Suggested solutions;

1. 54km/hr / 3.6 = 15m/s
2. 15 x 1.2 = 18m
3. u = 15m/s v= 0m/s t = 4.4s

   v= u + at

   0 = 15 + a x4.4

   a = -3.4 m/s^2
4. s = ut + ½ a t^2

   s = 15 x 4.4 – ½ x 3.4 x 4.4^2

   = 66 – 32.9 = 33.1 m

   18 m + 33.1 m = 51.1 m in total

5. F = m a = 1600 x 3.4 = 5440N

   Work = F s = 5440 x 33.1 = 180, 064 j = 180 kJ

6. a = gradient = -15/15 = -1.0 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 m/s^2
   F_{net} = ma = 32, 000 x 1.5 = 48,000N
   Resistive force = driving force – net force = 61,300 – 48, 000 = 13,300N
9. Average velocity = Displacement/time

   Displacement = positive area under graph = 787.5 – 375 = 412.5m

   Velocity = 412.5/ 140 = 2.95m/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 = 0m/s a= 10m/s s = 1.50m

    v^2= u^2 + 2as

    v^2= 2x 10 x 1.5

    v = 5.48m/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 = 10.53m/s upwards
15. F = mΔv/ t = 0.065 x 10.53/ 0.040 = 17.1 N

16. Initial KE = ½ x 0.065 x 5.48^2 = 0.976J
Final KE = ½ x 0.065 x 5.05^2 = 0.829J

Loss in KE = 0.976 – 0.829 = 0.147 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)

Max Velocity = a x t = 2.2 x 19 = 41.8 m/s

Total distance = 400m + ½ x 5.1 x 41.8

Total distance = 400m + 106.6m = 506.6

Average speed = total distance/time = 506.6/24.1 = 21.0m/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

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

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

$= 45$ 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

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

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

$v^2 = 900$

$v = 30$ m/s

Question 21

Taking moments about right-hand end:

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

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

$\therefore F_{\text{ground at } A} = 1.75 \times 10^5 \text{ N} + 1 \times 10^5 \text{ N}$

$= 2.75 \times 10^5 \text{ N}$ 1 mark

Question 22

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

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

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

Note: consequential answer 7×10^5 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