Math 130, Day 41. Hand In at Lab. Answers

1. (WeBWorK #3) A stone was dropped off a cliff and hit the ground with speed 120 ft/s. What was the height of the cliff?

Solution. The acceleration is constant due to gravity: $a = -32$ ft/s^2. The initial velocity is $v_0 = 0$ ft/s because the stone is dropped. We are trying to find the initial position, s_0. We know that the velocity is -120 ft/s when it hits the ground. We also know that

$$v(t) = -at + v_0 = -32t.$$

The time it hits the ground is t^* where

$$v(t^*) = -32t = -120, \text{ so } t^* = \frac{120}{32} = \frac{15}{4} \text{ s.}$$

The general position function is

$$s(t) = \frac{at^2}{2} - v_0 t + s_0 = -16t^2 + s_0.$$

We know the position at time t^* is $s(t^*) = 0$ (hits the ground). So

$$s(t^*) = s(\tfrac{15}{4}) = -16(\tfrac{15}{4})^2 + s_0 = 0, \text{ so } s_0 = 16(\tfrac{15}{4})^2 = 225\,\text{ft}.$$

2. (WeBWorK #2) Acceleration due to gravity is approximately -1.6 m/sec^2 on the moon (roughly) one-sixth of what it is on earth. Assume Neil Armstrong (do you know who he was?) threw a ball upward from the moon's surface at a velocity of 24 m/sec.

a) Find the position as a function of time.

Solution. Use constant acceleration, with $a = -1.6$ m/s^2, $v_0 = 0$ m/s, and $s_0 = 0$ m.

$$s(t) = \frac{at^2}{2} - v_0 t + s_0 = -0.8t^2 + 24t.$$

b) When did the ball hit the ground?

Solution. The ball hits the ground when $s(t) = 0$ m.

$$s(t) = -0.8t^2 + 24t = -t(0.8t - 24) = 0, \text{ so } t = 24/0.8 = 30\,\text{s (not 0)}.$$

c) What was the maximum height of the ball? First find the time of the maximum, then the height.

Solution. The maximum height occurs when the velocity is 0. But

$$v(t) = at + v_0 = -1.6t + 24 = 0, \text{ so } t = 24/1.6 = 15\,\text{s}.$$

Then

$$s(15) = -0.8(15)^2 + 24(15) = 180\,\text{m}.$$