1. Evaluate each of the following indefinite Integral:

     a. $\int \left(-x^2 + 3x - 1\right) dx$ **b.** $\int \left(\cos t - \sin t\right) dt$ **c.** $\int \left(2x + 1\right)^3 dx$

     d. $\int \dfrac{(x+2)(2x-1)}{x^4} dx$ **e.** $\int \left(2x - \sqrt{x}\right)^2 dx$ **f.** $\int \dfrac{\left(1 - \sqrt{x}\right)}{\sqrt{x}} dx$

     g. $\int \dfrac{2 + 3\cos^2 x}{\sin^2 x} dx$ **h.** $\int \sqrt{x}\left(\sqrt{x} + 1\right)^{100} dx$

2. Prove $\int b\, f(x)\, dx = b \int f(x)\, dx$.

3. Prove $\int \left[f(x) + g(x) \right] dx = \int f(x)\, dx + \int g(x)\, dx$.

4. Find the dimensions of the largest right circular cone that can be inscribed in a sphere with a constant radius R. (Answer: $r = \dfrac{2\sqrt{2}}{3} R$, $h = \dfrac{4}{3} R$)

5&6. Do the following problems from section 4.6 in the book: #20, 37

7. For each of the following functions, use the right-end method to find the area of enclosed region.

     a. $R_{xy} = \left\{ f(x) = 4 - x^2;\ x - axis\ ;\ x \in [-2, 2] \right\}$ **b.** $R_{ty} = \left\{ f(t) = t^3 + 2t;\ t - axis\ ;\ t \in [0, x] \right\}$

8. Evaluate the following integral using the formulas for area of different geometrical figures. (**do not** use antiderivative)

     $\displaystyle\int_{-3}^{3} f(x)\, dx$ where $f(x) = \begin{cases} x + 1 & if & x < -1 \\ \sqrt{1 - x^2} & if & |x| \le 1 \\ x - 1 & if & x > 1 \end{cases}$

9. Evaluate each of the following integrals.

     a. $\displaystyle\int_{0}^{3} \left(-x^2 + 3x - 1\right) dx$ **b.** $\displaystyle\int_{0}^{\frac{\pi}{3}} \left(\cos t - \sin t\right) dt$ **c.** $\displaystyle\int_{-3}^{0} \left| x^3 + 1 \right| dx$

     d. $\displaystyle\int_{0}^{1} \left(2x + 1\right)^3 dx$ **e.** $\displaystyle\int_{3}^{3} x \ln(x)\, dx$ **f.** $\displaystyle\int_{-2}^{0} \sqrt{4 - x^2}\, dx$

10. State the Mean Value theorem for definite integral. Illustrate it using a graph.

11&12. Prove the Fundamental Theorem of Calculus Part I & Part II.

13. Find the **area** of the region enclosed by the given curves.

     a. $R_{xy} = \left\{ x = y^2 - 4y,\quad y = \tfrac{1}{2}x \right\}$ **b.** $R_{xy} = \left\{ y = \sin(x),\ y = \cos(x),\ x \in [0, 2\pi] \right\}$

     c. $R_{xy} = \left\{ y = 2x,\quad y = \tfrac{1}{2}x,\ y = -x + 2 \right\}$ **d.** $R_{xy} = \left\{ y = |x - 3|,\quad y = -|x - 2| + 3 \right\}$

14. Given: $R_{xy} = \left\{ y = -x^2 + 4,\ y = x + 2 \right\}$. Setup an integral(s) representing the volume of the solid resulted from the revolution of this region about each of the following axis of revolution.

     a. x-axis   **b.** $x = 2$ **c.** $y = -1$ **d.** $x = -3$

15.   Given: $R_{xy} = \{y = x,\ x-axis,\ x = 3\}$. Setup an integral(s) representing the volume of the solid resulted from the revolution of this region about each of the following axis of revolution.
  a. x-axis   **b.** y-axis   **c.** $x = 3$

16.   Given: $R_{xy} = \{x = y^2,\ y = x-2\}$. Setup an integral(s) representing the volume of the solid resulted from the revolution of this region about each of the following axis of revolution.
  a. y-axis   **b.** $y = -2$ **c.** $y = 3$ **d.** $x = 4$

17.   Given $R_{xy} = \{y = f(x), y = g(x), x \in [a,b]\}$ where $f(x) \geq g(x) \geq 0, \forall x$. Prove that the area of the enclosed region R_{xy} is $A = \int_a^b [f(x) - g(x)]dx$.

18.   Use the methods developed in the volume of solids of revolution to **prove** the volume formula for a sphere of radius R.

19.   Use the methods developed in the volume of solids of revolution to **prove** the volume formula for a cone of radius r and altitude of h.