DEVIL PHYSICS

THE BADDEST CLASS ON CAMPUS

AP PHYSICS

STUDENT OF THE WEEK

HIGHEST GRADE ON CHAPTER 1 TEST

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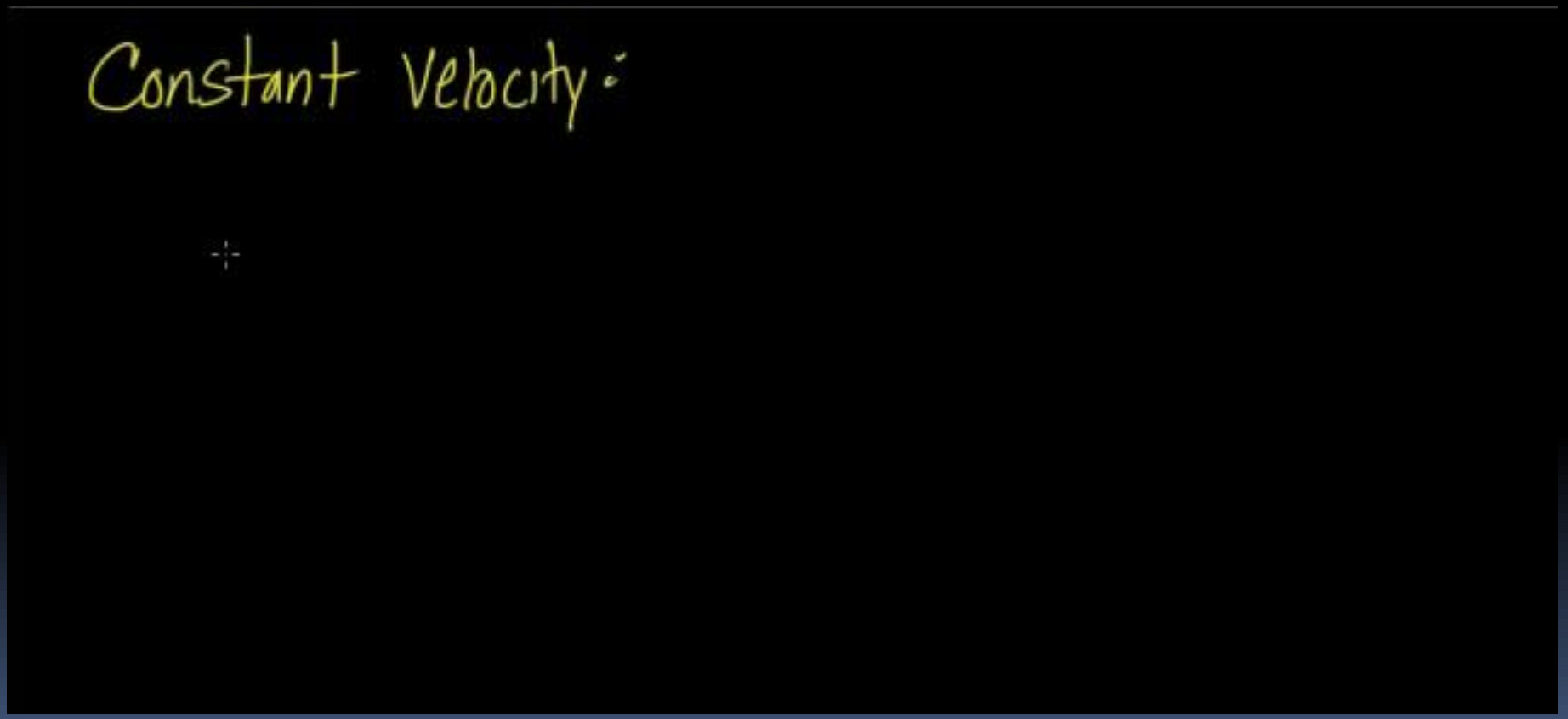
NATALIE DANNER

GIANCOLI LSN 2-8 GRAPHICAL ANALYSIS OF LINEAR MOTION

Introductory Video

Graphical Analysis of Constant Velocity



Big Idea(s):

- 3: The interactions of an object with other objects can be described by forces.
- 4: Interactions between systems can result in changes in those systems.

Enduring Understanding(s):

- 3.A: All forces share certain common characteristics when considered by observers in inertial reference frames.
- 4.A: The acceleration of the center of mass of a system is related to the net force exerted on the system, where

$$\vec{a} = \frac{\sum \vec{F}}{m}$$

Essential Knowledge(s):

- 3.A.1: An observer in a particular reference frame can describe the motion of an object using such quantities as position, displacement, distance, velocity, speed, and acceleration.
  - Displacement, velocity, and acceleration are all vector quantities.
  - Displacement is change in position. Velocity is the rate of change of position with time. Acceleration is the rate of change of velocity with time. Changes in each property are expressed by subtracting initial values from final values.
  - A choice of reference frame determines the direction and the magnitude of each of these quantities.

Essential Knowledge(s):

- 4.A.1: The linear motion of a system can be described by the displacement, velocity, and acceleration of its center of mass.

Essential Knowledge(s):

- 4.A.2: The acceleration is equal to the rate of change of velocity with time, and velocity is equal to the rate of change of position with time.
  - The acceleration of the center of mass of a system is directly proportional to the net force exerted on it by all objects interacting with the system and inversely proportional to the mass of the system.
  - Force and acceleration are both vectors, with acceleration in the same direction as the net force.

Learning Objective(s):

- (3.A.1.1): The student is able to express the motion of an object using narrative, mathematical, and graphical representations.
- (3.A.1.3): The student is able to analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations.

