



Kinematics Unit Outline

- I. Vectors
- II. Six Definitions:
Distance, Position, Displacement,
Speed, Velocity, Acceleration
- III. Two Equations:
Velocity, Displacement
- IV. Freefall

Speed and Velocity

Motion: How fast?

	The student will be able to:	HW:
1	Define and distinguish the concepts scalar and vector. Make the connection between the visual representation of a vector and its numerical representation of magnitude and direction angle.	
2	Define, distinguish, and apply the concepts: distance, displacement, position.	 1, 2
3	Define, distinguish, and apply the concepts: average speed, instantaneous speed, constant speed, average velocity, instantaneous velocity, constant velocity.	3 – 7
4	Define, distinguish, and apply the concepts: average acceleration and instantaneous acceleration, and constant acceleration.	8 – 16
5	State the displacement and velocity relations for cases of constant acceleration and use these to solve problems given appropriate initial conditions and values.	17 – 28
6	State and use the conditions of freefall, including the value of g , to solve associated problems.	29 – 41

Definitions:

- **Speed** is the time rate of change in distance.
Symbol: v
Speed is a scalar quantity that indicates how rapidly an object moves along its path of travel.
- **Velocity** is the time rate of change in position.
Symbol: \vec{v}
Velocity is a vector quantity indicating how rapidly an object is moving and in what direction. (speed and direction)

Average Speed:

$$v_{avg} = \frac{d}{t}$$

$$v_{avg} = \frac{\Delta d}{\Delta t}$$

Average Velocity:

$$\vec{v}_{avg} = \frac{\vec{d}}{t}$$

$$\vec{v}_{avg} = \frac{\Delta \vec{r}}{\Delta t}$$

Constant Speed and Velocity

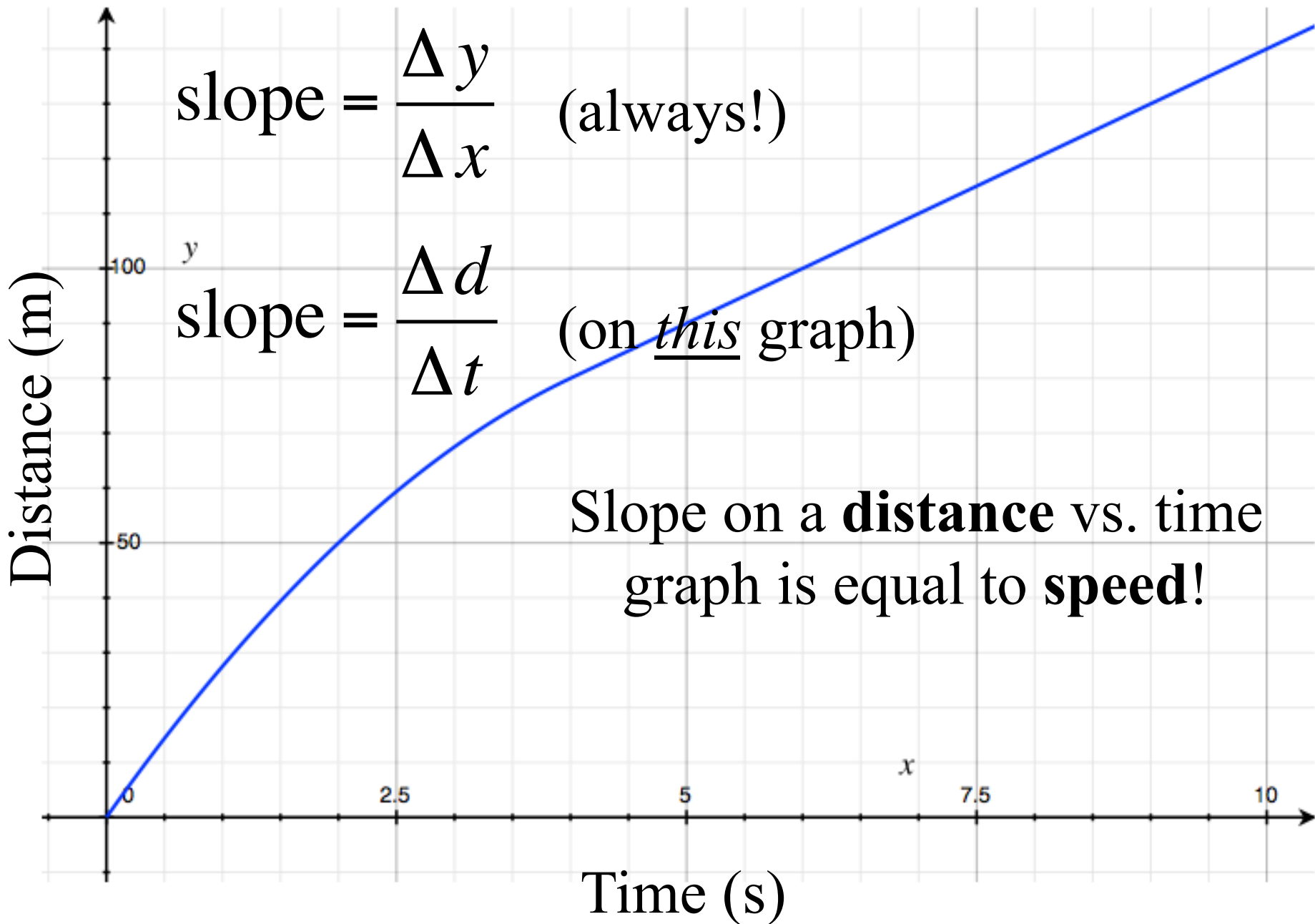
$$v = \frac{d}{t} \qquad \vec{v} = \frac{\vec{d}}{t}$$

