

4. [9 points] The city of Rainneapolis has a strange weather pattern. It is always sunny, except for February 2nd, when it rains substantially all day. This year, Amin prepared for the stormy day by building a machine which continuously removes rainwater from his backyard.

- Let $T(h)$ be the **total amount** of rainwater in Amin's backyard, in cubic feet, h hours after 12:00am on February 2nd.
- Let $A(h)$ be the **rate** at which the rain **adds** water to Amin's backyard, in cubic feet per hour, h hours after 12:00am on February 2nd.
- Let $M(h)$ be the **rate** at which Amin's **machine removes** rainwater from his backyard, in cubic feet per hour, h hours after 12:00am on February 2nd.

The functions $T(h)$, $A(h)$, and $M(h)$ are all differentiable. Assume that there is **no rainwater** in Amin's backyard **before** it starts raining at 12:00am on February 2nd.

- a. [3 points] Which of the following gives a correct interpretation of $\int_4^{10} M(h) dh = 8000$?

Circle **all** correct answers.

- (i) The total amount of rainwater in Amin's backyard decreases by 8000 cubic feet from 4:00am to 10:00am on February 2nd.
- (ii) Between 4:00am and 10:00am on February 2nd, Amin's machine removes a total of 8000 cubic feet of rainwater from his backyard.
- (iii) The rate at which Amin's machine removes rainwater from his backyard between 4:00am and 10:00am on February 2nd is 8000 cubic feet per hour.
- (iv) At 10:00am on February 2nd, Amin's machine removes rainwater from his backyard at a rate of 8000 cubic feet per hour faster than at 4:00am.
- (v) NONE OF THESE

- b. [3 points] Which of the following expressions gives the **total amount** of rainwater, in cubic feet, in Amin's backyard at 7:00am? Circle **all** correct answers.

(i) $\int_0^7 T'(h) dh$ (ii) $\int_0^7 T(h) dh$ (iii) $\int_0^7 (A(h) + M(h)) dh$

(iv) $\int_0^7 A(h) dh - \int_0^7 M(h) dh$ (v) NONE OF THESE

- c. [3 points] Which of the following expressions gives the **average amount** of rainwater, in cubic feet, in Amin's backyard between 6:00am and 9:00am? Circle **all** correct answers.

(i) $\frac{1}{9-6} \int_6^9 T'(h) dh$ (ii) $\frac{1}{9-6} \int_6^9 T(h) dh$ (iii) $\frac{T(9) - T(6)}{9-6}$

(iv) $\frac{1}{3} \int_6^9 T(h) dh + \frac{1}{3} \int_6^0 T(h) dh$ (v) NONE OF THESE