Name: KEY Recitation Part 1 APC

1. The acceleration of a rocket sled is given as $a(t) = 6t + 3$

a) How fast will the rocket sled be moving at t = 2s assuming it started from rest?

b) How far will the rocket sled have traveled between the 1s and the 3s time interval assuming it started from rest?

a) 18 m/s

$V_0 = \emptyset$

$\int a\,dt = V$

$\int a\,dt = \int (6t+3)\,dt$

$V_{(t)} = 3t^2 + 3t + \emptyset$

$V_{(2)} = 3(2)^2 + 3(2) = \boxed{18\text{ m/s}}$

b) 39m

$\int v\,dt = X$

$\Delta X_{(1-3)} = \int_{1s}^{3s} 3t^2 + 3t$

$\Delta X = t^3 + \frac{3}{2}t^2 \Big|_1^3$

$\Delta X = \left[(3)^3 + \frac{3}{2}(3)^2\right] - \left[(1)^3 + \frac{3}{2}(1)^2\right]$

$\Delta X = 40.5 - 2.5 = \boxed{38\text{m}}$

2. A stone is throw upward from the edge of a clift 20 meters high. It just misses the cliff on the way down and hits the ground with a speed of 35.0 m/s.

a) What was the initial velocity? Show work

b) What was the maximum distance from the ground during its flight? Show work

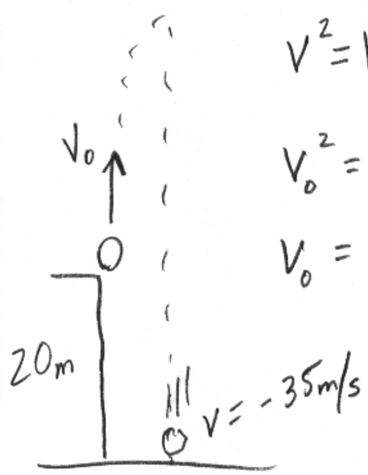
* c) Draw a displacement v. time graph for this problem

