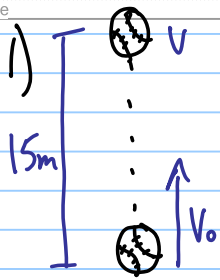


Worksheet 2.8

Note Title

25/10/2009



a) $V = 0$ ← at the top of its flight
 $V_0 = ?$
 $a = -9.80 \text{ m/s}^2$
 $d = 15 \text{ m}$
 $t = ?$

$$V^2 = V_0^2 + 2ad$$

$$0 = V_0^2 + 2ad$$

$$V_0^2 = -2ad$$

$$V_0 = \pm \sqrt{-2ad} = \pm \sqrt{2(+9.80)(15)}$$

it is going up so it must be "+" → $\pm 17.15 \text{ m/s}$ use extra digits for future calcs...
 $= \boxed{17 \text{ m/s}}$

b) $V = 0$
 $V_0 = 17.15 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = 15 \text{ m}$
 $t_{\frac{1}{2}} = ?$

$$V = V_0 + at_{\frac{1}{2}} \quad t_{\frac{1}{2}} = \frac{V - V_0}{a} = \frac{0 - 17.15 \text{ m/s}}{-9.80 \text{ m/s}^2}$$

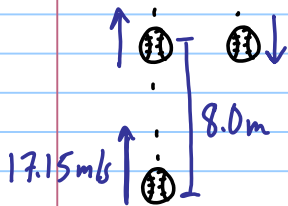
$$= 1.750 \text{ s}$$

total $t = 2 \times t_{\frac{1}{2}} = 2(1.750 \text{ s})$
 $= \boxed{3.5 \text{ s}}$

↑ this is only half of the total flight time

c) $\bar{V} = \frac{V + V_0}{2} = \frac{0 + 17.15 \text{ m/s}}{2} = \boxed{8.6 \text{ m/s}}$

d) This is a new situation so redo your variables...



$V = ?$
 $V_0 = 17.15 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = 8.0 \text{ m}$
 $t = ?$

$$V^2 = V_0^2 + 2ad$$

$$V = \pm \sqrt{V_0^2 + 2ad} = \pm \sqrt{(17.15)^2 + 2(-9.80)(8.0)}$$

$$= \pm 11.72 = \boxed{\pm 12 \text{ m/s}}$$

Keep both because ball is at $d = 8.0 \text{ m}$ on the way up and down...

e) To find the 2 times we will do 2 calculations:

$V = 11.72 \text{ m/s}$
 $V_0 = 17.15 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = 8.0 \text{ m}$
 $t = ?$

$$V = V_0 + at$$

$$t = \frac{V - V_0}{a} = \frac{11.72 - 17.15}{-9.80}$$

$$= \boxed{0.55 \text{ s}}$$

$V = -11.72 \text{ m/s}$
 $V_0 = 17.15 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = 8.0 \text{ m}$
 $t = ?$

$$V = V_0 + at$$

$$t = \frac{V - V_0}{a} = \frac{-11.72 - 17.15}{-9.80}$$

$$= \boxed{2.9 \text{ s}}$$

2)



a)

