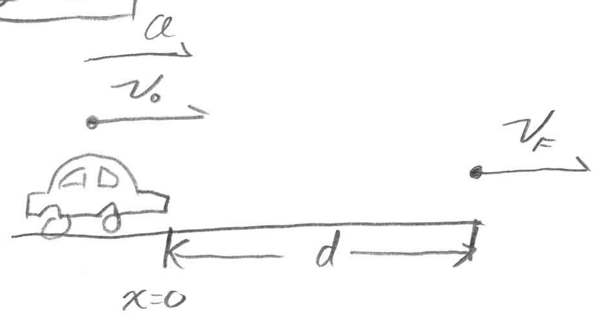
Physics 111
Homework

2-30



$v_0 = 70\ \text{km/h}$

$t = 6\text{s} \cdot \frac{1}{3600}\ \text{hr/s} = 1.7 \times 10^{-3}\ \text{hr}$

$v_F = 80\ \text{km/h}$

$d = ?$

$$x = x_0 + v_0 t + \tfrac{1}{2}at^2 \qquad v = v_0 + at$$

$$① \quad d = 0 + v_0 t + \tfrac{1}{2}at^2 \qquad ② \quad v_F = v_0 + at$$

Don't know <u>a</u> or <u>d</u>. Problem asks for <u>d</u> so eliminate <u>a</u>.

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

$$d = 0 + v_0 t + \frac{1}{2}\frac{v_F - v_0}{t} t^2$$

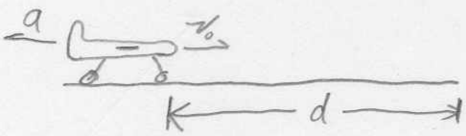
$$= v_0 t + \tfrac{1}{2}v_F t - \tfrac{1}{2}v_0 t = \tfrac{1}{2}v_F t + \tfrac{1}{2}v_0 t$$

$$\boxed{d = \tfrac{1}{2}(v_F + v_0)t}$$

$$d = \tfrac{1}{2}\left(80\ \text{km/hr} + 70\ \text{km/hr}\right)(1.7 \times 10^{-3}) = .128\ \text{km}$$

$$\boxed{d = 128\ \text{m}}$$

Ch2, #59



$v_0 = 220\ km/hr$

$t = 29\ s$

$d = ?$

$x(t) = x_0 + v_0 t + at^2$

$d = 0 + v_0 t - \frac{1}{2} a t^2$

$v(t) = v_0 + at$

$0 = v_0 - at$

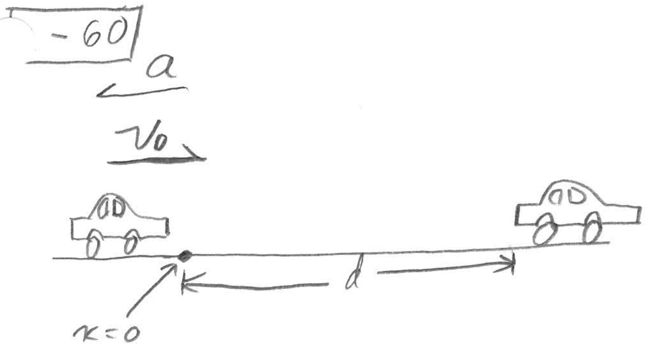
$\Rightarrow a = \frac{v_0}{t}$

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

$$\boxed{d = \frac{1}{2} v_0 t} = \frac{1}{2}\left(220 \frac{km}{hr} \cdot 1000 \frac{m}{km} \cdot \frac{1}{3600} \frac{hr}{s}\right)(29\ s)$$

$$\boxed{= 886\ m}$$

Physics 111
Homework



Given

$a = 6.3\ m/s^2$

$v_F = 18\ \frac{km}{hr} \cdot \frac{1\times10^3\ m/km}{3600\ s/hr} = 5\ m/s$

$d = 34\,m$

a) *Track the car's position:

$$x = x_0 + v_0 t + \tfrac{1}{2}at^2$$

(1) $d = 0 + v_0 t - \tfrac{1}{2}at^2$ Don't know v_0 or t ⇒ 1 eq, 2 unk.

[sign for neg accel.]

*Track car's velocity:

$$v = v_0 + at$$

(2) $v_F = v_0 - at$ Don't know v_0 or t

But now I have 2 eq. and 2 unknowns.

