

Suggested solutions;

1. $54\text{km/hr} / 3.6 = 15\text{m/s}$
2. $15 \times 1.2 = 18\text{m}$
3. $u = 15\text{m/s}$ $v = 0\text{m/s}$ $t = 4.4\text{s}$

$$v = u + at$$

$$0 = 15 + a \times 4.4$$

$$a = -3.4 \text{ m/s}^2$$

4. $s = ut + \frac{1}{2} a t^2$

$$s = 15 \times 4.4 - \frac{1}{2} \times 3.4 \times 4.4^2$$

$$= 66 - 32.9 = 33.1 \text{ m}$$

$$18 \text{ m} + 33.1 \text{ m} = 51.1 \text{ m in total}$$

5. $F = m a = 1600 \times 3.4 = 5440\text{N}$

$$\text{Work} = F s = 5440 \times 33.1 = 180,064 \text{ J} = 180 \text{ kJ}$$

6. $a = \text{gradient} = -15/15 = -1.0 \text{ m/s}^2$
7. There is no net force as the tram is moving with a constant velocity.
8. Acceleration in first 10 seconds $= 15/10 = 1.5 \text{ m/s}^2$
 $F_{\text{net}} = ma = 32,000 \times 1.5 = 48,000\text{N}$
Resistive force $= \text{driving force} - \text{net force} = 61,300 - 48,000 = 13,300\text{N}$
9. Average velocity $= \text{Displacement}/\text{time}$

$$\text{Displacement} = \text{positive area under graph} = 787.5 - 375 = 412.5\text{m}$$

$$\text{Velocity} = 412.5 / 140 = 2.95\text{m/s}$$

10. Careful: Look at the axes: horizontal axis is height. As height is greater PE is greater and is proportional to energy. **So Must be C**

11. $u = 0\text{m/s}$ $a = 10\text{m/s}$ $s = 1.50\text{m}$

$$v^2 = u^2 + 2as$$

$$v^2 = 2 \times 10 \times 1.5$$

$$v = 5.48\text{m/s}$$

12. Accelerating up as there is a net force up from the ground
13. See diagram
14. Change in velocity $= 5.48 + 5.05 = 10.53\text{m/s}$ upwards
15. $F = m\Delta v / t = 0.065 \times 10.53 / 0.040 = 17.1 \text{ N}$

$$16. \text{Initial KE} = \frac{1}{2} \times 0.065 \times 5.48^2 = 0.976\text{J}$$

$$\text{Final KE} = \frac{1}{2} \times 0.065 \times 5.05^2 = 0.829\text{J}$$

$$\text{Loss in KE} = 0.976 - 0.829 = 0.147 \text{ J}$$

Converted to Heat and sound

17a B

17.b C

Question 18 a

(2)

In a road test, a car was uniformly accelerated from rest over a distance of 400 m in 19.0 s. The driver then applied the brakes, stopping the car in 5.1 s with constant deceleration.

Calculate the acceleration of the car for the first 400 m.

$$x = ut + \frac{1}{2} at^2$$

$$400 = 0 + \frac{1}{2} a \times 19^2$$

$$a = 800 / 19^2$$

$$a = 2.2 \text{ m/s}^2$$

18.b

(3)

Calculate the average speed of the car for the entire journey, covering both the acceleration and braking sections. (Hint consider the velocity-time graph)

$$\text{Max Velocity} = a \times t = 2.2 \times 19 = 41.8 \text{ m/s}$$

$$\text{Total distance} = 400\text{m} + \frac{1}{2} \times 5.1 \times 41.8$$

$$\text{Total distance} = 400\text{m} + 106.6\text{m} = 506.6$$

$$\text{Average speed} = \text{total distance/time} = 506.6/24.1 = 21.0\text{m/s}$$

18c . B

18 d.. E

Question 19**(2)**

What is the depth of the mine shaft?

- a) 90 m **b) 45 m** c) 30 m d) 15 m

$$x = ut + \frac{1}{2} at^2$$

$$= \frac{1}{2} 10 \times 3^2$$

$$= 45 \text{ m}$$

Question 20**(2)**

What is the magnitude of the velocity of the stone at the instant before striking the bottom?

- a) 90 m/s b) 45 m/s **c) 30 m/s** d) 15 m/s

$$v^2 = u^2 + 2ax$$

$$v^2 = 2 \times 10 \times 45$$

$$v^2 = 900$$

$$v = 30 \text{ m/s}$$

Question 21

Taking moments about right-hand end:

$$F_A \times 0.4 \text{ m} = (2 \times 10^4 \times 10 \times 20 \text{ m}) + (3 \times 10^4 \times 10 \times 10 \text{ m}) \quad 1 \text{ mark}$$

$$F_A = 1.75 \times 10^5 \text{ N} \quad 1 \text{ mark}$$

$$\begin{aligned} \therefore F_{\text{ground at A}} &= 1.75 \times 10^5 \text{ N} + 1 \times 10^5 \text{ N} \\ &= 2.75 \times 10^5 \text{ N} \quad 1 \text{ mark} \end{aligned}$$

Question 22

$$\text{Translational forces } \Sigma F_{\text{up}} = \Sigma F_{\text{down}} \quad 1 \text{ mark}$$

$$2 \times (1 \times 10^5 \text{ N}) + (5 \times 10^5 \text{ N}) = 2.75 \times 10^5 \text{ N} + F_B \quad 1 \text{ mark}$$

$$\therefore F_B = 4.25 \times 10^5 \text{ N} \quad 1 \text{ mark}$$

Note: consequential answer $7 \times 10^5 \text{ N}$ – (Question 10).

Question 23

The force acting on the ground at point A becomes smaller, while the force acting on the ground at point B becomes larger, as the truck continues to move across the bridge. 2 marks