$$v =$$

$$v_0 = 0 \text{ m/s}$$

$$a = ?$$

$$d = 3.0 \text{ m}$$

$$t = 3.0 \text{ s}$$

$$d = v_0 t + \frac{1}{2} a t^2$$

$$d = \frac{1}{2} a t^2$$

$$a = \frac{2d}{t^2} = \frac{2(3.0 \text{ m})}{(3.0 \text{ s})^2}$$

$$= 0.66667 \text{ m/s}^2$$

$$= \boxed{0.67 \text{ m/s}^2}$$

b.) $v = ?$

$$v = v_0 + at$$

$$v_0 = 0 \text{ m/s}$$

$$a = 0.66667 \text{ m/s}^2 \quad = 0 + (0.66667)(6.0)$$

$$d =$$

$$t = 6.0 \text{ s}$$

$$= \boxed{4.0 \text{ m/s}}$$

c) $v =$

$$v_0 = 0 \text{ m/s}$$

$$a = 0.66667 \text{ m/s}^2$$

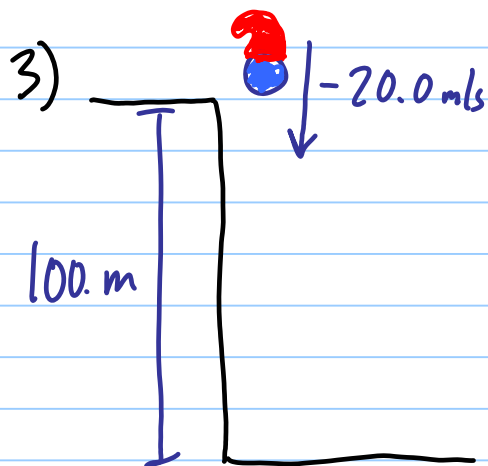
$$d =$$

$$t = 4.0 \text{ s}$$

$$d = v_0 t + \frac{1}{2} a t^2$$

$$= \frac{1}{2} (0.66667)(4.0)^2$$

$$= \boxed{5.3 \text{ m}}$$



a.) $v = ?$
 $v_0 = -20.0 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = -100. \text{ m}$
 $t =$

$$v^2 = v_0^2 + 2ad$$

$$v = \pm \sqrt{v_0^2 + 2ad}$$

$$= \pm \sqrt{(-20.0)^2 + 2(-9.80)(-100.)}$$

Since he hits the ground moving downwards it is only "-".

$$= \pm 48.56 \text{ m/s}$$

$$= \boxed{-48.6 \text{ m/s}}$$

b.) $v = -48.56 \text{ m/s}$
 $v_0 = -20.0 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = -100. \text{ m}$
 $t =$

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a} = \frac{-48.56 - (-20.0)}{-9.80} = \boxed{2.91 \text{ s}}$$

c.) $v = -34.7 \text{ m/s}$
 $v_0 = -20.0 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = ?$
 $t =$

$$v^2 = v_0^2 + 2ad$$

$$d = \frac{v^2 - v_0^2}{2a} = \frac{(-34.7)^2 - (-20.0)^2}{2(-9.80)}$$

$$= \boxed{41.0 \text{ m}}$$



$$v = ?$$

$$v_0 = 0 \text{ m/s}$$

$$a = ?$$

$$d = 0.75 \text{ m}$$

$$t = 0.0050 \text{ s}$$

a.) $d = v_0 t + \frac{1}{2} a t^2$

b.) $v = v_0 + a t$

$$d = \frac{1}{2} a t^2$$

$$= 0 + (60000)(0.0050)$$

$$a = \frac{2d}{t^2}$$

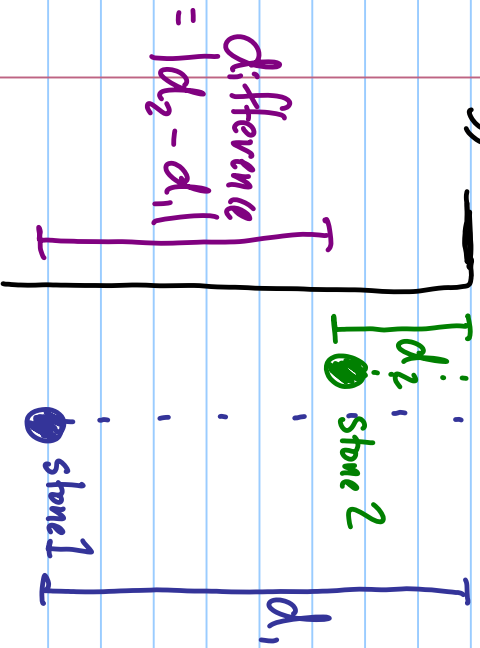
$$= 300 \text{ m/s}$$

$$= \frac{2(0.75 \text{ m})}{(0.0050 \text{ s})^2}$$

$$= \boxed{3.0 \times 10^2 \text{ m/s}}$$

$$= \boxed{6.0 \times 10^4 \text{ m/s}^2}$$

5)