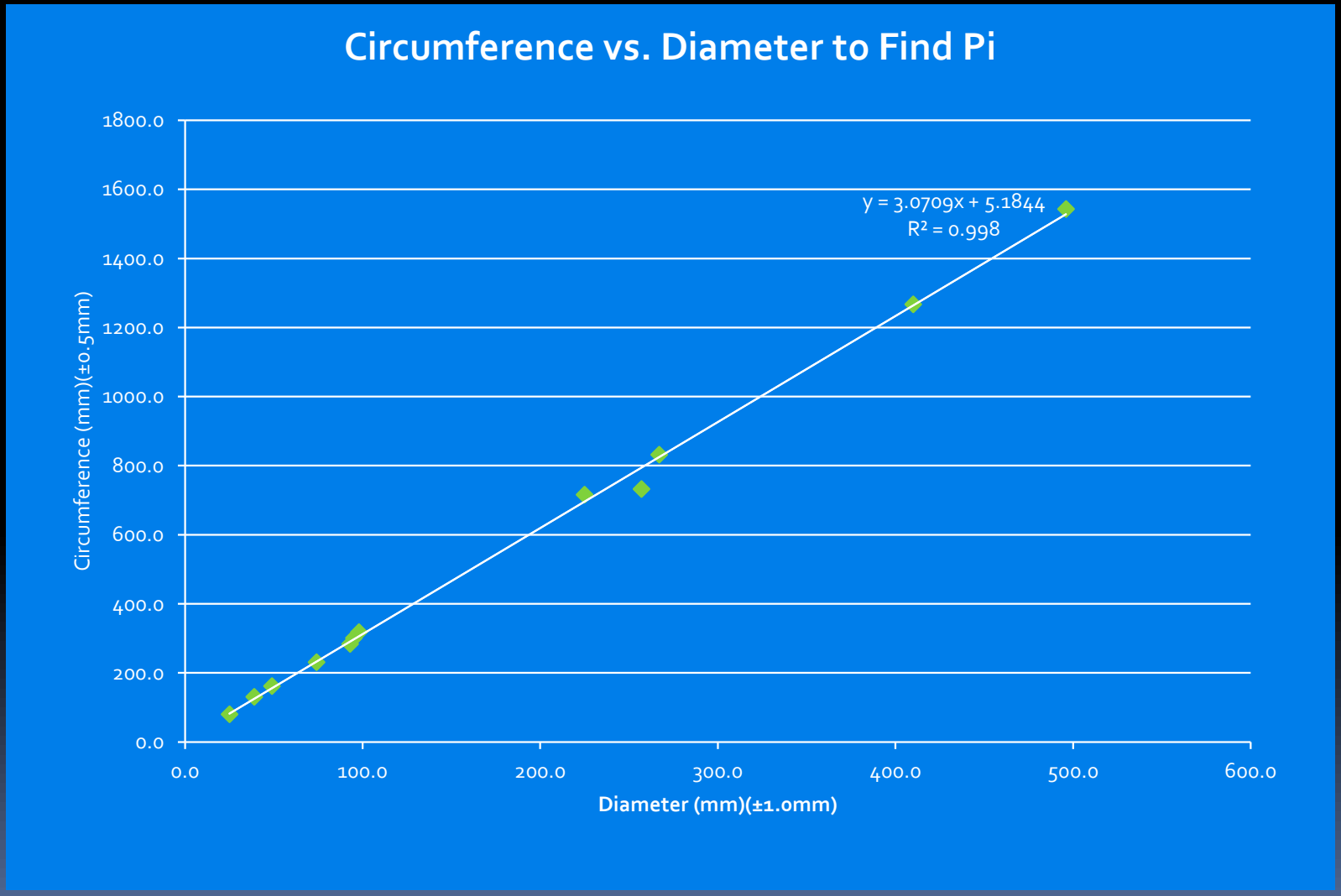
Learning Objective(s):

- (4.A.2.1): The student is able to make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time.

Learning Objective(s):

- (4.A.2.3): The student is able to create mathematical models and analyze graphical relationships for acceleration, velocity, and position of the center of mass of a system and use them to calculate properties of the motion of the center of mass of a system.

Measuring for Pi Lab



Measuring for Pi Lab

- Pi is the ratio of the circumference to the diameter
- We graphed circumference vs. diameter
- The slope of our graph was the ratio of circumference to diameter
- So, our slope was equal to Pi

$$C = \pi d$$

$$\pi = \frac{C}{d}$$

$$y = mx + b$$

$$m = \frac{rise}{run}$$

$$m = \frac{\Delta C}{\Delta d}$$

Slope

- In the equation for a line, m is the slope of the line
- Slope is a measurement of the change in the y-coordinate per unit x
- The slope of data reflects the change in the variable graphed on the y-axis ***(dependent variable)*** per unit of variable graphed on x-axis ***(independent variable)***

