Calculus Lesson Unit 7

Class Worksheet

Related Rates

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Examples:

1. Given any distance, s, say from a moveable point A on a line to a fixed point B on the line, the derivative ds/dt is the rate that s is changing (the velocity of point A). If s is measured in feet and t is measured in seconds, then ds/dt would be measured in feet per second.

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Examples:

2. Given any volume, V, say of water in a tank,

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Notation: If x represents any variable quantity, then the derivative dx/dt represents the rate that x is changing.

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2. Given any volume, V, say of water in a tank, the derivative dV/dt is the rate that this volume is changing (the rate that water is being added to the tank).

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Solving Related Rate Problems:

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Step 1: Analyze the problem stating clearly which rate(s) you are given and which rate(s) you are asked to find.

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Step 4: Solve the equation for the desired rate in terms of the other rates and/or variables.

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Step 4: Solve the equation for the desired rate in terms of the other rates and/or variables.

Step 5. Substitute in the current values of the rates and/or variables to find the desired result.

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Sample Problem:

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A 20-foot ladder stands upright against a vertical wall.
If the lower end of the ladder is pulled away from the wall (on level ground) at the rate of 2 feet per second (fps), then how fast is the top of the ladder coming down the wall at the instant it is 12 feet above the ground?

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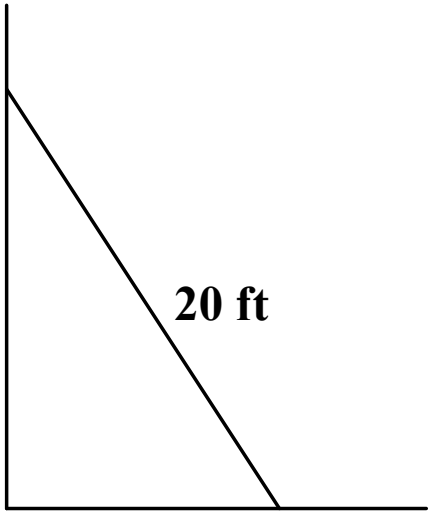

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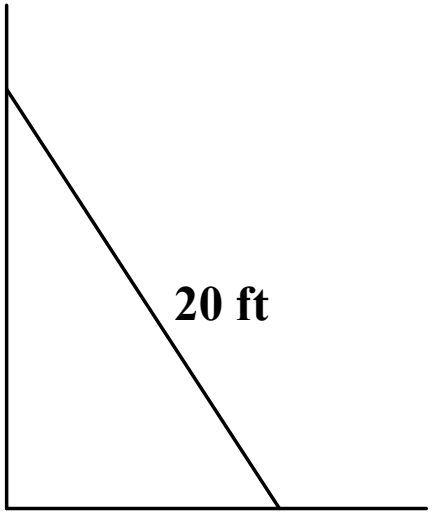

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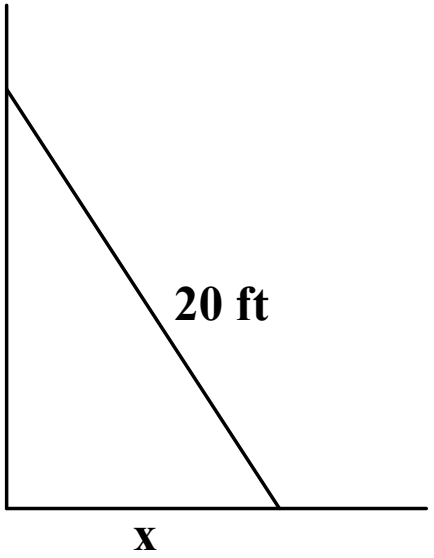

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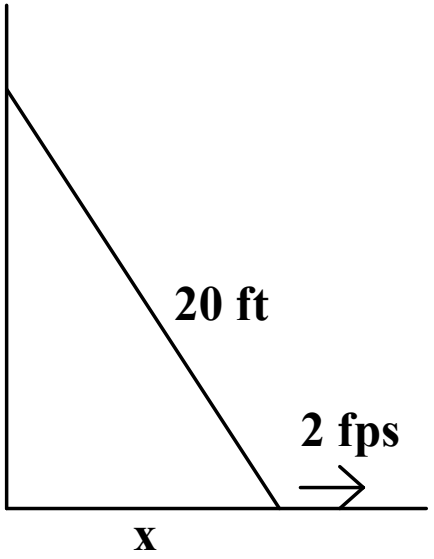

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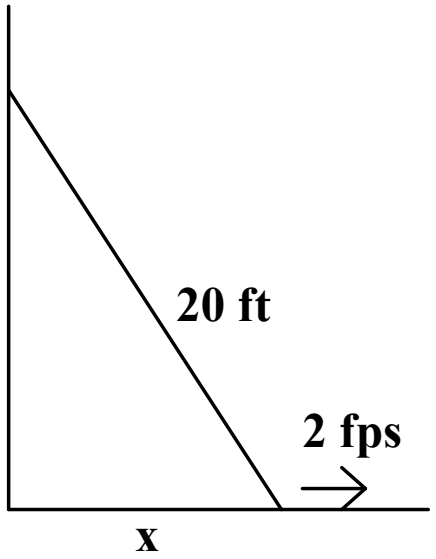

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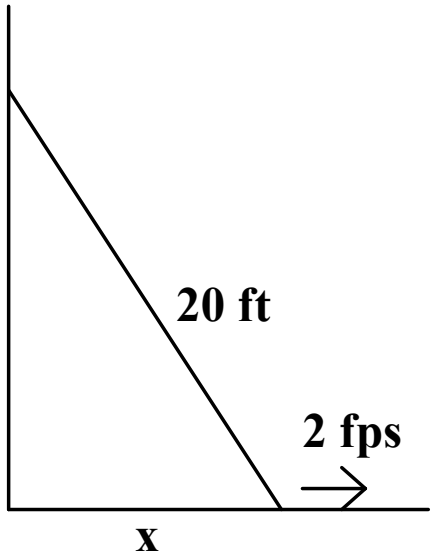

