Exercise 2D, P31 (odd N°s only)

① given: $u = 0$ m/s ↓ want: V
$s = 1.6$ m ↓
$a = 9.8$ m/s² ↓

$\therefore \quad v^2 = u^2 + 2as \Rightarrow v^2 = 0^2 + 2(1.6)(9.8)$
$= 31.36$

so $v = 5.6$ m/s

③ given: $u = 0$ m/s ↓ want: s
$a = 9.8$ m/s ↓
$v = 14$ m/s ↓

So $v^2 = u^2 + 2as \Rightarrow 14^2 = 0^2 + 2(9.8)s$
$\therefore s = 10$ m

⑤ given: $u = +21$ m/s ↑ want: s
$a = -9.8$ m/s² ↑
$t = 1, 2, 3$ seconds

So $s = ut + \frac{1}{2}at^2$
$\Rightarrow$ at $t = 1$: $s = +21(1) + \frac{1}{2}(-9.8)(1)^2 = +16.1$ m

So stone is 16.1 m above ground.

at $t = 2$: $s = 21(2) + \frac{1}{2}(-9.8)(2)^2 = 22.4$ m

at $t = 3$: $s = 21(3) + \frac{1}{2}(-9.8)(3)^2 = 18.9$ m

Extra: Note That between $t = 2$ secs & $t = 3$ secs, The Stone has stopped Rising & is Now falling.
we can find The max height Reached by The Stone as follows:

given $u = +21$ m/s ↑ want: s
$v = 0$ ↑
$a = -9.8$ m/s^2 ↑

So $v^2 = u^2 + 2as \Rightarrow 0^2 = 21^2 + 2(-9.8)s$
$\therefore s = 22.5$ m.

(7) given: $u = 21$ m/s ↑ from A
$a = -9.8$ m/s^2 ↑
$v = 0$ m/s ↑ at its max height

want: t

So $v = u + at \Rightarrow 0 = 21 + (-9.8)t$
$\therefore t = 2.\overline{142857} = 2\frac{1}{7}$ seconds

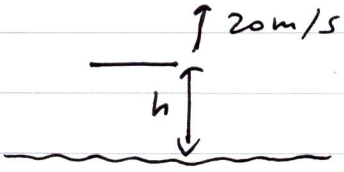
But This is time to Reach max height, so total time to Reach max height & come back is

$2t = 2 \times 2.\overline{142857} = 4.\overline{285714} = 4\frac{2}{7}$ seconds

(9) given: $u = 20\ m/s \uparrow$ want: h

$a = -9.8\ m/s^2 \uparrow$

Diag



First find max height. This is where $v = 0\ m/s$. So

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

$\Rightarrow 0^2 = 20^2 + 2(-9.8)s$

$\Rightarrow s = 20.4082\ m$ abo

Now find total height above ground.

So $s = ut + \frac{1}{2}at^2 \Rightarrow s = 0 + \frac{1}{2}(9.8)t^2$ ⊛

So we need to find time taken to get from max height to grou

$\therefore v = u + at \Rightarrow 0 = 20 - 9.8t \Rightarrow t = 2.041$ sec to Reach max heig

$\therefore t = 5 - 2.041 = 2.959$ sec to get from max he to ground

So Now use ⊛ : $s = 0 + \frac{1}{2}(9.8)(2.959)^2 = 42.9082\ m$

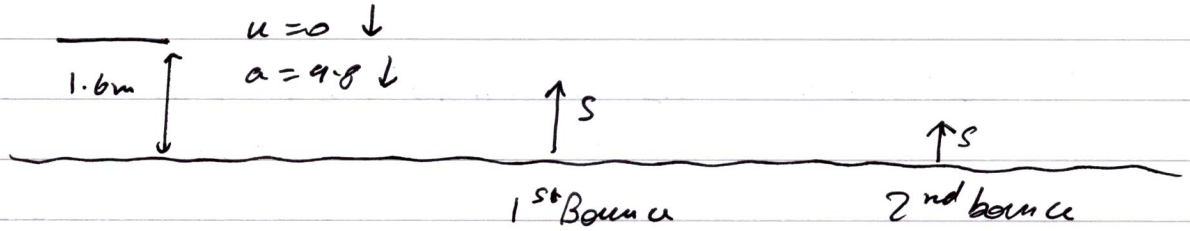
is total height above ground.