$$y = mx + b$$

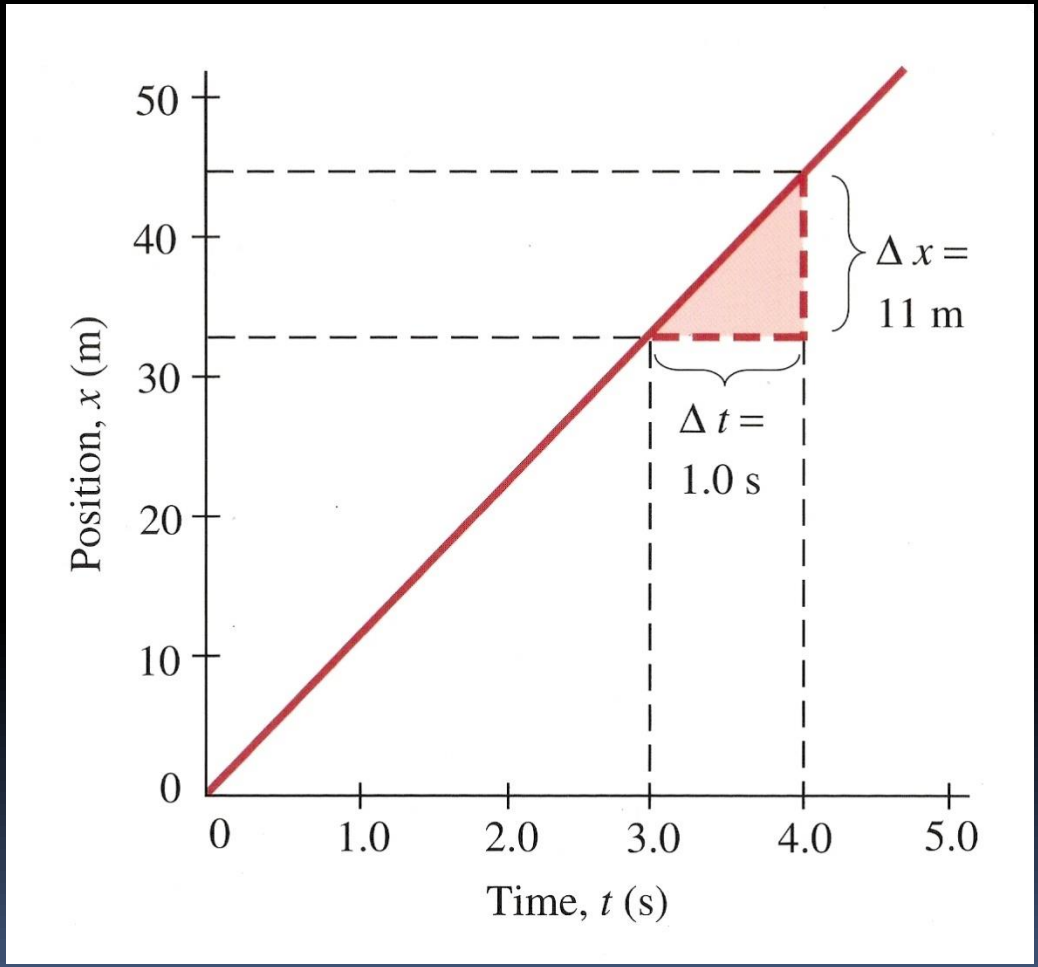
$$m = \frac{rise}{run}$$

$$m = \frac{\Delta y}{\Delta x}$$

Graphical Analysis

- Three main things you can get from a graph:
  - Individual data points
  - Slope – rate of change of y-variable per unit change of x-variable
  - Area under the curve – equal to the product of the change in the y-variable and the change in the x-variable

Position vs. Time Graph Constant Velocity



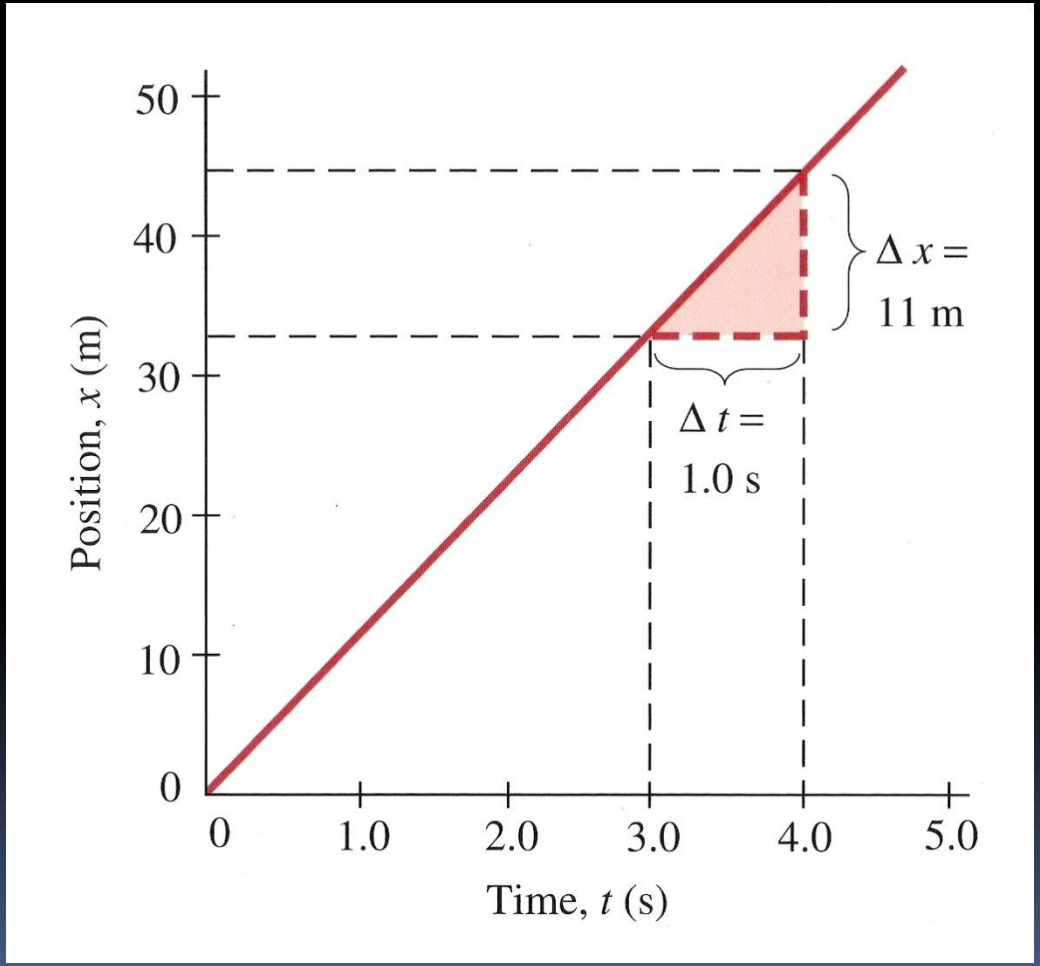
Position vs. Time Graph Constant Velocity

