

LECTURE 27

RIEMANN

SUMS

Oliver Knill, Harvard University

November 11, 2020

PLAN

1. Poll

2. Net Change

4. Marathon

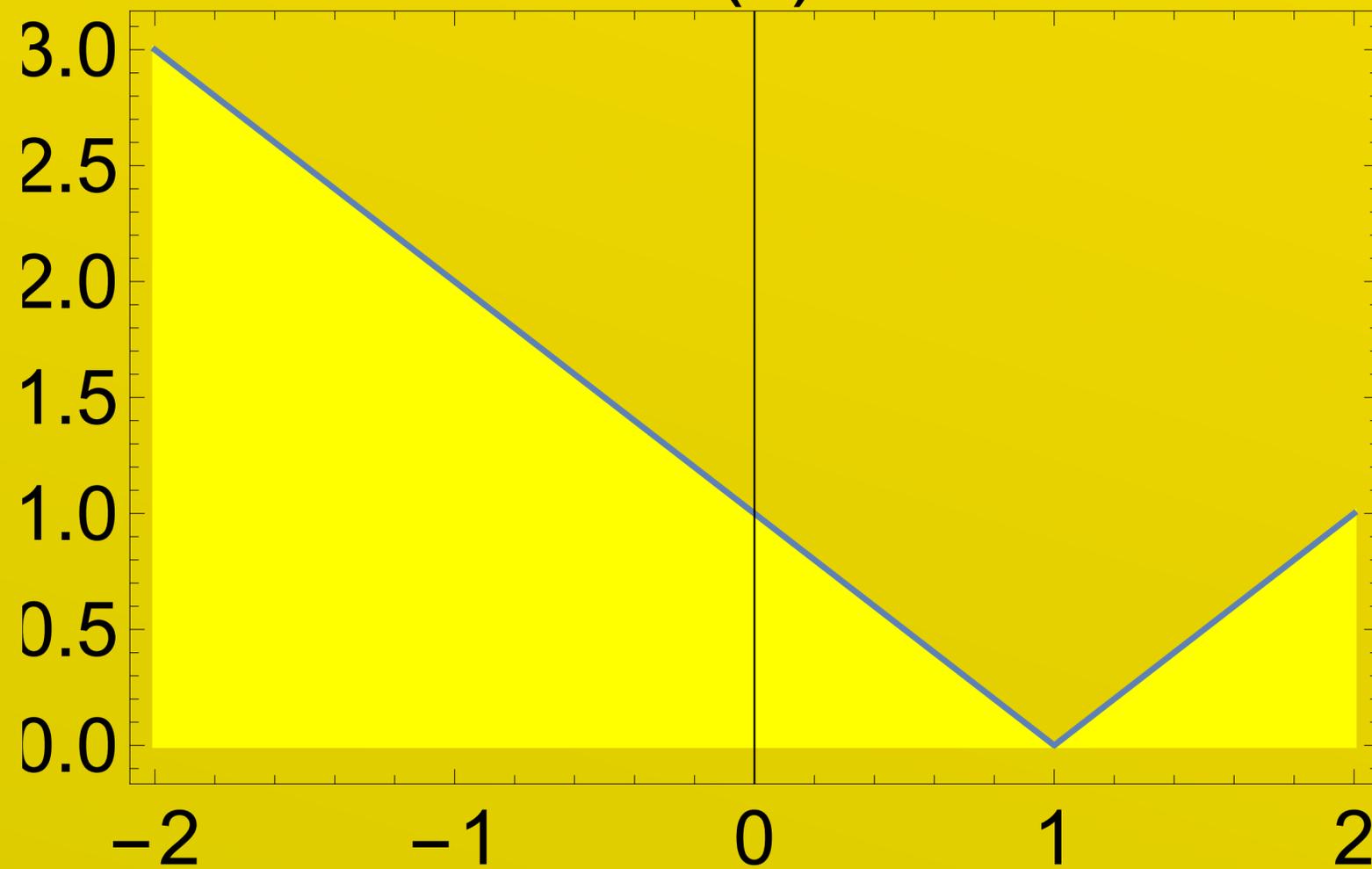
5. Fresh Pond

6. Arctic Sea

7. CA time:Project start

POLL

$f(x)$



A

-4

B

5

C

6

D

