P200 Sample Lab Homework 2 Solutions

1. $d = 1.90\,m = x(t) - x_0$ $\quad t = 2.34\,s$

Can choose $x_0 = 0$ $\quad v_0 = 0$ (rest)

$a = \star$

~~use (III)~~ $\quad$ Use (II)

$\cancel{v^2(t)}$

Not known

$$\underbrace{x(t) - x_0}_{d} = \cancel{v_0}^{\,0} t + \frac{1}{2}at^2$$

$$d = \frac{1}{2}at^2$$

$$\frac{2d}{t^2} = a = \frac{2\,(1.90\,m)}{(2.34\,s)^2}$$

$$\boxed{a = 0.69\,m/s^2}$$

2. $d = 1.72\,m$

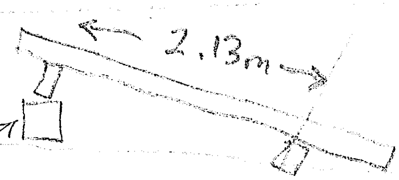
$\sin\theta = 0.077$, $\quad a = g\sin\theta$ $\quad g = 9.8\,m/s^2$ accel. due to Gravity on Earth

since $V_0 = 0$, and $v(t)$ unknown, use II again, finding: $d = \frac{1}{2}at^2$

$$\sqrt{t^2} = \sqrt{2d/a} = \pm\sqrt{\frac{1.72\,m \times 2}{9.8\,m/s^2\,(0.077)}} = \boxed{2.14\,s = t}$$

Choose (+).

3.



$h = 7.5\,cm$
$= 0.075\,m$

$$\sin\theta = \frac{0.075\,m}{2.13\,m} = 0.0352$$

No unit

$$a = g\sin\theta = \boxed{0.345\,m/s^2}$$

$d = 1.63\,m$ $\quad t = ?$ $\quad V_0 = 0$

use II again

$$d = \frac{1}{2}at^2$$

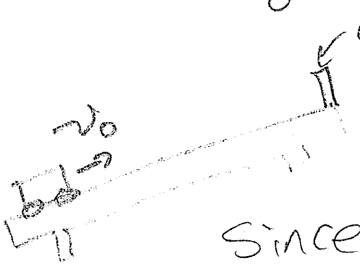
choose (+).

$$t = \sqrt{\frac{2d}{a}} = \pm\sqrt{\frac{1.63\,m \times 2}{0.345\,m/s^2}}$$

$$\boxed{t = 3.07\,s}$$

4. $\theta = 5^\circ \quad \sin\theta = 0.087$

$a = g\sin\theta = 0.853\,m/s^2$



$d = 1.80\,m$ max

arrive with $v(t) = 0$

$a < 0$ since its slowing

Since $v(t)$ known, $t = ?$, so use III

III $\quad \cancel{v^2(t)} = v_0^2 + 2a(\underbrace{x(t) - x_0}_{d})$

$0 = (v_0^2) + 2(-0.853\,m/s^2)(1.80\,m)$

$0 = v_0^2 - 3.07\,\frac{m^2}{s^2}$

$v_0 = \pm 1.75\,m/s$

choose + up the plane.

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5. Need total distance up track, use the 1.80m from problem 4.

Set $d_{max} = 0.90\,m$ Find v_0 and t.

until $v(t) = 0$ at this point.

Cannot use I or II since v_0 and t unknown.

Try III

$v^2(t) = v_0^2 + 2a(x(t) - x_0)$

$0 = v_0^2 + 2(-0.853\,m/s^2)(0.90\,m)$

$\boxed{v_0 = 1.24\,m/s}$

Now use I to get t:

$v(t) = v_0 + at$

$0 = 1.24\,m/s - 0.853\,m/s^2\,t \qquad t = \frac{-1.24\,m/s}{-0.853\,m/s^2}$

$\boxed{t = 1.45\,s}$

6. $d = 1.11\,m$, $a = -0.853\,m/s^2$

$v(t) = 0$ since it stops. $v_0 = ☆$

(III) $v^2(t) = v_0^2 + 2da$

$$v_0^2 = -2da = -2(1.11\,m)(-0.853\,m/s^2)$$

$$v_0^2 = 1.89\,\frac{m^2}{s^2}$$

$$\boxed{v_0 = 1.38\,m/s}$$

7. $t = 1.58\,s$, $v(t) = 0$ $v_0 = ☆$

Try (I) $v(t) = v_0 + at$

$$0 = v_0 + (-0.853\,m/s^2)(1.58\,s)$$

$$\boxed{v_0 = 1.35\,m/s}$$