Stone 1

$$v^2 = v_0^2 + 2ad_1$$

$$v = -40 \text{ m/s}$$

$$v_0 = 0$$

$$d_1 = \frac{v^2 - v_0^2}{2a} = \frac{(-40)^2 - 0^2}{2(-9.80)}$$

$$a = -9.80 \text{ m/s}^2$$

$$= -81.6 \text{ m}$$

$$d_1 = ?$$

$$t_1 = ?$$

$$v = v_0 + at_1$$

$$t_1 = \frac{v - v_0}{a} = \frac{-40 - 0}{-9.80}$$

$$= \underline{4.082 \text{ s}}$$

Stone 2

$$v =$$

$$v_0 = 0 \text{ m/s}$$

$$a = -9.80 \text{ m/s}^2$$

$$d_2 = ?$$

$$t_2 = t_1 - 2.0 \text{ s}$$

$$= \underline{2.082 \text{ s}}$$

because it is dropped
2.0 s later...

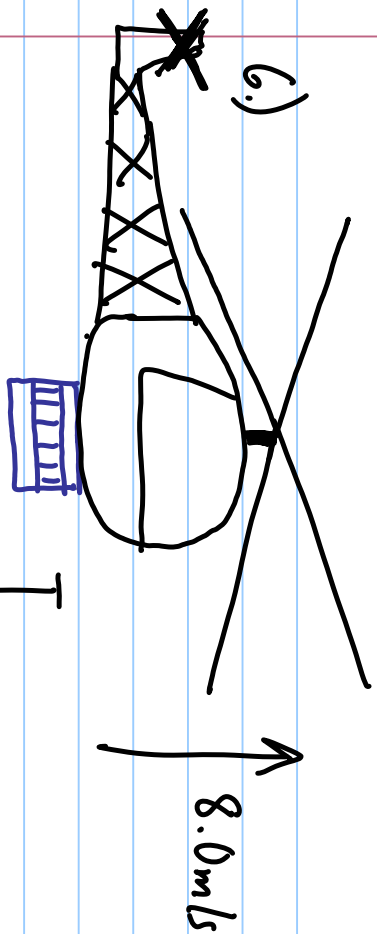
$$d = v_0 t + \frac{1}{2} a t^2 = \frac{1}{2} (-9.80 \text{ m/s}^2) (2.082 \text{ s})^2$$

$$= -21.2 \text{ m}$$

$$\text{difference} = |d_1 - d_2|$$

$$= |(-81.6 \text{ m}) - (-21.2 \text{ m})|$$

$$= \boxed{60 \text{ m}}$$



$$v =$$

$$v_0 = 8.0 \text{ m/s}$$

$$a = -9.80 \text{ m/s}^2$$

$$d = -120 \text{ m}$$

$$t = ?$$

$$d = v_0 t + \frac{1}{2} a t^2$$

← This gives us a quadratic which is no fun!

Instead let's find "v" then use it to find "t".

$$v^2 = v_0^2 + 2ad$$

$$v = \pm \sqrt{v_0^2 + 2ad}$$

$$= \pm \sqrt{(8.0)^2 + 2(-9.80)(-120)}$$

$$= \pm 49.15 \text{ m/s} \rightarrow -49.15 \text{ m/s}$$

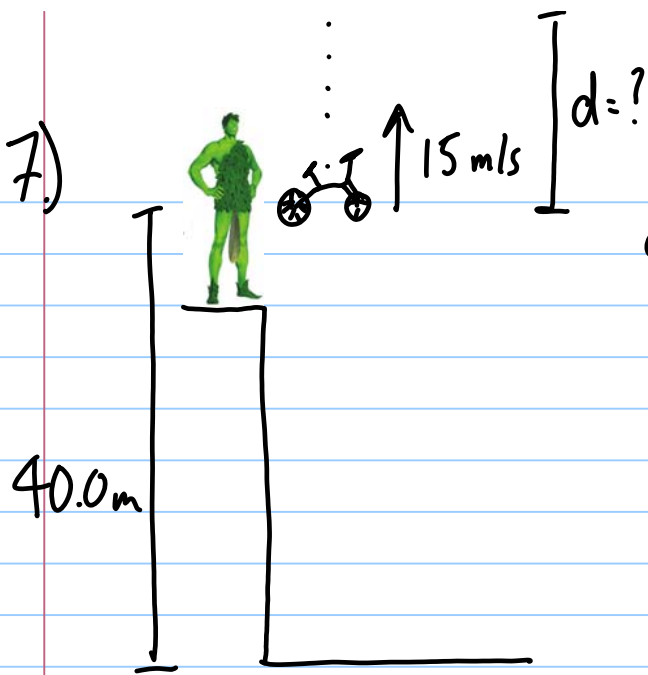
Since it is falling downward if it is " - "