$$m = \frac{\Delta y}{\Delta x}$$

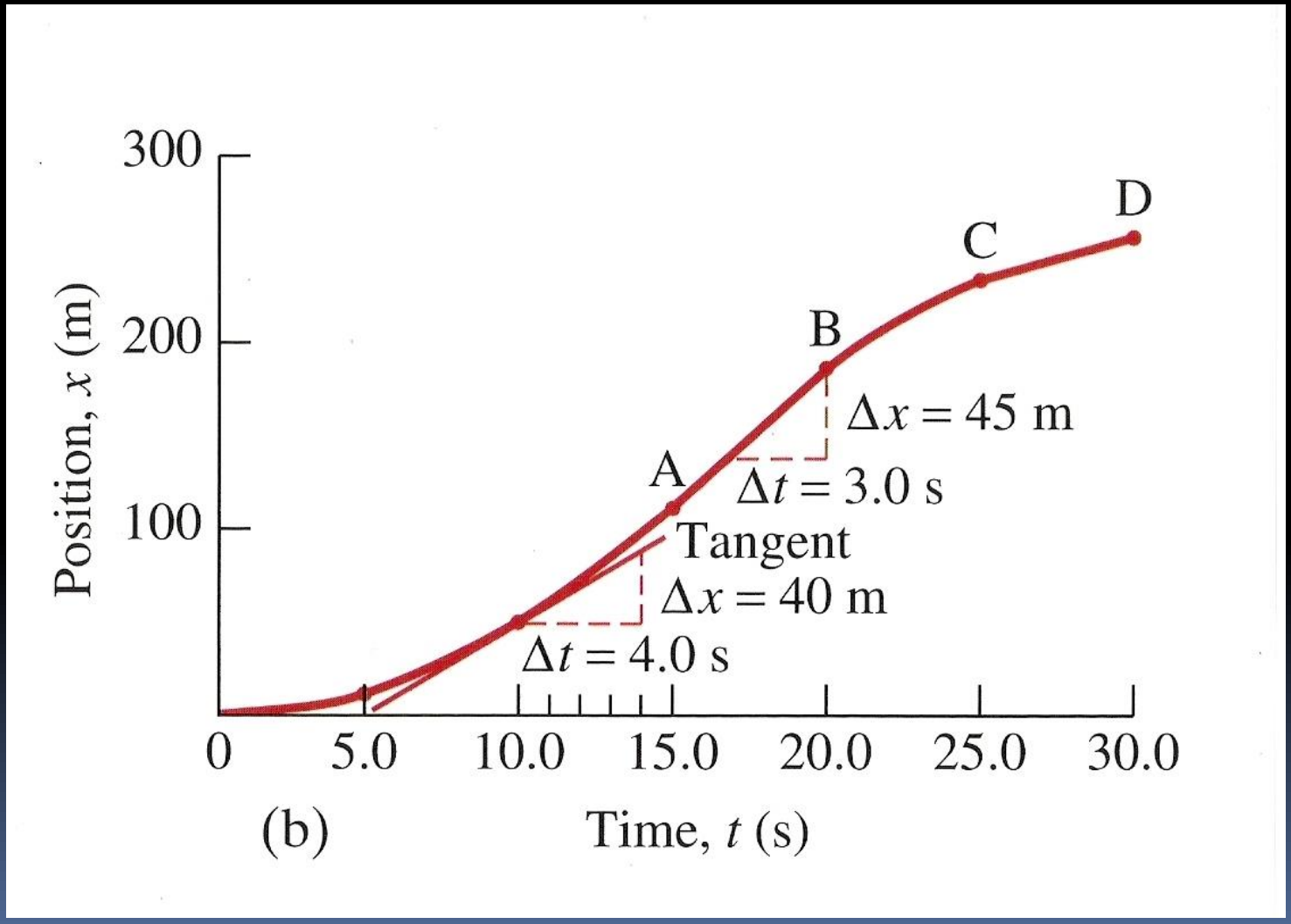
$$m = \frac{\Delta x}{\Delta t}$$

$$\bar{v} = \frac{x - x_0}{t - t_0} = \frac{\Delta x}{\Delta t}$$

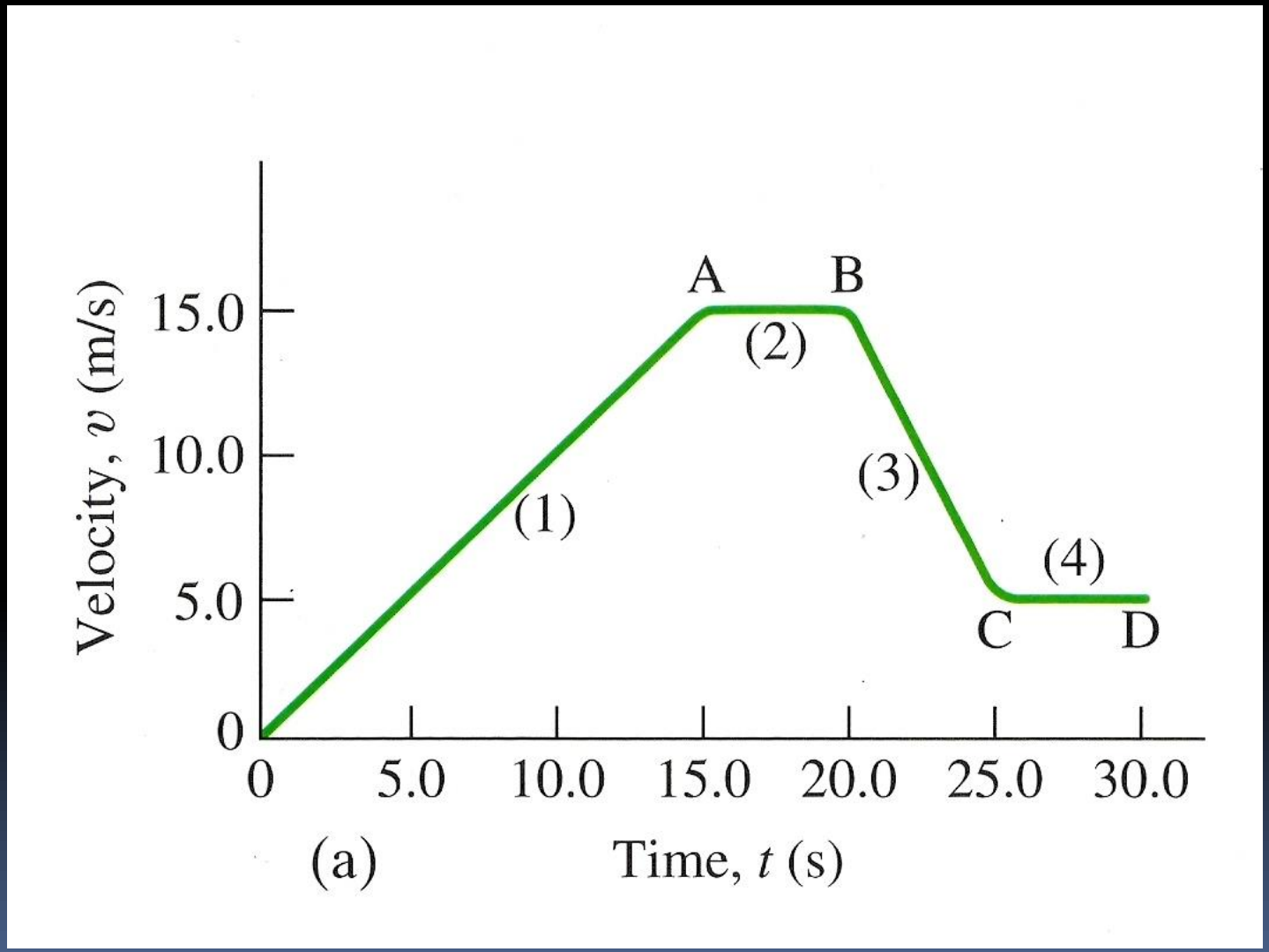
$$\bar{v} = m$$



Position vs. Time Graph Variable Velocity



Velocity vs. Time Graph



