EXAM QUESTIONS - PROJECTILE MOTION

1. (a)

vertically: $u = 0 ms^{-1}$

$v = -$

$a = 9.81 ms^{-2}$

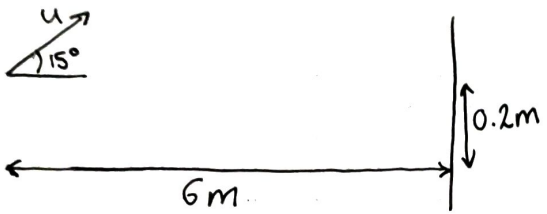
$s = 0.2m$

$t = ?$

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

$\Rightarrow 0.2 = 0 \times t + \frac{1}{2} \times 9.81 \times t^2 \Rightarrow t = \sqrt{\frac{0.2}{\frac{1}{2} \times 9.81}} = 0.202\,s$ (to 3sf)

(b)



vertically: $u = u\sin 15$

$a = -9.81$

$s = -0.2$

$t = ?$

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

(*) $-0.2 = u\sin 15\, t + \frac{1}{2} \times -9.81 t^2$

horizontally: $V = u\cos 15$

$x = 6$

$6 = u\cos 15\, t$

$\Rightarrow u = \frac{6}{t\cos 15}$ subst. into (*)

$-0.2 = \frac{6}{t\cos 15} \times \sin 15t - \frac{1}{2} \times 9.81 t^2$

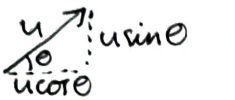
$\Rightarrow -0.2 = 6\tan 15 - \frac{1}{2} \times 9.81 t^2$

$\frac{1}{2} \times 9.81 t^2 = 6 \tan 15 + 0.2$

$\Rightarrow t = \sqrt{\frac{6 \tan 15 + 0.2}{\frac{1}{2} \times 9.81}} = 0.607 \text{ s}$

$u = \frac{6}{t \cos 15} = 10.232\ldots = 10.2 \text{ ms}^{-1} \text{ (to 3sf)}$

2. (a)



horizontally : $u \cos\theta = 15 \cos 20$ ①

vertically : $u = u \sin\theta$

$v = 15 \sin 20$

$s = ?$

$a = -9.81$

$t = 4$

$v = u + at$

$15 \sin 20 = u \sin\theta - 4 \times 9.81$

$u \sin\theta = 15 \sin 20 + 4 \times 9.81$ ②

② ÷ ① $\tan\theta = \frac{15 \sin 20 + 4 \times 9.81}{15 \cos 20} = 3.1478\ldots$

$\Rightarrow \theta = 72.4°$ (to 3sf)

$u = \frac{15 \cos 20}{\cos 72.4} = 46.6 \text{ ms}^{-1}$ (to 3sf).

(b) vertically → at max. height : $u = 15 \sin 20$

$v = 0$

$a = -9.81$

$s = -$

$t = ?$

$v = u + at$

$0 = 15 \sin 20 - 9.81 t$

$t = \frac{15 \sin 20}{9.81} = 0.523 \text{ s}$

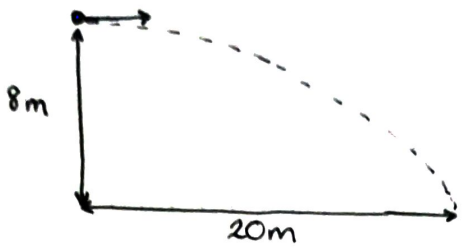
∴ total time is $0.523 \times 2 = 1.05 \text{ s}$ (to 3sf)

(c) time from O to C is $4 + 1.05 + 4 = 9.05$ s

horizontally: $u = 46.6 \cos 72.4 = 14.09 \text{ ms}^{-1}$

$x = 14.09 \times 9.05 = 128$ m (to 3sf)

3.(a)



vertically: $u = 0 \text{ ms}^{-1}$

$v = -$

$a = 9.81 \text{ ms}^{-2}$

$s = 8$ m

$t = ?$

$s = ut + \frac{1}{2}at^2 \Rightarrow 8 = 0 \times t + \frac{1}{2} \times 9.81 \times t^2$

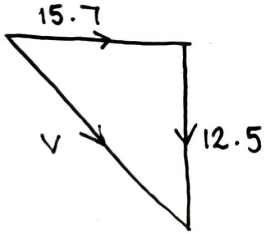
$\Rightarrow t = \sqrt{\frac{8}{\frac{1}{2} \times 9.81}} = 1.277\ldots = 1.28$ s (to 3sf)

(b) horizontally: $v = \frac{x}{t} = \frac{20}{1.28} = 15.66\ldots = 15.7 \text{ ms}^{-1}$ (to 3sf)

(c) $v^2 = u^2 + 2as$

$v^2 = 0^2 + 2 \times 9.81 \times 8$

$\Rightarrow v = \sqrt{2 \times 9.81 \times 8} = 12.528\ldots = 12.5 \text{ ms}^{-1}$ (to 3sf)



$V = \sqrt{15.7^2 + 12.5^2} = 20.1 \text{ ms}^{-1}$ (to 3sf)