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a}$$

$$= \frac{(-49.15) - (8.0)}{-9.80}$$

$$= \boxed{5.85}$$



a)

$$v = 0$$

$$v^2 = v_0^2 + 2ad$$

$$v_0 = 15 \text{ m/s}$$

$$a = -9.80 \text{ m/s}^2$$

$$d = ?$$

$$t = ?$$

$$d = \frac{v^2 - v_0^2}{2a} = 11.48 \text{ m}$$

$$= \boxed{11 \text{ m}}$$

b)

$$v = -15 \text{ m/s}$$

$$v_0 = 15 \text{ m/s}$$

$$a = -9.80 \text{ m/s}^2$$

$$d = ?$$

$$t = ?$$

← passes him on the way down at the same speed.

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a} = 3.06 \text{ s}$$

$$= \boxed{3.1 \text{ s}}$$

c)

$$v = ?$$

$$v_0 = 15 \text{ m/s}$$

$$a = -9.80 \text{ m/s}^2$$

$$d = -40.0 \text{ m}$$

$$t = ?$$

$$v^2 = v_0^2 + 2ad$$

$$v^2 = \pm \sqrt{v_0^2 + 2ad} = \pm \sqrt{(15)^2 + 2(-9.80)(-40.0)}$$

$$= \pm 31.76 \text{ m/s}$$

it is going downward so it is "-"

$$= \boxed{-32 \text{ m/s}}$$

d)

$$v = -31.76 \text{ m/s}$$

$$v_0 = 15 \text{ m/s}$$

$$a = -9.80 \text{ m/s}^2$$

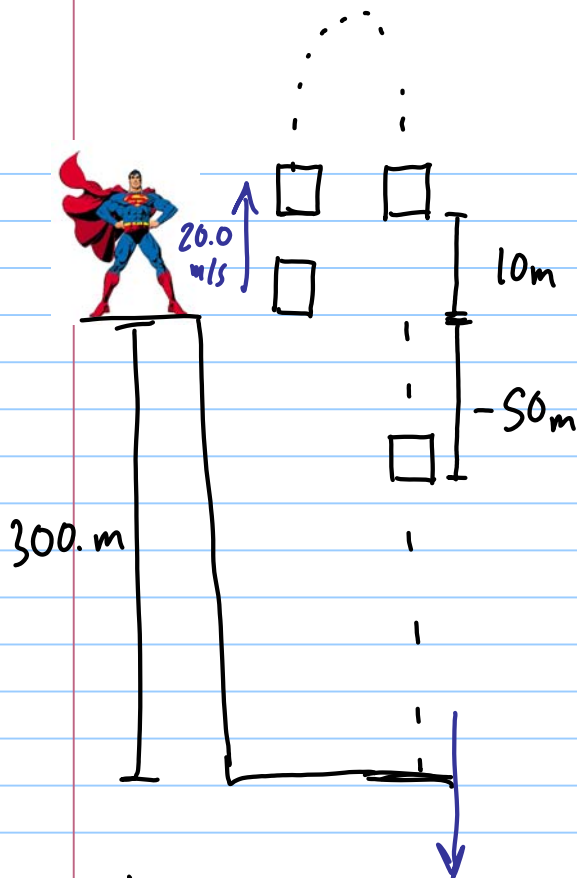
$$d = ?$$

$$t = ?$$

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a} = \frac{(-31.76) - (15)}{-9.80}$$

