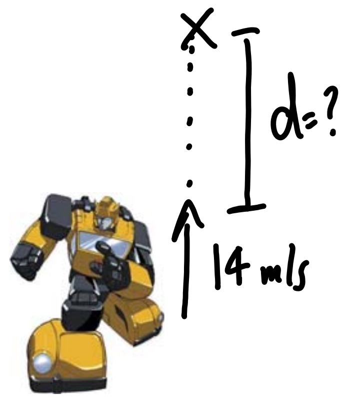
Worksheet 2.7 – Uniform Accelerated Motion

1) Bumblebee jumps straight upwards with a velocity of 14.0 m/s. What is his displacement of after 1.80 s?



$v =$ ← don't assume that this is zero!!!

$v_0 = 14.0$ m/s

$a = -9.80$ m/s^2

$d = ?$

$t = 1.80$ s

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

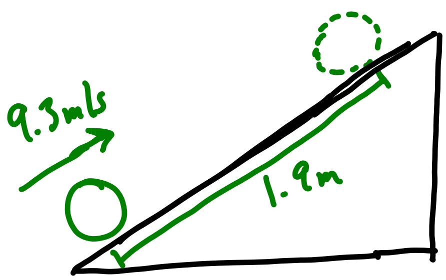
$$= (14.0)(1.80) + \frac{1}{2}(-9.80)(1.80)^2$$

don't forget negative

$$= \boxed{9.32\text{ m}}$$

(9.32 m)

2) A surprisingly spherical decepticon is rolled up a constant slope with an initial velocity of 9.3 m/s. What is the acceleration of the decepticon if its displacement is 1.9 m up the slope after 2.7 s?



$v =$

$v_0 = 9.3$ m/s

$a =$

$d = 1.9$ m

$t = 2.7$ s

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

$$d - v_0 t = \frac{1}{2}at^2$$

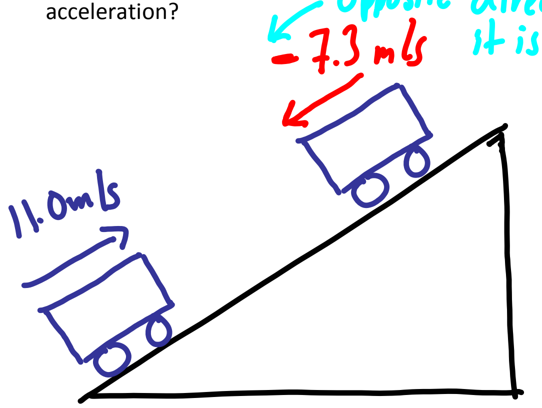
$$2(d - v_0 t) = at^2$$

$$a = \frac{2(d - v_0 t)}{t^2} = \frac{2[1.9 - (9.3)(2.7)]}{(2.7)^2}$$

$$= \boxed{-6.4\text{ m/s}^2}$$

(-6.4m/s^2)

3) Optimus Prime coasts up a hill initially at 11.0 m/s. After 9.3 s he is rolling back down the slope at 7.3 m/s. What is his acceleration?



$v = -7.3$ m/s

$v_0 = 11.0$ m/s

$a =$

$d =$

$t = 9.3$ s

$$v = v_0 + at$$

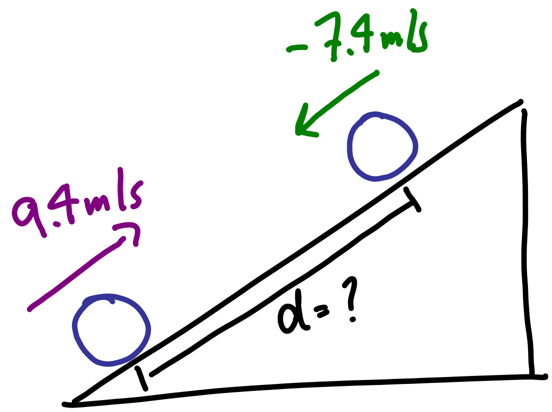
$$a = \frac{v - v_0}{t}$$

$$= \frac{(-7.3) - (11.0)}{9.3}$$

$$= \boxed{-2.0\text{ m/s}^2}$$

(-2.0 m/s^2)

4) Sonic (you know, the Hedgehog) rolls up a slope at 9.4 m/s. After 3.0 s he is rolling back down at 7.4 m/s. How far up the hill is he at this time?



