Name_____

Feb. 3, 2010

Quiz #1 – Spring 2010

Phys 2110 – Sec 3

1. A certain density is given as 845 $\frac{\text{kg}}{\text{m}^3}$. Express this value in units of $\frac{\text{g}}{\text{cm}^3}$.

$$845\ \tfrac{\text{kg}}{\text{m}^3} = (845\ \tfrac{\text{kg}}{\text{m}^3})\left(\frac{10^3\ \text{g}}{1\ \text{kg}}\right)\left(\frac{1\ \text{m}}{100\ \text{cm}}\right)^3 = 0.845\ \tfrac{\text{g}}{\text{m}^3}$$

2. A particle travels in one dimension, with its location given by

$$x = (2.0\tfrac{\text{m}}{\text{s}})t - (4.5\ \tfrac{\text{m}}{\text{s}^3})t^3$$

a) Find its velocity at $t = 2.0$ s

Differentiate to get v:

$$v = (2.0\tfrac{\text{m}}{\text{s}}) - 3(4.5\ \tfrac{\text{m}}{\text{s}^3})t^2 = (2.0\tfrac{\text{m}}{\text{s}}) - (13.5\ \tfrac{\text{m}}{\text{s}^3})t^2$$

Evaluated at $t = 2.0$ s, this gives

$$v = -52\tfrac{\text{m}}{\text{s}}$$

b) Find its acceleration at $t = 2.0$ s.

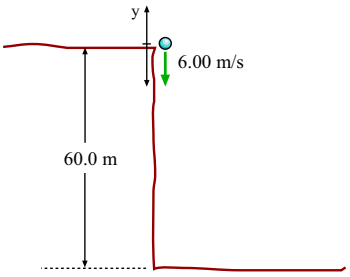
Differentiate again to get a:

$$a = -2(13.5\ \tfrac{\text{m}}{\text{s}^3})t = -(27\ \tfrac{\text{m}}{\text{s}^3})t$$

Evaluated at $t = 2.0$ s, this gives

$$a = -54\tfrac{\text{m}}{\text{s}^2}$$

3. A rock is thrown downwards with a speed of $6.0\frac{\text{m}}{\text{s}}$ from a height of 60 m.



a) Find the time it takes to hit the ground below.

With the origin at the point where the rock is thrown, we have $y_0 = 0$ and $v_0 = -6.0\frac{\text{m}}{\text{s}}$ and we can solve for t where $y = -60.0$ m:

$$-60 = -6.0t - \tfrac{1}{2}(9.8)t^2 \qquad \Longrightarrow \qquad 4.9t^2 + 6.0t - 60 = 0$$

Solve the quadratic equation and get

$$t = \frac{-6.0 \pm \sqrt{(6.0)^2 + 4(4.9)(60)}}{2(4.9)} = -4.16 \text{ s} \quad \text{or} \quad 2.94 \text{ s} \qquad \Longrightarrow \qquad t = 2.94 \text{ s}$$

b) Find the speed with which it hits the ground.

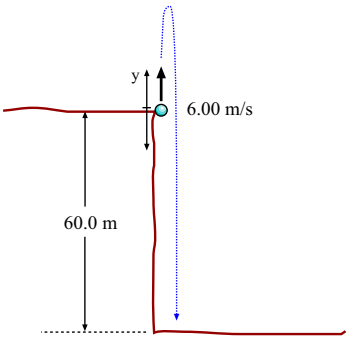
We can use

$$v_y^2 = v_{0y}^2 + 2a_y(y - y_0) = (-6.0\tfrac{\text{m}}{\text{s}})^2 + 2(-9.8\tfrac{\text{m}}{\text{s}^2})(-60.0 \text{ m}) = 1212 \ \tfrac{\text{m}^2}{\text{s}^2}$$

This gives (choosing the negative answer for v_y)

$$v_y = -34.8\tfrac{\text{m}}{\text{s}} \qquad \Longrightarrow \qquad s = 34.8\tfrac{\text{m}}{\text{s}}$$

c) If instead the rock had been thrown *upwards* with a speed of $6.0\frac{\text{m}}{\text{s}}$, with what speed would it hit the lower level?



We have the initial and final y coordinates and a_y so we can get v_y from the equation

$$v_y^2 = v_{0y}^2 + 2a_y(y - y_0)$$

but we see that since the initial velocity is *squared* we get the same result for v_y if v_{0y} is of the opposite sign. So the answer must be the same as in (b), namely $s = 34.8\frac{\text{m}}{\text{s}}$.

You must show all your work and include the right units with your answers!

$v = v_0 + at$ $\quad x = x_0 + v_0 t + \frac{1}{2}at^2$ $\quad v^2 = v_0^2 + 2a(x - x_0)$ $\quad x - x_0 = \frac{1}{2}(v_0 + v)t$

$g = 9.80\frac{\text{m}}{\text{s}^2}$ $\quad 1 \text{ kg} = 10^3 \text{ g}$ $\quad$ Neglect air resistance!