Valid **ONLY** if the ratio of change is constant!

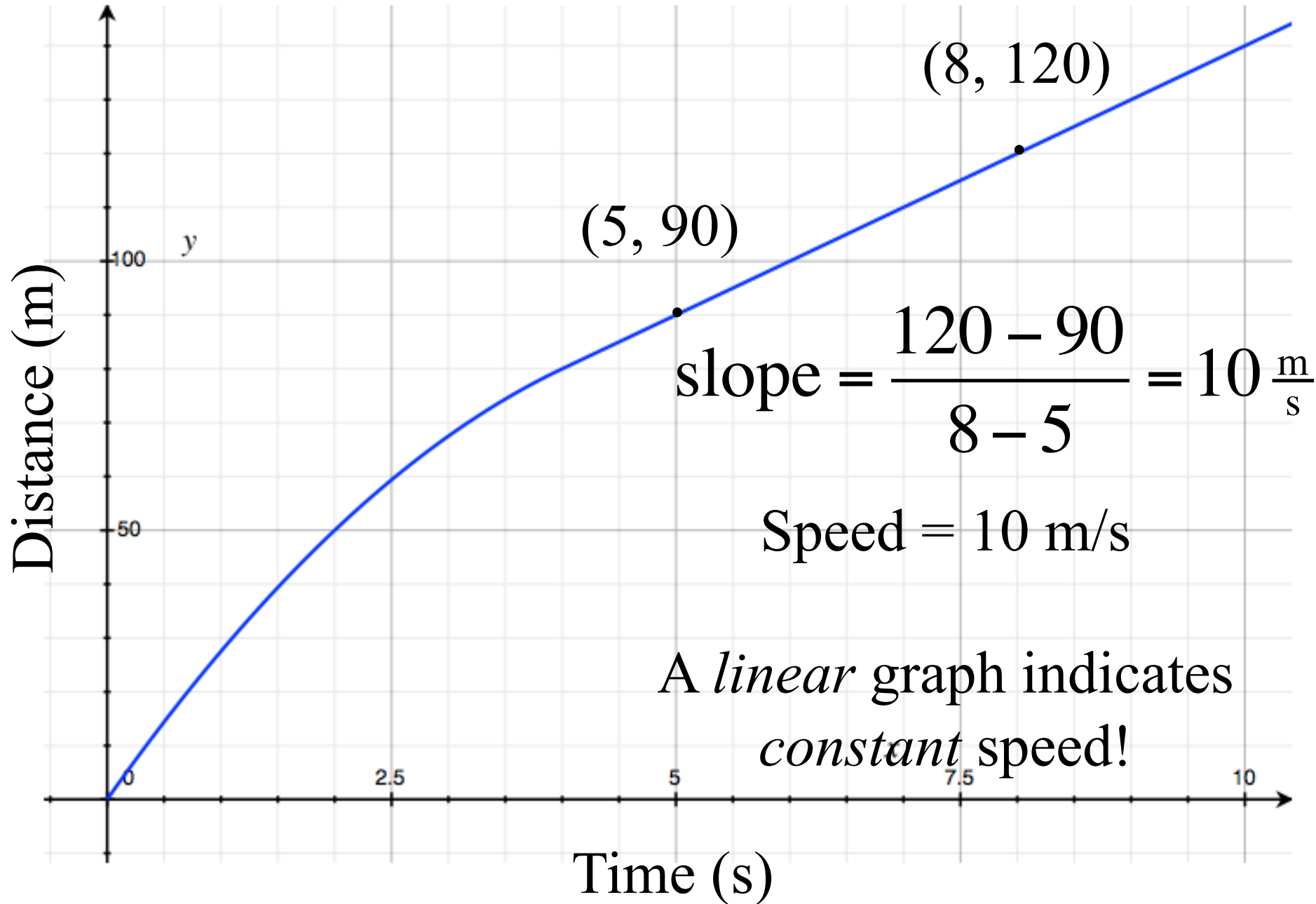
Constant Speed or Velocity

- “Constant speed” means the ratio of change in distance to time is constant.
(Object moves the same number of meters every second.)
- “Constant velocity” means the ratio of change in position to time is constant.
(Object moves the same number of meters in the *same direction* every second.)

