$$\mathbb{R} \setminus \{ n\pi \mid n \in \mathbb{Z} \} = \bigcup_{n \in \mathbb{Z}} (n\pi, (n+1)\pi)$$

$$\frac{d}{dx}\left[\left((\sin x)^2\right)^{\frac{1}{2}}\right] \qquad \mathbb{Z}$$

$$= \underline{\frac{1}{2}\left((\sin x)^2\right)^{-\frac{1}{2}}} \cdot \underbrace{(2\sin x)' \cdot \cos x}$$

$$\frac{d}{dx}\left[(x^2-3x)^7\right] = 7(2x-3)^6 \text{ No}$$

$$\frac{d}{dx}\left[x^{\frac{1}{2}}\right] = \frac{1}{2}x^{-\frac{1}{2}} \qquad 7(x^2-3x)^6(2x-3) \text{ Yes}$$

$$\cos x + \sqrt{y} = 5 \implies$$

$$\cos x + y^{\frac{1}{2}} = 5 \qquad \frac{d}{dx}[\text{this equation}] \implies$$

$$-\sin x + \frac{1}{2}y^{-\frac{1}{2}}y' = 0$$

$$\frac{1}{2}y^{-\frac{1}{2}}y' = \sin x$$

$$\frac{1}{x^{-2}} = \qquad \boxed{y' = \frac{\sin x}{\frac{1}{2}y^{-\frac{1}{2}}}} = \boxed{2\sin x\, y^{\frac{1}{2}}}$$

$$\frac{x^5}{x^3} = x^{5-3} = x^5 \cdot x^{-3} = x^2$$

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$h(t) = (t^4-1)^3(t^3+1)^4$

$(\underbrace{\quad}_{f} \cdot \underbrace{\quad}_{g})' = f'g + fg'$

$h'(t) = \underbrace{3(t^4-1)^2(4t^3)}_{f'}\underbrace{(t^3+1)^4}_{g} + \underbrace{(t^4-1)^3}_{f}\underbrace{(4(t^3+1)^3(3t^2))}_{g'}$

Takes Chain Rule AND Product Rule

Another Example.

$h(x) = (3x^2+2)^5(2x^3-1)^7$

$\frac{d}{dx}\left[\cos^2(xy)\right] = 2(\cos(xy))' \cdot (-\sin(xy))(y+xy')$

$\frac{dy}{dx} = y' \neq yy'$

$\frac{d}{dx}\left[xy\right] = y + xy'$

$(fg)' = f'g + fg'$

$$\frac{d}{dx}[x] = 1$$

$$\frac{d}{dx}[y] = \frac{dy}{dx} = y'$$ If you assume y depends on x. If it doesn't, then

$$\frac{dy}{dx} = 0$$

$$\frac{r}{\sqrt{r^2+1}} = \frac{r}{(r^2+1)^{\frac{1}{2}}}$$

$$\frac{d}{dx}[r] = 0$$

$$\frac{d}{dr}[r] = 1$$

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$$\left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2} = \frac{f'g - fg'}{g^2}$$

$$\frac{d}{dr}\left[\sqrt{r^2+1}\right] = \frac{d}{dr}\left((r^2+1)^{\frac{1}{2}}\right)$$

$$= \frac{1}{2}(r^2+1)^{-\frac{1}{2}}(2r)$$

$$y = \frac{r}{\sqrt{r^2+1}} = \frac{r}{(r^2+1)^{1/2}}$$

$$y' = \frac{1 \cdot (r^2+1)^{\frac{1}{2}} - r\left(\frac{1}{2}(r^2+1)^{-\frac{1}{2}}(2r)\right)}{\left((r^2+1)^{1/2}\right)^2}$$