The Snow Problem

Snow accumulates at a RATE modeled by

$f(t) = 7te^{\cos t}$ cubic feet per hour

Snow is removed at a RATE in ft^3/hr of

$$g(t) = \begin{cases} 0 & for \quad 0 \le t < 6 \\ 125 & for \quad 6 \le t < 7 \\ 108 & for \quad 7 \le t \le 9 \end{cases}$$

(a) $\int_0^6 f(t)\,dt \approx 142.274$ or $142.275\ ft^3$

(b) $f(8) - g(8) \approx -59.582$

or $-59.583 \ \frac{ft^3}{hr}$

(c) We'll need a lot of Calculus here

Note: From time t = 0 to t = 6, no snow is removed because Janet is getting a good night's sleep.

$$\int_6^t 125\,dx = 125x\Big|_6^t$$

$$= 125(t-6)$$

for $6 < t \leq 7$

$$h(t) = h(7) + \int_7^t 108\,dx$$

$$= 125 + \int_7^t 108\,dx$$

$$= 125 + 108x \Big|_7^t$$

$$= 125 + 108(t-7)$$

$$h(t) = \begin{cases} 0, & 0 \le t \le 6 \\ 125(t-6), & 6 < t \le 7 \\ 125 + 108(t-7), & 7 < t \le 9 \end{cases}$$

(d)

$$\left[\int_0^9 f(t)\,dt \right] - h(9)$$

$$\approx 26{,}334 \text{ or}$$
$$26{,}335 \text{ ft}^3$$

Water Tank Problem

Look at these cool water tanks!

We will skip part (b) until January

$$r(t) = \begin{cases} \dfrac{600t}{t+3} & \text{for } 0 \le t \le 5 \\ 1000e^{-0.2t} & \text{for } t > 5 \end{cases}$$

(a)

$$\lim_{t \to 5^-} r(t) = 375$$

$$\lim_{t \to 5^+} r(t) \approx 367.879$$

Because left- and right-hand limits are not equal, then r is NOT continuous at $t=5$

(c)

$$r'(t) = \frac{(t+3)(600) - (600t)(1)}{(t+3)^2}$$

$$r'(3) = 50 \frac{l}{hr^2}$$

The rate at which water is draining out of the tank at time t = 3hours is increasing at $50 \frac{l}{hr^2}$

(d)

$$12000 - \int_0^A r(t)\,dt = 9000\ l$$