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 1. Riemann Sum Computations [CORE]. I can estimate the signed area between a function and the x-axis ever more accurately using Riemann sums.

Criteria for Success: I can

- calculate a left, right, or midpoint Riemann sum for a given function and partition
- go back and forth between an expanded sum and its sigma notation
- use the sigma notation to compute Riemann sums for an arbitrary number of rectangles
- use Riemann sums to estimate the displacement of some moving object, or total accumulation of some quantity

Question: Consider the graph of $f(x) = 2x^{1/3} - 1$ on the interval $[-3, 3]$.

(a) Approximate the signed area between $y = f(x)$ and the x-axis on the interval $[-3, 3]$ using any Riemann Sum with 3 rectangles of equal base lengths. Make sure to draw a sketch of the function and the rectangles. Use desmos `https://www.desmos.com/calculator/oceoomwdiy` to help with visualization and checking your answer (note that you need to update the function within desmos). **Hint:** Helpful questions to ask yourself at the end: Does my answer seem reasonable? Did I check my computations by typing it into the desmos link above?

Sketch of function with rectangles:

Riemann sum computation:

(b) Express the above Riemann sum computation using sigma notation.

$$\sum_{k=}$$

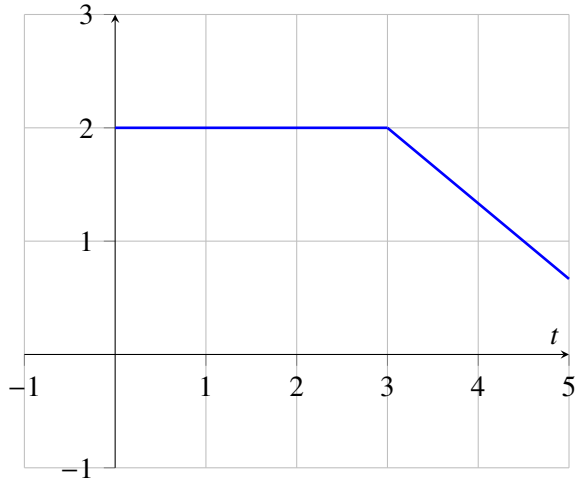
LO 3. FTC Applications [CORE]. I can use Fundamental Theorem of Calculus (FTC) to compute displacement and accumulation.

Criteria for Success: I can

- compute the distance and displacement of a moving object using a definite integral
- find the total net change or accumulation of some quantity through a definite integral, and use appropriate units
- find antiderivatives of functions using the Fundamental Theorem of Calculus
- analyze definite integrals with functions as bounds

Question: Water is pouring out of a pipe at the rate of $f(t)$ gallons/minute as graphed below.

t	0					
$W(t)$	3					



(a) Fill out the table above with relevant times and amount of water $W(t)$ that has poured out up to time t, if initially there were 3 gallons of water, i.e., $W(0) = 3$. You do not need to fill up the whole table, and values of t could be decimals as well.

(b) Use the above table and graph to describe the amount of water $W(t)$ that flows from the pipe in your own words. Make sure to include appropriate units in your description. (Note that there's more quesitons on the next page.)

(c) Circle all that apply, and briefly explain why each option is correct or not. The amount of water that was poured out of the pipe during the first 3 minutes, together with the initial 3 gallons, is equal to:

(a) $3 + \int_0^3 f(x)dx$

(b) $f(3)$

(c) $W(3)$

(d) 5

(e) 6

(f) none of the above

(d) Circle all that apply, and briefly explain why each option is correct or not. How is $F(t) = \int_0^{5t} f(x)dx$ related to $W(t)$?

(a) $F(t) = W(t)$

(b) $F(t) = 5W(t)$

(c) $F(t)$ and $W(t)$ are antiderivatives of $f(t)$.

(d) None of the above