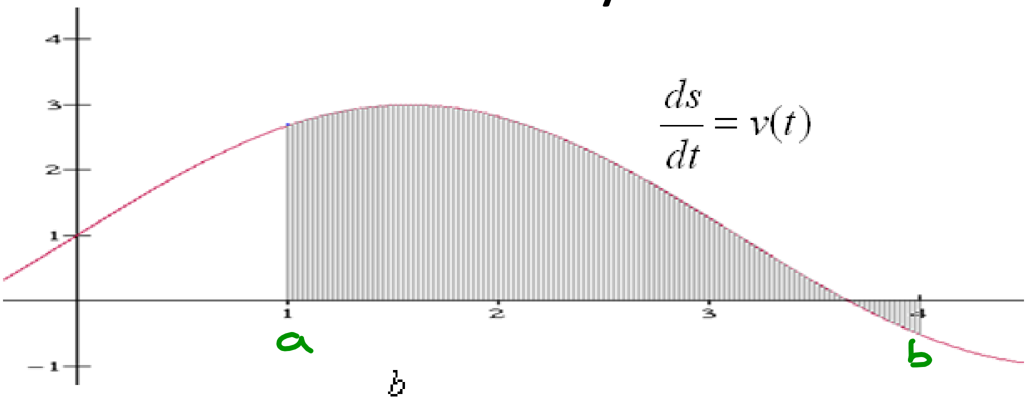
7-1 Integral as Net Change

Learning Targets

Given a differenal equaon, I can use integraon to find a net change in a real world situaon.

Given a differenal equaon and a starng value, I can use integraon to find a the ending value in a real world situaon.

Velocity



- What does $\int_a^b v(t)\,dt$ mean?

net change in position (displacement) area from time = a to time = b

- If s(a)=12 and $\int_a^b v(t)\,dt = 9$, what is s(b)?

Final position = initial position + displacement

$12 + 9 = 21$

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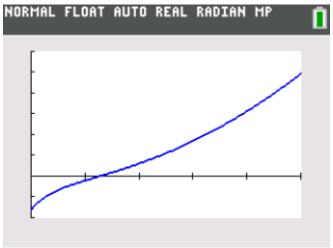
Example 1: $\frac{ds}{dt} = v(t) = t^2 - \frac{8}{(t+1)^2}\ \frac{cm}{\sec}$

is a velocity funcon on $0 \le t \le 5$



- Graph the velocity for
- Describe the moon.
- What is the parcle's posion at me t=1 sec and at t=5 sec if s(0)=9?

$\int_0^1 \left(t^2 - \frac{8}{(t+1)^2}\right) dt = -3.667$

$9 - 3.667 = 5.333$ cm

$\int_0^5 v(t)\,dt = 35$ $\quad 9 + 35 = 44$ cm

- What was the total distance travelled from t=0 to t=5?

$\int_0^5 |v(t)|\,dt = 42.587$ cm

Integral as a Net Change

If f is a connuous and differenable funcon over [a,b], then

$$f(b) = f(a) + \int_a^b f'(x)dx$$

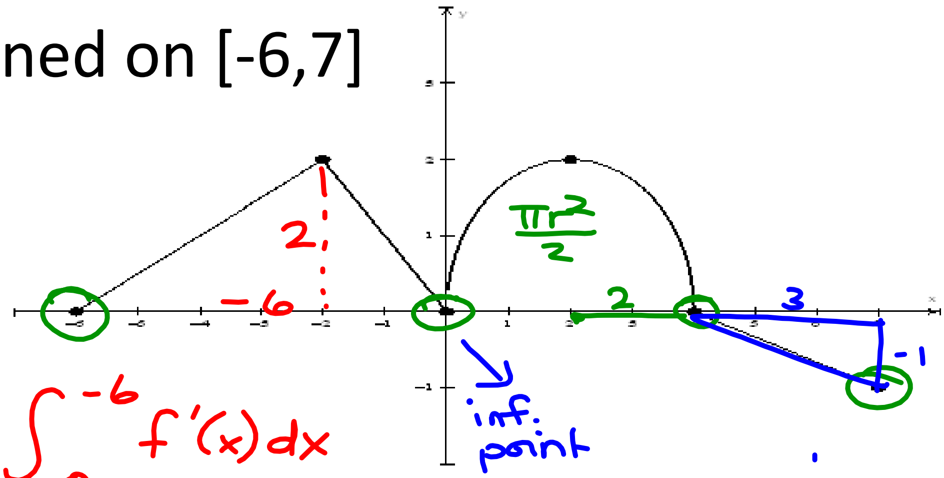
final position = initial position + displacement

And the integral $\int_a^b f'(x)dx$ tells you how much the funcon has changed from a to b.

Example 2:

f'(x) is defined on [-6,7]

f(0)=5



Candidates:

$-6, \cancel{0}, 4, 7$

-6: $5 + \int_0^{-6} f'(x)\,dx$

$5 + -6 = -1$

4: $5 + \int_0^{4} f'(x)\,dx$

$5 + 2\pi$

$= 11.28$

7: $5 + \int_0^{7} f'(x)\,dx$

$5 + 2\pi + -1.5$

9.78

- Find the absolute maximum of f(x) on [-6,7].
  11.28
- Find the absolute minimum of f(x) on [-6,7].
  −1

Homework

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