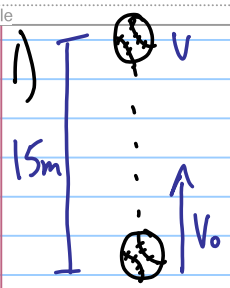
Worksheet 2.8

Note Title 25/10/2009

1)



a) $v = 0$ ← at the top of its flight
$v_0 = ?$
$a = -9.80\ m/s^2$
$d = 15\ m$
$t =$

$\cancel{v^2}^{\,0} = v_0^2 + 2ad$
$0 = v_0^2 + 2ad$
$v_0^2 = -2ad$
$v_0 = \pm\sqrt{-2ad} = \pm\sqrt{+2(+9.80)(15)}$
$= \pm 17.15\ m/s$ use extra digits for future calcs!!

it is going up so it must be "+"

$= \boxed{17\ m/s}$

b) $v = 0$
$v_0 = 17.15\ m/s$
$a = -9.80\ m/s^2$
$d = 15\ m$
$t_{\frac{1}{2}} = ?$

this is only half of the total flight time

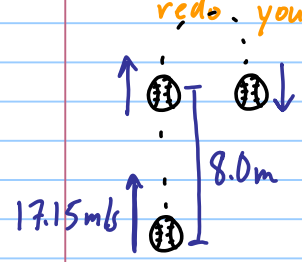
$v = v_0 + at_{\frac{1}{2}}$

$t_{\frac{1}{2}} = \frac{v - v_0}{a} = \frac{0 + 17.15\ m/s}{+9.80\ m/s^2}$
$= 1.750\ s$

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

c) $\bar{v} = \frac{v + v_0}{2} = \frac{0 + 17.15\ m/s}{2} = \boxed{8.6\ m/s}$

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



$v = ?$
$v_0 = 17.15\ m/s$
$a = -9.80\ m/s^2$
$d = 8.0\ m$
$t =$

$v^2 = v_0^2 + 2ad$
$v = \pm\sqrt{v_0^2 + 2ad} = \pm\sqrt{(17.15)^2 + 2(-9.80)(8.0)}$
$= \pm 11.72 = \boxed{\pm 12\ m/s}$

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

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

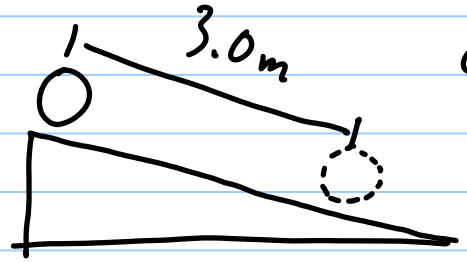
$v = 11.72\ m/s$
$v_0 = 17.15\ m/s$
$a = -9.80\ m/s^2$
$d = 8.0\ m$
$t = ?$

$v = v_0 + at$
$t = \frac{v - v_0}{a}$
$= \frac{11.72 - 17.15}{-9.80}$
$= \boxed{0.55\ s}$

$v = -11.72\ m/s$
$v_0 = 17.15\ m/s$
$a = -9.80\ m/s^2$
$d = 8.0\ m$
t

$v = v_0 + at$
$t = \frac{v - v_0}{a}$
$= \frac{-11.72 - 17.15}{-9.80}$
$= \boxed{2.9\ s}$

2)



a)

$v =$
$v_0 = 0\,m/s$
$a = ?$
$d = 3.0\,m$
$t = 3.0\,s$

$$d = \cancel{v_0 t}^{\,0} + \frac{1}{2}at^2$$

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

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

$$= 0.66667\,m/s^2$$

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

b.)

$v = ?$
$v_0 = 0\,m/s$
$a = 0.66667\,m/s^2$
$d =$
$t = 6.0\,s$

$$v = v_0 + at$$

$$= 0 + (0.66667)(6.0)$$

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

c)

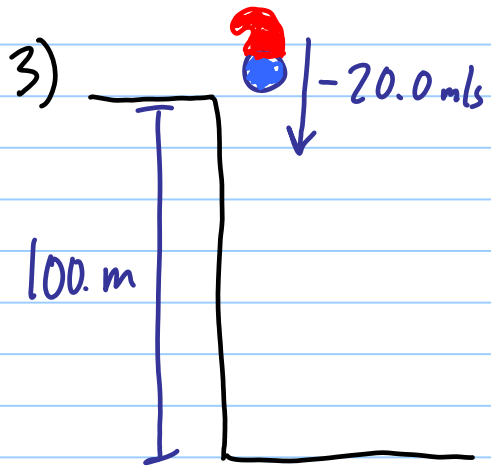
$v =$
$v_0 = 0\,m/s$
$a = 0.66667\,m/s^2$
$d =$
$t = 4.0\,s$

$$d = \cancel{v_0 t}^{\,0} + \frac{1}{2}at^2$$

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

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

3)



