1. (a) \( \lim_{x \to 0} \frac{1 - \cos x}{x} \) yields the indeterminate form 0/0. So we apply l'Hopital's rule.

\[
\lim_{x \to 0} \frac{1 - \cos x}{x} = \lim_{x \to 0} \frac{\sin x}{1} = 0 = 0
\]

(b) \( \lim_{x \to \infty} \frac{e^x}{x^2} \) yields the indeterminate form \( \infty / \infty \).

\[
\lim_{x \to \infty} \frac{e^x}{x^2} = \lim_{x \to \infty} \frac{e^x}{2x} \quad \text{l'Hopital's rule}
\]
\[
= \lim_{x \to \infty} \frac{e^x}{2} \quad \text{apply l'Hopital's rule again}
\]
\[
= \infty
\]

2. Maple and Main Streets are straight and perpendicular to each other. A stationary police car is located on Main Street 0.25 miles from the intersection of the two streets. A sports car on Maple Street approaches the intersection at 40 miles per hour. At what rate is the distance between the two cars changing when the sports car is 0.125 miles from the intersection?

![Diagram of right triangle with police car and sports car approaching intersection.

We are given \( \frac{dy}{dt} = -40 \text{ mph} \), but need to find \( \frac{dz}{dt} \).

Using the Pythagorean Theorem we can establish a relationship between the sides of the right triangle:

\[
(0.25)^2 + y^2 = z^2
\]

Differentiating both sides with respect to \( t \) and solving for \( \frac{dz}{dt} \) gives:

\[
2y \frac{dy}{dt} = 2z \frac{dz}{dt}
\]
\[
\frac{dz}{dt} = \frac{y}{z} \frac{dy}{dt}
\]

When \( y = 0.125 \) then \( z = \sqrt{(0.25)^2 + (0.125)^2} \approx 0.2795 \). Therefore,

\[
\frac{dz}{dt} \approx \frac{0.125}{0.2795} \cdot (-40) = -17.89 \text{ mph}.
\]

In other words, the distance between the two cars is decreasing at 17.89 miles per hour.