

**Discussion Section Worksheet**  
**Calc II - Week 3 - 9/16/2021**

**Warm-Up: 5+5**

1. Suppose  $s(x)$  is the slope of a road at a distance of  $x$  kilometers from its start, what does  $\int_2^4 s(x) dx$  represent?
2. If  $f$  is continuous and  $\int_1^4 f(x) dx = 6$ , then find  $\int_1^2 xf(x^2) dx$ .

**Group Work and Discussion: 30+10**

1. Toxic sludge leaks from a factory onto a playground at a rate of  $8/(t^2 + 1)$  liters per day, where  $0 \leq t \leq 5$ . How much sludge leaks onto the playground during the first day?
2. The velocity function (in meters per second) of a particle moving along a line is  $v(t) = t^2 + 3t - 4$ .
  - (a) Find the displacement of the particle from  $t = 0$  to  $t = 3$ .
  - (b) Find the distance traveled by the particle from  $t = 0$  to  $t = 3$ .
3. Evaluate the following definite integrals

(a)  $\int_0^1 \frac{e^x}{1 + e^x} dx.$

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

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

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

4. *Challenge.* A bacteria population is 2000 at time  $t = 0$  and its rate of growth is  $1000 \cdot 2^t$  bacteria per hour after  $t$  hours. What is the population of bacteria after 1 hour?
5. *Extra Challenge.* Evaluate the following indefinite integrals.

(a)  $\int x\sqrt{1 - x^2} dx.$

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

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

(d)  $\int \frac{1}{\sqrt[3]{(1 + x)^2}} dx.$

(e)  $\int \frac{1}{(1 + \sqrt{x})^4} dx.$

6. *Extra Challenge.* The linear density of a rod of length 1m is given by  $\rho(x) = \sqrt[3]{1 + 7x}$ , measured in kilograms per meter, where  $x$  is measured in meters from one end of the rod. Find the total mass of the rod.

7. *Super Extra Challenge.* Evaluate  $\int \frac{1}{\sqrt{x} + \sqrt[3]{x}} dx.$