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

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

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

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

$= \pm 48.56\ m/s$

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

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

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

$v = v_0 + at$

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

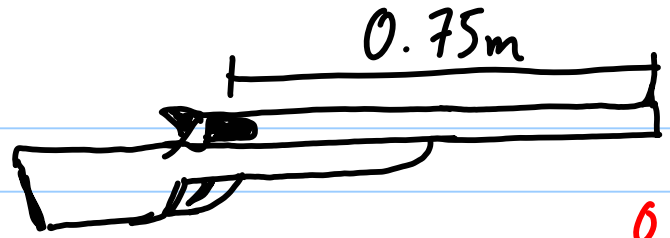
c.) $v = -34.7\ m/s$
$v_0 = -20.0\ m/s$
$a = -9.80\ m/s^2$
$d = ?$
$t =$

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

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

$= \boxed{41.0\ m}$

4)



$v = ?$
$v_0 = 0\ m/s$
$a = ?$
$d = 0.75\ m$
$t = 0.0050\ s$

a.) $d = \cancelto{0}{v_0 t} + \frac{1}{2}at^2$

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

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

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

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

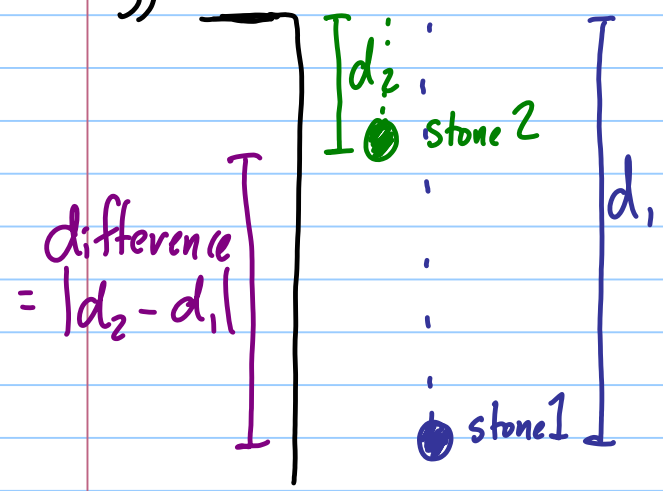
b.) $v = v_0 + at$

$= 0 + (60000)(0.0050)$

$= 300\ m/s$

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

5)



Stone 1

$V = -40\,m/s$
$V_0 = 0$
$a = -9.80\,m/s^2$
$d_1 = ?$
$t_1 = ?$

$V^2 = V_0^2 + 2ad_1$

$d_1 = \frac{V^2 - V_0^2}{2a} = \frac{(-40)^2 - 0^2}{2(-9.80)}$

$= \underline{-81.6\,m}$

$V = V_0 + at_1$

$t_1 = \frac{V - V_0}{a} = \frac{-40 - 0}{-9.80}$

$= \underline{4.082\,s}$

Stone 2

$V =$
$V_0 = 0\,m/s$
$a = -9.80\,m/s^2$
$d_2 = ?$
$t_2 = t_1 - 2.0\,s$
$= \underline{\underline{2.082\,s}}$

because it is dropped 2.0 s later...

$d = \cancel{V_0}^{\,0} t + \frac{1}{2}at^2 = \frac{1}{2}(-9.80\,m/s^2)(2.082\,s)$