Given: dx/dt =

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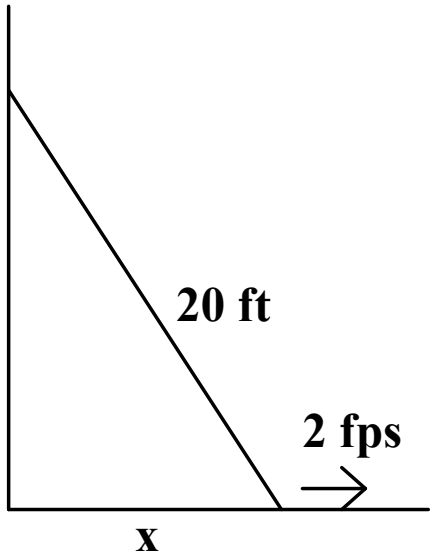

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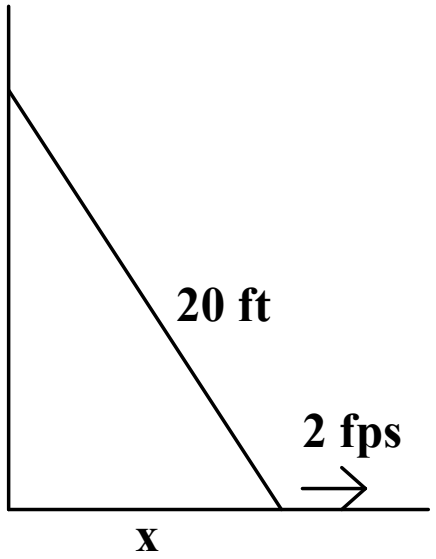

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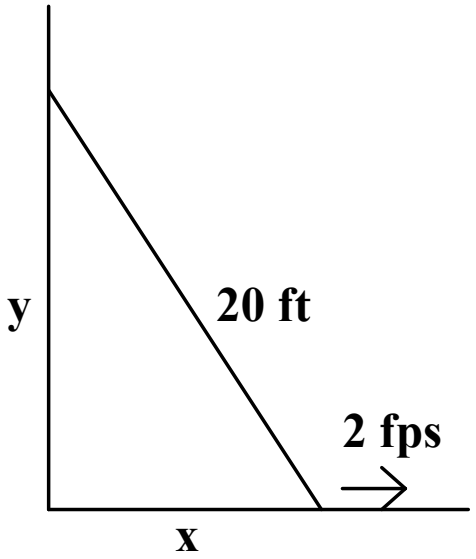

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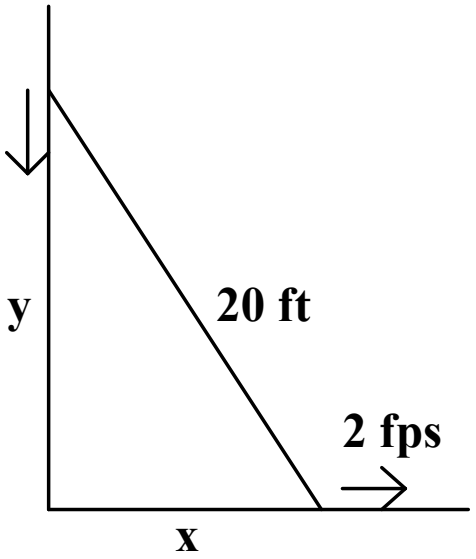

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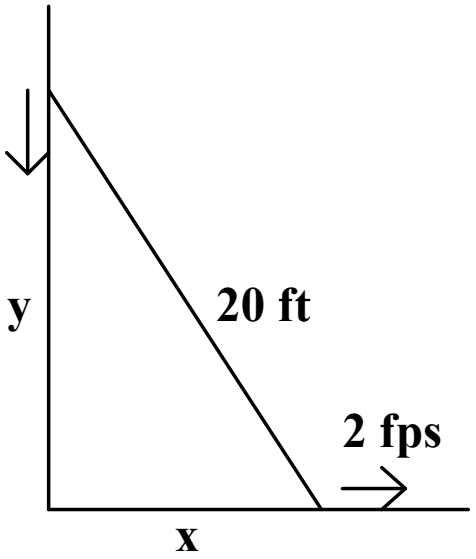

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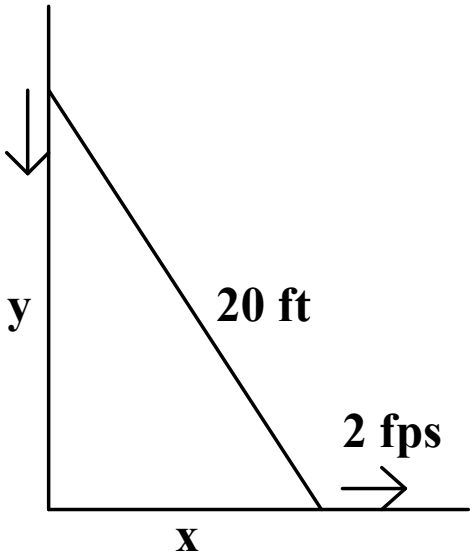

Given: dx/dt = 2 fps

Find: dy/dt

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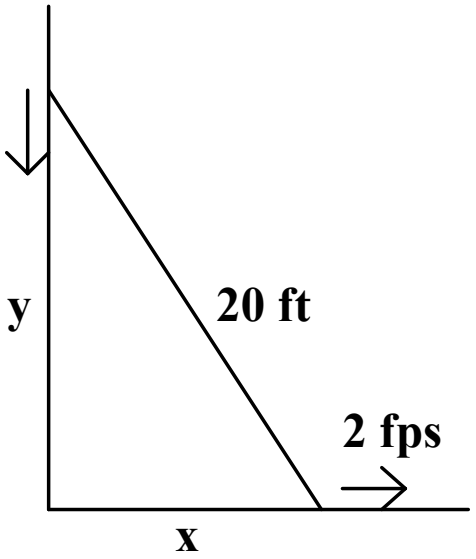