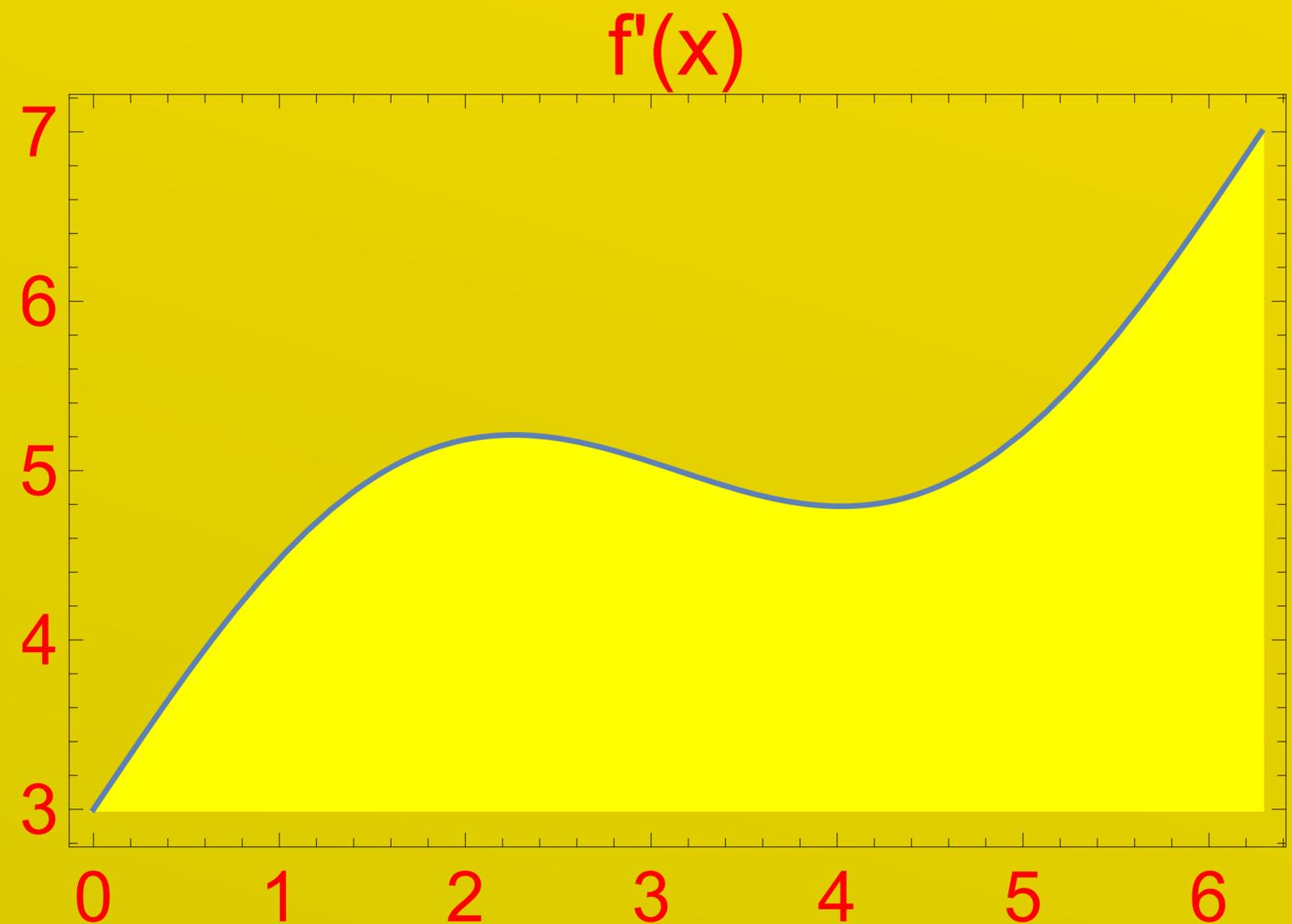
-2

What is the net change?

NET CHANGE

The net change of a function f' on an interval $[a,b]$ is $f(b)-f(a)$.

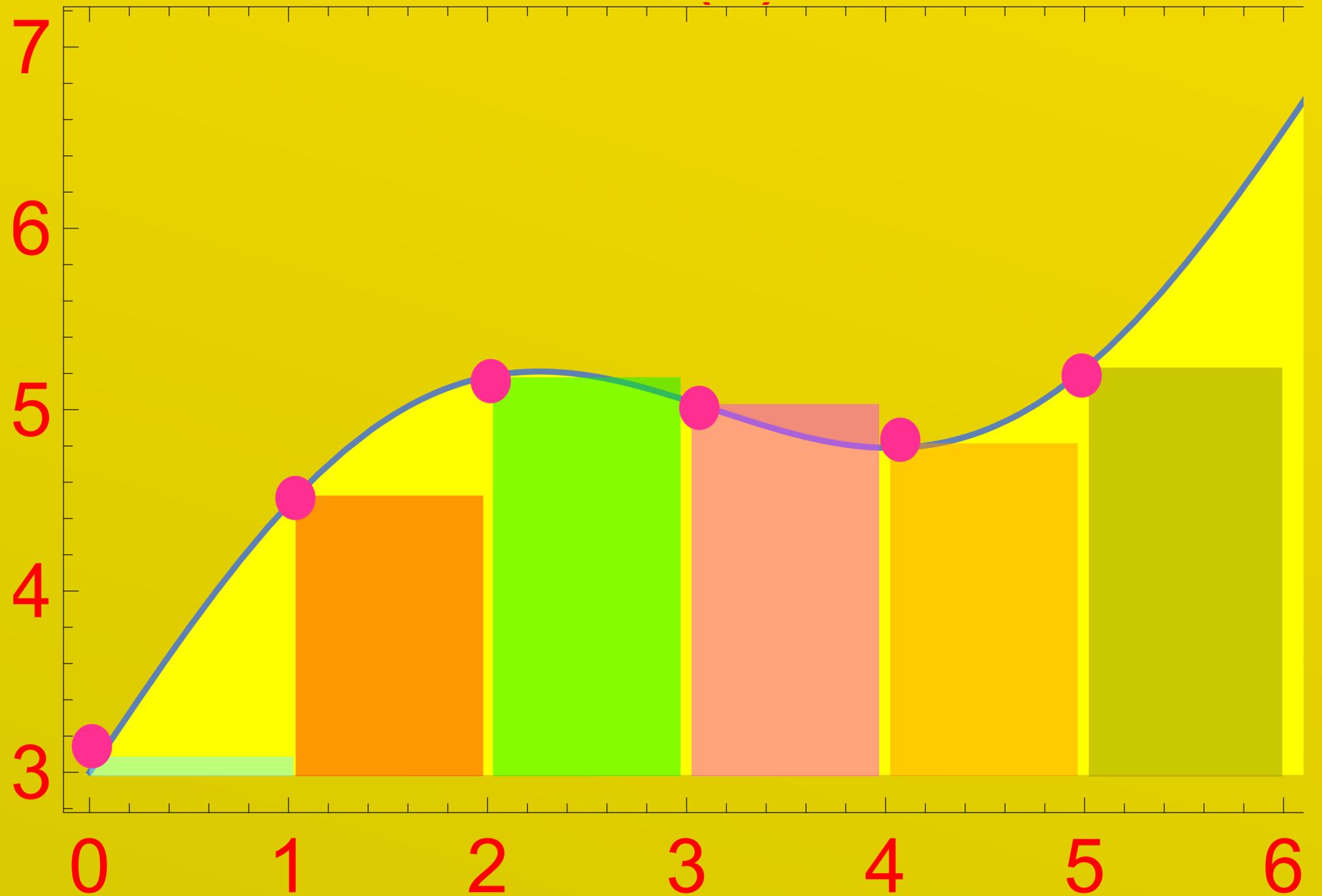
When adding up all the changes, we get the signed area under the curve of the function $f'(x)$.



