Motion Equation Solutions 1: Time

1.

(a) $t = ?\quad s = 11 \text{ m}\quad v_0 = 1.5 \text{ ms}^{-1}\quad a = 0 \text{ ms}^{-2}$

$s = v_0 t$

$\therefore t = \dfrac{s}{v_0}$

$= \dfrac{11}{1.5}$

$= 7.3 \text{ s}$

The ball will take 7.3 s to travel 11 m

(b) $s = 0 \text{ m}\quad v_0 = 9 \text{ ms}^{-1}\quad a = -9.8 \text{ ms}^{-2}\quad t = ?$

$s = v_0 t + \frac{1}{2} a t^2$

$0 = t\left(v_0 + \frac{1}{2} a t\right)$

$\therefore v_0 + \frac{1}{2} a t = 0 \quad \text{or} \quad t = 0$

$\therefore t = \dfrac{-v_0}{\frac{1}{2} a} = \dfrac{-9}{\frac{1}{2} \times -9.8} = 2 \text{ s}$

Nirk's time of flight is 2 s

2.

(a) $s = -215 \text{ m (down)}\quad a = -9.8 \text{ ms}^{-2}\quad v_0 = 0 \text{ ms}^{-1}\quad t = ?$

$s = v_0 t + \frac{1}{2} a t^2$

$\therefore s = \frac{1}{2} a t^2$

$\therefore t = \sqrt{\dfrac{s}{\frac{1}{2} a}} = \sqrt{\dfrac{-215}{\frac{1}{2} \times -9.8}} = 6.6 \text{ s}$

(b) It would be increased because the acceleration would be slower

3.

(a) The cannon is fired horizontally and components don't affect each other

(b) $s = -36 \text{ m (down)}\quad a = -9.8 \text{ ms}^{-2}\quad v_0 = 0 \text{ ms}^{-1}\quad t = ?$

$s = v_0 t + \frac{1}{2} a t^2$

$\therefore s = \frac{1}{2} a t^2$

$\therefore t = \sqrt{\dfrac{s}{\frac{1}{2} a}} = \sqrt{\dfrac{-36}{\frac{1}{2} \times -9.8}} = 2.7 \text{ s}$

4.

(a) $v_{0_H} = v_0 \cos\theta = 20.8\cos 17.5° = 19.8 \text{ ms}^{-1}$

(b) Because the only other force acting is weight, which is a downwards force.

(c) $s = 25.3 \text{ m} \quad v_0 = 19.8 \text{ ms}^{-1} \quad a = 0 \text{ ms}^{-2} \quad t = ?$

$s = v_0 t + \frac{1}{2}at^2$

$\therefore s = v_0 t$

$\therefore t = \dfrac{s}{v_0} = \dfrac{25.3}{19.8} = 1.3 \text{ s}$

(d) $v_{0_V} = v_0 \sin\theta = 20.8\sin 17.5° = 6.25 \text{ ms}^{-1}$

(e) $s = 0 \text{ m} \quad v_0 = 6.25 \text{ ms}^{-1} \quad a = -9.8 \text{ ms}^{-2} \quad t = ?$

$s = v_0 t + \frac{1}{2}at^2$

$0 = t\left(v_0 + \frac{1}{2}at\right)$

$\therefore v_0 + \frac{1}{2}at = 0 \quad \text{or} \quad t = 0$

$\therefore t = \dfrac{-v_0}{\frac{1}{2}a} = \dfrac{-6.25}{\frac{1}{2}\times -9.8} = 1.3 \text{ s}$