

Watch. Practice. Understand. | Lesson 273

Calculus Section 3.7 Application Problems with Derivatives

Watch the matching video: <https://www.youtube.com/watch?v=vsd4O2F8jbl>

Practice focus: Average and instantaneous rates

Original extra practice matched to the listed lesson topic.

Name: _____ Date: _____ Show your reasoning and check units.

01 Find the average rate of $f(x) = x^2$ on $[1,3]$.

02 Find the instantaneous rate of $f(x) = x^2$ at $x = 3$ using a difference quotient.

03 For position $s(t) = t^2 + 2t$ meters, find average velocity on $[1,4]$ seconds.

04 Approximate $f'(2)$ for $f(x)=x^3$ with the centered quotient using $h=0.1$.

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Practice focus: Related rates

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Name: _____ Date: _____ Show your reasoning and check units.

05 A circle's radius increases at 2 cm/s. How fast is area increasing when $r=5$ cm?

06 A 10-ft ladder has foot moving away at 1 ft/s. Find the top's vertical rate when its foot is 6 ft away.

07 A sphere's radius grows at 0.5 cm/s. Find volume rate when $r=4$.

08 A square's area grows at $24 \text{ cm}^2/\text{s}$ when side length is 6 cm. Find the side's rate.

Worked answers | Lesson 273

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01 Find the average rate of $f(x) = x^2$ on $[1,3]$.

$$(f(3) - f(1))/(3 - 1) = (9 - 1)/2 = 4.$$

02 Find the instantaneous rate of $f(x) = x^2$ at $x = 3$ using a difference quotient.

$$[(3+h)^2 - 9]/h = 6+h. \text{ Let } h \rightarrow 0 \text{ to obtain } 6.$$

03 For position $s(t) = t^2 + 2t$ meters, find average velocity on $[1,4]$ seconds.

$$s(4)=24, s(1)=3, \text{ so } (24 - 3)/3 = 7 \text{ m/s.}$$

04 Approximate $f'(2)$ for $f(x)=x^3$ with the centered quotient using $h=0.1$.

$$[f(2.1)-f(1.9)]/0.2 = (9.261-6.859)/0.2 = 12.01, \text{ close to exact value } 12.$$

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- 05** A circle's radius increases at 2 cm/s. How fast is area increasing when $r=5$ cm?

$A=\pi r^2$ gives $dA/dt=2\pi r \, dr/dt=20\pi \text{ cm}^2/\text{s}$.

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- 06** A 10-ft ladder has foot moving away at 1 ft/s. Find the top's vertical rate when its foot is 6 ft away.

$x^2+y^2=100$; $y=8$. Differentiate: $x \, x' + y \, y' = 0$. $y' = -(6/8)(1) = -3/4 \text{ ft/s}$.

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- 07** A sphere's radius grows at 0.5 cm/s. Find volume rate when $r=4$.

$V=4\pi r^3/3$ gives $V'=4\pi r^2 r'=32\pi \text{ cm}^3/\text{s}$.

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- 08** A square's area grows at $24 \text{ cm}^2/\text{s}$ when side length is 6 cm. Find the side's rate.

$A=s^2$ implies $A'=2ss'$; $s'=24/(12)=2 \text{ cm/s}$.