

1a)

vertical motion:

$$s = ?$$

$$u = \cancel{40} 25 \sin 40$$

$$v = 0$$

$$a = -9.8$$

t

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

$$0 = (25 \sin 40)^2 + 2(-9.8)s$$

$$s = \underline{\underline{13 \text{ m}}} \quad (2 \text{ sf})$$

b)

vertical motion (to top)  ~~$v = u + at$~~ 

$$v = u + at$$

$$0 = 25 \sin 40 + (-9.8)t$$

$$t = 1.639 \dots$$

$$\text{total time} = 2 \text{ (Ans)}$$

$$= 3.28 \text{ seconds}$$

horizontal motion

$$s = ?$$

$$u = 25 \cos 40$$

$$v = 25 \cos 40$$

$$a = 0$$

$$t = 3.28$$

$$s = (25 \cos 40)(3.28) + \frac{1}{2}(0)(3.28)^2$$

$$= 25 \cos(40) \times 3.28$$

$$= \underline{\underline{63 \text{ m}}} \quad (2 \text{ sf})$$

2a)

vertical:  $s$ 

$$u = 4$$

$$v = ?$$

$$a = -9.8$$

$$t = 2$$

horizontal:  $s$ 

$$u = 3$$

$$v = ?$$

$$a = 0$$

$$t = 2$$

$$v = u + at$$

$$= 4 + (-9.8)(2)$$

$$= -15.6$$

$$v = u + at$$

$$= 3 + 0(2)$$

$$= 3$$

$$\begin{aligned} \text{Speed} &= \sqrt{15.6^2 + 3^2} \\ &= \underline{\underline{16 \text{ ms}^{-1}}} \quad (2\text{sf}) \end{aligned}$$

b/

vertical:  $s = ?$ 

$$u = 4$$

$$v = 0$$

$$a = -9.8$$

$$t =$$

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

$$0 = (4)^2 + 2(-9.8)s$$

$$s = 0.82 \text{ m} \quad (2\text{sf})$$

$$\text{Greatest Height} = 20.82 \text{ m}$$

c/

$$s = -20$$

$$u = 4$$

$$v =$$

$$a = -9.8$$

$$t = ?$$

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

$$-20 = 4t + -4.9t^2$$

$$0 = 4.9t^2 - 4t - 20$$

$$t = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(4.9)(-20)}}{2(4.9)}$$

$$= \underline{\underline{2.47 \text{ s}}} \quad \text{or } -1.65 \text{ s}$$

 $t$  cannot be negative.

Horizontal

$$s = ?$$

$$u = 3$$

$$v = 3$$

$$a = 0$$

$$t = 2.47$$

$$s = 2.47(3)$$

$$= \underline{\underline{7.4 \text{ m (2st)}}}$$

3a) vertical  $s = 0$   
 $u = 25 \sin \theta$   
 $v =$   
 $a = -9.8$   
 $t = 5$

