Week 14 Worksheet

November 24th

Group 1

According to Fick's law, the diffusion of a solute across a cell membrane is given by

$$c'(t) = \frac{kA}{V}[C - c(t)], \tag{1}$$

where A is the area of the cell membrane, V is the volume of the cell, $c(t)$ is the concentration outside the cell, and k is a constant. If c_0 represents the concentration of the solute inside the cell when $t = 0$, then it can be shown that

$$c(t) = (c_0 - C)e^{-kAt/V} + C. \tag{2}$$

1. Use the last result to find $c'(t)$.
2. Substitute back into Equation (1) to show that (2) is indeed the correct antiderivative of (1).

Group 2

Use Substitution to find each indefinite integral

1. $$\int (-4t + 1)^3 dt$$
2. $$\int \frac{6x^2 dx}{(2x^3 + 7)^{3/2}}$$
3. $$\int re^{-r^2} dr$$

Group 3

Use Substitution to find each indefinite integral

1. $$\int \frac{e^{\sqrt{y}}}{2\sqrt{y}} dy$$

2. $$\int \frac{(\log_2(5x+1))^2}{5x+1} dx$$

3. $$\int x 8^{3x^2+1} dx$$

Group 4

A company incurs dept at a rate of

$$D'(t) = 90(t+6)\sqrt{t^2+12t}$$

dollars per year, where t is the amount of time (in years) since the company began. By the fourth year, the company had accumulated $ 16,260 in dept.

1. Find the total debt function.
2. How many years must pass before the total dept exceeds $ 40,000.

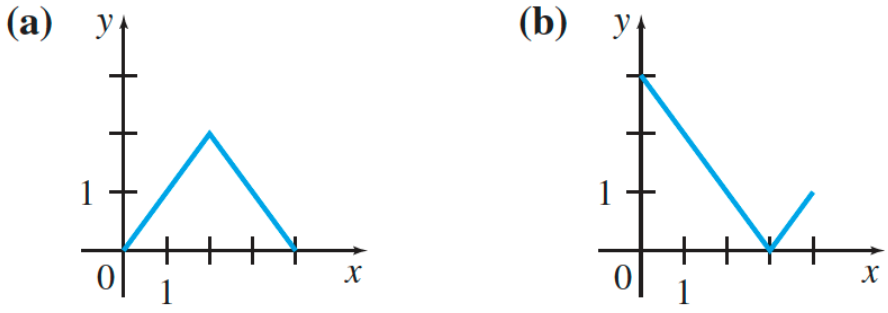
Group 5

Find the exact value of each integral using formulas from geometry

1. $\int_{-4}^{0} \sqrt{16-x^2} dx$
2. $\int_{2}^{5} (1+2x) dx$

Extra problems

1. Find $\int_0^4 f(x) dx$ for each graph of $y = f(x)$.



2. **Application to Economics** The total revenue for a product can be calculated as the area under the demand curve. Suppose that the demand curve for a curve wine (in dollars per liter) is given by

$$D(q) = \frac{1}{10}q^2 - 10q + 260$$

for $0 \leq q \leq 40$, where q is the demand in liters. Estimate the total revenue using rectangles of with 10 liters. Use the left endpoint of each sub-interval to determine the height of the rectangle. (Calculators allowed here.)