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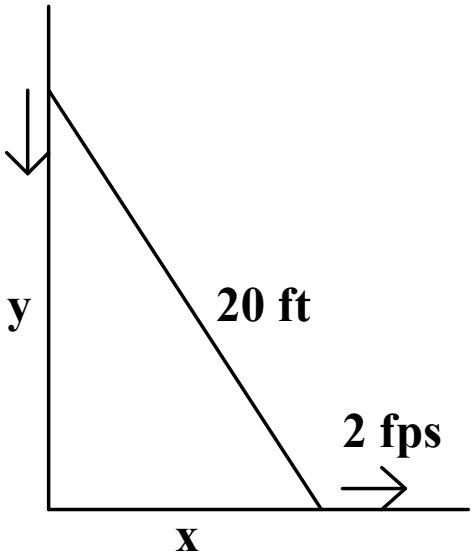

Given: dx/dt = 2 fps

Find: dy/dt when y = 12 ft.

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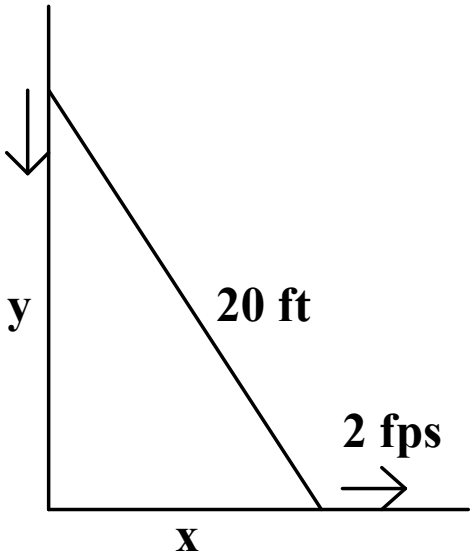

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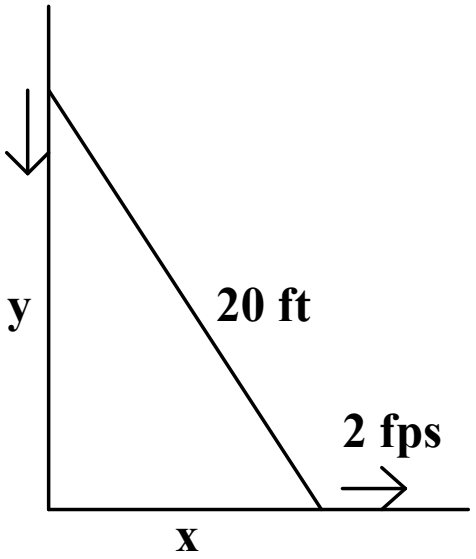

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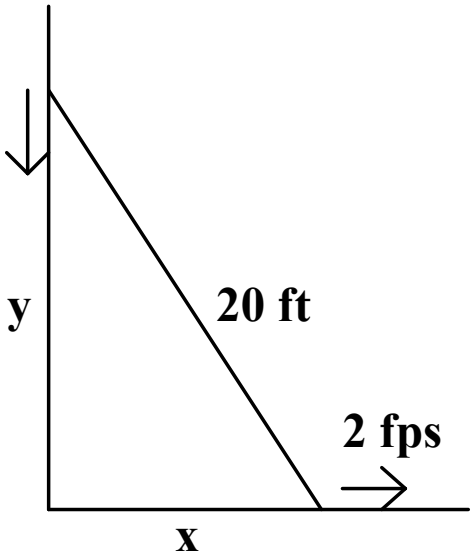
x^2



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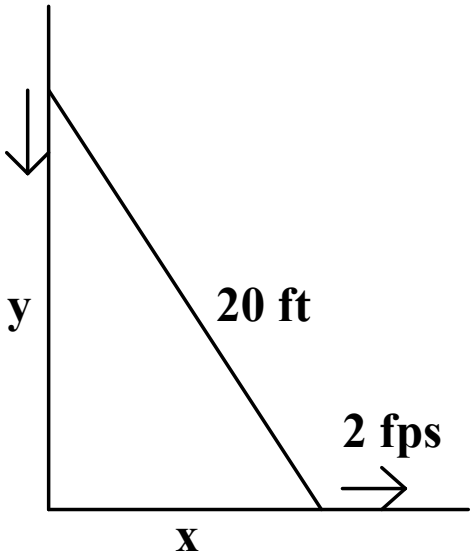
$x^2 + y^2$



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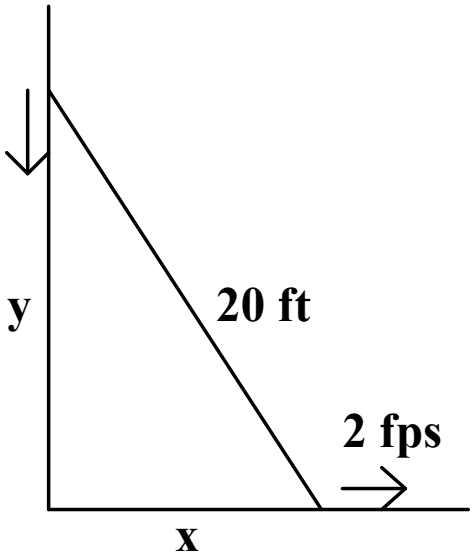
$$x^2 + y^2 = 400$$



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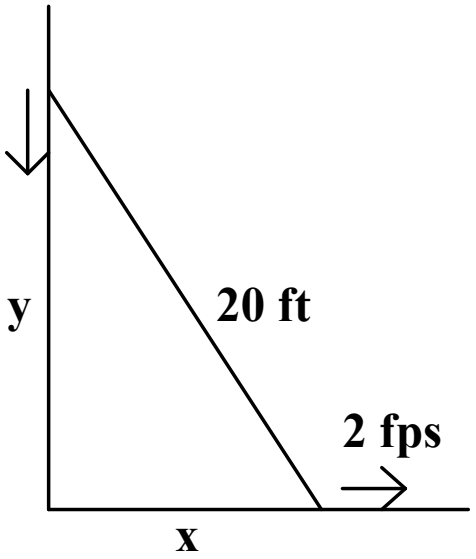

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Find: dy/dt when $y = 12$ ft.