RIEMANN SUM

L_6

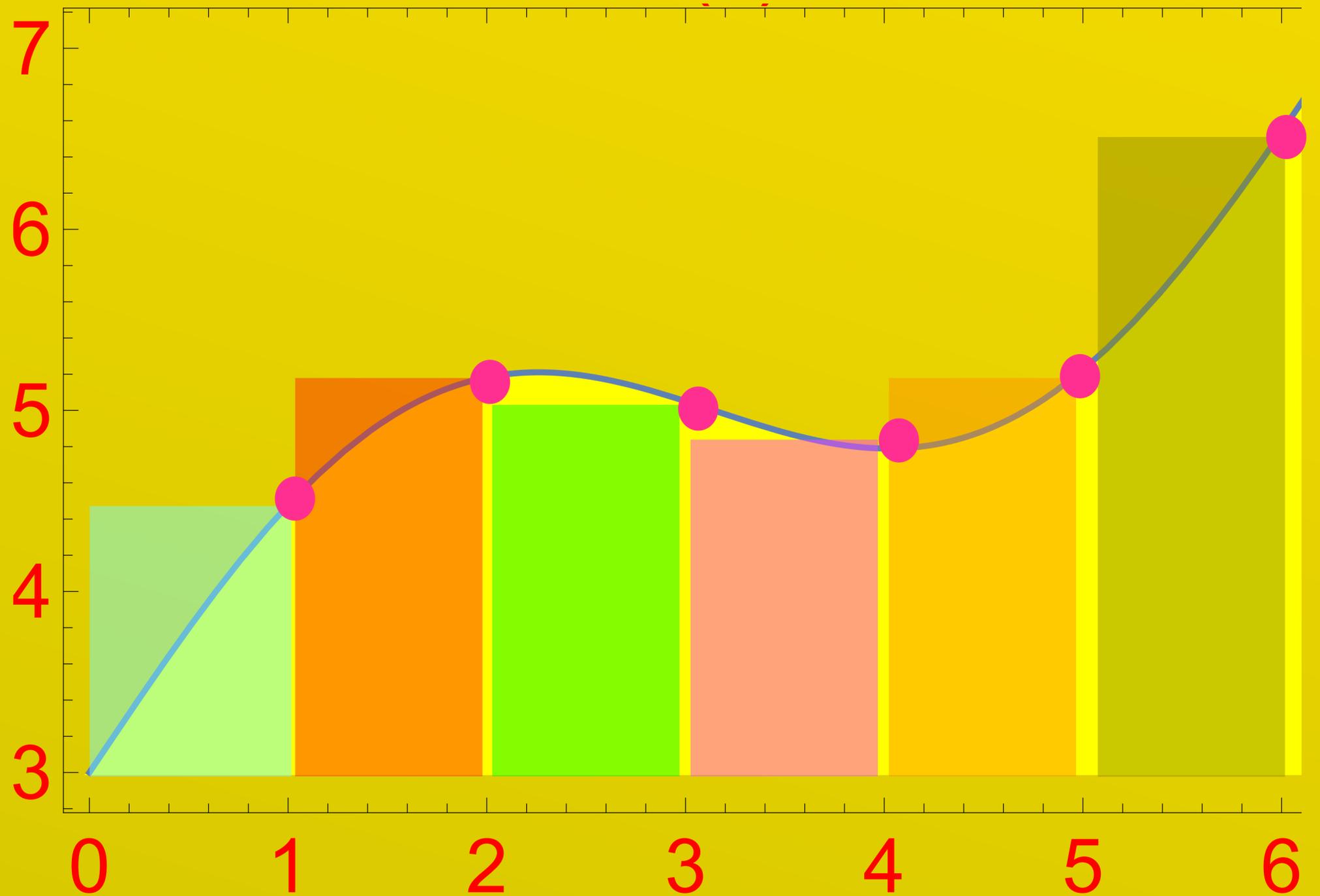
Left Riemann Sum



RIEMANN SUM

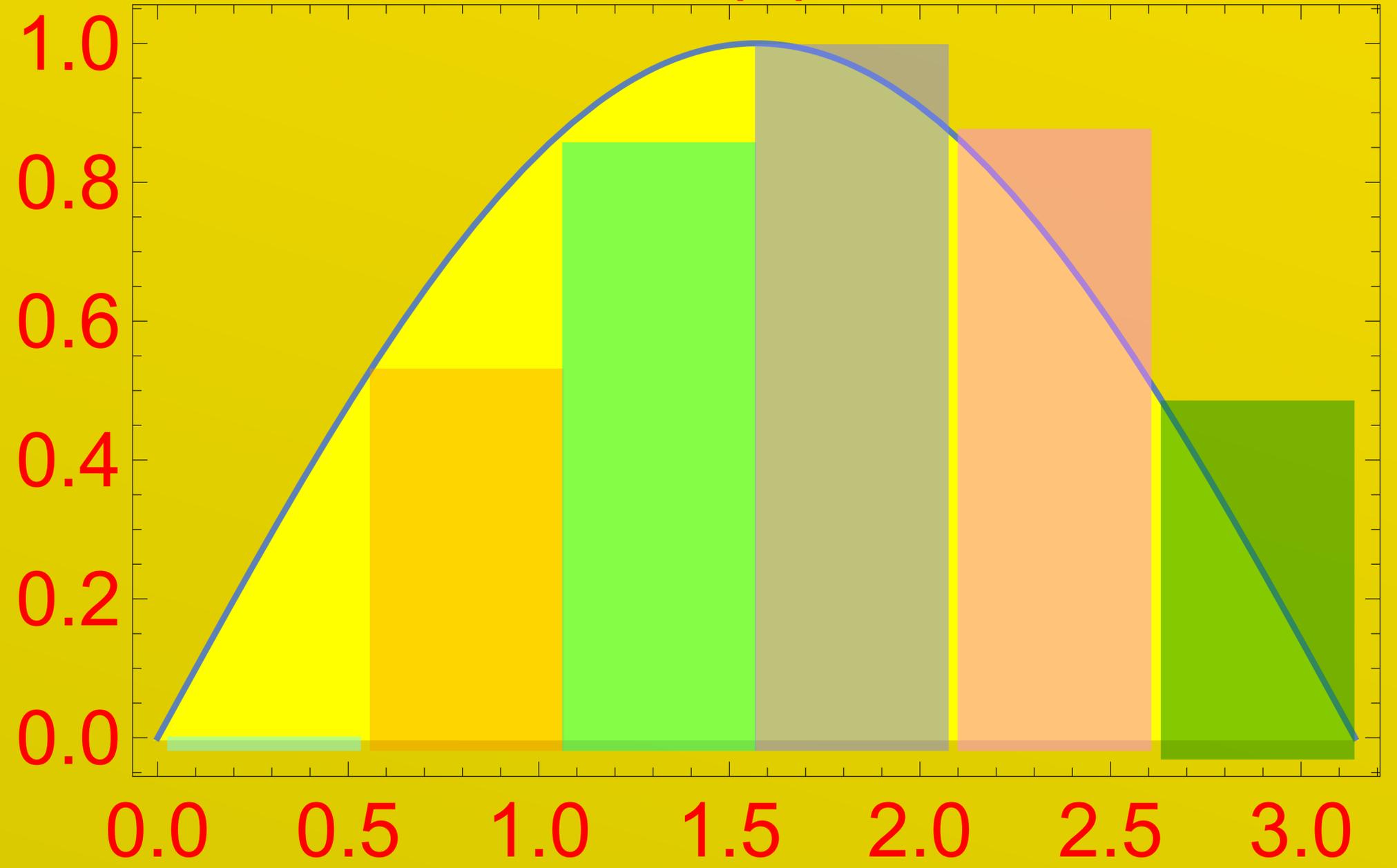
R_6

Right Riemann Sum



SUMS ARE HARD

