Motion Questions – OCR A Level Physics

Praneel Physics

1. A car travels at a constant speed of 15 m/s for 12 seconds. How far does it travel? **(P)**

Working:
Distance = speed × time = $15 \times 12 = 180$ m
Answer: $\boxed{180 \text{ m}}$

2. A ball is dropped from rest and falls 45 m. How long does it take to reach the ground?

($g = 9.8$ m/s^2) **(P)**

Working:
$s = \frac{1}{2}gt^2 \Rightarrow 45 = \frac{1}{2}(9.8)t^2 \Rightarrow t \approx 3.03$ s

Answer: Approximately 3.03 s

3. A cyclist accelerates from rest at 2 m/s^2 for 5 seconds. What is the final speed? **(P)**

Working:
$v = u + at = 0 + 2 \times 5 = 10$ m/s

Answer: $\boxed{10 \text{ m/s}}$

4. A vehicle moves at 20 m/s and stops in 4 seconds. Find its acceleration. **(P)**

Working:
$a = \frac{v-u}{t} = \frac{0-20}{4} = -5 \text{ m/s}^2$

Answer: $\boxed{\text{-5 m/s}^2}$

5. A sprinter runs 100 m in 10 seconds. What is the average speed? **(P)**

Working:
Speed = distance / time = 100/10 = 10 m/s

Answer: $\boxed{10 \text{ m/s}}$

6. A car accelerates from rest to 25 m/s in 8 seconds. Find the distance travelled. **(PP)**

Working:
$s = \frac{1}{2}(u+v)t = \frac{1}{2}(0+25)(8) = 100$ m

Answer: $\boxed{100 \text{ m}}$

7. A stone is thrown upward at 12 m/s. What is the maximum height reached? ($g = 9.8$

m/s^2) **(PP)**

Working:
$v^2 = u^2 + 2as \Rightarrow 0 = 144 - 19.6s \Rightarrow s \approx 7.35$ m

Answer: $\boxed{7.35 \text{ m}}$

8. A ball is projected horizontally at 6 m/s from a 45 m height. How far does it land from

the base? **(PP)**

Working:
$t = \sqrt{\frac{2s}{g}} = \sqrt{\frac{90}{9.8}} \approx 3.03$ s
Range $= 6 \times 3.03 \approx 18.2$ m

Answer: $\boxed{18.2 \text{ m}}$

9. A train slows from 30 to 10 m/s in 15 seconds. Find its acceleration and distance. **(PP)**

Working:
$a = \frac{10-30}{15} = -1.33$ m/s^2
$s = \frac{1}{2}(30+10)(15) = 300$ m

Answer: Acceleration = -1.33 m/s^2, Distance = 300 m

10. A projectile is launched at 20 m/s at 45°. What is the time of flight? ($g = 9.8$ m/s^2)

(PP)

Working:
$u_y = 20\sin(45^\circ) = 14.14$ m/s
$t = \frac{2u_y}{g} = \frac{28.28}{9.8} \approx 2.89$ s

Answer: $\boxed{2.89 \text{ s}}$

11. A car travelling at 25 m/s comes to rest in 120 m. Find the time taken. **(PPP)**

Working:
$v^2 = u^2 + 2as \Rightarrow 0 = 625 + 240a \Rightarrow a = -2.604$ m/s^2
$t = \frac{0-25}{-2.604} \approx 9.6$ s

Answer: $\boxed{9.6 \text{ s}}$

12. A motorbike accelerates from 10 m/s to 30 m/s in 100 m. Calculate the acceleration and

time taken. **(PPP)**

Working:
$v^2 = u^2 + 2as \Rightarrow 900 = 100 + 200a \Rightarrow a = 4$ m/s^2
$t = \frac{30-10}{4} = 5$ s

Answer: $\boxed{\text{Acceleration} = 4 \text{ m/s}^2, \text{ Time} = 5 \text{ s}}$

13. A projectile is launched at 30 m/s at 60°. Find max height and horizontal range. **(PPPP)**

Working:
$u_y = 30\sin(60°) = 25.98$ m/s
$h = \frac{u_y^2}{2g} = \frac{675.5}{19.6} \approx 34.5$ m
$t = \frac{2u_y}{g} \approx 5.3$ s, $u_x = 15$ m/s
Range $= 15 \times 5.3 = 79.5$ m

Answer: $\boxed{\text{Height} \approx 34.5 \text{ m, Range} \approx 79.5 \text{ m}}$

14. A car accelerates from 5 m/s to 25 m/s in 10 s. How far does it travel? **(PPPP)**

Working:
$s = \frac{1}{2}(5 + 25)(10) = 150$ m

Answer: $\boxed{150 \text{ m}}$

15. A diver jumps from a 20 m platform with upward velocity of 2 m/s. Time to hit water?

(PPPP)

Working:
$s = ut + \frac{1}{2}gt^2 \Rightarrow -20 = 2t - 4.9t^2 \Rightarrow t \approx 2.25$ s

Answer: Approximately 2.25 s

16. A plane accelerates along a 1500 m runway in 30 s. Find its acceleration and final speed.

(PPPPP)

Working:
$s = \frac{1}{2}at^2 \Rightarrow a = \frac{2s}{t^2} = \frac{3000}{900} = 3.33$ m/s^2
$v = at = 100$ m/s

Answer: Acceleration = 3.33 m/s^2, Final speed = 100 m/s

17. A rocket is launched at 60 m/s. How long until it reaches 90 m? **(PPPPP)**

Working:
$90 = 60t - 4.9t^2 \Rightarrow 4.9t^2 - 60t + 90 = 0 \Rightarrow t \approx 1.6$ s or 11.5 s

Answer: $\boxed{1.6 \text{ s (up), } 11.5 \text{ s (down)}}$

18. A ball returns to the ground in 6 s. What was its initial speed? **(PPPPP)**

Working:
$t_{\text{up}} = 3$ s, $u = gt = 9.8 \times 3 = 29.4$ m/s

Answer: $\boxed{29.4 \text{ m/s}}$

19. A train at 40 m/s decelerates uniformly over 1 km. Find its deceleration and time.

(PPPPP)

Working:
$v^2 = u^2 + 2as \Rightarrow 0 = 1600 + 2000a \Rightarrow a = -0.8$ m/s^2
$t = \frac{40}{0.8} = 50$ s

Answer: $\boxed{\text{Deceleration} = 0.8 \text{ m/s}^2, \text{ Time} = 50 \text{ s}}$

20. A projectile is launched from 80 m cliff at 25 m/s at 30°. Time until impact? **(PPPPP)**

Working:
$u_y = 25\sin(30°) = 12.5$ m/s
$-80 = 12.5t - 4.9t^2 \Rightarrow t \approx 5.2$ s
Answer: Approximately 5.2 s