Calculus 112 Practice Problems

Section 5.3 Problems #18, #27, #39

18. (a) If the level first becomes acceptable at time t_1, then $R_0 = 4R(t_1)$, and

$$\frac{1}{4}R_0 = R_0 e^{-0.004t_1}$$
$$\frac{1}{4} = e^{-0.004t_1}.$$

Taking natural logs on both sides yields

$$\ln\frac{1}{4} = -0.004t_1$$
$$t_1 = \frac{\ln\frac{1}{4}}{-0.004} \approx 346.574 \text{ hours.}$$

(b) Since the initial radiation was four times the acceptable limit of 0.6 millirems/hour, we have $R_0 = 4(0.6) = 2.4$. The rate at which radiation is emitted is $R(t) = R_0e^{-0.004t}$, so

$$\text{Total radiation emitted} = \int_0^{346.574} 2.4e^{-0.004t}\,dt.$$

Evaluating the integral numerically, we find that 450 millirems were emitted during this time.

27. Since W is in tons per week and t is in weeks since January 1, 2005, the integral $\int_0^{52} W\,dt$ gives the amount of waste, in tons, produced during the year 2005.

$$\text{Total waste during the year} = \int_0^{52} 3.75e^{-0.008t}dt = 159.5249 \text{ tons.}$$

Since waste removal costs $\$15/\text{ton}$, the cost of waste removal for the company is $159.5249 \cdot 15 = \$2392.87$.

39. Since $t = 0$ in 1975 and $t = 35$ in 2010, we want:

$$\text{Average Value} = \frac{1}{35-0}\int_0^{35} 225(1.15)^t dt$$
$$= \frac{1}{35}(212{,}787) = \$6080.$$