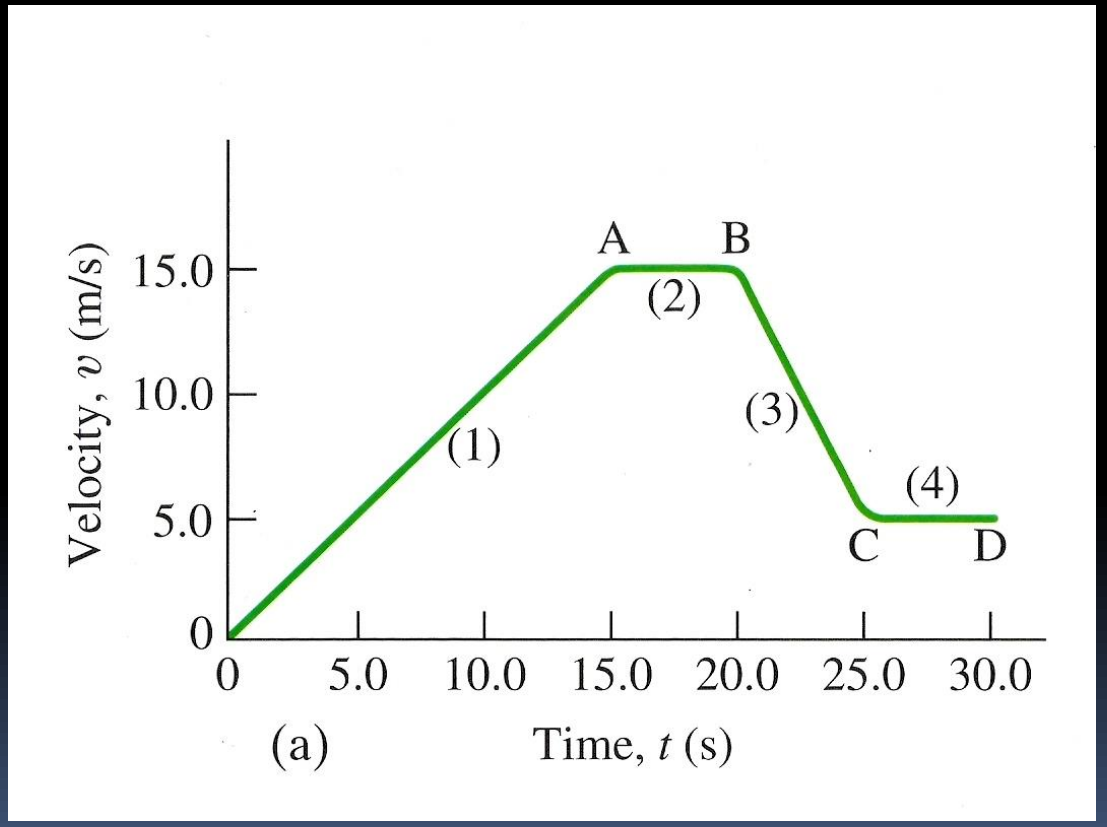
Velocity vs. Time Graph

$$m = \frac{\Delta y}{\Delta x}$$

$$m = \frac{\Delta v}{\Delta t}$$

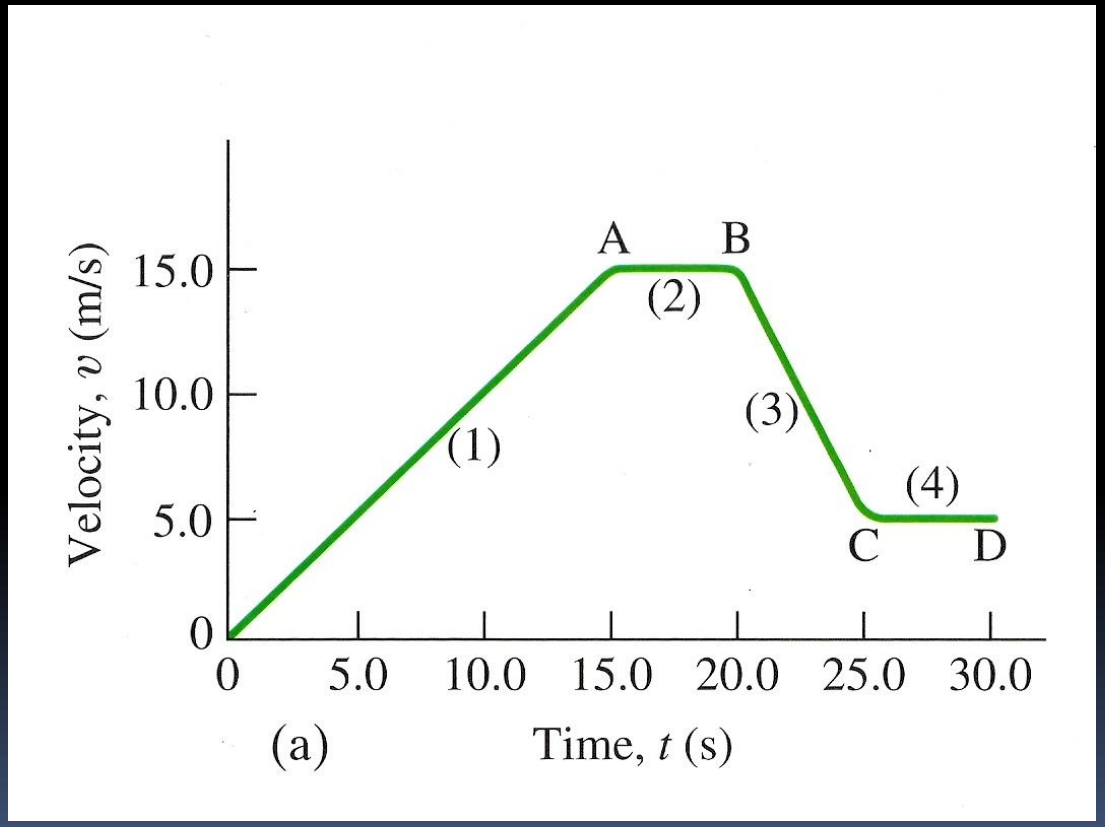
$$\bar{a} = \frac{v - v_0}{t - t_0} = \frac{\Delta v}{\Delta t}$$

$$\bar{a} = m$$



Velocity vs. Time Graph

What is the average acceleration from B to C?



