## Examples 8.4 – The Fundamental Theorem of Calculus (Part 1)

1. Use the FTC to evaluate $\int_1^9 \frac{3}{\sqrt{t}}\,dt$.

   **Solution:** $\int_1^9 \frac{3}{\sqrt{t}}\,dt = 3\int_1^9 t^{-1/2}\,dt = 3\cdot\left.\frac{t^{1/2}}{1/2}\right|_1^9 = 6\sqrt{t}\,\Big|_1^9 = 6\left(\sqrt{9}-\sqrt{1}\right) = 12$

2. If $g$ is a function such that $g(2) = 10$ and $g(5) = 14$, then what is the net area bounded by $g'$ on the interval [2, 5]?

   **Solution:** The net area bounded by $g'$ on the interval [2, 5] is $\int_2^5 g'(x)dx$. By the FTC,

   $$\int_2^5 g'(x)dx = g(x)\Big|_2^5 = g(5) - g(2) = 14 - 10 = 4$$

3. Explain why we cannot use the FTC to evaluate $\int_{-1}^1 \frac{1}{x^2}dx$?

   **Solution:** In order to use the Fundamental Theorem of Calculus, the integrand must be continuous on the interval of integration. Since $y = \frac{1}{x^2}$ is not continuous at $x = 0$ (the graph has a vertical asymptote there), and 0 is in the interval [–1, 1], the FTC cannot be used. See Activity 8.4 for more details.

   The integral $\int_{-1}^1 \frac{1}{x^2}dx$ is said to be improper. Improper integrals are studied in Calculus II.