$$= 4.772 \text{ s} = \boxed{4.8 \text{ s}}$$



find these first
then get the
times

a) $v = ?$
 $v_0 = 20.0 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = 10 \text{ m}$
 $t = ?, ?$

$$v^2 = v_0^2 + 2ad$$

$$v = \pm \sqrt{v_0^2 + 2ad}$$

$$= \pm 14.28 \text{ m/s}$$

up and down

$$\underline{v = 14.28 \text{ m/s}}$$

$$\underline{v = -14.28 \text{ m/s}}$$

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a} = \boxed{0.58 \text{ s}}$$

$$t = \frac{v - v_0}{a} = \boxed{3.5 \text{ s}}$$

b) $v = ?$
 $v_0 = 20.0 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = -50$
 $t = ?$

$$v^2 = v_0^2 + 2ad$$

$$v = \pm \sqrt{v_0^2 + 2ad}$$

$$= \pm 37.15 \text{ m/s}$$

$$= \underline{-37.15 \text{ m/s}}$$

$$v = v_0 + at$$

$$t = \frac{v - v_0}{a}$$

$$= \boxed{5.8 \text{ s}}$$

c) $v = ?$
 $v_0 = 20.0 \text{ m/s}$
 $a = -9.80 \text{ m/s}^2$
 $d = -300. \text{ m}$
 $t =$

$$v^2 = v_0^2 + 2ad$$

$$v = \pm \sqrt{v_0^2 + 2ad}$$

$$= \pm 79 \text{ m/s} = -79 \text{ m/s}$$

$$v = v_0 + at$$

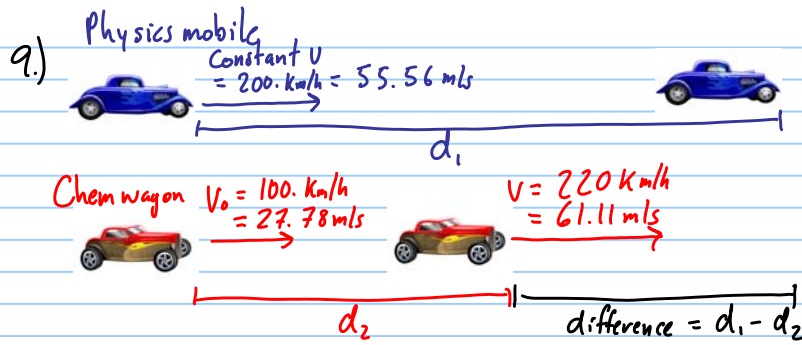
$$t = \frac{v - v_0}{a}$$

$$= \boxed{10. \text{ s}}$$

d)

velocity = -79 m/s

speed = $\boxed{79 \text{ m/s}}$



a) Physicsmobile - const. v

$$v = 55.56 \text{ m/s} \quad v = \frac{d}{t} \quad d = v \cdot t = \underline{555.6 \text{ m}}$$

$$d = ?$$

$$t = 10.0 \text{ s}$$

Chemwagon - const. a

$$v = 61.11 \quad v = v_0 + at \quad d_2 = v_0 t + \frac{1}{2} at^2$$

$$v_0 = 27.78$$

$$a = ? \quad a = \frac{v - v_0}{t} \quad = \underline{444.4 \text{ m}}$$

$$d = ?$$

$$t = 10.0 \text{ s} \quad = 3.333 \text{ m/s}^2$$

$$\text{difference} = d_2 - d_1 = \boxed{111 \text{ m}}$$

b.) Since $v_{\text{chem}} = 61.11 \text{ m/s}$
 and $v_{\text{phys}} = 55.56 \text{ m/s}$

$5.55 \text{ m/s} = \text{how much faster } v_{\text{chem}} \text{ is}$

$$\text{Time to catch physicsmobile after acceleration: } t = \frac{d}{v} = \frac{111 \text{ m}}{5.55 \text{ m/s}}$$

$$= 20 \text{ s}$$

Time for chemwagon to accelerate = 10 s

$$\text{Total time} = 10 \text{ s} + 20 \text{ s} = \boxed{30 \text{ s}}$$

