What you'll Learn About

- How to find the derivative of:
- Functions with positive and negative integer powers
- Functions with products and quotients

Find the equation for the tangent line at the given point

Q) $y = \frac{x^5 + 2x}{x^2}$ at x = 1

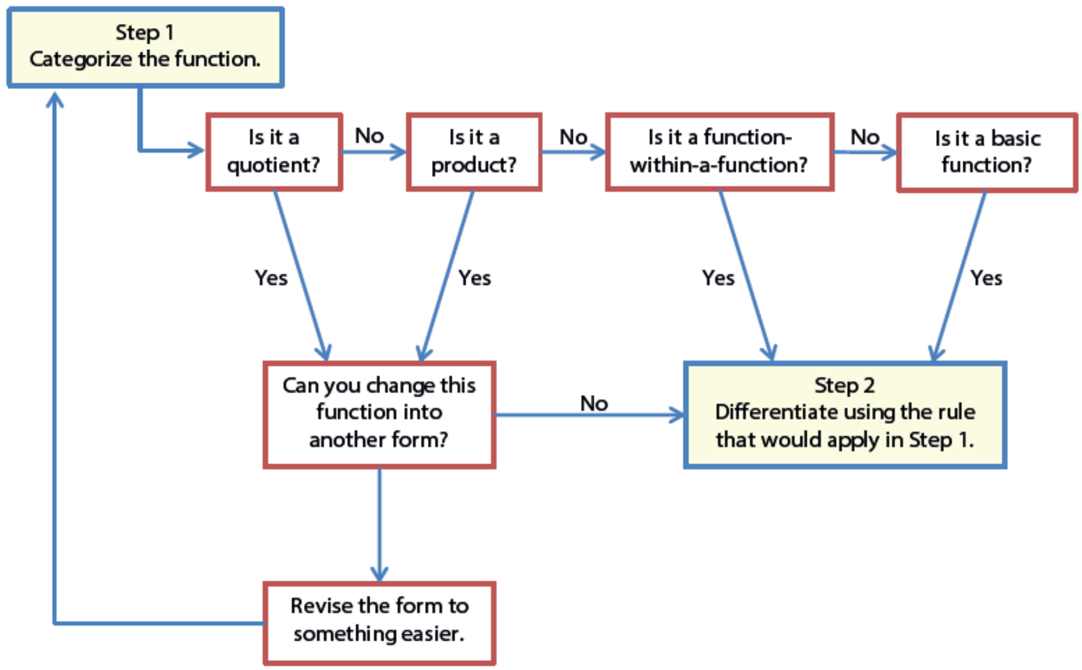
R) $y = 5x^2 + 3$ at x = 3

S) Find an equation of the line perpendicular to the tangent to the curve $y = 4x^3 - 6x + 2$ at the point (2, 22).

T) Find the points on the curve $y = x^3 - 3x^2 - 9$ where the tangent is parallel to the x-axis

	U) Suppose u and v are differentiable functions at x = 2 and u(2) = 3, $u'(2) = 3$, v(2)=1, $v'(2) = 2$ i) Find $\frac{d}{dx}(uv)$ ii) Find $\frac{d}{dx}\left(\frac{u}{v}\right)$ iii) Find $\frac{d}{dx}(3u - 2v + 2uv)$ V) Find the derivative of y = x with respect to x W) Find the derivative of y = x with respect to t X) Find the derivative of y = x with respect to P

Flowchart: Selecting a Procedure for Derivatives



What you'll Learn About

- How to find the derivative of a trig function

Find equations for the lines that are tangent and normal to the graph of y = 2cosx at $x = \frac{\pi}{4}$

Find the points on the curve y = cot x, $0 \le x \le \frac{\pi}{2}$, where the tangent line is parallel to the line y = -2x.

