

Read each question carefully and be sure to SHOW ALL WORK. Correct answer without proper justification will not receive a “Complete” grade. Paç fat! Good luck!

Name: _____

LO 5. Integrals Challenge. I deeply understand the concepts behind Riemann sums, definite integrals, and their connection to antiderivatives and indefinite integrals through the Fundamental Theorem of Calculus.

Criteria for Success: I can solve conceptual questions related to Riemann sums, definite integrals, and the Fundamental Theorem of Calculus that lie on the top half of Bloom’s Taxonomy (analyze, evaluate, and create).

Question: Scientists have mapped out a 200-km path on the surface of Mars for a rover to follow, and have collected satellite data about the composition of the Martian surface at various points along the route using a LiDAR Spectrometer. If the position p along the path takes values on $[0, 200]$ km, we can model the amount of dust per distance traveled using the function $R(p) = 6(p/50 + 1)^{-2}$ mg/km.

- (a) Approximate the total amount of dust accumulated along the route for p on the interval $[0, 200]$ using any Riemann Sum you wish with 4 rectangles of equal base lengths. Make sure to draw a sketch of the function and the rectangles clearly indicating your choice of left, right, or midpoint Riemann sum. Use desmos <https://www.desmos.com/calculator/oceoomwdiy> to help with visualization.

Sketch of function with rectangles:

Riemann sum computation:

- (b) Express the above Riemann sum computation using sigma notation, where the expression inside the sigma symbol is suppose to be an explicit function of k .

$$\sum_{k=}$$

- (c) As n gets larger and larger in the above expression, we end up getting closer and closer to $\int_0^{200} R(p)dp = \int_0^{200} 6(p/50 + 1)^{-2}dp$. Circle all that apply and for each option explain why you chose to circle it or not. Clearly state u and du if needed. The integral $\int_0^{200} 6(p/50 + 1)^{-2}dp$ is equal to

- (I) 240
- (II) $-\frac{300}{u} + C$
- (III) $\left(-\frac{300}{5}\right) - \left(-\frac{300}{1}\right)$
- (IV) $-\frac{300}{p/50 + 1} + C$
- (V) $\left(-\frac{300}{200/50 + 1}\right) - \left(-\frac{300}{0/50 + 1}\right)$
- (VI) $\int_1^5 300u^{-2}du$
- (VII) $\int_0^{200} 300u^{-2}du$
- (VIII) $\int_0^4 300(u + 1)^{-2}du$

- (d) Explain in your own words the meaning of the numerical value of the above integral in terms of the rover data collected.