Calc AB

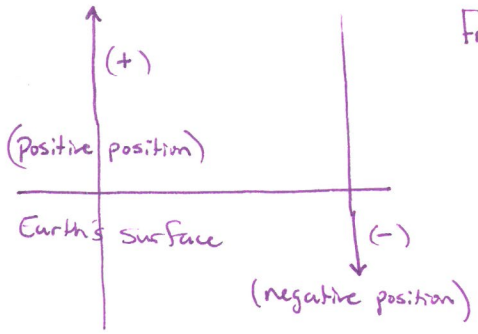
Lesson 65

11/10/15

Agenda: 11/10/15

Lesson 65

Falling - Body Problems



Free - falling bodies

P V Q

¬ Q

∴ P

Acceleration Due to Gravity $\approx -9.8\ m/s^2$

(Downwards hence negative)

$$h(t) = h_0 + \underset{\text{initial velocity}}{V_0}\,t - \tfrac{1}{2}(9.8)\,t^2 \quad [\text{Position}]$$

(h_0: Initial position)

$$h'(t) = v(t) = V_0 - 9.8t \quad [\text{velocity}]$$

$$h''(t) = v'(t) = a(t) = -9.8 \quad [\text{acceleration}]$$

Ex 65.3

A boy stood on top of a 40m building and threw a stone upwards with an initial velocity of 20 m/s. Begin with the acceleration function and develop the velocity and acceleration function for the stone. ① How high will the stone go? ② How long after the stone is thrown will it hit the ground.

$$a(t) = -9.8 \qquad v(t) = 20 - 9.8t \qquad h(t) = 40 + 20t - 4.9t^2$$

① $0 = v(t) = 20 - 9.8t \Rightarrow t = \frac{20}{9.8}$ seconds $\approx$ 2.0408 seconds

$$h\left(\tfrac{20}{9.8}\right) = 40 + \frac{20^2}{9.8} - \frac{1}{2}\cdot 9.8\left(\frac{20}{9.8}\right)^2 \approx 60.4082 \text{ meters}$$

② $0 = h(t) = 40 + 20t - 4.9t^2$

$$t = \frac{-20 \pm \sqrt{400 + 160(4.9)}}{2(-4.9)} \approx 5.5520 \text{ or } -1.4703$$

$$t = \frac{20 + \sqrt{400 + 160(4.9)}}{9.8} \text{ seconds}$$