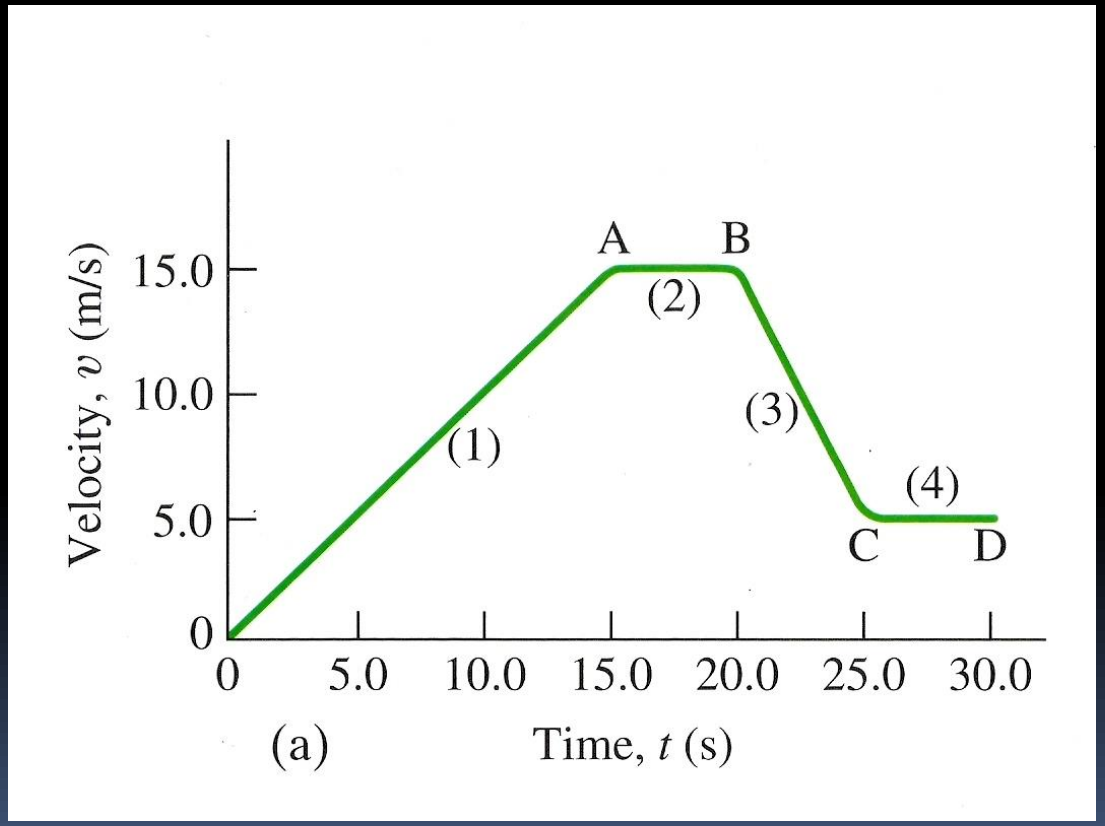
Velocity vs. Time Graph

What is the average acceleration from B to C?