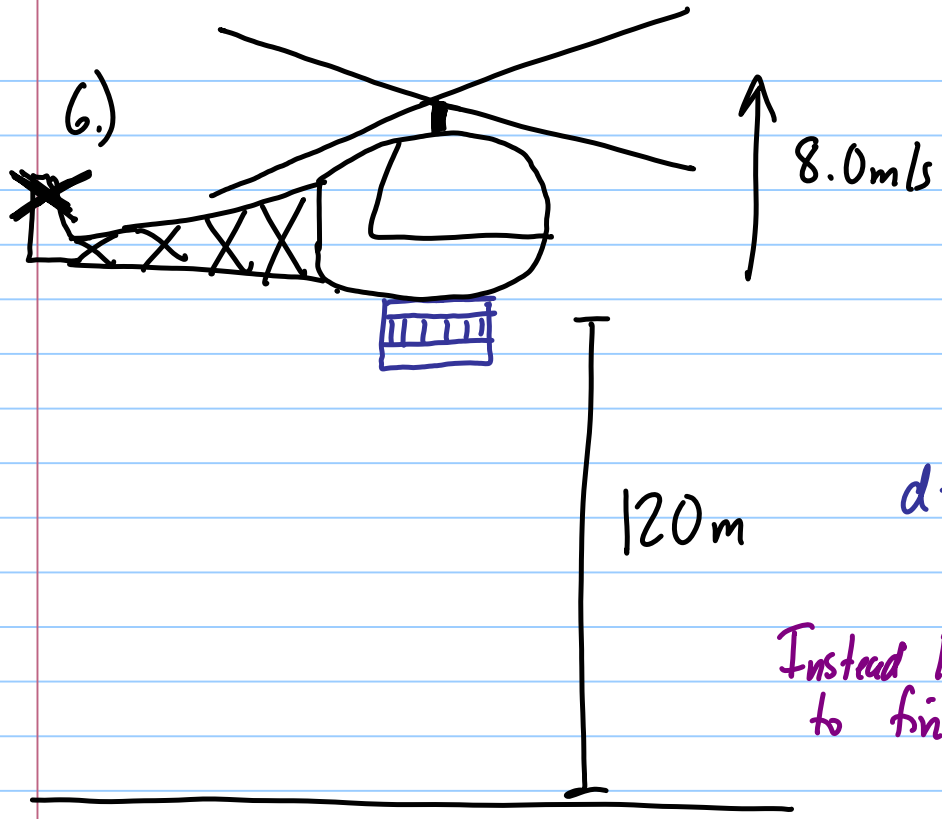
$= -21.2\,m$

difference $= |d_1 - d_2|$

$= |(-81.6\,m) - (-21.2\,m)|$

$= \boxed{60\,m}$

6.)



$v =$

$v_0 = 8.0\ m/s$

$a = -9.80\ m/s^2$

$d = -120\ m$

$t = ?$

$d = v_0 t + \frac{1}{2}at^2$ ← This gives us a quadratic which is no fun!

Instead lets find "v" then use it to find "t".

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

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

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

$= \pm 49.15\ m/s = -49.15\ m/s$

Since it is falling downward it is "-".

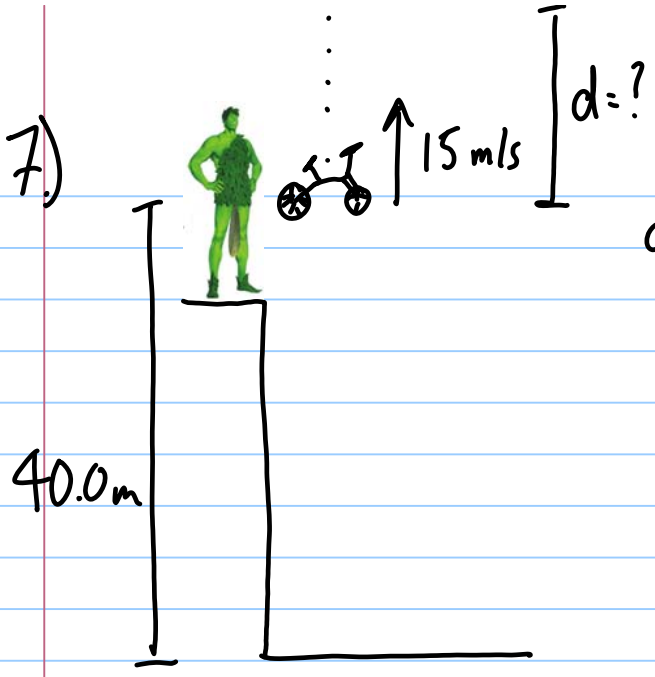
$v = v_0 + at$

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

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

$= \boxed{5.8\ s}$

7)



a) $v = 0$
$v_0 = 15\,m/s$
$a = -9.80\,m/s^2$
$d = ?$
$t =$

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

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

$= \boxed{11\,m}$

b) $v = -15\,m/s$ ← passes him on the way down at the same speed.
$v_0 = 15\,m/s$
$a = -9.80\,m/s^2$
$d =$
$t = ?$