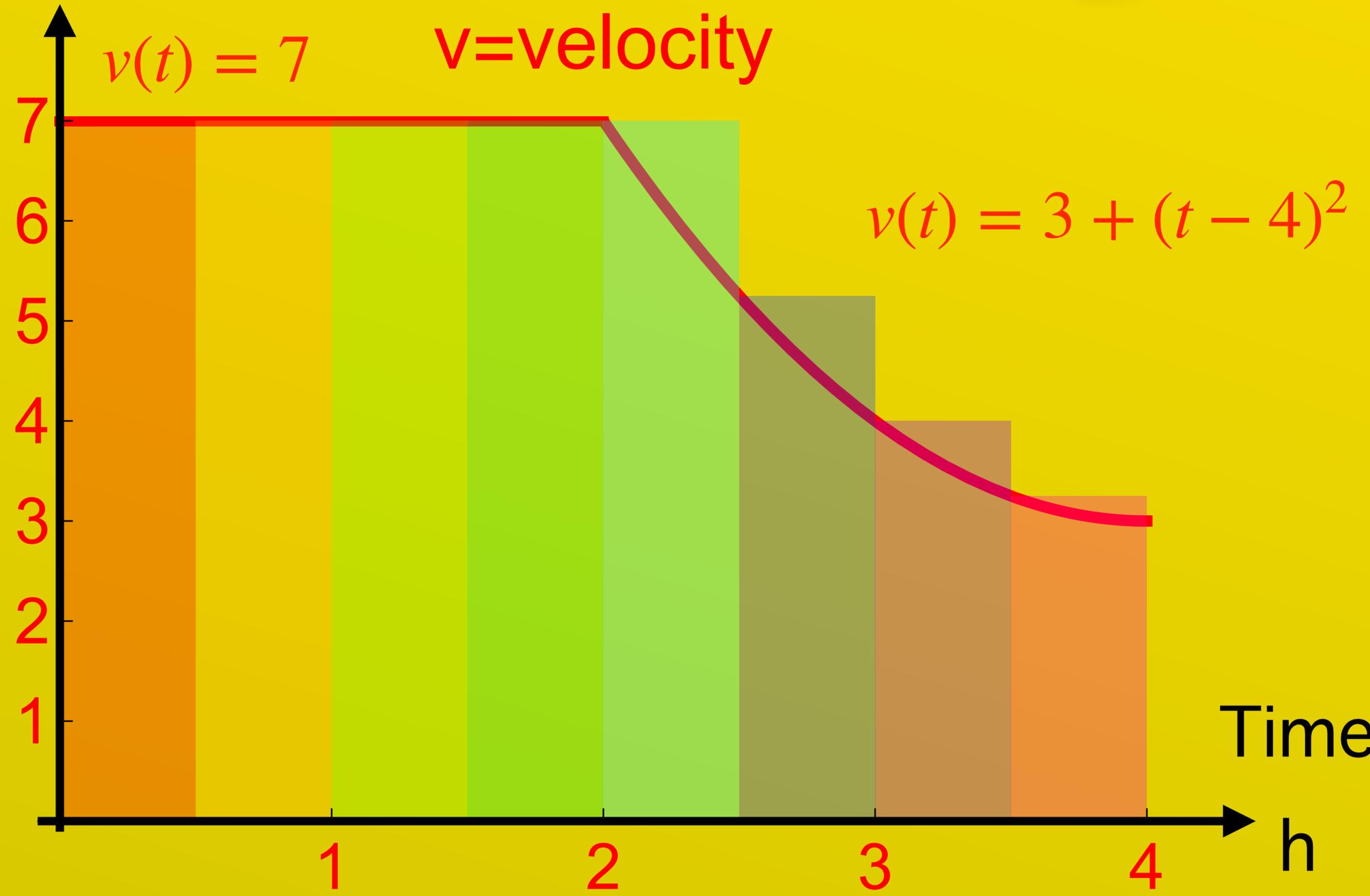
$f(x)$



Calculus will allow us to compute such sums in the limit

BOSTON RUN

m/h



How many miles did we run in 4 hours?