Hence h = total height − height above h

$= 42.9082 - 20.4082 = 22.5\ m$

(11) given: $u = 0$ m/s ↓

$a = 9.8$ m/s² ↓



Speed at impact is v: hence $v^2 = u^2 + 2as$

$\Rightarrow v^2 = 0^2 + 2(9.8)(1.6) = 31.36$

$\therefore v = 5.6$ m/s

Now $u = \frac{1}{2}v \Rightarrow u = 2.8$ m/s ↑

& $a = -9.8$ m/s² ↑

& $v = 0$ at max height

So $v^2 = u^2 + 2as \Rightarrow 0 = 2.8^2 + 2(-9.8)s$

$\therefore s = 0.4$ m $= 40$ cm after 1st Bounce.

Now at top of 1st bounce: $u = 0$ m/s ↓

$a = +9.8$ m/s² ↓

$s = 0.4$ m

Find v

So $v^2 = u^2 + 2as \Rightarrow v^2 = 0^2 + 2(9.8)(0.4) = 7.84$

$\therefore v = 2.8$ m/s as it hits The ground a second time.

Now $u = \frac{1}{2}v \Rightarrow u = 1.4$ m/s ↑

So $u = 1.4\ m/s \uparrow$

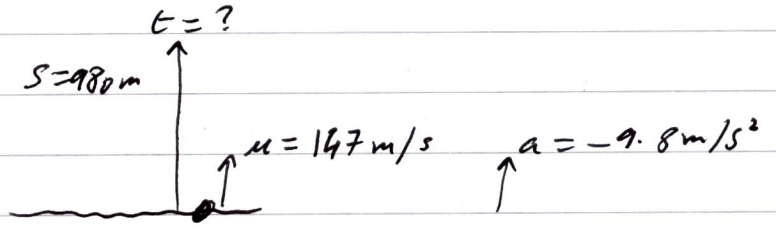
$a = -9.8\ m/s^2 \uparrow$

& $v = 0$ at top of bounce

$\therefore \quad v^2 = u^2 + 2as \Rightarrow 0 = (1.4)^2 + 2(-9.8)s$

$\therefore s = 0.1\ m = 10\ cm$

(13)



given: $u = 147\ m/s$ want: t

$a = -9.8\ m/s$

$s = 980\ m$

So $s = ut + \frac{1}{2}at^2 \Rightarrow 980 = 147t + \frac{1}{2}(-9.8)t^2$

$\Rightarrow \quad 4.9t^2 - 147t + 980 = 0$

$\therefore \quad t^2 - 30t + 200 = 0$

$\therefore \quad (t-10)(t-20) = 0$

$\Rightarrow \quad t = 10$ secs & 20 secs

i.e. 10 secs to get upto 980 m & 20 secs to come back down to 980 m on its return journey.

(15)

$\uparrow u_1 = 30\ m/s \uparrow$; $a = 9.8\ m/s^2 \downarrow = -9.8\ m/s^2 \uparrow$

$\downarrow u_2 = 30\ m/s \uparrow$; $a = 9.8\ m/s^2 \downarrow$

given: $u_1 = 30\ m/s \uparrow$; $a = 9.8\ m/s^2 \downarrow$ | want: s

$u_2 = 30\ m/s \downarrow$; $t = 3$

Now $s = ut + \frac{1}{2}at^2 \Rightarrow$ <u>For u_1</u>

$$s_1 = 30(3) + \frac{1}{2}(-9.8)(3)^2$$
$$= 45.9 \text{ m up}$$

<u>For u_2</u>

$$s_2 = 30(3) + \frac{1}{2}(9.8)(3)^2$$
$$= 134.1 \text{ m down}$$

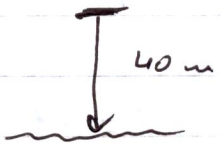
So distance between the two stones

$$s = s_1 + s_2 = 45.9 + 134.1 = 180 \text{ m}.$$

Ex 2D, P31 (even Nos only)

(2)

S	U	V	A	T
+40	0		+9.8	?



down as +ve

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

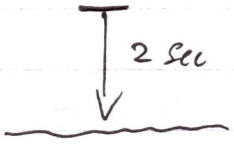
$\Rightarrow 40 = 0 + \frac{1}{2}(9.8)t^2$ $\Rightarrow t^2 = 8.163$

$\Rightarrow t = 2.86$ sec

$= 2\frac{6}{7}$ sec

(4)

S	U	V	A	T
?	+4		+9.8	2
✓		?		



