key Level I Physics Pd 3

KINEMATICS TEST

AT KINEMATICS (14)

Directions: Solve the following problems. Write all work. Be sure to include units with all values (even within the problem!!!). Circle your answer. Each problem is worth 5 points.

1) According to Google Maps, driving from MASH to Virginia Beach will take 4 hours and 49 minutes without traffic. The distance is 312 miles. At the time I checked the information, with traffic (There was a traffic incident on I-95 south around Washington), the drive should take 5 hours and 5 minutes. Determine the difference in the average speed with and without traffic. Determine your values in miles/hour.

4hrs + 49min = 4.817hrs

5hrs + 5min = 5.0833hrs

$\frac{312mi}{4.817hr} = 64.8 mi/hr$

$\frac{312mi}{5.0833hr} = 61.38 mi/hr$

Diff = 3.4 mi/hr

2) A 2015 Corvette Z06 (This is the fastest of the factory produced Vettes) has a 0-60 mi/hr time of 3.4 seconds. A 2000 Suzuki 1300R Hayabusa (This is a motorcycle…a VERY fast motorcycle) has a 0-60 mi/hr 2.6 seconds. 60mi/hr converts to 26.8 m/s. The two vehicles start at rest 400 m apart and accelerate toward each other (They pass each other…This isn't "Chicken"). Determine how fast the Hayabusa is going when the two vehicles pass each other. Work in m/s.

Vette

$v_0 = 0$

$v = 26.8\ m/s$

$a = ?$

$t = 3.4s$

$v = v_0 + at$

$v = at$

$\frac{v}{t} = a$

$\frac{26.8\ m/s}{3.4s} = a = 7.88\ m/s^2$

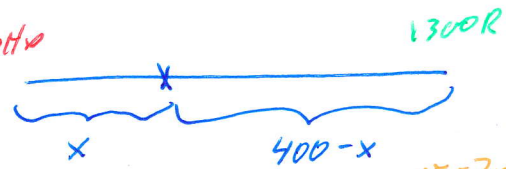
1300R

$v_0 = 0$

$\downarrow$

$\frac{v}{t} = a$

$\frac{26.8\ m/s}{2.6s} = 10.3\ m/s^2$



Vette: $v_0 = \text{zero}$, $a = 7.66\ m/s^2$, $x = x$, $t = t$

1300R: $v_0 = \text{zero}$, $a = 10.3\ m/s^2$, $x = 400 - x$, $t = t$

$x = \frac{1}{2}at^2$

$(400 - x) = \frac{1}{2}at^2$

$\frac{2(400-x)}{a} = t^2$

$x = \frac{1}{2}a\frac{(2)(400-x)}{a}$

Duh… Failed To Distribute a!

$x = \frac{a_{vette}(400 - x)}{a_{1300}}$

$x\left(1 + \frac{a_{vette}}{a_{1300}}\right) = \frac{a_{vette}\ 400m}{a_{1300R}}$

$x = \frac{a_{vette}(400m) - a_{vette}(x)}{a_{1300R}}$

$x = \frac{(a_{vette})(400m)}{a_{1300}\left(1 + \frac{a_{vette}}{a_{1300}}\right)} = \frac{(7.88\ m/s^2)(400m)}{(10.3\ m/s^2)\left(1 + \frac{7.66\ m/s^2}{10.3\ m/s^2}\right)}$

$x = \frac{(a_{vette})(400m)}{a_{1300R}} - \frac{(a_{vette})(x)}{a_{1300R}}$

$x = 173.4m$ (Vette)

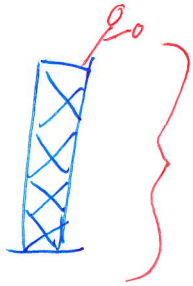
$x + \frac{(a_{vette})x}{a_{1300}} = \frac{(a_{vette})400m}{a_{1300R}}$

$x_{1300R} = 400m - 173.4m = 226.6m$

$v^2 = 2ax \Rightarrow \sqrt{(2)(10.3\ m/s^2)(226.6m)} = 68\ m/s$

$146\ mi/hr$

3) A bridge crosses over a fast moving river. The distance from the bridge to the water is 12 m. The water is flowing at a rate of 4 m/s. A tennis ball is thrown downward at a rate of 10 m/s. Determine how far downstream the ball is from "under the bridge" 35 seconds after it is thrown. Assume the ball floats on the water and moves with the water when it floats.



Time To Fall

$y = -12m$

$t = ?$

$v_0 = -10 m/s$

$a = -9.8 m/s^2$

$y = v_0 t + \frac{1}{2} a t^2$

$-12m = -10 m/s\, t + \left(\frac{1}{2}\right)\left(-9.8 m/s^2\right) t^2$

$0 = \underset{A}{\left(-4.9 m/s^2\right) t^2} \underset{B}{\left(-10 m/s\right) t} \underset{C}{+12m}$

$t = .85s$

$35s - .85s =$ Time To Go Down Stream

$34.15s \; @ \; 4 \frac{m}{s} =$ 136.6m Downstream

4) A ball is thrown upward at 20 m/s. Determine how long the ball will be in the air if it is caught at the same place/height that it was thrown.

$v_0 = 20\ m/s$

$v = -20\ m/s$

$a = -9.8\ m/s^2$

$t = ?$

$v = v_0 + at$

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

$\frac{-20\ m/s - 20\ m/s}{-9.8\ m/s^2} = t$

$4.1\ s = t$

5)Storm Runner at Hershey Park accelerates from 0 to 72mi/hr (32.2 m/s) in 2 seconds. Determine the acceleration in m/s^2.

$v = v_0 + at$

$v = at$

$\frac{v}{t} = a$

$\frac{32.2\ m/s}{2} = 16.1\ m/s^2$

6) If the brakes on a car result in an acceleration of 5.2 m/s^2, determine the stopping distance of the car if it is traveling at 60 mi/hr. Solve in meters.

$$v^2 = v_0^2 + 2ax$$

$$\frac{-v_0^2}{2a} = \frac{-(26.8\ m/s)^2}{(2)(5.2\ m/s^2)} = x = 69m$$