What you'll Learn About

- How to find the derivative of inverse functions

1. Let f be a differentiable function such that f(3) = 15, f(6) = 3, $f'(3) = -8$ and $f'(6) = -2$.
   The function g is differentiable and g(x) = f^{-1}(x) for all x. What is the value of $g'(15)$?

a) -1/2 b) -1/8 c) 1/6 d) 1/3
e) The value of $g'(15)$ cannot be determined

2. Let f be a differentiable function such that f(3) = 5, f(8) = 4, $f'(3) = 6$ and $f'(8) = 3$.
   The function g is differentiable and g(x) = f^{-1}(x) for all x. What is the value of $g'(4)$?

a) -1/2 b) -1/8 c) 1/6 d) 1/3
e) The value of $g'(4)$ cannot be determined

	3. • Let f be a differentiable function such that $f(3) = 5$, $f(8) = 4$, $f'(3) = 6$ and $f'(8) = 3$. The function g is differentiable and $g(x) = f^{-1}(x)$ for all x. What is the value of $g'(5)$? a) -1/2 b) -1/8 c) 1/6 d) 1/3 e) The value of $g'(5)$ cannot be determined 4. If $f(2) = -3$, $f'(2) = \frac{4}{3}$, and $g(x) = f^{-1}(x)$, what is the equation of the tangent line to g(x) at x = -3? A) $y-2 = \frac{-3}{4}(x+3)$ B) $y+2 = \frac{-3}{4}(x-3)$ C) $y-2 = \frac{3}{4}(x+3)$ D) $y+3 = \frac{3}{4}(x-2)$ E) $y-2 = \frac{4}{3}(x+3)$

	5. *If* $f(2) = -3,\ f'(2) = \frac{-4}{3}$, and $g(x) = f^{-1}(x)$, what is the equation of the tangent line to g(x) at x = -3? A) $y - 2 = \frac{-3}{4}(x+3)$ B) $y + 2 = \frac{-3}{4}(x-3)$ C) $y - 2 = \frac{3}{4}(x+3)$ D) $y + 2 = \frac{4}{3}(x-3)$ E) $y - 2 = \frac{4}{3}(x+3)$ 6. *If* $f(2) = -3,\ f'(2) = \frac{-3}{4}$, and $g(x) = f^{-1}(x)$, what is the equation of the tangent line to g(x) at x = -3? A) $y - 2 = \frac{-3}{4}(x+3)$ B) $y + 3 = \frac{-4}{3}(x+2)$ C) $y - 2 = \frac{3}{4}(x+3)$ D) $y + 2 = \frac{4}{3}(x-3)$ E) $y - 2 = \frac{-4}{3}(x+3)$

What you'll Learn About
How to take the derivative of functions in Parametric Form

Graph the parametric function given

A) $x = t^2 - 3 \quad y = t \quad t \geq 0$

B) Find the derivative of the function at t=5

C) Find the equation of the tangent line at t=1

$x = 3t \quad y = 9t^2$

D) Find the equation of the tangent line at $\theta = \dfrac{\pi}{4}$

$x = \cos\theta \quad y = \sin\theta$

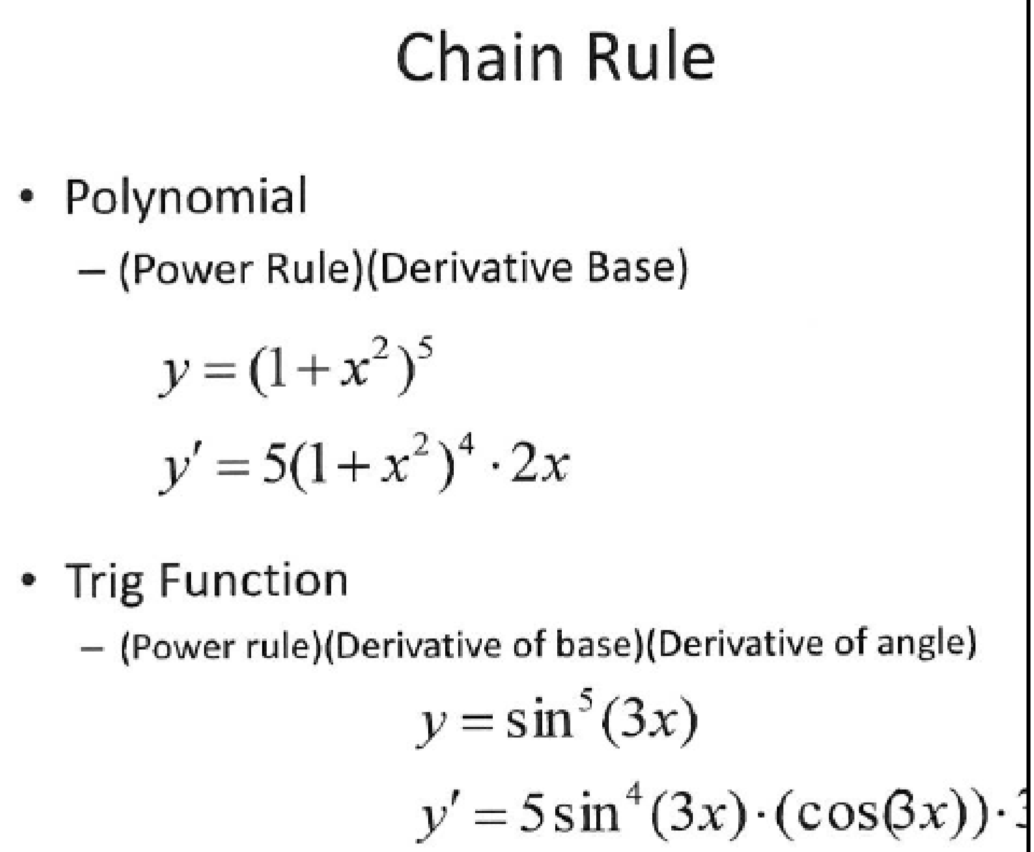
E) Find the equation of the tangent line at $t = \pi$

