1.

We could use $s_H = v_{0_H} + \frac{1}{2}a_H t^2$ for horizontal motion. However there is no acceleration due to gravity in the horizontal direction, so $a_H = 0$. Also, since we assume no air resistance, $v_H = v_{0_H}$ so we have $s_H = v_H t + \frac{1}{2}(0)t^2 \ \therefore s = v_H t$

2.

$s_V = h \quad a_V = -g \quad v_{0_V} = v\{\text{given}\} \quad v_V = 0$ at max height

$$v_V{}^2 = v_{0_V}{}^2 + 2a_V s_V$$

$$\therefore 0^2 = v^2 + 2(-g)(h)$$

$$\therefore -v^2 = 2(-g)(h)$$

$$\therefore h = \frac{-v^2}{2(-g)}$$

$$\therefore h = \frac{v^2}{2g}$$

3.

a)

$$v_{0_V} = 0 \text{ ms}^{-1}$$

$$v_V = v_{0_V} + a_V t$$

$$= 0 + -9.8 \times 1.93$$

$$= -18.9 \text{ms}^{-1}$$

The BASE jumper is falling vertically at 18.9 ms^{-1} (3 s.f.) when he starts to open his parachute.

b)

$$v_H = v_{0_H} = 5.56 \text{ ms}^{-1}$$

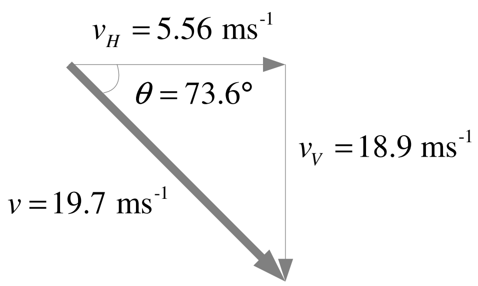
$$s_H = v_H t$$

$$= 5.56 \times 1.93$$

$$= 10.7 \text{m}$$

The jumper has moved 10.7 m away from the bridge horizontally by this time (3 s.f.)

c)



$$\theta = \tan^{-1}\left(\frac{18.9}{5.56}\right) = 73.6° \text{ (3 s.f.)}$$

$$v = \sqrt{v_H{}^2 + v_V{}^2} = \sqrt{5.56^2 + 18.9^2} = 19.7 \text{ ms}^{-1} \text{ (3 s.f.)}$$

d) A parachute has a large projected area therefore increases the force of air resistance.

4. a)

$$v_{0_H} = v_0 \cos\theta = 30\cos 40° = 23\text{ms}^{-1}$$

$$v_{0_V} = v_0 \sin\theta = 30\sin 40° = 19\text{ms}^{-1}$$

b)

$$s_V = v_{0_V} t + \tfrac{1}{2} a_V t^2$$

$$0 = 19.3t + \tfrac{1}{2}(\text{-}9.8)t^2$$

$$\therefore 0 = t\left(19.3 + \tfrac{1}{2}(\text{-}9.8)t\right)$$

$$\therefore t = 0 \text{ or } 19.3 + \tfrac{1}{2}(\text{-}9.8)t = 0$$

$$\therefore t = \frac{-19.3}{\tfrac{1}{2}(\text{-}9.8)} = 3.9 \quad \{t = 0 \text{ is beginning of flight, not useful}\}$$

The time of flight of the golf ball is 3.9s (2 s.f.)

c) If launched from a height the ball will have greater range (travel further horizontally). The ball has further to fall, increasing its time of flight. Since $s_H = v_H t$, range increases.

5.

a) The projectile travels 40m in 4 seconds

$$s_H = v_H t$$

$$\therefore v_H = \frac{s_H}{t} = \frac{40}{4} = 10 \text{ ms}^{-1}$$

b) $s_V = 20$ m $\qquad t = 4$ s

$$s_V = v_{0_V} t + \tfrac{1}{2} a_V t^2$$

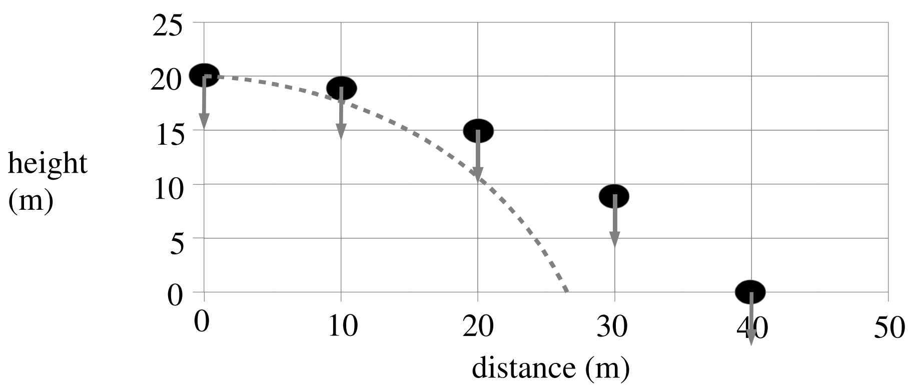
$v_{0_V} = 0$ since launched horizontally

$$\therefore s_V = \tfrac{1}{2} a_V t^2$$

$$\therefore a_V = \frac{s_V}{\tfrac{1}{2}t^2} = \frac{20}{\tfrac{1}{2}(4)^2} = 2.5 \text{ ms}^{-2}$$

5.

c) and d)



(The acceleration arrows don't have to be all equal length since question only asks to show direction.)