(1) [4 points] Determine the limit:

$$\lim_{x \to \infty} e^{-2x} \sin(x)$$

(2) [4 points] Differentiate:

$$y = \ln(e^{-x} + x^2 e^{-x})$$

(3) [7 points] Use logarithmic differentiation to determine the derivative:

$$y = (\sec x)^{\sqrt{x}}$$