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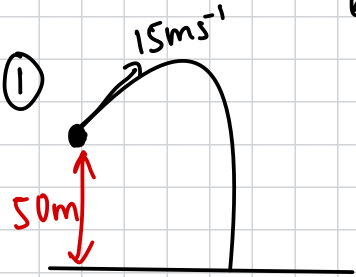
6.1: Horizontal projection

①



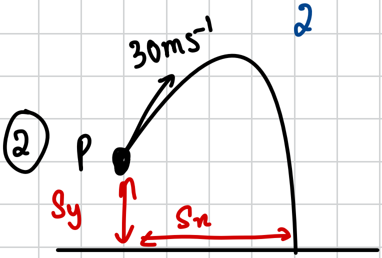
	x	y
s	s_x	50
u	15	0 → (as it is projected horizontally)
v		
a	0	g
t	t	t

a) $y: s = ut + \frac{1}{2}at^2 \Rightarrow 50 = \frac{1}{2}(9.8)t^2 \Rightarrow \frac{500}{49} = t^2$

$\Rightarrow t = \sqrt{\frac{500}{49}} = \frac{10\sqrt{5}}{7}$ seconds

b) $x: s = ut + \frac{1}{2}at^2 \Rightarrow 15\left(\frac{10\sqrt{5}}{7}\right) + \frac{1}{2}(0)\left(\frac{10\sqrt{5}}{7}\right)^2 = \frac{150\sqrt{5}}{7}$ m

②



	x	y
s	30t	$\frac{1}{2}at^2$
u	30	0
v		
a	0	g
t	t	t

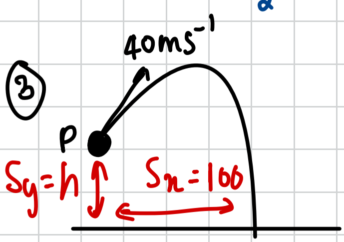
a) $x: s = ut + \frac{1}{2}at^2$

$\Rightarrow s = 30t + \frac{1}{2}(0)t^2$

$s = 30t$ m

b) $y: s = ut + \frac{1}{2}at^2 \Rightarrow 0(t) + \frac{1}{2}gt^2 = 4.9t^2$ m

③



	x	y
s	100	h
u	40	0
v		
a	0	g
t	t	t

a) $x: s = ut + \frac{1}{2}at^2$

$\Rightarrow 100 = 40(t) + \frac{1}{2}(0)(t^2)$

$\Rightarrow \frac{10}{4} = 2.5$ seconds $= t$

b) $y: s = ut + \frac{1}{2}at^2 \Rightarrow h = 0t + \frac{1}{2}gt^2 \Rightarrow h = \frac{1}{2}(g)(2.5)^2$

$h = 30.625$ m

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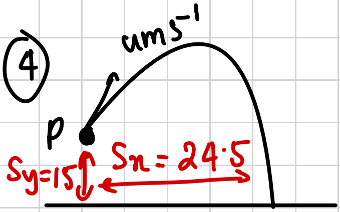

	x	y
s	24.5	15
u	u	0
v		
a	0	g
t	t	t

a) y: $s = ut + \frac{1}{2}at^2$

$\Rightarrow 15 = \frac{1}{2}gt^2 \Rightarrow t = \frac{5\sqrt{6}}{7}$

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

$\Rightarrow 24.5 = u\left(\frac{5\sqrt{6}}{7}\right) + \frac{1}{2}(0)t^2$

$\Rightarrow u = 24.5 \div \frac{5\sqrt{6}}{7} \Rightarrow u = 14.0$ (3sf)

b) Air resistance negligible.

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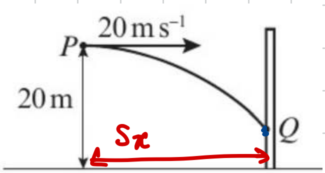


	x	y
s	S_x	20
u	20	0
v		
a	0	g
t	2	2

a) x: $s = ut + \frac{1}{2}at^2$

$\Rightarrow s = 20(2) + \frac{1}{2}(0)t^2$

$s = 40\,m$

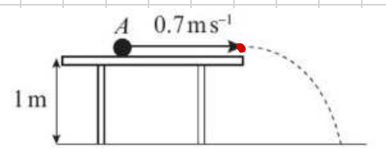
b) y: $s = s$ $a = g$ $t = 2$ $v = 0$ $\Rightarrow s = vt - \frac{1}{2}at^2 \Rightarrow -s = -\frac{1}{2}(g)(4)$

$-s = -19.6\,m$

$\Rightarrow 20\,m - 19.6\,m = 0.4\,m$

c) Q will be closer to the horizontal surface.

6



	x	y
s	S_x	1
u	0.7	0
v		
a	0	g
t	2	2

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

(time of free fall)

$\Rightarrow 1 = 0t + \frac{1}{2}(g)t^2$

$\Rightarrow t^2 = \frac{2}{g}$ $t = \sqrt{\frac{10}{49}}$

$\Rightarrow$ Total time $= 2 - \sqrt{\frac{10}{49}}$

Distance = velocity × time $\Rightarrow 0.7 \times \left(2 - \sqrt{\frac{10}{49}}\right) = \frac{14 - \sqrt{10}}{10}\,m$

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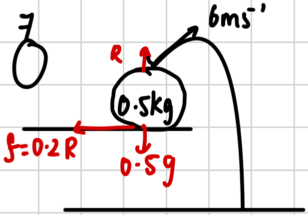

	x	y
s	s_x	s_y
u	6	0
v	v_x	v_y
a	1.96	g
t	t	t

a) Friction = $f = \mu \times mg$

$\Rightarrow f = 0.2 \times 0.5g = 0.98N$

$\Rightarrow F = ma \Rightarrow a = \frac{f}{m}$

$\Rightarrow \frac{0.98}{0.5} = 1.96\ ms^{-2}$ (decceleration)

$\Rightarrow v = u + at \Rightarrow 6 - (1.96)(2) \Rightarrow v = 2.08\ ms^{-1}$

b)

	x	y
s	0.78	s_y
u	6	0
v	2.08	v_y
a	0	g
t	t	t

$x: s = vt - \frac{1}{2}at^2 \Rightarrow s = vt \Rightarrow t = \frac{0.78}{2.08}$

$\Rightarrow t = 0.375$

$y: s = \frac{1}{2}at^2 \Rightarrow \frac{1}{2}(g)(0.375)^2 = \frac{441}{640}\ m$

c) The table height would be less than previously calculated.