

Instructions: This homework is an individual effort. Answer each question. This is due on **Monday, April 6th. Show all work to receive full credit.**

1. Approximate the following integrals using (i) a left-hand sum with $n = 4$ subdivisions; and then (ii) a right-hand sum with $n = 4$ subdivisions; and then use these to get a better approximation. Does the left-hand sum overestimate or underestimate the integral? What about the right-hand sum?

a. $\int_1^3 e^x dx.$

b. $\int_{-3}^{-1} x^2 dx.$

c. $\int_1^3 \ln(x) dx.$

d. $\int_{-1}^{-3} \frac{1}{x} dx.$

e. $\int_1^3 \sqrt{x} dx.$

2. Consider the following table:

x	0	10	20	30	40
$f(x)$	350	410	435	450	460

a. Estimate $\int_0^{40} f(x) dx$ with a left-hand sum.

b. Estimate $\int_0^{40} f(x) dx$ with a right-hand sum.

c. Use the above to find a better approximation.

3. After a foreign substance is introduced into the blood, the rate at which antibodies are made is given by $r(t) = \frac{t}{t^2 + 1}$ thousands of antibodies per minute, where t is in minutes. Interpret

$$\int_0^4 r(t) dt.$$

4. A forest fire is growing at a rate of $8\sqrt{t}$ acres per hour. Interpret $\int_0^{24} 8\sqrt{t} dt.$

5. Water is pumped out of a holding tank at a rate of $5 - 5e^{-0.12t}$ liters per minute, where t is the number of minutes since the pump started. Write an equation, $w(t)$, representing the amount of water pumped out after 1 hour.

6. Let $f(x)$ be given the below graph. Find the following:

a. $\int_0^3 f(x)dx$

b. $\int_3^6 f(x)dx$

c. $\int_0^6 f(x)dx$

d. $\int_{10}^6 f(x)dx$

e. $\int_0^{10} f(x)dx$

f. $\int_0^{10} |f(x)|dx$