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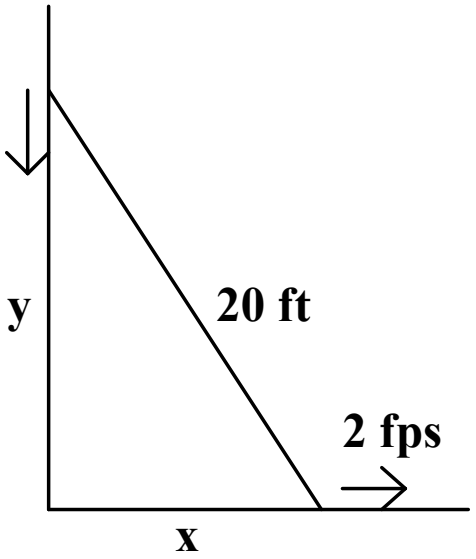

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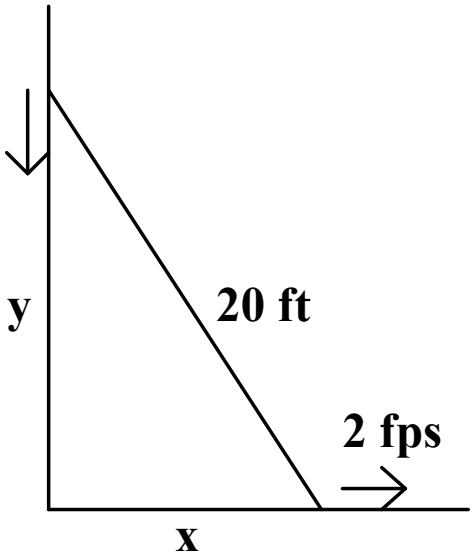

$$x^2 + y^2 = 400$$

$$2x(dx/dt)$$

Given: $dx/dt = 2$ fps

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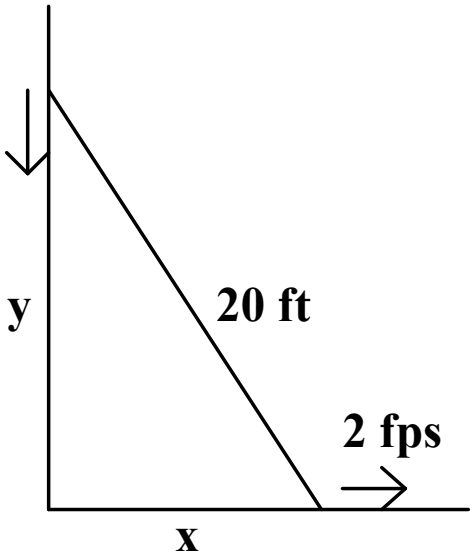

$$x^2 + y^2 = 400$$

$$2x(dx/dt) + 2y(dy/dt)$$

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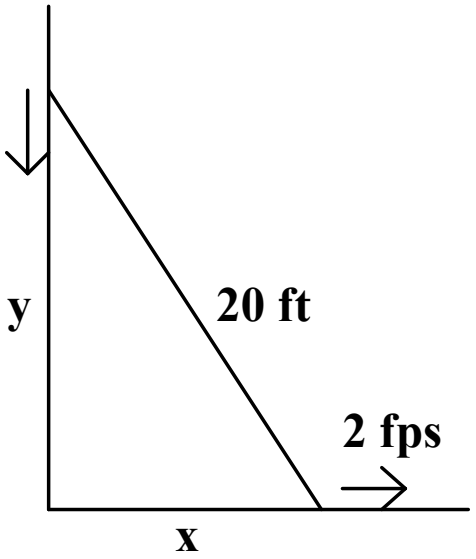

$$x^2 + y^2 = 400$$

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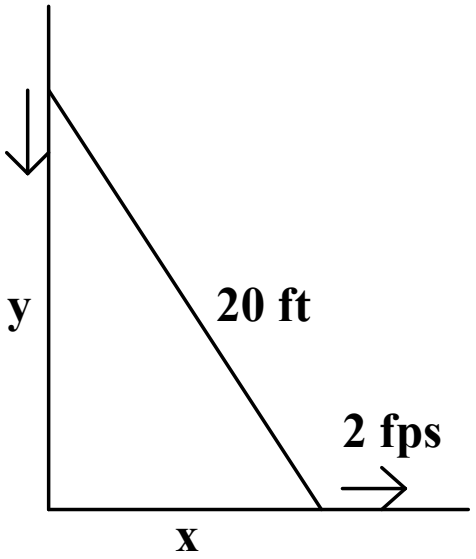

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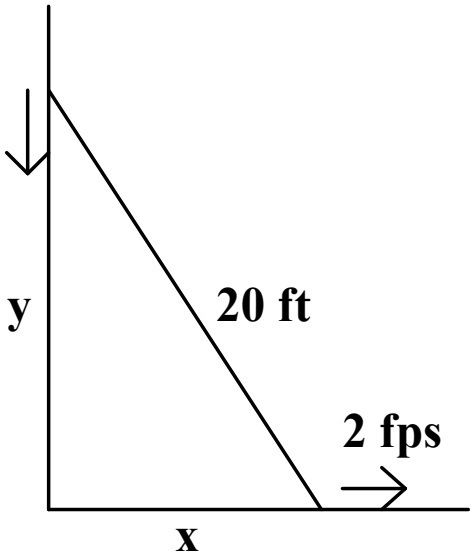

$$x^2 + y^2 = 400$$

$$2x(dx/dt) + 2y(dy/dt) = 0$$

Given: $dx/dt = 2$ fps

Find: dy/dt when $y = 12$ ft.