* d) Draw a velocity v. time graph for this problem

e) Draw an acceleration v. time graph for this problem

} on BACK

a) 28.7 m/s



$V^2 = V_0^2 - 2g\Delta y$

$V_0^2 = V^2 + 2g\Delta y$

$V_0 = \sqrt{(-35)^2 + 2g(-20)}$

$V_0 = 28.7\text{ m/s}$

b) 61.2 m

$V = \emptyset$

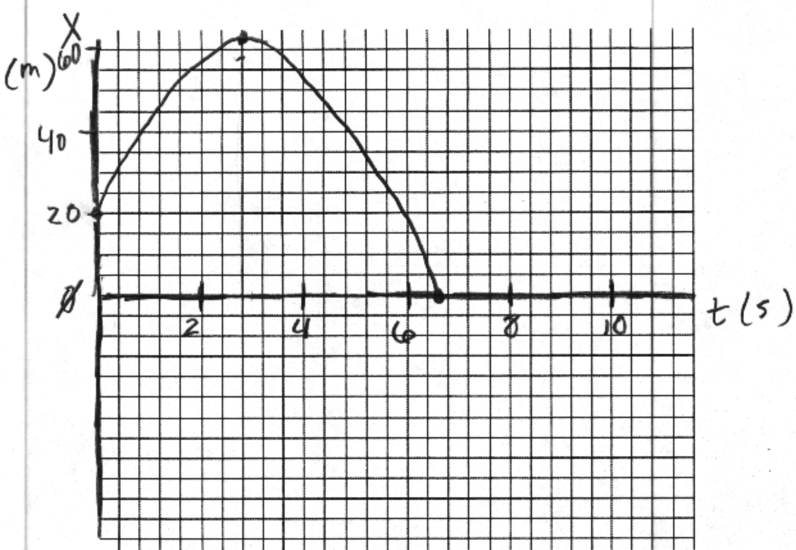
$V_0 = 28.7\text{ m/s}$

$V^2 = V_0^2 - 2g\Delta y$

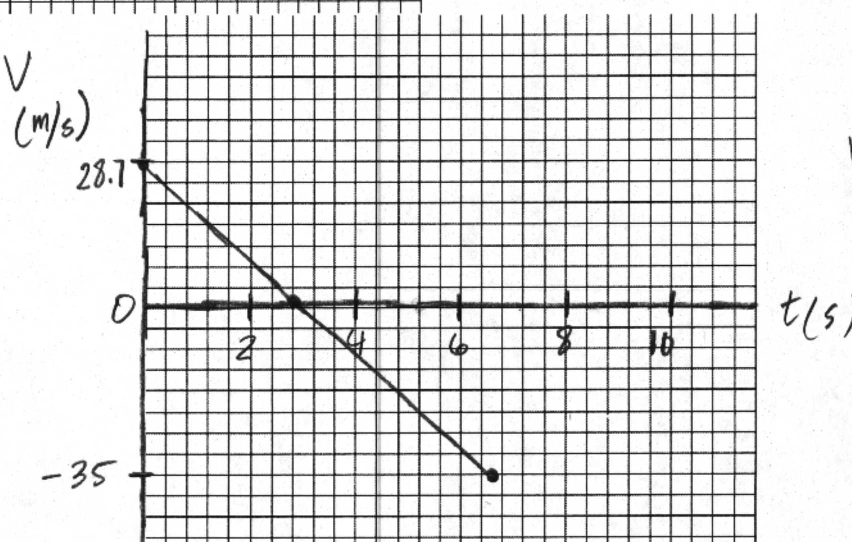
$y - y_0 = \frac{\cancel{V^2} - V_0^2}{-2g} = \frac{-(28.7)^2}{-2(10)}$

$y = 41.18 + y_0 = \boxed{61.2\text{m}}$

* These graphs should each contain 3 obvious points that I will be looking for on your graph. The shape of these graphs is important.

