

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

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

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

(e) $\int e^x \sin(e^x) dx$

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

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

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

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

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

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

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

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

7. Assume f is a continuous function.

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

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