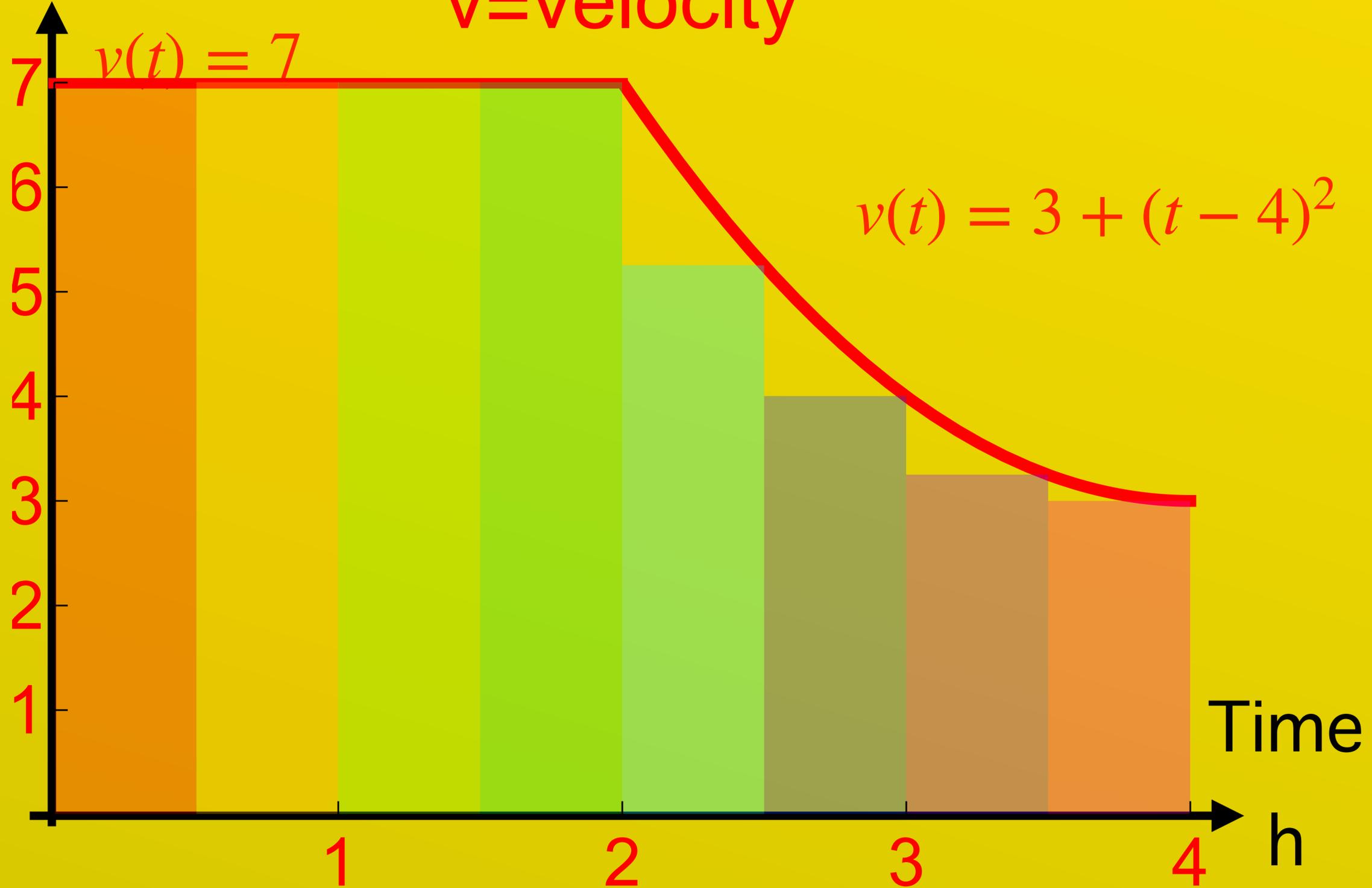
LEFT AND RIGHT

m/h

v=velocity

$$v(t) = 7$$

$$v(t) = 3 + (t - 4)^2$$





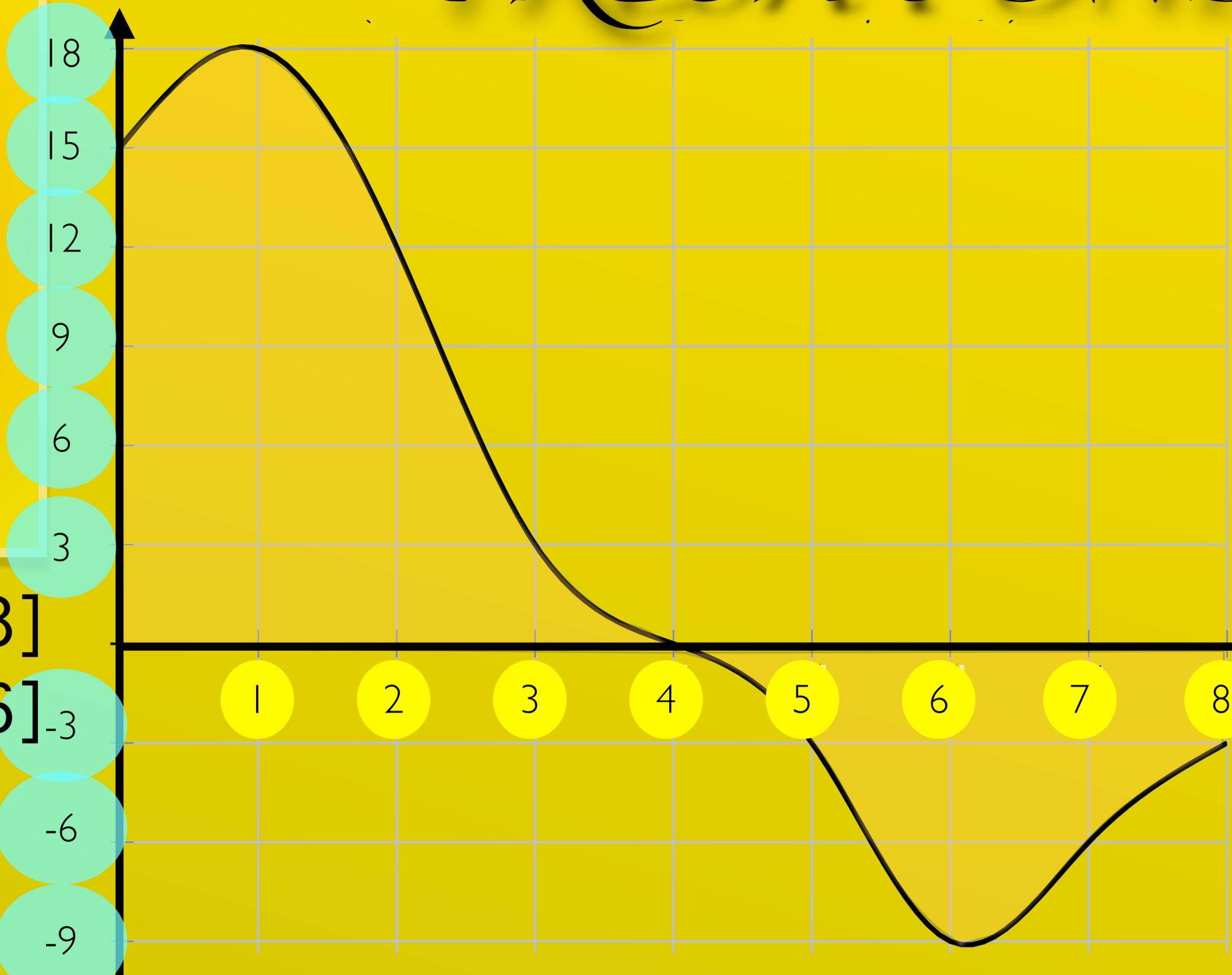
