1. Find the following definite integrals:

   a. \( \int_{0}^{\frac{\pi}{4}} \sec^2 x \, dx \)  
   b. \( \int_{1}^{4} \left( 5r\sqrt{r} + \frac{1}{r\sqrt{r}} \right) \, dr \)  
   c. \( \int_{-2}^{0} (x + 4)^2 \, dx \)  
   d. \( \int_{0}^{2 \ln 6} e^x \, dx \)  
   e. \( \int_{-\sqrt{e}}^{-1} \frac{1}{x} \, dx \)  
   f. \( \int_{0}^{\frac{1}{2}} \left( \frac{3}{\sqrt{1-x^2}} - 2x \right) \, dx \)

2. In June 2009, the Essex County Environmental Protection Agency became concerned about the level of carbon monoxide (CO) in the air in Essex County on a typical summer day. The agency predicted that, unless more stringent measures were taken to protect the atmosphere, the CO concentration present in the air on a typical summer day would increase at a rate of \( 0.003t^2 + 0.06t + 0.1 \) ppm/year over the next \( t \) years. If no further pollution-control efforts are made, by how much will the CO concentration on a typical summer day have increased by June 2012?

   * The carbon monoxide (CO) level is measured in parts per million (ppm).

3. An object is moving back and forth along a straight line with velocity \( v(t) = t^3 - 3t^2 - 4t \) meters/second. Find the following:

   (a) The net distance traveled by the object (that is, the displacement) over the time interval \([0, 5]\) seconds.

   (b) The total distance traveled by the object over the time interval \([0, 5]\) seconds.