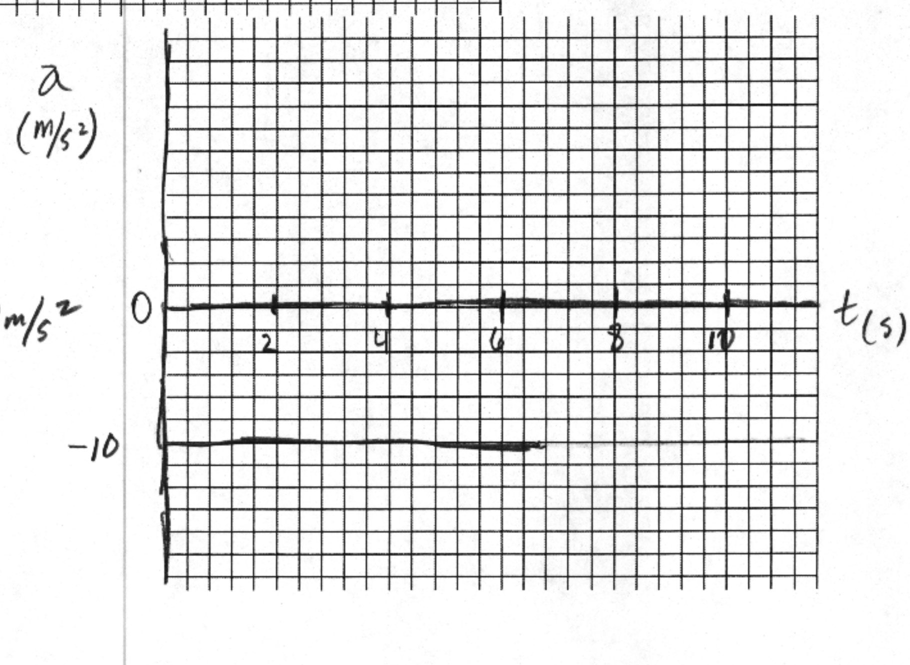


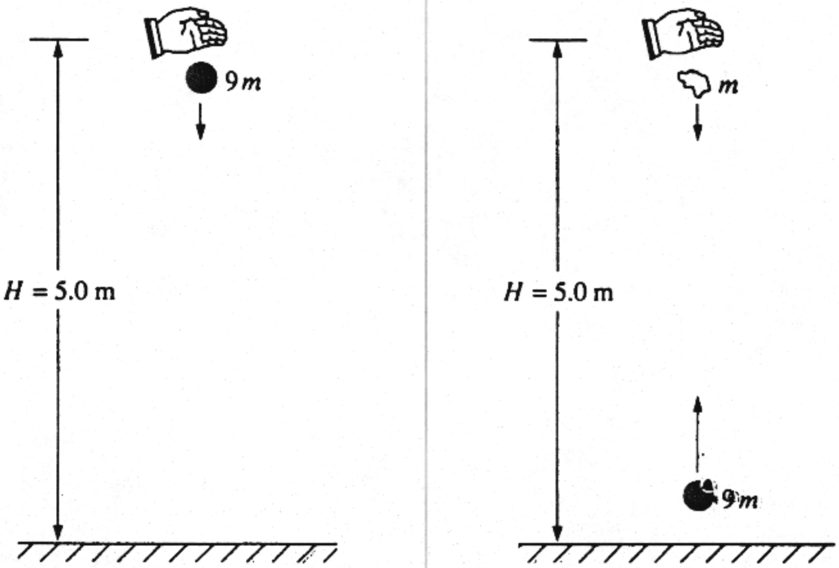
$$X_{(t)} = 20 + 28.7t - \frac{1}{2}10t^2$$



$$V_{(t)} = 28.7 - 10t$$

$$a_{(t)} = -10 \, m/s^2$$





3. A ball is dropped from rest from a height H = 5.0 meters above the ground, as shown above on the left. It undergoes a perfectly elastic collision with the ground and rebounds. At the instant that the ball rebounds, a small blob of clay is released from rest from the original height H, directly above the ball, as shown above on the right. The clay blob, which is descending, eventually collides with the ball, which is ascending. Assume that g = 10 m/s^2, that air resistance is negligible, and that the collision process takes negligible time.

a. Determine the speed of the ball immediately before it hits the ground.

$$\Delta y = v_0 t - \frac{1}{2} g t^2$$
$$-H = -\frac{1}{2} g t^2$$
$$t = \sqrt{\frac{2H}{g}}$$
$$v = v_0 - g t$$
$$v = -g\sqrt{\frac{2H}{g}} = g\sqrt{\frac{2H}{g}}$$
$$\boxed{v = \sqrt{2gH}}$$
$$\boxed{v = 10\ m/s}$$

b. Determine the time after the release of the clay blob at which the collision takes place.

Clay

$$y = y_0 + v_0 t - \frac{1}{2} g t^2$$
$$y = H - \frac{1}{2} g t^2$$

rubber

$$y = y_0 + v_0 t - \frac{1}{2} g t^2$$
$$y = \sqrt{2gH}\, t - \frac{1}{2} g t^2$$

$$H - \cancel{\frac{1}{2} g t^2} = \sqrt{2gH}\, t - \cancel{\frac{1}{2} g t^2}$$
$$\boxed{t = \frac{H}{\sqrt{2gH}}} = 0.5\ s$$

c. Determine the height above the ground at which the collision takes place.

rubber

$$y = y_0 + v_0 t - \frac{1}{2} g t^2$$
$$y = \sqrt{2gH}\left(\frac{H}{\sqrt{2gH}}\right) - \frac{1}{2} g \left(\frac{H}{\sqrt{2gH}}\right)^2$$

d. Determine the speeds of the ball and the clay blob immediately before the collision.

