Answers Key....

Kinematics

AT kinematics (17)

Directions: Solve the following problems (5 points each). Show all work. Be neat. Your solution should mathematically read like an essay.

1) While on a long road trip in a car, you notice your favorite nationally franchised restaurant is 28 miles ahead. How long will it take you to get there considering your cruise control is set to 73 mi/hr? (Assume that traffic with not affect your speed)

Factor Label...

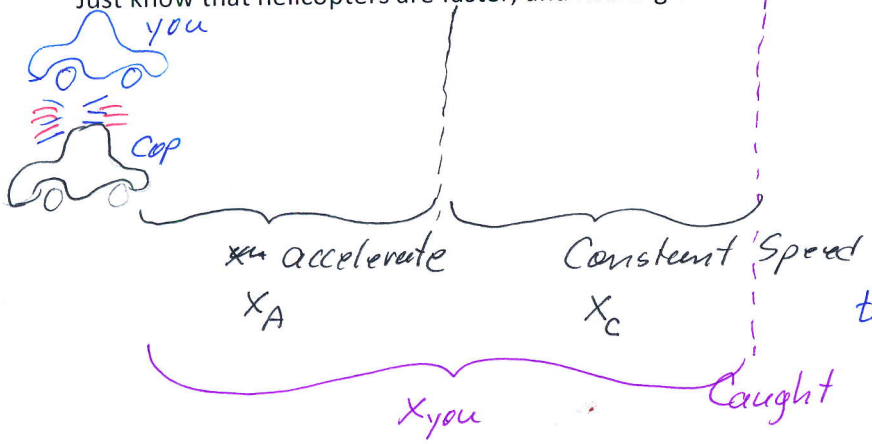
$$\left(\frac{28\,mi}{73\,mi/hr}\right)\left(\frac{60\,min}{1\,hr}\right) = 23\,min = .38\,hr$$

Same As...

$$\left(\frac{28\,mi\,hr}{73\,m}\right)\left(\frac{60\,min}{1\,hr}\right) = \ldots$$

Answers Key....

2) While driving along on the PA turnpike (I-76) with the cruise set to 83mi/hr (37.1m/s), a police officer "appears" in your review mirror, essentially on your rear bumper, with lights flashing. Yep, you are being pulled over for speeding. The first question you ask yourself is, "Where was this officer sitting?" Assuming the trooper was sitting stationary along the road, how far back was the trooper positioned when you went speeding by? According to www.Autoblog.com, the Ford 3.5L V6 EcoBoost will accelerate 0-60mph in 5.8 seconds (60mph=26.8m/s). The officer will limit speed to 100 mph (100mph=44.7m/s), and we will assume the acceleration is constant from 0-100mph (which just isn't true). According to www.autoblog.com, the fastest production police cruiser tops out at 155mph, FYI. Just know that helicopters are faster, and nothing outruns the radio.



you

x_{you}

$v = 37.1\ m/s$

$a = \text{zero}$

$t = t_{you} = t_{cop} = t_{Total}$

$t_{Total} = t_a + t_c$

Cop

$x_{cop} = x_A + x_c = x_{you}$

accelerant

$v_0 = \text{zero}$

$v = 44.7\ m/s$

$a = ?\ 4.6\ m/s^2$

$x_A = ?\ 216m$

$t_A = ? = 9.7s$

Const.

$v = 44.7\ m/s$

$a = \text{zero}$

$x_c = ?$

$v = v_0 + at$

$v = at$

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

$\frac{26.8\ m/s}{5.8s} = 4.6\ m/s^2$

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

$v^2 = 2ax$

$\frac{v^2}{2a} = x$

$\frac{(44.7\ m/s)^2}{(2)(4.6\ m/s^2)} = 216m$

Time For Cop To Accel

$\frac{v}{a} = t = \frac{44.7\ m/s}{4.6\ m/s^2} = 9.7s$

$x_{cop} = x_A + x_c = x_{you}$

$216m + x_c = v_{you} t$

$216m + v_c t_c = v_{you} t$

$216m + v_c t_c = v_{you}(t_c + t_a)$

$216m + v_c t_c = v_{you} t_c + v_{you} t_a$

$216m + v_c t_c - v_{you} t_c = v_{you} t_a$

$v_c t_c - v_y t_c = v_{you} t_a - 216m$

$t_c = \frac{v_{you} t_a - 216m}{(v_c - v_y)}$

$t_c = \frac{(37.1\ m/s)(9.7s) - (216m)}{(44.7\ m/s - 37.1\ m/s)} = 18.9s$ Time police Travel @ Const. Speed

Const. accel Total

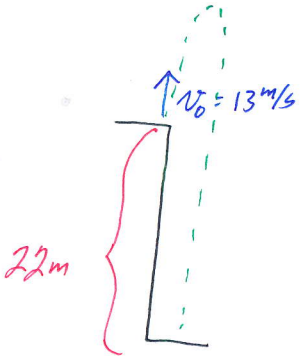
$18.9s + 9.7s = 28.6s$

Time You Travel @ Const. Speed

$(37.1\ m/s)(28.6s) = 1062m$

Answers Key….

3) While standing atop a 22m tall cliff, you throw a ball up into the air with an initial speed of 13 m/s. The ball goes up, and down, landing at the bottom of the cliff. How fast was the ball moving just before it hit the ground?



$v_0 = 13\ m/s$

$x = -22m$

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

$v = ?$

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

$v = \sqrt{(13\ m/s)^2 + (2)(-9.8\ m/s^2)(-22m)}$

$v = -24.5\ m/s$

Answers Key….

4) The best a car can do in braking is about 6m/s2. Determine the shortest possible stopping distance when traveling at 30 mph & 60 mph. What is the relationship between speed and stopping distance? **This question does have 3 responses!**

$30 \frac{mi}{hr} = 13.4 m/s$ $60 mi/hr = 26.8 m/s$

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

$\frac{v^2}{2a} = x = \frac{(13.4 m/s)^2}{(2)(6 m/s^2)} = 14.9 m$

15m ~ 60m

Squared

Answers Key….

5) Using the information from #3, how long did it take for the ball to hit the ground?

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

$$-22\,m = (13\,m/s)t + (4.9\,m/s^2)t^2$$

$$0 = (-4.9\,m/s^2)t^2 + (13\,m/s)t + 22\,m$$ Quadratic…

3.8s

Answers Key….

6) A car accelerates at 4 mi/hr/s. Determine how fast (in mph) the car would be going if it was initially at rest and it accelerated for 6 seconds.

$$\left[\frac{4\,mi}{hr/s}\right](6s) = 24\,mi/hr$$