Step 4: Solve the equation for the desired rate in terms of the other rates and/or variables.

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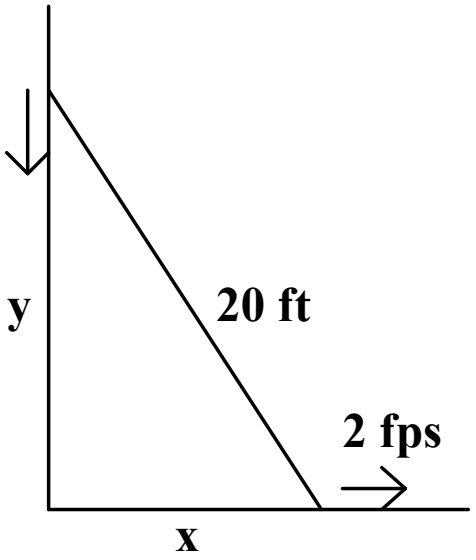

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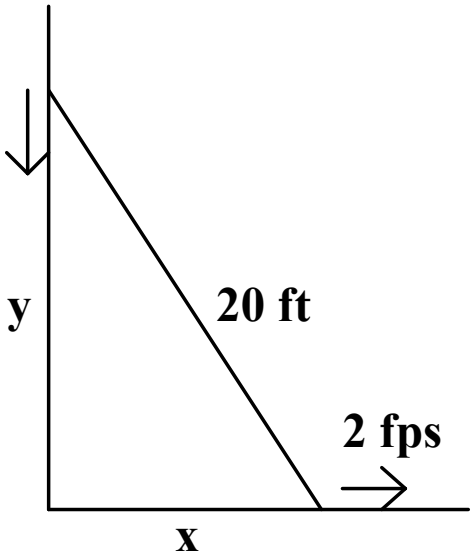

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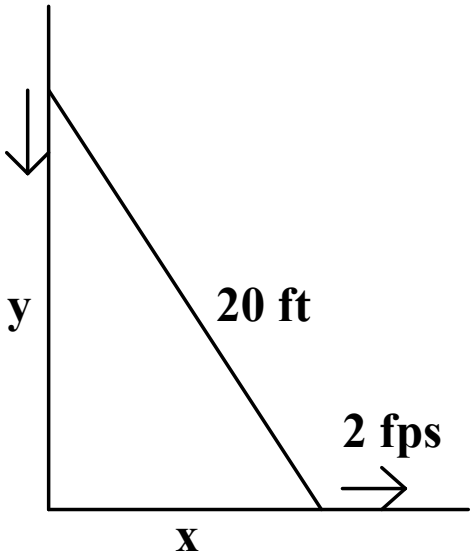

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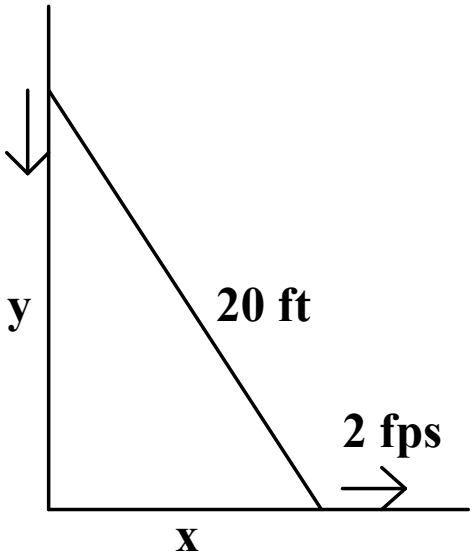

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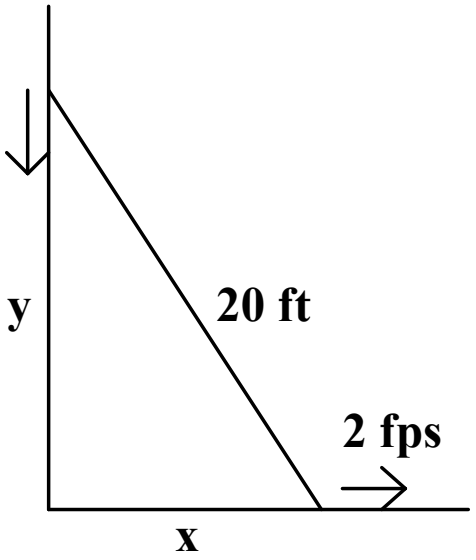

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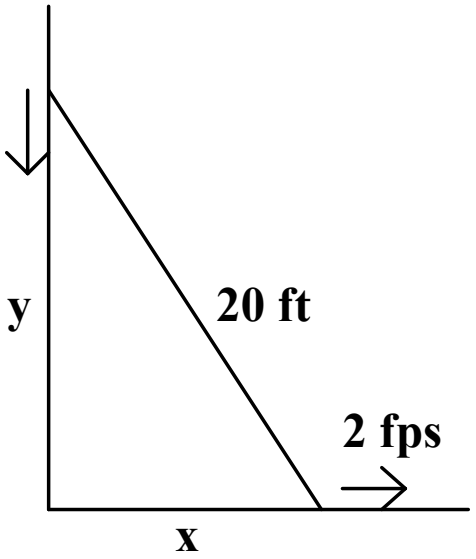

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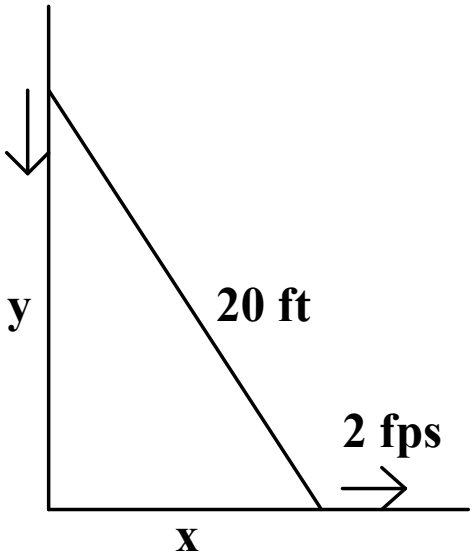

