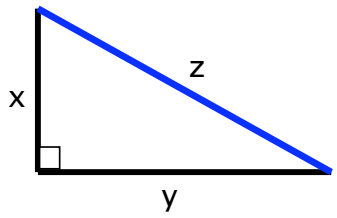
Math 151 Quiz #8 Answers

1. We have the following figure.



Let x = the distance between the northbound car and the intersection.
Let y = the distance between the eastbound car and the intersection.
Let x = the distance between the cars.

$\Rightarrow \quad \frac{dx}{dt} = 40$ mph, $\quad \frac{dy}{dt} = 60$ mph, $\quad$ and $\quad \frac{dz}{dt} = ?$ when $x = 3$ and $y = 4$

Equation: $x^2 + y^2 = z^2 \qquad \Rightarrow \qquad 2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 2z\frac{dz}{dt} \quad$ or $\quad x\frac{dx}{dt} + y\frac{dy}{dt} = z\frac{dz}{dt}$

Plugging in known values to solve for $\frac{dz}{dt}$:
Note: When $x = 3$ and $y = 4$, we have that $z = 5$. (Using original equation.)

$$3(40) + 4(60) = 5\frac{dz}{dt} \qquad \Rightarrow \qquad \frac{dz}{dt} = 72 \text{ mph}$$

The distance between the cars is increasing by 72 mph when $x = 3$ and $y = 4$.

2. (a) Note that $f(0) = 1 - 3\sin 0 + 5(0)e^0 = 1$.

Also, note that $\quad f'(x) = 0 - 3\cos x + 5 \cdot e^x + 5x \cdot e^x \quad$ (Using the product rule)
$= -3\cos x + 5e^x + 5xe^x$.

$$\Rightarrow \quad f'(0) = -3\cos 0 + 5e^0 + 5(0)e^0 = -3 + 5 = 2.$$

So, $\boxed{L(x) = 2(x - 0) + 1 = 2x + 1.}$

(b) $f(-0.1) \approx L(-0.1) = 2(-0.1) + 1 = \boxed{0.8}$