# Worksheet # 25: Net Change and The Substitution Method

1. A population of rabbits at time $t$ increases at a rate of $40 - 12t + 3t^2$ rabbits per year. Find the population after 8 years if there are 10 rabbits at $t = 0$.

2. Suppose the velocity of a particle traveling along the $x$-axis is given by $v(t) = 3t^2 + 8t + 15$ m/s and the particle is initially located 5 meters left of the origin. How far does the particle travel from $t = 2$ seconds to $t = 3$ seconds? After 3 seconds, where is the particle with respect to the origin?

3. Suppose an object traveling in a straight line has a velocity function given by $v(t) = t^2 - 8t + 15$ km/hr. Find the displacement and distance traveled by the object from $t = 2$ to $t = 4$ hours.

4. An oil storage tank ruptures and oil leaks from the tank at a rate of $r(t) = 100e^{-0.01t}$ liters per minute. How much oil leaks out during the first hour?

5. Evaluate the following indefinite integrals, and indicate any substitutions that you use:

   (a) $\displaystyle\int \frac{4}{(1+2x)^3}\,dx$

   (b) $\displaystyle\int x^2\sqrt{x^3+1}\,dx$

   (c) $\displaystyle\int \cos^4(\theta)\sin(\theta)\,d\theta$

   (d) $\displaystyle\int \sec^3(x)\tan(x)\,dx$

   (e) $\displaystyle\int e^x \sin\left(e^x\right)\,dx$

   (f) $\displaystyle\int \frac{2x+3}{x^2+3x}\,dx$

6. Evaluate the following definite integrals, and indicate any substitutions that you use:

   (a) $\displaystyle\int_0^7 \sqrt{4+3x}\,dx$

   (b) $\displaystyle\int_0^{\frac{\pi}{2}} \cos(x)\cos\left(\sin(x)\right)\,dx$

   (c) $\displaystyle\int_0^4 \frac{x}{\sqrt{1+2x^2}}\,dx$

   (d) $\displaystyle\int_e^{e^4} \frac{dx}{x\sqrt{\ln x}}$

   (e) $\displaystyle\int_1^2 \frac{e^{\frac{1}{x}}}{x^2}\,dx$

7. Assume $f$ is a continuous function.

   (a) If $\displaystyle\int_0^9 f(x)\,dx = 4$, find $\displaystyle\int_0^3 x\cdot f(x^2)\,dx$.

   (b) If $\displaystyle\int_0^u f(x)\,dx = 1 + e^{u^2}$ for all real numbers $u$, find $\displaystyle\int_0^2 f(2x)\,dx$.