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

$$0 = 5(25 \sin \theta) + \frac{1}{2}(-9.8)(5)^2$$

$$0 = 125 \sin \theta - 122.5$$

$$122.5 = 125 \sin \theta$$

$$\sin \theta = 49/50$$

$$\theta = \sin^{-1}(49/50)$$

$$= 78.5^\circ \quad \underline{\underline{79^\circ (2 \text{ sf})}}$$

b/  $s = ?$   
 $u = 25 \cos(78.5^\circ)$   
 $v =$   
 $a = 0$   
 $t = 5$

$$s = ut$$

$$= 5(25 \cos(78.5^\circ))$$

$$= 24.87$$

$$= \underline{\underline{25 \text{ m} (2 \text{ sf})}}$$

4a/

Vertical:  $s = 16$ 

$$u = u \sin 60 = \frac{\sqrt{3}}{2} u$$

$$v = 0$$

$$a = -9.8$$

$$t = ?$$

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

$$0 = \left(\frac{\sqrt{3}}{2}u\right)^2 + 2(-9.8)(16)$$

$$0 = \frac{3}{4}u^2 - 313.6$$

$$313.6 = 0.75u^2$$

$$418.13 = u^2$$

$$u = 20.448\dots$$

$$= 20.4 \text{ ms}^{-1} \text{ (3sf)}$$

b/

~~$$v = u + at$$~~  $s = -20$

$$u = 20.4 \sin 60$$

$$v =$$

$$a = -9.8$$

$$t = ?$$

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

$$v^2 = (20.4 \sin 60)^2 + 2(-9.8)(-20)$$

$$= 705.6$$

$$v = \pm 26.56$$

$$v = u + at$$

$$-26.56 = 20.4 \sin 60 + (-9.8)t$$

$$t = 4.52 \text{ s}$$

Horizontal distance:  $s = ut$ 

$$= 20.4 \cos 60 \cdot 4.52$$

$$= 46.188\dots$$

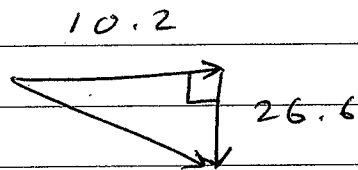
$$= \underline{\underline{46 \text{ m}}} \text{ (2sf)}$$

c/

vertical

$$\downarrow 26.6 \text{ ms}^{-1}$$

$$\text{horizontal} \longrightarrow 20.4 \cos 60 = 10.2$$



$$\text{speed} = \sqrt{10.2^2 + 26.6^2}$$

$$= \underline{\underline{28.5 \text{ ms}^{-1} \text{ (3sf)}}}$$

5a) vertical :  $s = 24$   
 $u = 4k$   
 $v = 0$   
 $a = \cancel{-9.8} -g$   
 $t =$

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

$$0 = (4k)^2 + 2(\cancel{-9.8})(24)$$

$$0 = 16k^2 - 48g$$

$$48g = 16k^2$$

$$3g = k^2$$

$$k = \sqrt{3g}$$

b/ To the top :

$$v = u + at$$

$$0 = 4\sqrt{3g} + -9.8 t$$

$$t = 2.213 \dots$$

$$\text{total time} = 2 \times \text{Ans}$$

$$= 4.426 \dots \text{ seconds}$$

Horizontal distance :

$$s = ut$$

$$= 3\sqrt{3g} \cdot "4.426"$$

$$= \underline{\underline{72 \text{ m}}}$$

6a)

vertical

$$s = y$$

$$u = u \sin \theta$$

$$v =$$

$$a = -g$$

$$t = t$$

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

$$y = u \sin \theta \cdot t + \frac{1}{2}(-g)t^2$$

$$y = ut \sin \theta - \frac{g}{2}t^2 \quad (1)$$

horizontal :

$$s = x$$

$$u = u \cos \theta$$

$$v =$$

$$a = 0$$

$$t = t$$

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

$$x = u \cos \theta \cdot t$$

$$x = ut \cos \theta$$

$$t = \frac{x}{u \cos \theta} \quad [\text{sub. into } (1)]$$

$$y = u \left( \frac{x}{u \cos \theta} \right) \sin \theta - \frac{g}{2} \left( \frac{x}{u \cos \theta} \right)^2$$

$$y = \frac{ux \sin \theta}{u \cos \theta} - \frac{g}{2} \frac{x^2}{u^2 \cos^2 \theta}$$

$$y = x \tan \theta - \frac{gx^2}{2u^2 \cos^2 \theta}$$



b/

$$2 = 6 \tan 45 - \frac{g(6)^2}{2u^2(\cos 45)^2}$$

$$2 = 6 - \frac{36g}{u^2}$$

$$\frac{36g}{u^2} = 4$$

$$9g = u^2$$

$$\underline{\underline{u = 3\sqrt{g}}}$$

$$\text{when } x = 6 \quad t = \frac{6}{3\sqrt{g} \cos 45}$$

$$= 0.9035079\dots$$

$$\begin{aligned} \text{vertical : } v &= u + at \\ &= 3\sqrt{g} \sin 45 + (-9.8)(0.9035) \\ &= -2.21 \text{ ms}^{-1} \end{aligned}$$

$$\begin{aligned} \text{horizontal : } v &= 3\sqrt{g} \cos 45 \\ &= 6.64 \text{ ms}^{-1} \end{aligned}$$

$$\begin{aligned} \text{speed} &= \sqrt{(2.21)^2 + (6.64)^2} \\ &= \underline{\underline{7 \text{ ms}^{-1}}} \end{aligned}$$