

8. [9 points] Zoltan is undergoing an anti-aging skin treatment that involves a machine that uses electrical current to deliver medicine through the skin. During a treatment session, the total amount of medicine that has been absorbed by the skin is a function of the total electrical charge that has entered the skin.

A particular treatment session begins before noon and ends after 12:30 pm, and at noon, Zoltan has already absorbed 4 mg of the medicine.

- Let $m(c)$ be the total amount of medicine, in mg, that has been absorbed when a total electrical charge of c coulombs has entered the skin. Assume that m is invertible and that both m and m^{-1} are differentiable.
- During the treatment, let $q(t)$ be the total electrical charge, in coulombs, that has entered the skin at t minutes after noon. Assume that q is invertible and that both q and q^{-1} are differentiable.

For each of the questions below, circle the one best answer. No points will be given for ambiguous or multiple answers.

- a. [2 points] Which of the following expressions represents the total amount of medicine, in mg, that has been absorbed by Zoltan's skin at 12:06 pm?

- i. $m(6)$ ii. $m(q(6))$ iii. $m(q(6) + 4)$ iv. $m(q(6)) + 4$
 v. $m(6) + 4$ vi. $q(m(6))$ vii. $q(m(6) + 4)$ viii. $q(m(6)) + 4$

- b. [2 points] Which of the following equations best supports the statement "Between 12:03 pm and 12:04 pm, Zoltan absorbs about 0.2 mg of the medicine." ?

- i. $m(3) = 0.2$ ii. $m(q(4)) = 0.2$ iii. $q'(3) = 0.2$
 iv. $m'(q(4)) = 0.2$ v. $m'(3) = 0.2$ vi. $q'(4) \cdot m'(4) = 0.2$
 vii. $m'(q'(3)) = 0.2$ viii. $q'(4) \cdot m'(q(4)) = 0.2$ ix. $(q^{-1})'(0.2) = 3$

- c. [3 points]

Which of the following is the best interpretation of the equation $\int_0^{30} q'(t) dt = 200$?

- i. Between noon and 12:30 pm, 200 coulombs of electrical charge enter the skin.
 ii. Between noon and 12:30 pm, about 200 coulombs of electrical charge enter the skin.
 iii. Between noon and 12:30 pm, electrical charge enters the skin at an average rate of 200 coulombs per minute.
 iv. Between noon and 12:30 pm, electrical charge enters the skin at an average rate of about 200 coulombs per minute.

- d. [2 points] Which of the following equations expresses the statement:

"Between 12:15 pm and 12:25 pm, Zoltan absorbs an additional 7 mg of the medicine."

- i. $m(25) - m(15) = 7$ ii. $\frac{m(25) - m(15)}{10} = 7$ iii. $m'(20) = 0.7$
 iv. $\int_{q(15)}^{q(25)} m'(c) dc = 7$ v. $\int_{q(15)}^{q(25)} m(c) dc = 7$ vi. $\int_{15}^{25} m(c) dc = 7$
 vii. $\int_{15}^{25} m(q(t)) dt = 7$ viii. $\int_{15}^{25} m'(q(t)) dt = 7$