$v = -7.4$ m/s
$v_0 = 9.4$ m/s
$a =$ Find first
$d = ?$
$t = 3.0$ s

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

$= \frac{(-7.4\text{ m/s}) - (9.4\text{ m/s})}{3.0\text{ s}} = -5.6\text{ m/s}^2$

Now Find d:

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

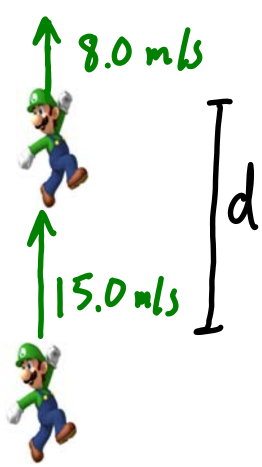
$d = \frac{v^2 - v_0^2}{2a} = \frac{(-7.4\text{ m/s})^2 - (9.4\text{ m/s})^2}{2(-5.6\text{ m})}$

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

(3.0 m)

5) Luigi jumps straight upwards at 15.0 m/s. How high is he when he is travelling at:

a) 8.0 m/s upwards?



$v = 8.0$ m/s
$v_0 = 15.0$ m/s
$a = -9.80$ m/s²
$d =$
$t =$

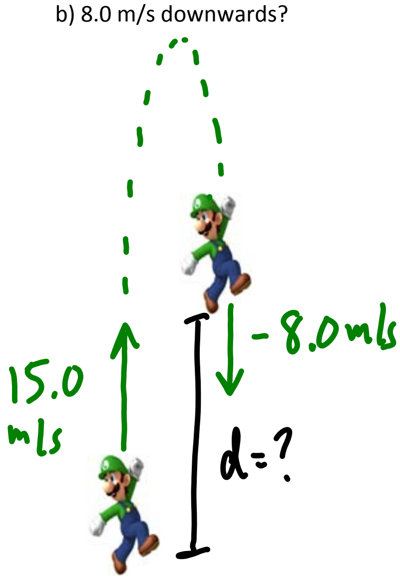
$v^2 = v_0^2 + 2ad$

$d = \frac{v^2 - v_0^2}{2a} = \frac{(8.0)^2 - (15.0)^2}{2(-9.80)}$

$= \boxed{8.2\text{ m}}$

(8.2 m)

b) 8.0 m/s downwards?



$v = -8.0$ m/s
$v_0 = 15.0$ m/s
$a = -9.80$ m/s²
$d = ?$
$t =$

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

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

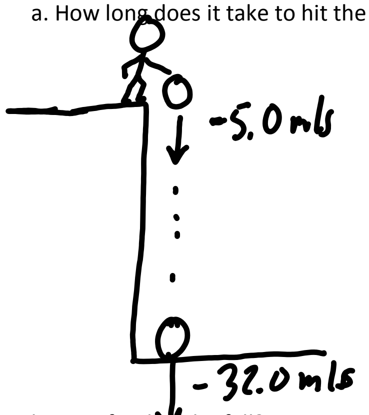
$= \frac{(-8.0\text{ m/s})^2 - (15.0\text{ m/s})^2}{2(-9.80\text{ m/s}^2)}$

$= \boxed{8.2\text{ m}}$

(8.2 m, weird huh?)

6) Sick of his guff, Optimus decides to throw Megatron down off the top of a building at 5.0 m/s. Megatron hits the ground traveling at 32.0 m/s.

a. How long does it take to hit the ground?



$v = -32.0\ m/s$
$v_0 = -5.0\ m/s$
$a = -9.80\ m/s^2$
$d =$
$t = ?$

$v = v_0 + at$

$$t = \frac{v - v_0}{a} = \frac{(-32.0\ m/s) - (-5.0\ m/s)}{-9.80\ m/s^2}$$

$= 2.755\ s$

$= \boxed{2.8\ s}$

(2.8 s)

b. How far does he fall?

$v = -32.0\ m/s$
$v_0 = -5.0\ m/s$
$a = -9.80\ m/s^2$
$d = ?$
$t = 2.755\ s$

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

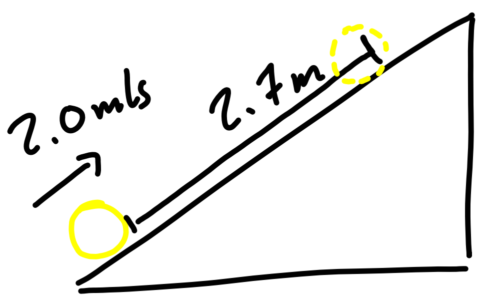
$$d = \frac{v^2 - v_0^2}{2a} = \frac{(-32.0\ m/s)^2 - (-5.0\ m/s)^2}{2(-9.80\ m/s^2)}$$

$= \boxed{51\ m}$

(- 51 m)

7) Mario rolls a coin up a slope at 2.0 m/s. It travels 2.7 m, comes to a stop and rolls back down. What is the coin's entire time of travel?

