PHYS 201 Kinematic Equations Name: KEY Due 8/30

Equations of Kinematics for constant acceleration are given below:

1.	2.	3.	4.	5.
$x = \bar{v}\,t$	$x = \frac{1}{2}(v_0 + v)t$	$v = v_0 + at$	$x = v_0 t + \frac{1}{2}at^2$	$v^2 = v_0^2 + 2ax$

1. Describe each of the terms in the above equations. (First one is done for you)

a = average acceleration x = displacement t = time interval

v = final velocity v_0 = initial velocity $\bar{v}$ = average velocity

2. Derive the fifth equation using 3 & 2.

Need to eliminate "t" between 2. & 3.

$x = \frac{1}{2}(v_0+v)t$

$v = v_0 + at \rightarrow t = \frac{v-v_0}{a}$

$x = \frac{1}{2}(v_0+v)\left(\frac{v-v_0}{a}\right)$

$x = \frac{1}{2}\frac{(v+v_0)(v-v_0)}{a} \rightarrow 2ax = (v+v_0)(v-v_0)$

$2ax = v^2 - v_0^2$

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

3. Suppose a car merges into freeway traffic on a 205-m-long ramp. If its initial velocity is 10.0 m/s and it accelerates at 2.00 m/s^2, how long does it take to travel the 205 m up the ramp? (Such information might be useful to a traffic engineer.)

$x = 205\text{m}$

$v_0 = 10\text{ m/s}$

$a = 2\text{ m/s}^2$

$t = ?$

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

$205 = 10t + \frac{1}{2}\times 2t^2$

$205 = 10t + t^2$

$t^2 + 10t - 205 = 0$

$a = 1$, $b = 10$, $c = -205$

Quadratic equation: $ax^2 + bx + c = 0$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-10 \pm \sqrt{100 + 4\times 1\times 205}}{2}$

$x = \frac{-10 \pm 30.3}{2} = 10.16$

$t = 10.2\text{ sec}$

4. A plane is landing with a speed of 69 m/s. Once the jet touches down, it can decelerate at 3.2 m/s^2. What length of runway is needed to reduce its speed to 5.0 m/s?

$v_0 = 69\text{ m/s}$ $a = -3.2\text{ m/s}^2$

$v = 50\text{ m/s}$ $x = ?$

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

$5^2 = 69^2 - 2\times 3.2\times x$

$25 = 4761 - 6.4x$

$6.4x = 4736$

$x = 740\text{ m}$