Use integration by parts to evaluate each integral.

$$1. \int \frac{\ln x}{x^2} dx$$

$$2. \quad \text{(a)} \quad \int 2x \sin(3x) \, dx$$

(b) 
$$\int_0^{\pi/3} 2x \sin(3x) \, dx$$

$$3. \int y^2 \cos y \, dy$$

$$4. \int e^t \cos t \ dt$$