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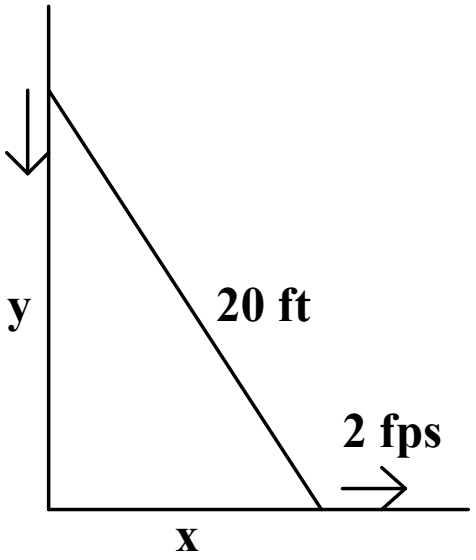

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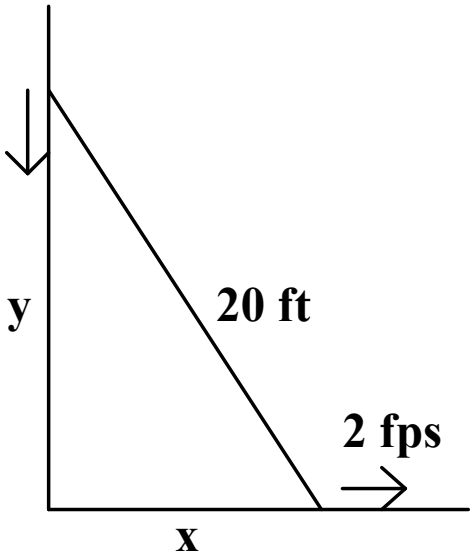

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When y = 12 ft. $x^2 + 144$

Given: dx/dt = 2 fps

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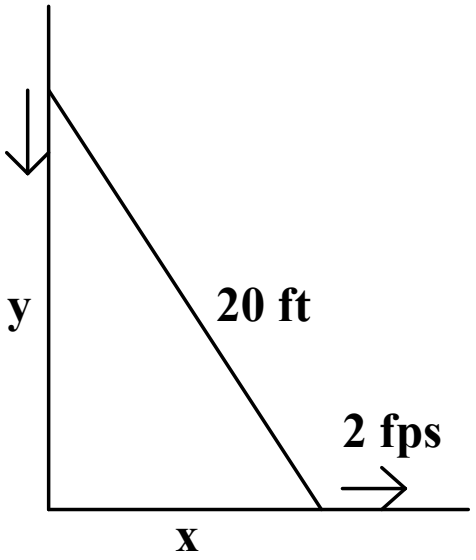

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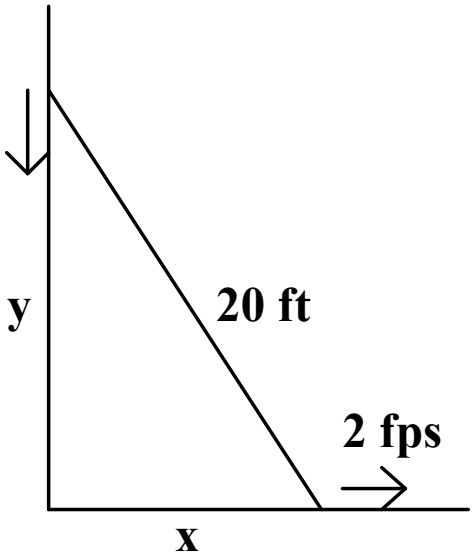

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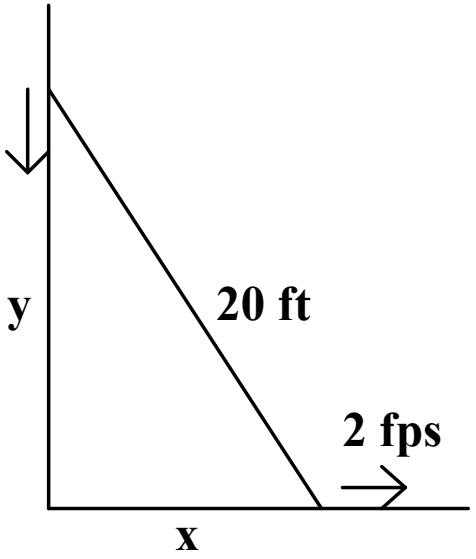

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When y = 12 ft. $x^2 + 144 = 400$

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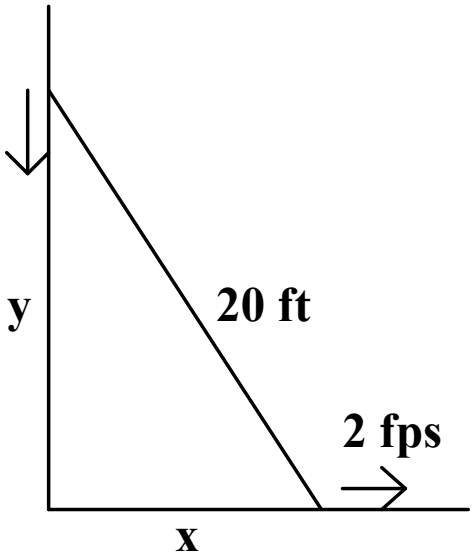