$x = \sec^2(2t) - 1 \quad y = \tan(2t)$

	A curve C is defined by the parametric equations $x = t^2 - 4t + 1$ and $y = t^3$. Determine the equation of the line tangent to the graph of C at the point (1, 64)? Determine the horizontal and vertical tangents for the parametric curve *A*) $x = 1 - t \quad y = t^2 - 4t$ *B*) $x = \cos\theta \quad y = 2\sin(2\theta)$

$$\frac{d}{dx}e^u = e^u\frac{du}{dx}$$	The derivative of e^x is: (Itself)(Derivative of the power)
$$\frac{d}{dx}\left(a^u\right) = a^u \ln a \frac{du}{dx}$$	The derivative of a^x is: (Itself)(*ln* of the base)(Derivative of the power)
$$\frac{d}{dx}\ln u = \frac{1}{u}\frac{du}{dx}$$	The derivative of a^x is: (Itself)(*ln* of the base)(Derivative of the power)
$$\frac{d}{dx}\log_a u = \frac{1}{u \ln a}\frac{du}{dx}$$	The derivative of *ln u* is: (one over what you are taking the ln of) times now you should be in the numerator (Derivative of what you are taking the *ln* of)
	$$\frac{d}{dx}\sin^{-1} u = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$$ • One over the square root of 1 – the ratio squared all times the derivative of the ratio. $$\frac{d}{dx}\cos^{-1} u = -\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}$$ • Negative One over the square root of 1 – the ratio squared all times the derivative of the ratio.

	$$\frac{d}{dx}\tan^{-1}u = \frac{1}{1+u^2}\frac{du}{dx}$$ • One over 1 + the ratio squared all times the derivative of the ratio. $$\frac{d}{dx}\cot^{-1}u = -\frac{1}{1+u^2}\frac{du}{dx}$$ • Negative One over 1 + the ratio squared all times the derivative of the ratio. $$\frac{d}{dx}\sec^{-1}u = \frac{1}{\lvert u\rvert\sqrt{u^2-1}}\frac{du}{dx}$$ • One over the absolute value of the ratio times the square root of the ratio squared minus 1 all times the derivative of the ratio. $$\frac{d}{dx}\csc^{-1}u = -\frac{1}{\lvert u\rvert\sqrt{u^2-1}}\frac{du}{dx}$$ Negative One over the absolute value of the ratio times the square root of the ratio squared minus 1 all times the derivative of the ratio.

	When you do the power rule the base does not change only the power - Once you have done the power rule, you are done with the powers When you do the derivative of a trig function the angle does not change 

Chain Rule

- Product and quotient rule over rule everything when you have 2 functions

$$y = x(\sin 3x)^{1/2}$$

$$y' = x[\frac{1}{2}(\sin 3x)^{-1/2} \cdot (\cos(3x)) \cdot 3] + (\sin 3x$$

  - If the base is a product or quotient rule then you must start with the power rule

$$y = (x \sin 3x)^{1/2}$$

$$y' = \frac{1}{2}(x \sin 3x)^{-1/2} \cdot [x(\cos(3x)) \cdot 3] + (\sin 3x)$$