C. cont.

$$y = H - \frac{1}{2} g \frac{H^2}{2gH}$$
$$y = H - \frac{H}{4} = \boxed{\frac{3}{4} H} = \boxed{3.75\ m}$$

d.) Ball

$$v = v_0 - g t$$
$$v = \sqrt{2gH} - g\frac{H}{\sqrt{2gH}} = \boxed{5\ m/s}$$

Both

NAME: Period:

[redacted]

$-2.5\,m$ / $12\,m$

1. Suppose the velocity function of a particle moving along the x-axis is $v(t) = 6t^2 - \cancel{3}23t + 17$ and that the particle at $t = 0s$ is 0 m. How far does the particle move between the 2^{nd} and the 3^{rd} second? What is the particle's position at $t = 4s$? $X_0 = \emptyset$

$x = \int v\,dt$

$\Delta X_{2-3} = \int_2^3 (6t^2 - 23t + 17)\,dt$

$\Delta X = \left[2(3)^3 - \frac{23}{2}(3)^2 + 17(3)\right] - \left[2(2)^3 - \frac{23}{2}(2)^2 + 17(2)\right]$

$\Delta X = (54 - 103.5 + 51) - (16 - 46 + 34) = (1.5) - (-64)$

2. Suppose that the acceleration for a particle moving along the x-axis is $a(t) = \cancel{3}4t - 30$. Assume that at time $t = 0s$ that $x_o = -5$ m and $v_o = 3$ m/s.

$v(t) =$

(a) What is the velocity function with respect to time for this particle?

$v = \int a\,dt$

$\boxed{V_{(t)} = \frac{3}{2}t^2 - 30t + 3}$

$x(t) =$

(b) What is the position function with respect to time for this particle?

$x = \int v\,dt$

$\boxed{X_{(t)} = \frac{1}{2}t^3 - 15t^2 + 3t - 5}$

$-73.5\,m/s$ (c) What would the velocity of the particle be at $t = 3$ s

$V_{(t)} = \frac{3}{2}(3)^2 - 30(3) + 3$

$V_{(3)} = -73.5\,m/s$

$-185\,m$ (d) What is the displacement of the particle between the 3^{rd} and 5^{th} second?

$\Delta X_{3-5} = \left(\frac{1}{2}(5)^3 - 15(5)^2 + 3(5) - 5\right) - \left(\frac{1}{2}(3)^3 - 15(3)^2 + 3(3) - 5\right)$

$(62.5 - 375 + 15 - 5) - (13.5 - 135 + 9 - 5)$

$-302.5 - (-117.5) = -185\,m.$

$-36\,m/s$ (e) What is the change in velocity between the 3^{rd} and the 5^{th} second?

$\Delta V_{3-5} = \left(\frac{3}{2}(5)^2 - 30(5) + 3\right) - \left(\frac{3}{2}(3)^2 - 30(3) + 3\right)$

$37.5 - 150 + 3 \quad - \quad 13.5 - 90 + 3$

$-109.5 - -73.5$

$\sqrt{3}\,V_0$ 3. A baseball is thrown straight up with an initial velocity of V_0 and reaches a maximum height of h. How much faster (in terms of V_0) must the baseball be thrown to reach a maximum height of 3h?

$\cancel{V^2} = V_0^2 - 2gh$ $\quad V_0^2 \propto h$ $\quad \boxed{\sqrt{3}\,V_0}$ $\quad (\sqrt{3}\,V_0)^2 \propto h(\times 3)$

$\frac{V_0^2}{2g} = h$

$\sqrt{3}\,t$ 4. If the baseball w/ an initial velocity of V_0 ~~stays~~ reaches max h in time t, how much time (in terms of t) will it take to reach a max height of 3h?

time up = time down $\quad t \propto \sqrt{h}$

$t = \sqrt{\frac{2h}{g}}$