$t_{\frac{1}{2}}$ = time to top $\qquad t_{total} = 2 \times t_{\frac{1}{2}}$



$v = 0\ m/s$
$v_0 = 2.0\ m/s$
$a =$ Find first
$d = 2.7\ m$
$t_{\frac{1}{2}} =$

$v^2 = v_0^2 + 2ad \qquad a = \frac{v^2 - v_0^2}{2d}$

$$a = \frac{(0)^2 - (2.0\ m/s)^2}{2(2.7\ m)}$$

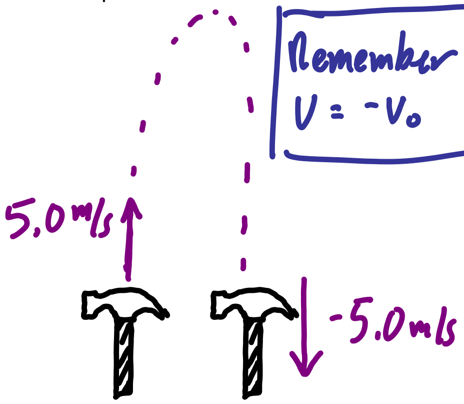
$= -0.7407\ m/s^2$

$v = v_0 + at_{\frac{1}{2}} \qquad t_{\frac{1}{2}} = \frac{v - v_0}{a} = \frac{(0\ m/s - 2.0\ m/s)}{-0.7407\ m/s^2} = 2.700\ s$

(5.4 s)

$t_{total} = 2 \times (2.700\ s) = \boxed{5.4\ s}$

8) While strolling along on Planet X an astronaut decides to throw a hammer and a feather upwards at 5.0 m/s. They both return to the point of release in 3.0 s. What is the acceleration due to gravity on Planet X.



Remember $V = -V_o$

$V = -5.0$ m/s
$V_o = 5.0$ m/s
$a = ?$
$d =$
$t = 3.0$ s

$V = V_o + at$

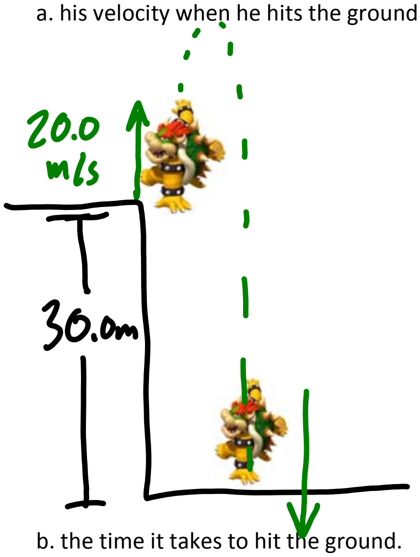
$a = \frac{V - V_o}{t} = \frac{(-5.0 \text{ m/s}) - (5.0 \text{ m/s})}{3.0 \text{ s}}$

$= -3.3$ m/s²

(-3.3 m/s^2)

9) Princess Toadstool stands on the edge of a 30.0 m high cliff. She throws Bowser upwards at 20.0 m/s. If Bowser falls all the way to the bottom of the cliff, find:

a. his velocity when he hits the ground.



$V = ?$
$V_o = 20.0$ m/s ← thrown upwards so positive
$a = -9.80$ m/s²
$d = -30.0$ m ← falls downward so negative
$t =$

$V^2 = V_o^2 + 2ad$

$V = \pm\sqrt{V_o^2 + 2ad}$

$= \pm\sqrt{(20.0 \text{ m/s})^2 + 2(-9.80)(-30.0)}$

$= \pm 31.4$

bowser is falling downward

$\therefore V = -31.4$ m/s

(-31.4 m/s)

b. the time it takes to hit the ground.

$V = -31.4$ m/s
$V_o = 20.0$ m/s
$a = -9.80$ m/s²
$d = -30.0$ m
$t = ?$

$V = V_o + at$

$t = \frac{V - V_o}{a} = \frac{(-31.4 \text{ m/s}) - (20.0 \text{ m/s})}{-9.80 \text{ m/s}^2}$

$= 5.24$ s

(5.24 s)