down as +ve

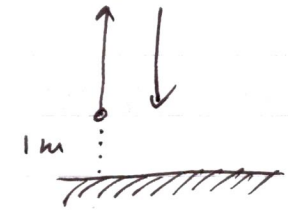
a) $S = ut + \frac{1}{2}at^2$

$\Rightarrow S = (4)(2) + \frac{1}{2}(9.8).2^2 = 27.6$ m

b) $v = u + at \Rightarrow v = 4 + (9.8)(2) = 23.6$ m/s

(6)

S	U	V	A	T
	28		-9.8	
?		0		



up as +ve

a) No calculation involved : -28 m/s = velocity so Speed = 28 m/s

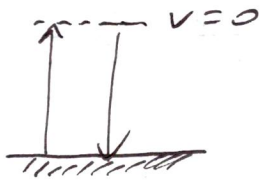
b) $v = 0$ at highest point, so $v^2 = u^2 + 2as$

$\Rightarrow 0 = 28^2 - 2(9.8)s$

$\Rightarrow s = 40$ From point of Projection

(8)

S	U	V	A	T
?	14	0	−9.8	?



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

$\Rightarrow S = (14)$

Does not work yet

up as +ve

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

$\Rightarrow 0 = 14^2 + 2(-9.8)s \Rightarrow s = 10$ m

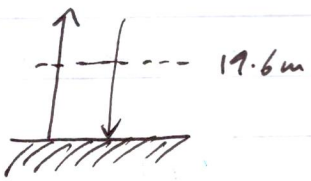
Then $v = u + at \Rightarrow 0 = 14 - 9.8t \Rightarrow t = 1.43$ sec

But this is to reach heighest point. So total time $= 2 \times 1.43$
$= 2.86$ sec

cannot do S U V A T
2 of 4 ?
since a changes direction

(10)

S	U	V	A	T
+19.6	+24.5		−9.8	?



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

$\Rightarrow 19.6 = 24.5t + \frac{1}{2}(-9.8)t^2$

up as +ve

$\Rightarrow 4.9t^2 - 24.5t + 19.6 = 0$

$\Rightarrow t^2 - 5t + 4 = 0 \Rightarrow (t-1)(t-4) = 0$

(a) So First time $t = 1$ sec

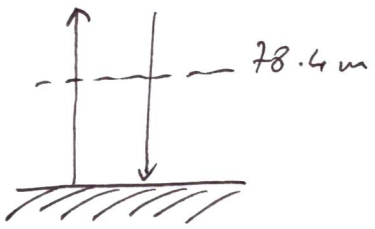
(b) & 2nd time $t = 4$ secs

(c) "At least 19.6 m" means 19.6m & higher, so

$t = 4 - 1 = 3$ sec.

(12)

S	U	V	A	T
78.4	+49		−9.8	?



Up as +ve

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

$\Rightarrow 78.4 = 49t + \frac{1}{2}(-9.8)t^2$

$\Rightarrow 4.9t^2 - 49t + 78.4 = 0$

$\Rightarrow t^2 - 10t + 16 = 0$

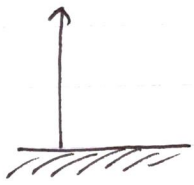
So $(t-8)(t-2) = 0$

So object Reaches 78.4 m after 2 secs & again after 8 secs.

∴ time Spent at "at least 78.4 m" is $t = 8 - 2 = 6$ secs. ✓

(14)

S	U	V	A	T
?	+14		−9.8	1
?	✓		✓	2



Up as +ve

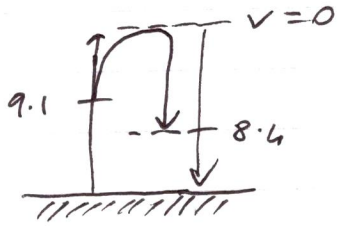
a) $S = ut + \frac{1}{2}at^2$

$\Rightarrow S = 14(1) + \frac{1}{2}(-9.8).1^2 = 9.1$ m

b) $S = 14(2) + \frac{1}{2}(-9.8).2^2 = 8.4$ m

c)

S	U	V	A	T
?	+14	0	−9.8	1



Max height: $V^2 = u^2 + 2as$

$\Rightarrow 0 = 14^2 + 2(-9.8)s \Rightarrow s = 10$ m

So From 9.1 m to 10 m, $S = 0.9$ m, & From 10 m to 8.4 m, $S = 1.6$ m

$\Rightarrow$ Distance travelled in 2nd second is $S = 0.9 + 1.6 = 2.5$ m ✓