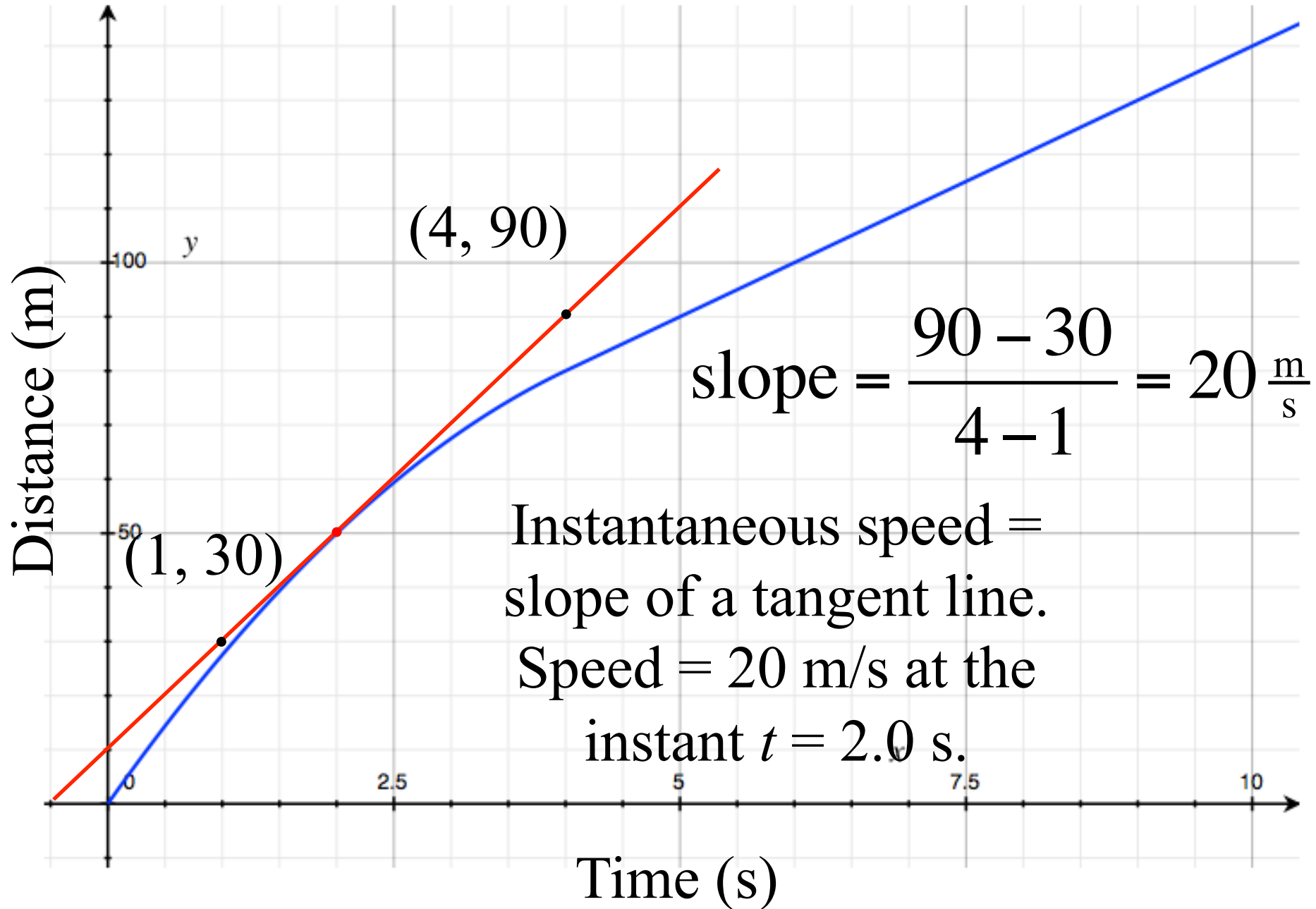
Distance vs. Time



Distance vs. Time



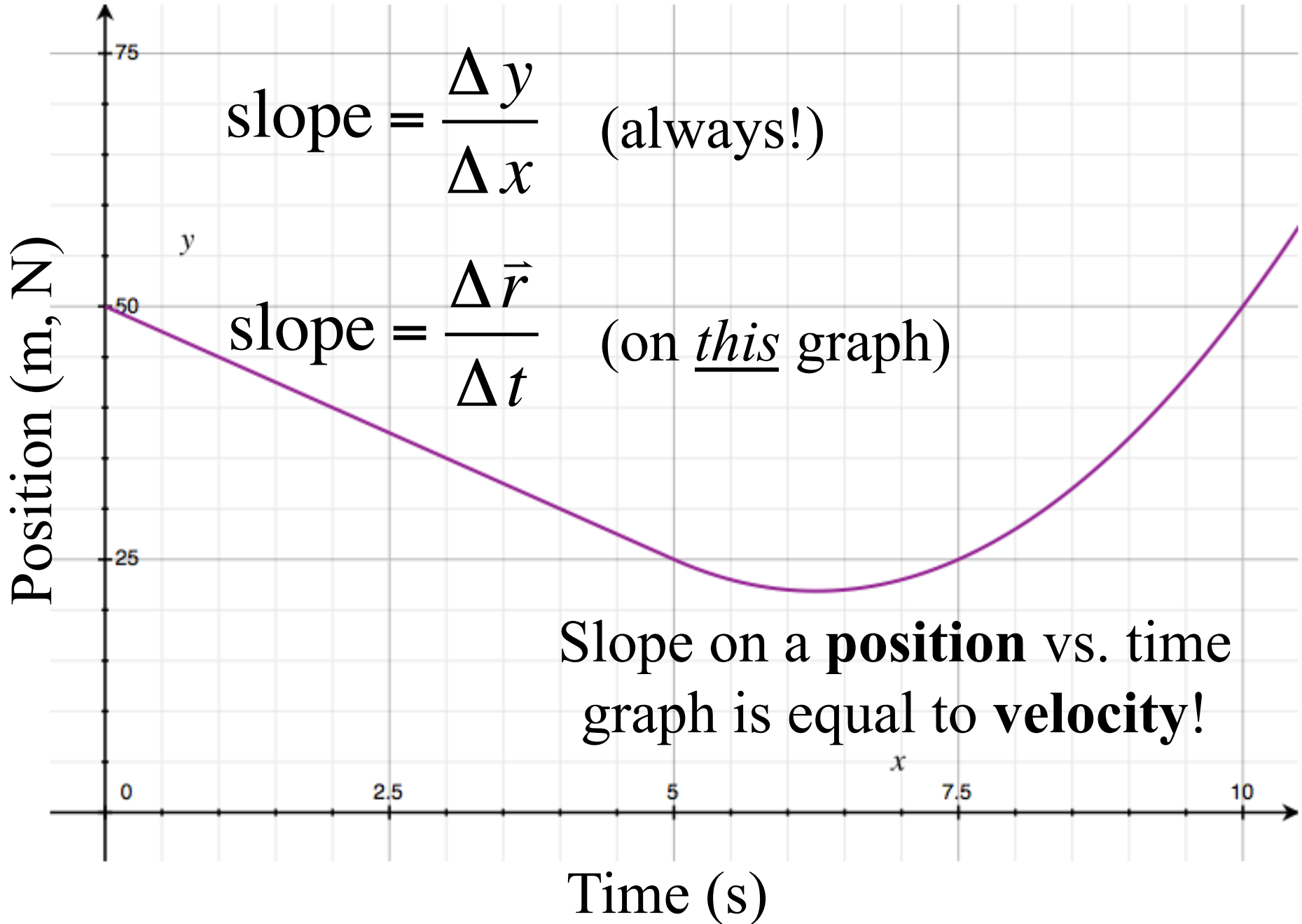
Distance vs. Time



