FULLY WORKED SOLUTIONS

Chapter 5: Built for safety, built for speed

Review questions

7. (a) $v_{av} = 20\text{ m s}^{-1}$, $t = 0.6\text{ s}$

$s_{reaction} = v_{av}t = 20 \times 0.6 = 12\text{ m}$

(b) $u = 20\text{ m s}^{-1}$, $a = -8.2\text{ m s}^{-2}$

$$s_{braking} = \frac{-u^2}{2a} = \frac{-(20^2)}{2 \times -8.2} = 24.4\text{ m}$$

(c) $s_{stopping} = s_{reaction} + s_{braking} = 12 + 24.4 = 36.4\text{ m}$

8. $\boldsymbol{F}_{drag}$ is proportional to v^2. When the speed is increased from 60 km h^{-1} to 100 km h^{-1} (i.e. increased by a factor of 1.67), the drag will be increased by a factor of $(1.67)^2 = 2.78$. Thus, the drag at 100 km h^{-1} = 2.78 × 300 N = 833 N

9. (a) This can be determined by substituting in values from the diagram. For example, when the speed is 60 km h^{-1} the reaction distance is 25 m.

$v_{av} = 60\text{ km h}^{-1} = 16.7\text{ m s}^{-1}$, $s_{reaction} = 25\text{ m}$

$$t = \frac{s_{reaction}}{v_{av}} = \frac{25}{16.7} = 1.49\text{ s}$$

(b) By substituting in values from the diagram, it can be found that the acceleration assumed was around –4.6 m s^{-2} (±0.1 m s^{-2}). For example, when the speed was 50 km h^{-1} (13.9 m s^{-1}), the braking distance was 21 m.

$$a = \frac{-u^2}{2s_{braking}} = \frac{-(13.9^2)}{2 \times 21} = -4.6\text{ m s}^{-2}$$

(d) $t = 1.49\text{ s}$, $a = -4.6\text{ m s}^{-2}$, $v_{av} = u = 85\text{ km h}^{-1} = 23.6\text{ m s}^{-1}$

$s_{reaction} = v_{av}t = 23.6 \times 1.49 = 35.2\text{ m}$

$$s_{braking} = \frac{-u^2}{2a} = \frac{-(23.6^2)}{2 \times (-4.6)} = 60.5\text{ m}$$

$s_{stopping} = s_{reaction} + s_{braking} = 35.2 + 60.5 = 95.7\text{ m}$