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- Chain rule

$$\boxed{(f \circ g)'(x) = (f' \circ g)(x) g'(x)}$$

$$f'(x) = \frac{df}{dx}$$

$$\therefore (f \circ g)(x) = f(g(x))$$

$$(f \circ g)'(x) = (f'(g(x))) g'(x)$$

Let,

$$y = f(u) \quad \text{and} \quad u = g(x)$$

$$f'(u) = \frac{dy}{du}$$

$$\frac{dy}{dx} = (f'(u)) u'$$

$$\frac{dy}{dx} = \frac{dy}{du} \quad \text{and} \quad u' = \frac{du}{dx}$$

$$\Rightarrow \boxed{\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx}}$$



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$$\#1$$

$$\rightarrow y = \sqrt{1+2x}$$

Write the function in the form

$$y = f(u) \text{ and } u = g(x)$$

then find

$$\frac{dy}{dx}$$


---

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx}$$

Set,

$$u = 1+2x \quad \text{and} \quad y = (u)^{\frac{1}{2}}$$

then

$$\frac{du}{dx} = 2 \quad \text{and} \quad \frac{dy}{du} = \frac{1}{2}(u)^{-\frac{1}{2}}$$



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From Britney Alexis to Everyone

wait go back to the explicit form please

$$\frac{dy}{du} = 2 \quad \text{and} \quad \frac{du}{dx} = \frac{1}{2}(u)^{-\frac{1}{2}}$$

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} \Rightarrow \frac{dy}{dx} = (u)^{-\frac{1}{2}}$$

$$\because u = 1+2x \Rightarrow \frac{dy}{dx} = (1+2x)^{-\frac{1}{2}}$$

$$(f \circ g)'(x) = f'(g(x)) g'(x)$$

□

$$y = \cos((\ln|x|)^{\frac{1}{2}})$$

$$\downarrow (f \circ g \circ h)'(x) \approx \left[ (f \circ g) \circ h \right]'(x) = (f \circ g)'(h(x)) h'(x)$$

$$\rightarrow h = \ln|x|$$

$$\rightarrow g = (h)^{\frac{1}{2}}$$

$$\rightarrow f = \cos(g)$$

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$$\frac{dy}{du} = 2 \quad \text{and} \quad \frac{du}{dx} = \frac{1}{2}(u)^{-\frac{1}{2}}$$

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} \Rightarrow \frac{dy}{dx} = (u)^{-\frac{1}{2}}$$

$$\because u = 1 + 2x \Rightarrow \frac{dy}{dx} = (1 + 2x)^{-\frac{1}{2}}$$

$$(f \circ g)'(x) = f'(g(x)) g'(x)$$

□

$$y = \cos((\ln|x|)^{\frac{1}{2}})$$

$$\downarrow (f \circ g \circ h)'(x) \approx \boxed{(f \circ g \circ h)'(x) = (f \circ g)'(h(x)) h'(x)}$$

$$\rightarrow h = \ln|x|$$

$$\rightarrow g = (h)^{\frac{1}{2}}$$

$$\rightarrow f = \cos(g)$$



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$$(f \circ g \circ h)'(x) = [(f \circ g) \circ h]'(x)$$

$$\Rightarrow (f \circ g)'(h(x)) h'(x)$$

$$\therefore (f \circ g)'(h(x)) = f'(g(h(x))) g'(h(x))$$

$$\therefore (f \circ g \circ h)'(x) = f'[g(h(x))] g'(h(x)) h'(x)$$



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$x$	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
1	3	8	3	6
2	4	1	5	2
3	7	2	6	1

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

$$\text{find } h'(3)$$

$$(f \circ g)'(x) = f'(g(x)) g'(x)$$

$$(f \circ g)(x) = f(g(x)) = h(x)$$

$$\Rightarrow h'(x) = f'(g(x)) g'(x)$$

$$\Rightarrow h'(3) = f'(g(3)) g'(3)$$

$$\because g(3) = 2$$

$$\Rightarrow h'(3) = f'(2) g'(3)$$

$$h'(3) = 5 \cdot 1 = 5$$



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# implicit form and explicit form

$$x^2 + y^2 = r^2$$

where  $r \equiv$  radius

implicit form

also,

$$y^2 = r^2 - x^2 \Rightarrow y = \sqrt{r^2 - x^2}$$

explicit form

$$\frac{dy}{dx}$$



$$\text{For } y = \sin^{-1}(x)$$

$$\text{find } \frac{dy}{dx}$$

$$\frac{dy(x)^2}{dx} = \frac{dy^2}{dx}$$

$$\therefore y(x) = \sin^{-1}(x)$$

$$\Rightarrow \boxed{\sin(y(x)) = x}$$

$$\frac{d}{dx} [\sin(y(x))] = \frac{d}{dx} [x]$$

$$\cos(y(x)) \frac{dy(x)}{dx} = 1$$

$$\frac{dy(x)}{dx} = \frac{1}{\cos(y(x))} \Rightarrow \frac{dy(x)}{dx} = \frac{1}{\sqrt{1 - \sin^2(y(x))}}$$

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

$$\Rightarrow \cos^2(y(x)) = 1 - \sin^2(y(x))$$

$$\Rightarrow \cos(y(x)) = \sqrt{1 - \sin^2(y(x))}$$





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$$\sin(y(x)) = x$$

$$\frac{dy}{dx} = \frac{1}{\sqrt{1-x^2}}$$



$$V = 2\pi r^2 h$$

and the volume and radius are changing  
with respect to time  $t$

$$V(t) = 2\pi [r(t)]^2 h$$

$$\frac{dV(t)}{dt} = 4\pi r(t) \frac{dr}{dt} h$$



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Find the slope of the curve

$$y = 1 - 3x^2$$

at a given point  $P(x_1, y_1)$

and the eqn. of the tangent line

@ P

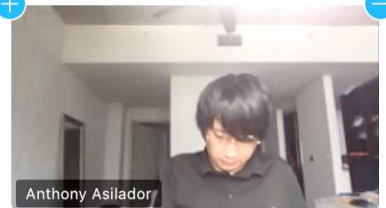
$$\left. \frac{dy}{dx} \right|_{x=x_1} = -6x = -6\left(\frac{1}{3}\right) = -1$$

$$m = \left. \frac{dy}{dx} \right|_{x=x_1}$$

$$\therefore m = -12$$

$$\therefore m = \frac{y - y_1}{x - x_1} \Rightarrow m(x - x_1) = y - y_1$$

$$\Rightarrow m(x - x_1) + y_1 = y$$



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$$y = m(x - x_1) + y_1$$

$$P, (3, -25)$$

$$m = -18$$

$$y = -18(x - 3) - 25$$



~~$$y = -18(x - 3) - 25$$~~

~~$$y = -18x + 36 - 25$$~~

~~$$y = -18x +$$~~



Anthony Asilador

