Chain Rule

$y = f(g(x))$

$\frac{dy}{dx} = f'(g(x)) \cdot g'(x)$

$y = f(g(h(x)))$

$\frac{dy}{dx} = f'(g(h(x))) \cdot g'(h(x)) \cdot h'(x)$

Find $\frac{dy}{dx}$ if $y = \underset{\text{out}}{\sin}(\underset{\text{in}}{3x})$

$\frac{dy}{dx} = \cos(3x) \cdot 3$

$= 3\cos 3x$

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Find $\frac{dy}{dx}$ if $y = \sqrt{(\sin 3x)}$

$\frac{dy}{dx} = \frac{1}{2\sqrt{\sin 3x}} \cdot \cos 3x \cdot 3$

$= \frac{3\cos 3x}{2\sqrt{\sin 3x}}$

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$y = (1+\sin 2x)^2$

$\frac{dy}{dx} = 2(1+\sin 2x)\cdot \cos 2x \cdot 2$

$= 4\cos 2x(1+\sin 2x)$

$4\cos 2x + 4\sin 2x\cos 2x$

$y = x^3(2x-5)^4$

$\frac{dy}{dx} = 3x^2(2x-5)^4 + x^3(4(2x-5)^3\cdot 2)$

$= 3x^2(2x-5)(2x-5)^3 + 8x^3(2x-5)^3$

$(2x-5)^3(3x^2(2x-5)+8x^3)$

$(2x-5)^3(6x^3-15x^2+8x^3)$

$(2x-5)^3(14x^3-15x^2)$

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Implicit Differentiation

Find $\frac{dy}{dx}$ if $x^2+y^2=9$

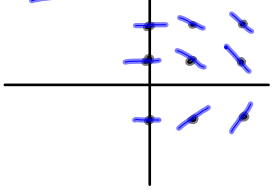
$2x\frac{dx}{dx} + 2y\frac{dy}{dx} = 0$

$2x+2y\frac{dy}{dx}=0$

$\frac{2y\frac{dy}{dx}}{2y} = \frac{-2x}{2y}$

$\frac{dy}{dx} = -\frac{x}{y}$

Draw Slope Field



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Find the general solution $y = f(x)$

for $\frac{dy}{dx} = \frac{-x}{y}$

$$\int y\,dy = \int -x\,dx$$

$$\frac{1}{2}y^2 = -\frac{1}{2}x^2 + C$$

$$y^2 = -x^2 + C$$

$$y = \pm\sqrt{-x^2 + C}$$

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Find $\frac{dy}{dx}$: $x^2 = \frac{x^2+1}{y^2}$

$$y^2 = \frac{x^2+1}{x^2}$$

$$2y\frac{dy}{dx} = \frac{x^2(2x) - (x^2+1)(2x)}{x^4}$$

$$2y\frac{dy}{dx} = \frac{2x(x^2 - x^2 - 1)}{x^3}$$

$$\frac{2y\frac{dy}{dx}}{2y} = -\frac{2}{x^3} \cdot \frac{1}{2y} = \frac{-1}{x^3 y}$$

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Let v(t) be the velocity, in feet per second, of a skydiver at time t seconds. After her parachute opens, her velocity satisfies the differential equation dv/dt= -2v-32, with initial condition v(0)=-50.

a. Use separation of variables to find an expression for v in terms of t, where t is measured in seconds.

$$\frac{dv}{dt} = -2v-32$$

$$\frac{dv}{dt} = -2(v+16)$$

$$\int \frac{dv}{v+16} = \int -2\,dt$$

$$\ln|v+16| = -2t+C$$

$$\ln|-50+16| = 0+C$$

$$C = \ln|-34| = \ln(34)$$

$$\ln|v+16| = -2t+\ln 34$$

$$e^{-2t+\ln 34} = v+16$$

$$e^{-2t}\cdot e^{\ln 34} = v+16$$

$$V = 34e^{-2t}-16$$

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Linearization

The linearization of f at a is:

$$L(x) = f'(a)(x-a)+f(a)$$

2007 FR #5

t	0	2	5	7	11	12
r'(t)	5.7	4.0	2.0	1.2	.6	.5

The radius is 30 ft when t=5.

Estimate r when t=5.4.

approx: $r(5.4) \approx 30+(2.0)(.4)$

≈ 30.8

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2008 MC

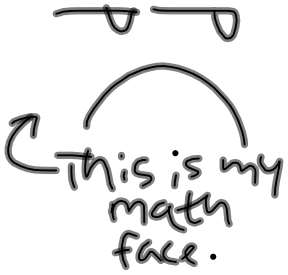
24. $f(2)=1$ $f'(2)=4$ $f''(2)=3$

approx $f(1.9)$

$\approx f(2) + \Delta f$ ✓ how long

$\approx 1 + (4)(-.1)$

$\approx .6$



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