BOSTON MARATHON



2007

gallon/day

FRESH POND



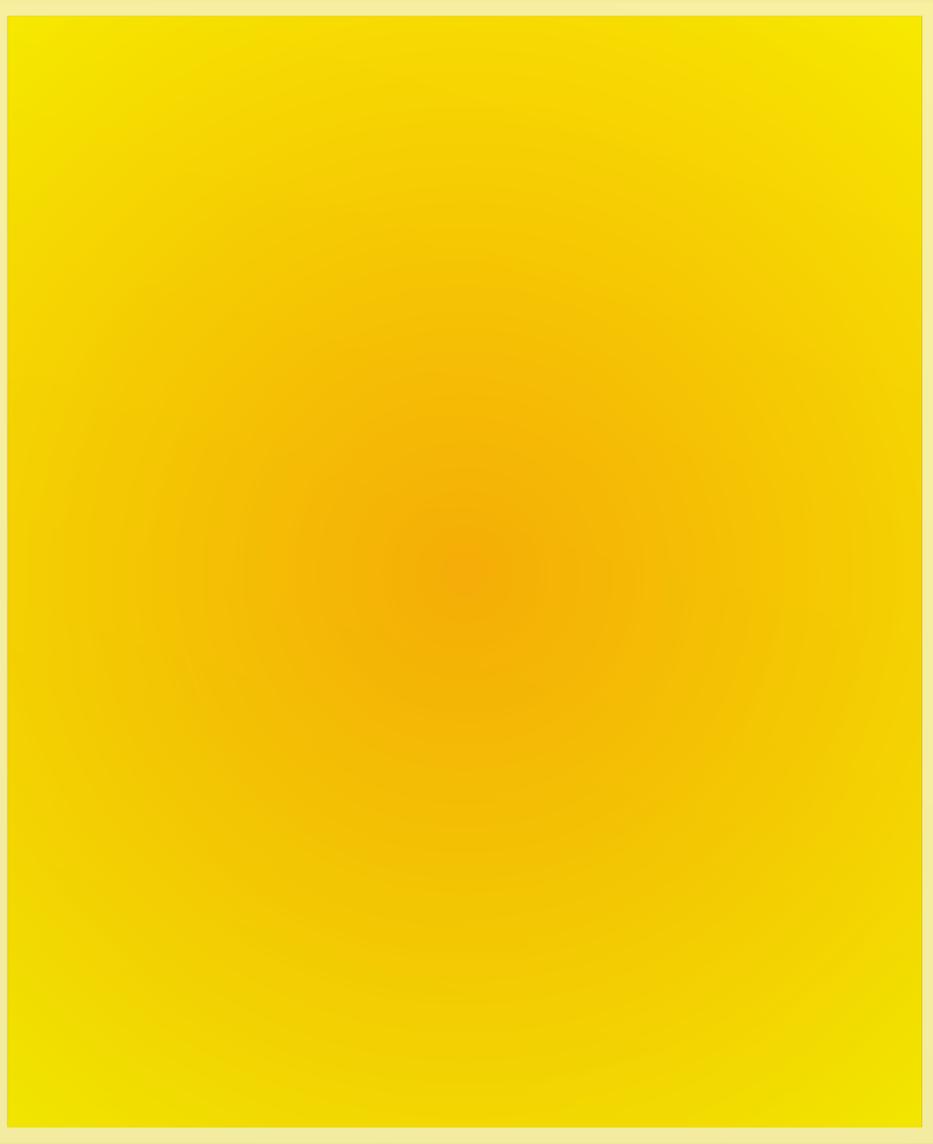
net change [0,8]

net change [3,6]

