

“MR. CALCULUS” ANSWERS TO THE 2010 FREE RESPONSE QUESTIONS

AB/BC 1

Rate that snow accumulates: $f(t) = 7te^{\cos t} \frac{ft^3}{hr}$

Rate that snow removed: $g(t) = \begin{cases} 0 & \text{for } 0 \leq t < 6 \\ 125 & \text{for } 6 \leq t < 7 \\ 108 & \text{for } 7 \leq t \leq 9 \end{cases} \frac{ft^3}{hr}$

(a) Snow that has accumulated by 6am: $\int_0^6 f(t)dt = \boxed{142.275 ft^3}$

(b) Rate of change of the volume of snow on the driveway at 8am:

$$f(8) - g(8) = 48.41703221 - 108 = \boxed{-59.583 \frac{ft^3}{hr}}$$

(c) $h(t)$ is the total amount of snow removed when $0 \leq t \leq 9$:

$$h(t) = \begin{cases} 0 & \text{for } 0 \leq t < 6 \\ \int_6^t 125dt & \text{for } 6 \leq t < 7 \\ 125 + \int_7^t 108dt & \text{for } 7 \leq t \leq 9 \end{cases} \quad \text{OR} \quad h(t) = \begin{cases} 0 & \text{for } 0 \leq t < 6 \\ 125(t-6) & \text{for } 6 \leq t < 7 \\ 125 + 108(t-7) & \text{for } 7 \leq t \leq 9 \end{cases}$$

(d) The amount of snow on the driveway, in ft^3 , at 9am will be the amount accumulated from midnight until 9am minus the amount removed from 6am until 9am:

$$\int_0^9 f(t)dt - \int_6^7 g(t)dt - \int_7^9 g(t)dt = \boxed{26.335 ft^3}$$

or

$$\int_0^9 f(t)dt - h(9) = \boxed{26.335 ft^3}$$