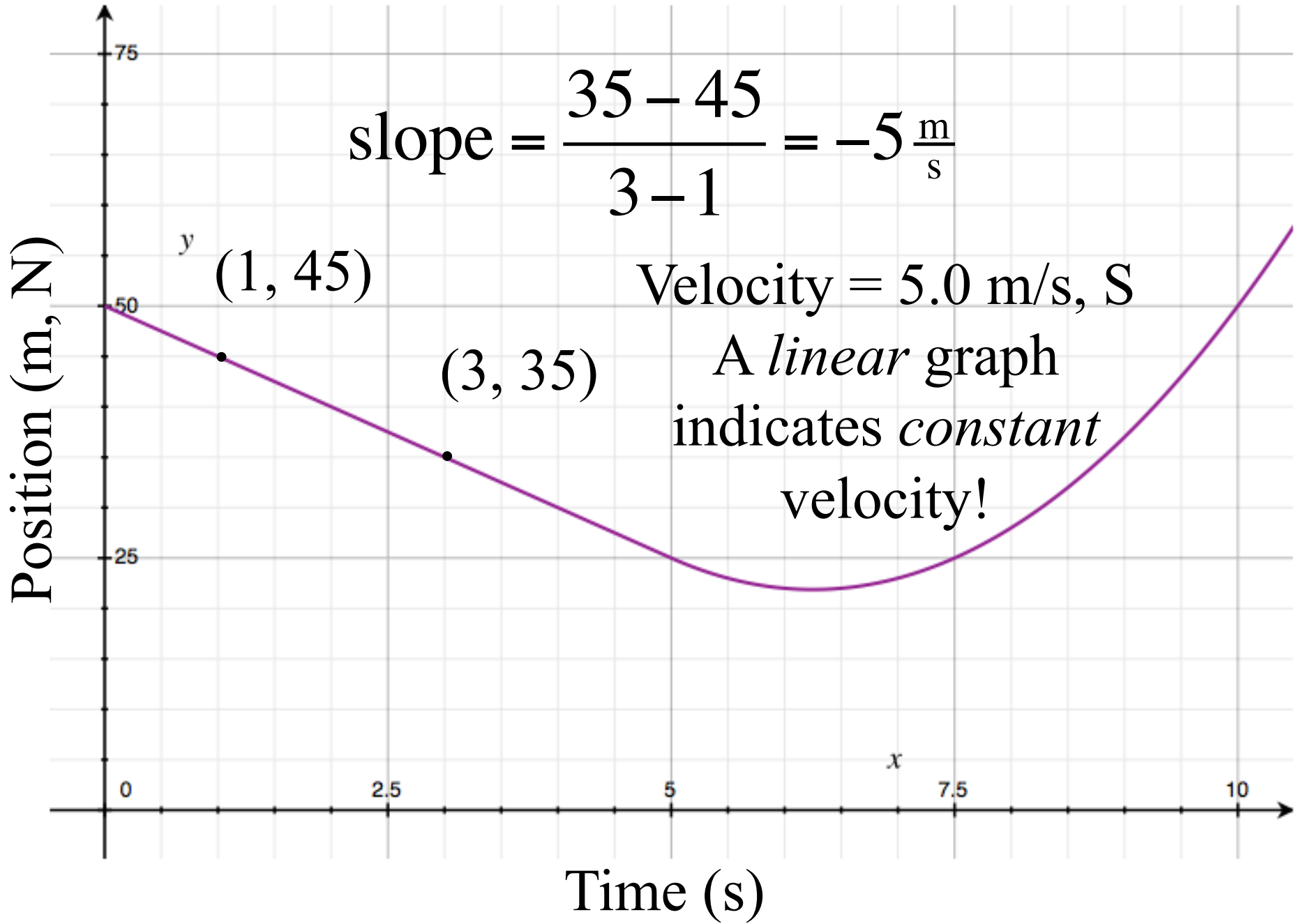
Position vs. Time

$$\text{slope} = \frac{\Delta y}{\Delta x} \quad (\text{always!})$$

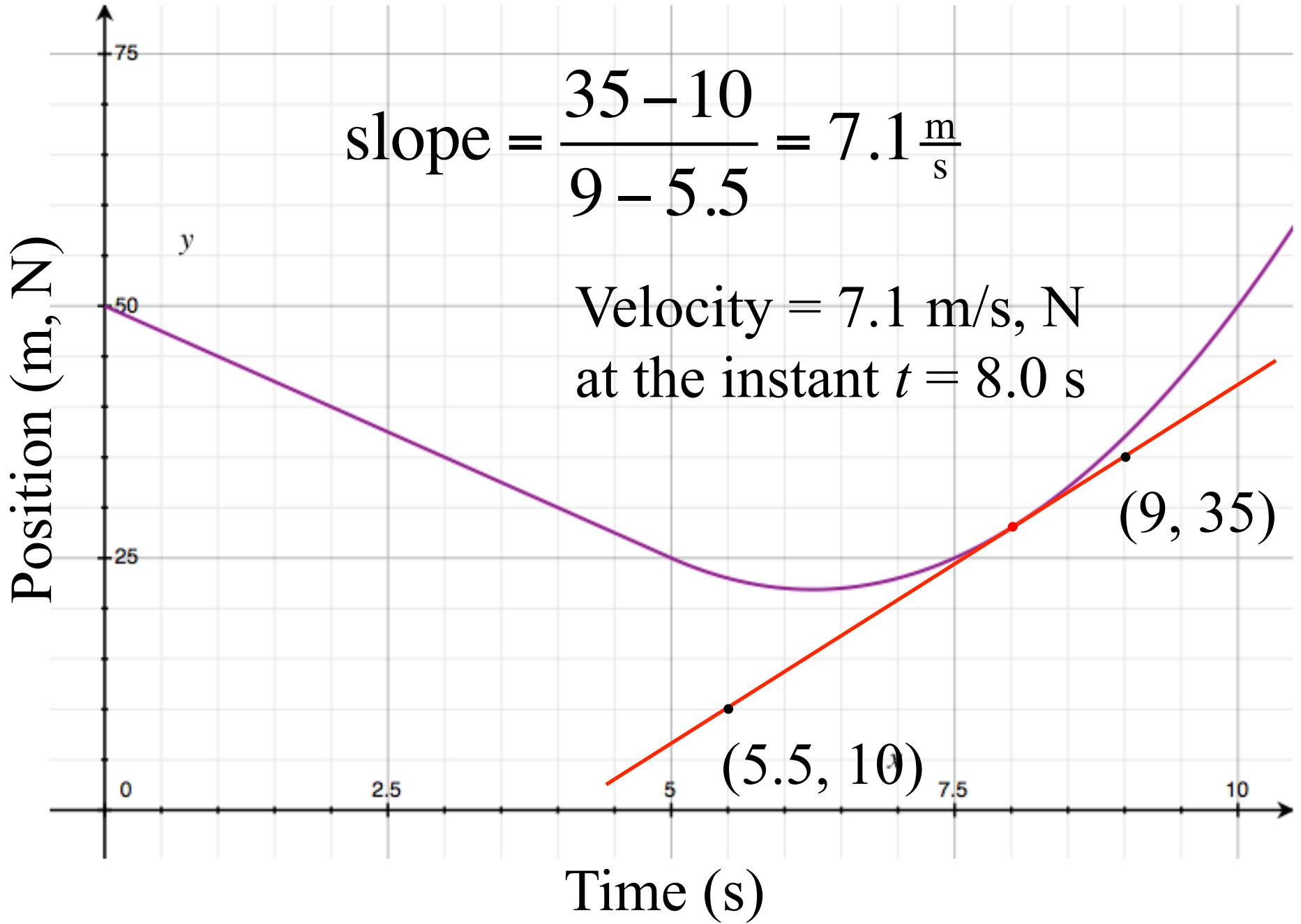
$$\text{slope} = \frac{\Delta \vec{r}}{\Delta t} \quad (\text{on this graph)}$$



Position vs. Time



Position vs. Time



$$\text{slope} = \frac{35 - 10}{9 - 5.5} = 7.1 \frac{\text{m}}{\text{s}}$$

Velocity = 7.1 m/s, N
at the instant $t = 8.0 \text{ s}$

$(9, 35)$

$(5.5, 10)$

Position (m, N)

Time (s)

Position vs. Time