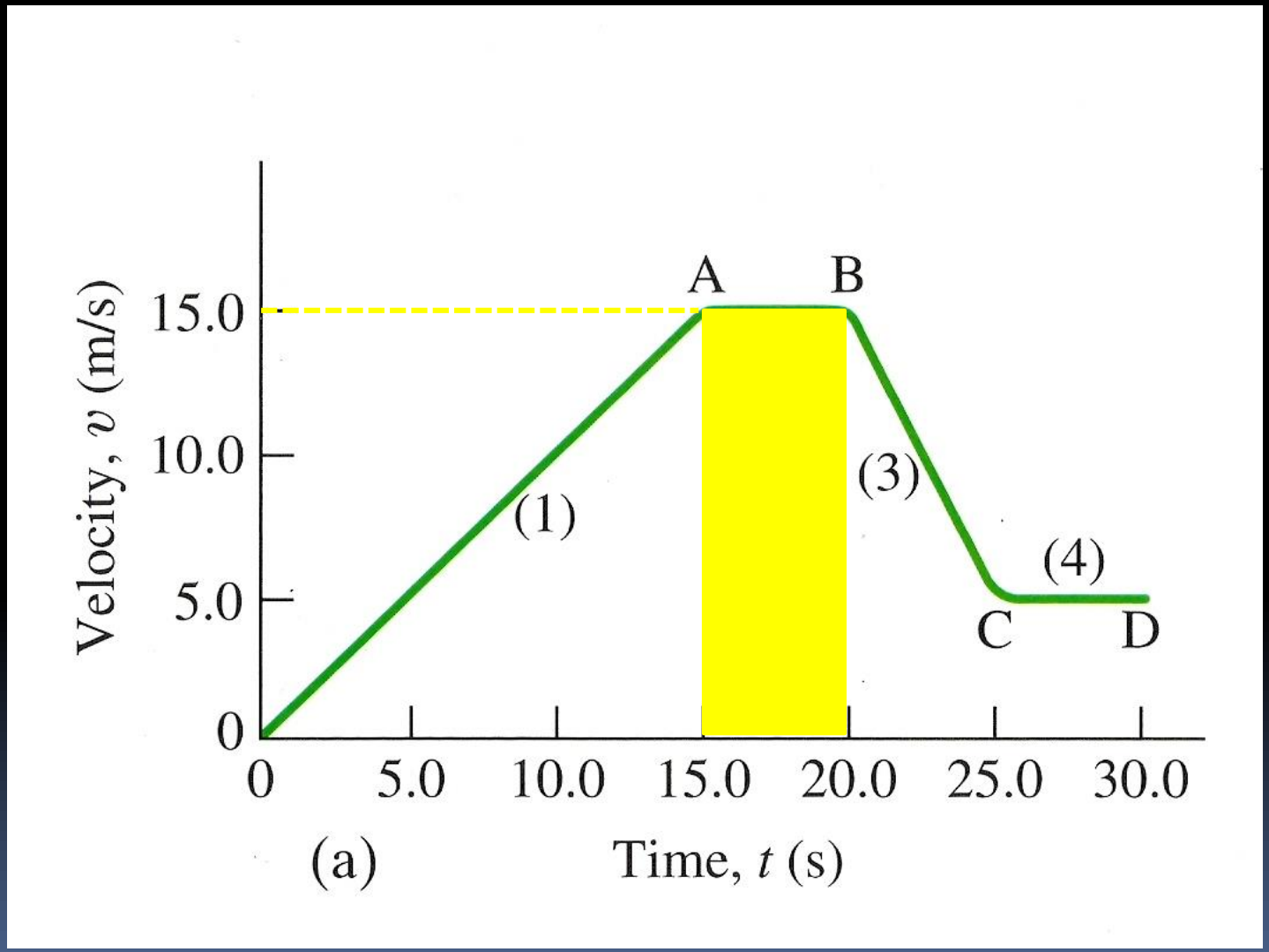
$$\bar{a} = \frac{v - v_0}{t - t_0}$$

$$\bar{a} = \frac{5 - 15}{25 - 20}$$

$$\bar{a} = -2\,m/s^2$$



Velocity vs. Time Graph



Velocity vs. Time Graph

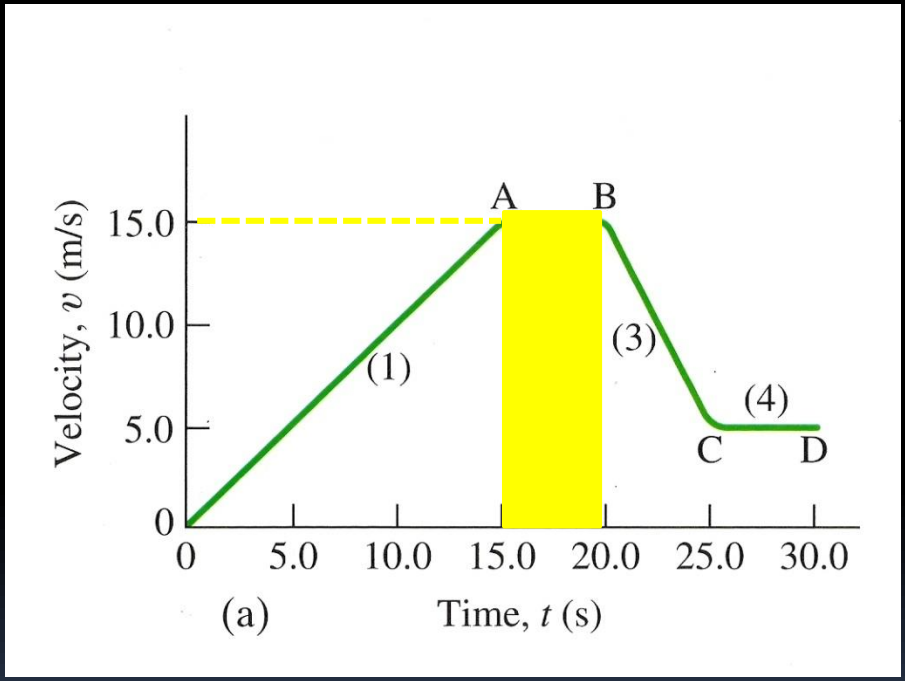
$$A = bh$$

$$A = (5s)(15m/s) = 75m$$

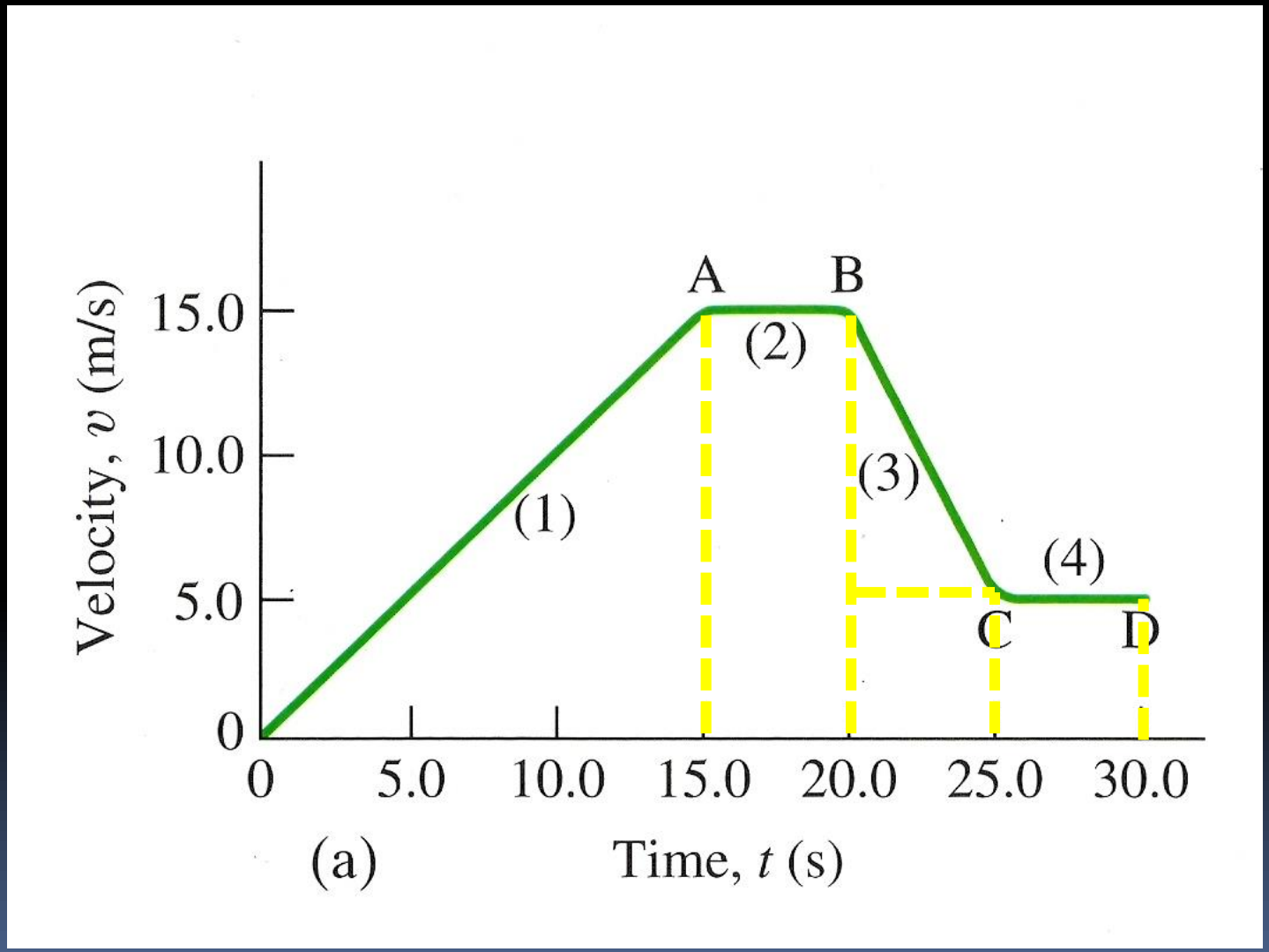
$$A = (time)(velocity)$$

$$\bar{v} = \frac{\Delta x}{\Delta t}$$

