1):

$$s = \frac{u^2}{2a} = \frac{2500}{12.5} = 200 \text{ m} = 4 \times 50 \text{ m} \checkmark$$

(quadrupling shown C1, A1) (d) Any well-explained: brakes overheat and fade; or deceleration throws occupants forward – injury without restraint; or tyres break traction – skid and loss of steering.