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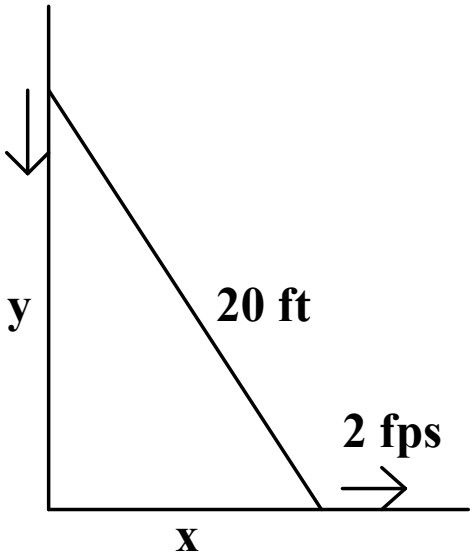

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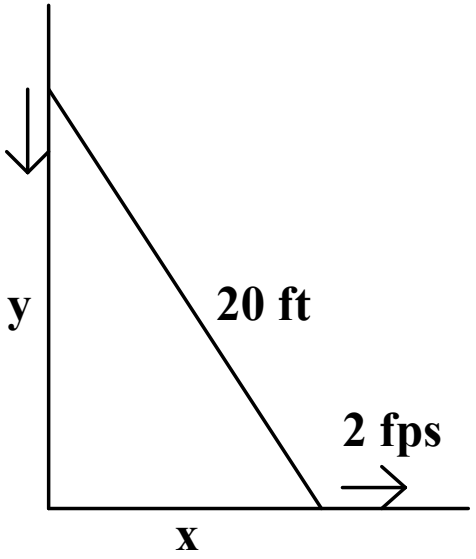

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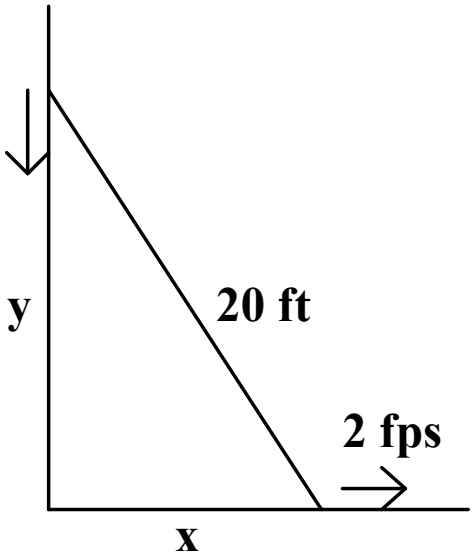

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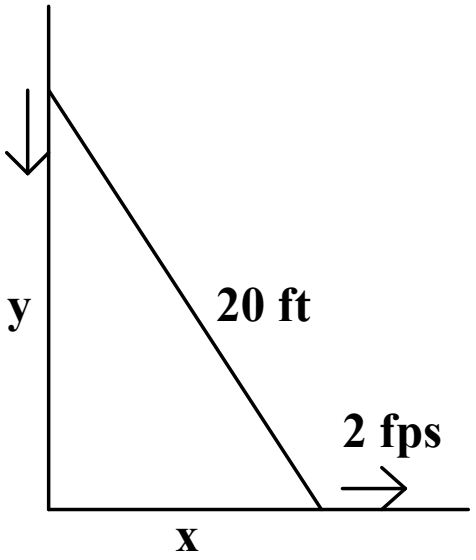

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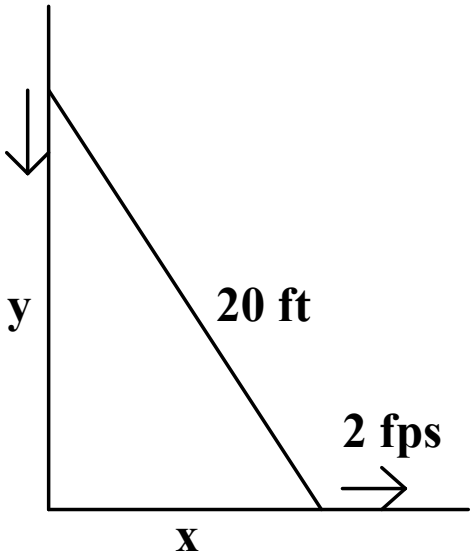

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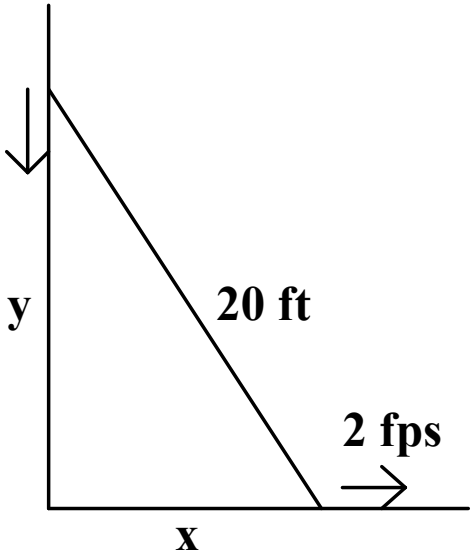

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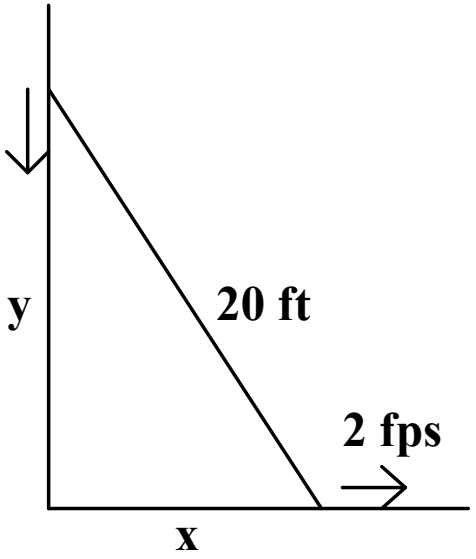

