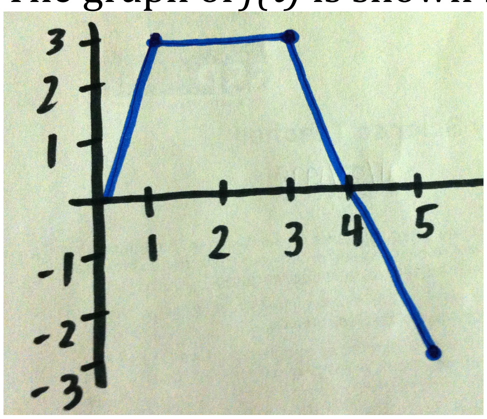
Lesson #85/86

Accumulation

- Given information about a derivative, we can discuss how much area has accumulated over an interval to solve for information about the original function.
- The integral of a rate over a period of time gives you the amount accumulated.
- We apply the first fundamental theorem of calculus:

Example #1:

The graph of *f(t)* is shown below.

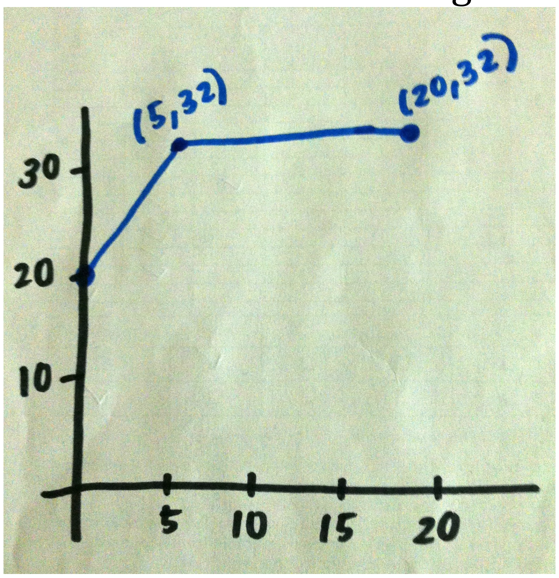


***The integral of a rate with bounds gives you the amount accumulated over the period of time on the bounds.**

A. Suppose *f(t)* gives the rate of change of the water level in a lake where the water is described in meters above sea level over time, *t*, in months. If the level of the lake is 110 m above sea level at the starting time, what is the level of the lake at time t=4 months?

Example #2:

The acceleration of an airplane from the moment of liftoff (t=0) until 20 minutes into the flight is shown below.



a) If the velocity at lift off is 900 ft/min, what is the velocity of the plane after 20 minutes?

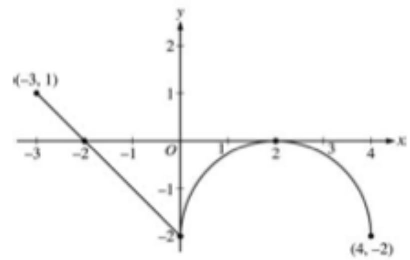
b) Different scenario: If the velocity is 500 at t=5, what was the velocity at t=20? What about at t=0?

Lesson #85/86

AP Prep Question from Composition Book- 2003 (d)

**This question can be found in your composition book.*

Let f be a function defined on the closed interval $-3 \leq x \leq 4$ with $f(0) = 3$. The graph of f', the derivative of f, consists of one line segment and a semicircle, as shown above.



Graph of f'

(d) Find $f(-3)$ and $f(4)$. Show the work that leads to your answers.

**The answer in the video for f(-3) is incorrect, even though the set up is right. The correct answer can be found at the bottom of this page. ☺*

Answers: f(-3)=9/2 and f(4)=-5+2π

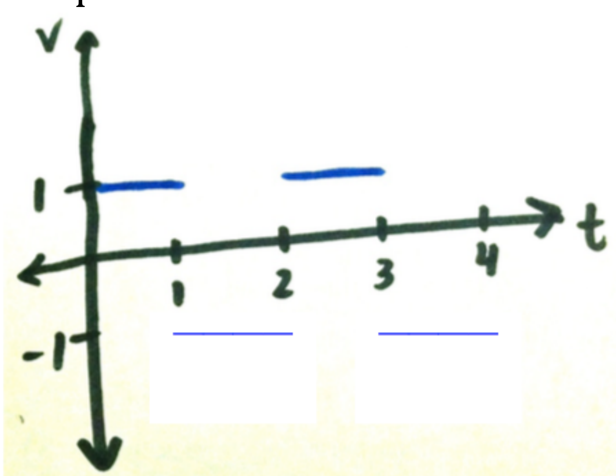
Example #3:

A cake, heated to a temperature of 350 degrees Fahrenheit, is taken out of an oven and placed in a 70 degree room at time t=0 minutes. The temperature of the cake is changing at a rate of $C(t) = -60e^{-.2t}$ degrees per minute.

To the nearest degree, what is the temperature of the cake at time t=5 minutes?

Example #4:

The graph of the velocity of a particle moving on the x-axis is given below. The particle starts at x=2 when t=0.



A. Find where the particle is at the end of the trip, t=4.

B. Find the total distance travelled by the particle.

Example #5:

Water is being pumped into a tank at a constant rate of 5 gallons per minute. Water leaks out of the tank at the rate of $\sqrt{t}$ gallons per minute, for $0 \leq t \leq 45$ minutes. At time t=0, the tank contains 30 gallons of water.

A. How many gallons leak out of the tank from t=0 to t=3?

Please note that Mrs. Young meant to write that the antiderivative is $\frac{2}{3}t^{\frac{3}{2}}$ (in terms of t) for this problem and did not catch her mistake until later. Whoops!

B. How many gallons are added to the tank from t=0 to t=3?

C. How many gallons of water are in the tank at time t=3?

D. Write an expression for A (t), the total amount of water in the tank at time *t*.

E. Is the amount of water increasing or decreasing at time t=3? Why?