$$\Delta x = (\Delta t)(\bar{v})$$

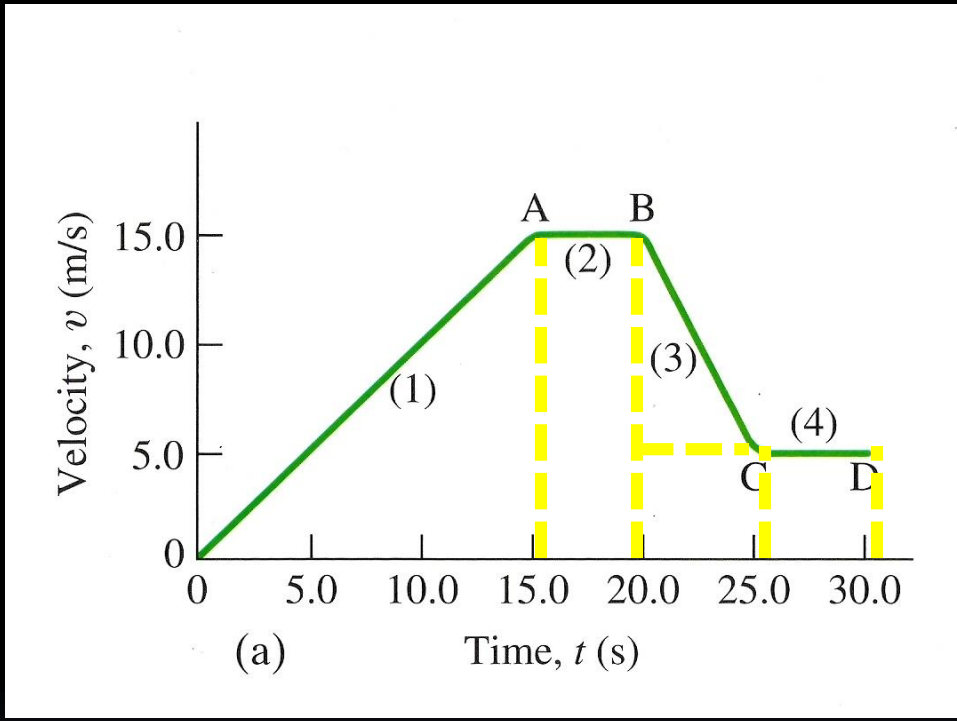


Velocity vs. Time Graph



Velocity vs. Time Graph

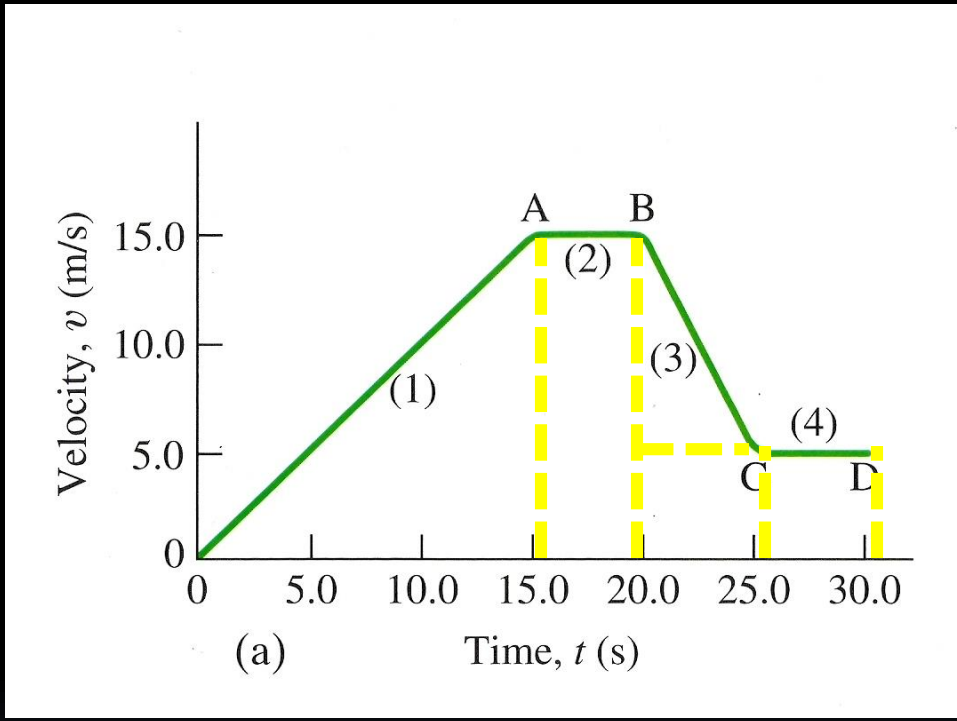
What is the total displacement from 0 to 30.0 seconds?



Velocity vs. Time Graph

What is the total displacement from 0 to 30.0 seconds?

262.5 m



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QUESTIONS

Homework

- #49-56