

Solutions

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

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

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

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 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.

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) $F = ma = 1200 \times 6.25 = \mathbf{7500}$ 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.