L_4 R_4

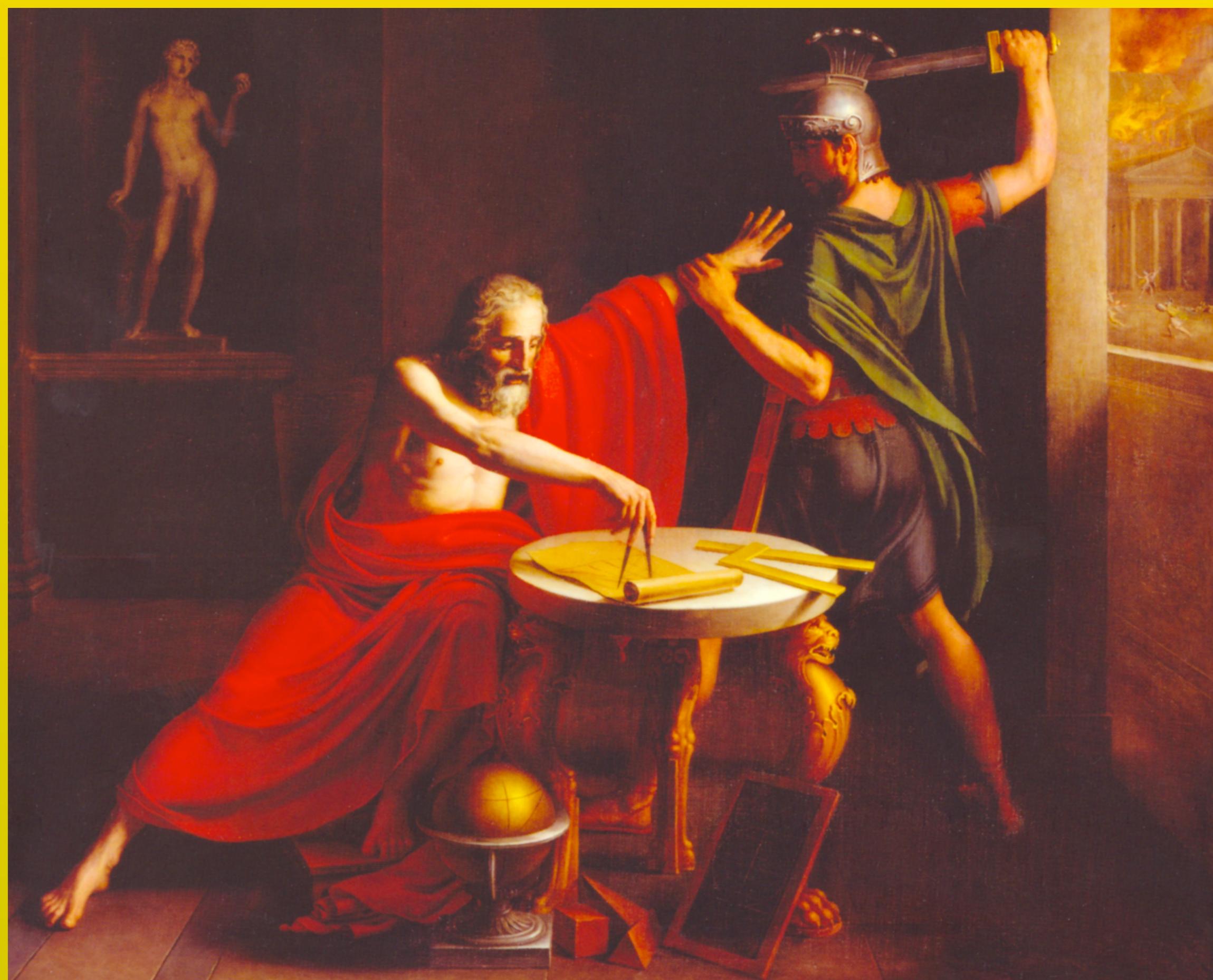
days





HISTORY

Archimedes

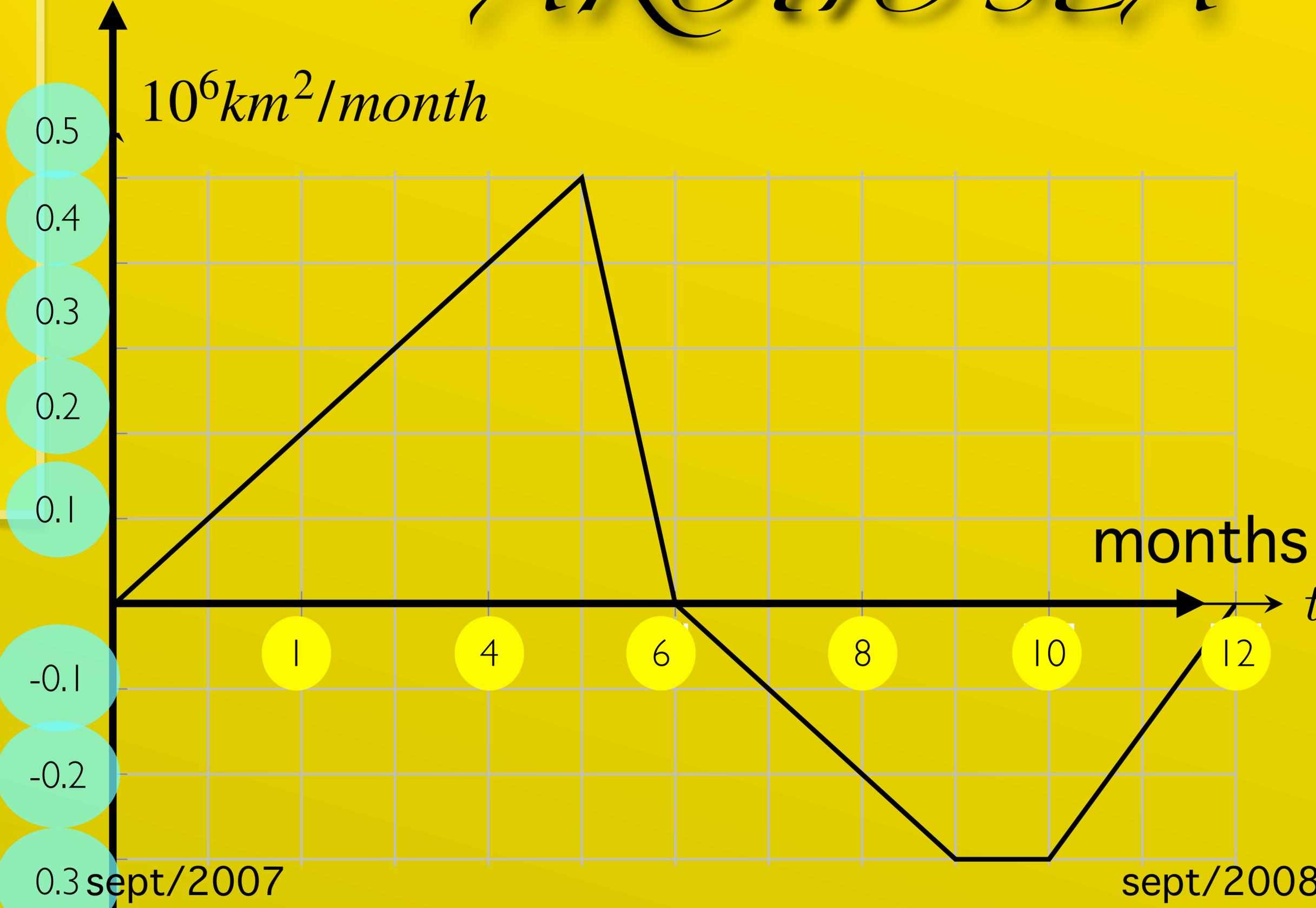




The volume of a sphere is

ARCTIC SEA

JAM



net change
from 0 to 12?

0.3 sept/2007

sept/2008



CATIME
PROJECT START

TOOLS FOR NATURAL DISASTER PLANNING

Course concepts:

- Modeling and investigating with data
- Rates of change
- Net change
- Definite Integral

Outline of the project and due dates (UPDATED 11/6):

Anticipate and Explore

Submit your responses before moving to the next section.

(Due 11/17/2020)

Analyze

Here is the [PDF version of the paper](#)  you will look at for this section.

(Due 12/1/2020)

THE END