$v = v_0 + at$

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

$= \boxed{3.1\,s}$

c) $v = ?$
$v_0 = 15\,m/s$
$a = -9.80\,m/s^2$
$d = -40.0\,m$
$t =$

it is going down ward so it is "−"

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

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

$= \pm 31.76\,m/s$

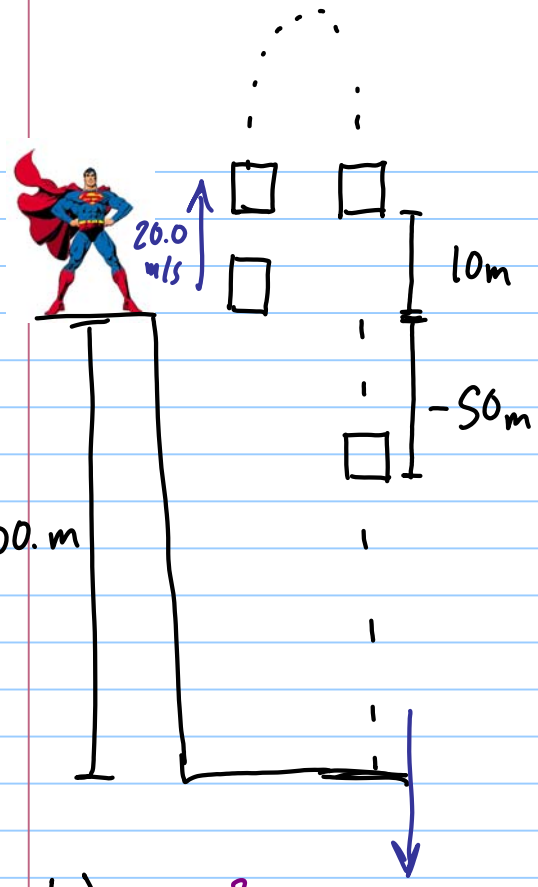
$= \boxed{-32\,m/s}$

d) $v = -31.76\,m/s$
$v_0 = 15\,m/s$
$a = -9.80\,m/s^2$
$d =$
$t = ?$

$v = v_0 + at$

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

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



find these first then get the times

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

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

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

$= \pm 14.28\,m/s$

up and down

$v = 14.28\,m/s$

$v = -14.28\,m/s$

$v = v_0 + at$

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

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

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

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

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

$= \pm 37.15\,m/s$

$= -37.15\,m/s$

$v = v_0 + at$

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

$= \boxed{5.8\,s}$

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

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

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

$= \pm 79\,m/s = -79\,m/s$

$v = v_0 + at$

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

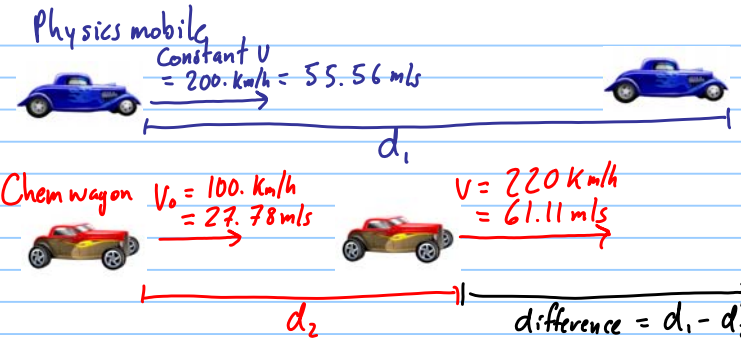
$= \boxed{10.\,s}$

d)

velocity $= -79\,m/s$

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

9.)



a) Physicsmobile - const. v

$v = 55.56$ m/s
$d = ?$
$t = 10.0$ s

$v = \frac{d}{t}$ $\quad d = v \cdot t = \underline{555.6\,m}$

Chemwagon - const. a

$v = 61.11$
$v_0 = 27.78$
$a = ?$
$d = ?$
$t = 10.0$ s

$v = v_0 + at$

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

$= 3.333\,m/s^2$

$d_2 = v_0 t + \frac{1}{2} a t^2$

$= \underline{444.4\,m}$

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

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

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

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

$= 20\,s$

Time for chemwagon to accelerate = 10 s

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

c)