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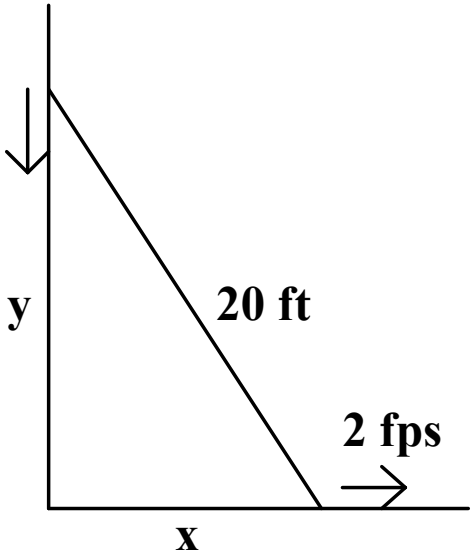

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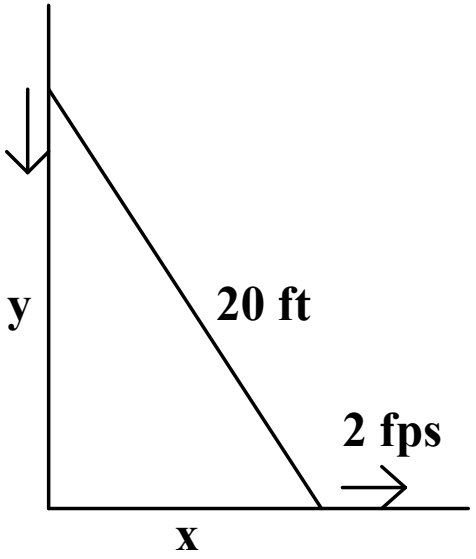

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Calculus Lesson Unit 7 Related Rates

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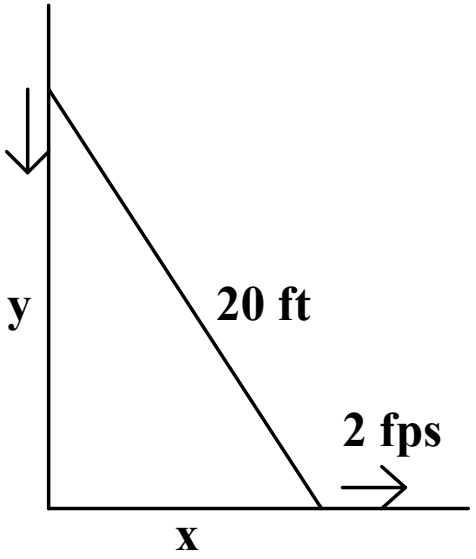

Given: $dx/dt = 2$ fps

Find: dy/dt when $y = 12$ ft.

$$x^2 + y^2 = 400$$

$$2x(dx/dt) + 2y(dy/dt) = 0$$

$$2y(dy/dt) = -2x(dx/dt)$$

$$dy/dt = \frac{-x(dx/dt)}{y}$$

When $y = 12$ ft. $\quad x^2 + 144 = 400$

$$x^2 = 256$$

$$x = 16$$

$$dy/dt = \frac{-16(2)}{12}$$

$$dy/dt = -8/3$$

Answer: The ladder is coming down the wall

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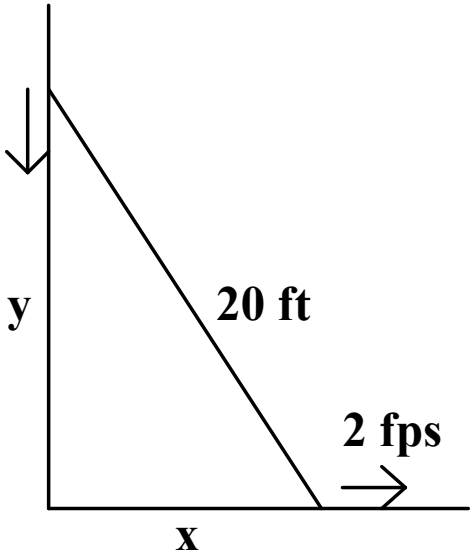

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Answer: The ladder is coming down the wall at 8/3 fps.

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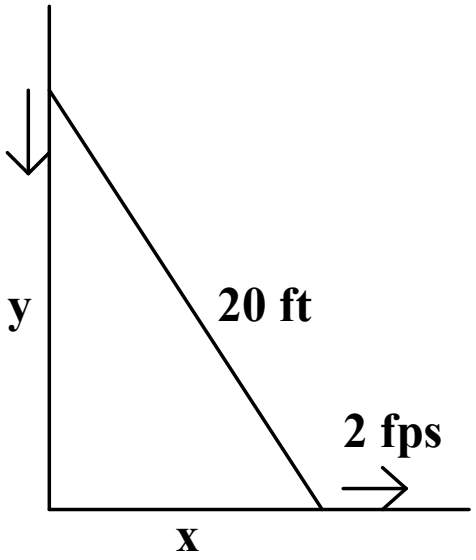

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Answer: The ladder is coming down the wall at 8/3 fps (2 ft. 8 in. per second).

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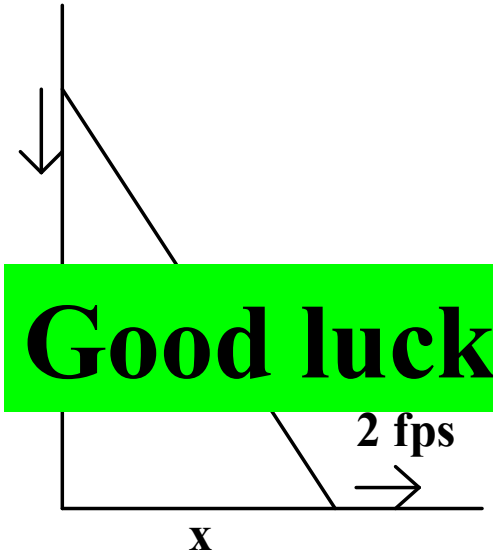

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Good luck on your homework !!

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Answer: The ladder is coming down the wall at 8/3 fps (2 ft. 8 in. per second).