(1) [4] Differentiate $y = \ln\left(xe^{-x} - e^{-x}\right)$

$$y' = \frac{1}{xe^{-x} - e^{-x}} \left[e^{-x} - xe^{-x} + e^{-x}\right]$$

$$= \frac{e^{-x}(2-x)}{e^{-x}(x-1)}$$

$$= \frac{2-x}{x-1}$$

(2) [3] Differentiate $y = \frac{e^x}{x^2}$

$$y' = \frac{x^2 e^x - e^x(2x)}{x^4}$$

$$= \frac{e^x(x^2 - 2x)}{x^4}$$

$$= \frac{e^x x(x-2)}{x^4}$$

$$= \frac{e^x(x-2)}{x^3}$$

(3) [8]   Use logarithmic differentiation (or some other method) to determine the derivative of

$$y = (\cos x)^{1/x}$$

$$\ln y = \frac{1}{x} \ln(\cos x)$$

$$\frac{1}{y} y' = \left(\frac{-1}{x^2}\right) \ln(\cos x) + \frac{1}{x} \frac{1}{\cos x} \cdot (-\sin x)$$

$$y' = (\cos x)^{\frac{1}{x}} \left[\frac{-\ln(\cos x)}{x^2} - \frac{\tan x}{x} \right]$$