Solve (2) for t and plug into (1):

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

$$d = 0 + v_0\frac{(v_0 - v_F)}{a} - \frac{1}{2}a\frac{(v_0 - v_F)^2}{a^2}$$

continued
↓

2-60 continued

continuing algebra...

$$d = \frac{1}{a}\left[V_0(V_0 - V_F) - \frac{1}{2}(V_0 - V_F)^2\right]$$

$$= \frac{1}{a}\left[V_0^2 - V_0V_F - \frac{1}{2}V_0^2 + V_0V_F - \frac{1}{2}V_F^2\right]$$

$$= \frac{1}{a}\left[\frac{1}{2}V_0^2 - \frac{1}{2}V_F^2\right]$$

$$\boxed{d = \frac{V_0^2 - V_F^2}{2a}}$$

Solve for V_0:

$$\boxed{V_0 = (2ad + V_F^2)^{1/2}}$$

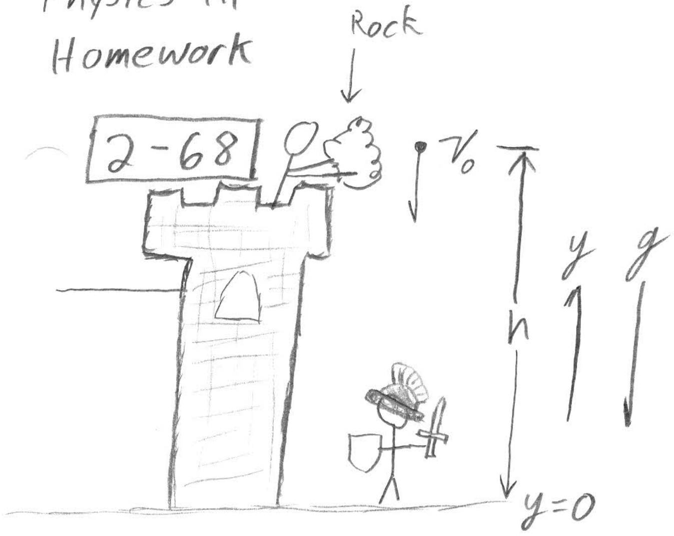
Now plug in numbers. Remember we already put in the sign for neg. a!

$$V_0 = ((2)(6.3)(34) + 5^2)^{1/2} = 21.3 \text{ m/s} \cdot \frac{3600 \text{ s/hr}}{1\times10^3 \text{ m/km}}$$

$$\boxed{= 76.7 \text{ km/hr}}$$

b) From part a $\quad t = \frac{V_0 - V_F}{a} = \frac{21.3 \text{ m/s} - 5 \text{ m/s}}{6.3 \text{ m/s}^2} = \boxed{2.6 \text{ s}}$

Physics 111
Homework



$v_0 = 10\,m/s \Rightarrow$ sign? $\quad v_1$ = thrown

$h = 15\,m \quad v_2$ = Dropped

$g = 9.8\,m/s^2$

Let's calculate the Final velocity when the rock is thrown.

The problem statement doesn't specify a sign for v_0...
Let's leave it positive for now...

Basic kinematics equations:

$$y = y_0 + v_0 t + \tfrac{1}{2}at^2 \qquad v = v_0 + at$$

$$0 = h + v_0 t - \tfrac{1}{2}gt^2 \qquad v_1 = v_0 - gt$$

$$t = \frac{v_0 - v_1}{g}$$

$$0 = h + \frac{v_0(v_0 - v_1)}{g} - \frac{1}{2}g\frac{(v_0 - v_1)^2}{g^2}$$

$$= h + \frac{1}{g}\left[v_0^2 - v_0 v_1 - \frac{1}{2}v_0^2 + v_0 v_1 - \frac{1}{2}v_1^2\right]$$

$$0 = h + \frac{v_0^2 - v_1^2}{2g} \Rightarrow \boxed{v_1 = \left(v_0^2 + 2gh\right)^{1/2}} \quad (1)$$

continued ↓

Castle defence continued

In eq. ①, the V_0 term is squared. So, it doesn't matter if the rock is thrown up or down, the final velocity, V_1, is the same.

To find V_2, we can use eq. ① and set V_0 to zero

$$\boxed{V_2 = (0 + 2gh)^{1/2} = (2gh)^{1/2}}$$

The problem asks for the difference in velocities.

$$V_1 - V_2 = (V_0^2 + 2gh)^{1/2} - (2gh)^{1/2}$$

$$= (10^2 + (2)(9.8)(15))^{1/2} - ((2)(9.8)(15))^{1/2}$$

$$\boxed{V_1 - V_2 = 1.7 \text{ m/s}}$$

Much less than 10 m/s faster...
not worth the effort.