

Solutions

2.1 With zero resultant force, a moving object continues at the same velocity (same speed and direction).

2.2

$$a = F/m = 48/12 = \mathbf{4.0 \text{ m/s}^2}$$

(C1, A1)

2.3 Two interacting objects exert equal and opposite forces on each other; e.g. the foot pushes the ground backwards and the ground pushes the foot forwards (both named, B1).

3.1 (a) Independent: the pulling force (masses on the hanger); dependent: the acceleration; control: total mass of the system (or friction compensation / runway angle). (b) Force: $F = mg$ of the hanger and masses; acceleration: light gates measure velocities at two points and $a = (v_2 - v_1)/t$ – or ticker-tape spacing; repeat each force and average. (c) Acceleration is directly proportional to the force.

3.2 (a) $W = mg = 70 \times 9.8 = \mathbf{686 \text{ N}}$ (C1, A1). (b) $F = ma = 70 \times 3.2 = \mathbf{224 \text{ N}}$ down (C1, A1). (c) Drag = weight – resultant = $686 - 224 = \mathbf{462 \text{ N}}$ up (C1, A1).

3.3 (a)

$$0 - 18^2 = 2a \times 25 \quad \Rightarrow \quad a = -\frac{324}{50} = \mathbf{-6.5 \text{ m/s}^2}$$

(substitution C1, rearrangement C1, answer A1) (b) $F = ma = 1400 \times 6.48 = \mathbf{9072} \approx 9100 \text{ N}$ (2 s.f.) (C1, A1). (c) The car's brakes (wheels) push the road forwards... the third-law pair: the car exerts a forward force on the road surface, and the road exerts an equal backward friction force on the tyres. They act on **different objects** (road vs car), so neither balances the other on the car – the backward friction on the tyres is what decelerates it.