

PRINT Your Name: \_\_\_\_\_

**Quiz for January 21, 2010**

The quiz is worth 5 points. **Remove EVERYTHING from your desk except this quiz and a pen or pencil.** SHOW your work. Express your work in a neat and coherent manner. BOX your answer.

Suppose that a car skids 15 meters if it is moving at 50 km/hr when the brakes are applied. Assuming that the car has the same constant deceleration, how far will it skid if it is moving at 100 km/hr when the brakes are applied?

**ANSWER:** Let  $x(t)$  be the position of the car at time  $t$ . Measure  $t$  in hours and  $x$  in km. We take  $x(0) = 0$ . We are told that  $x''(t) = -k$  for some positive constant  $k$ . For the first car, we have  $x'(0) = 50$  and  $x(\text{when the car stops}) = .015$ . For the second car, we have  $x'(0) = 100$  and we are supposed to find  $x(\text{when the car stops})$ .

For the first car:  $x' = -kt + 50$  and  $x = -kt^2/2 + 50t$ . The car stops when  $x'(t) = 0$ ; so,  $t = 50/k$  and

$$\begin{aligned} .015 &= x(\text{when the car stops}) = x(50/k) = -k(50/k)^2/2 + 50(50/k) \\ &= \frac{-(50)^2/2 + (50)^2}{k} = \frac{50^2}{2k}. \end{aligned}$$

We have learned that  $k = (50)^2/2(.015)$ .

Now we consider car 2. We have  $x' = -kt + 100$  and  $x = -kt^2/2 + 100t$ . The car stops when  $x'(t) = 0$ ; so,  $t = 100/k$  and

$$\begin{aligned} x(\text{when the car stops}) &= x(100/k) = -k(100/k)^2/2 + 100(100/k) = \frac{100^2}{2k} \\ &= \frac{100^2}{2} \frac{2(.015)}{(50)^2} = 4(.015) = .06 \text{ km} = \boxed{60 \text{ meters.}} \end{aligned}$$