Opener

Non-Calculator

A particle moves along the x-axis so that its position at time t is given by $x(t) = t^2 - 6t + 5$. For what value of t is the velocity of the particle zero?

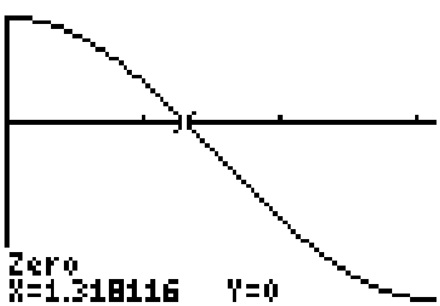
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

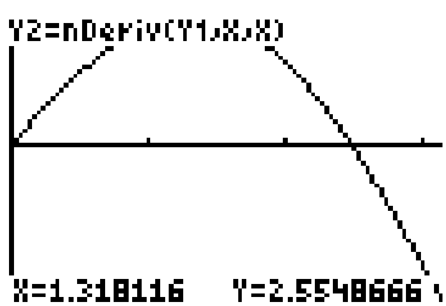
$$v(t) = 2t - 6 = 0$$
$$2t = 6$$
$$t = 3$$

Calculator

A particle moves along a line so that at time t, where $0 \le t \le \pi$, its position is given by $s(t) = -4\cos t - \frac{t^2}{2} + 10$. What is the velocity of the particle when its acceleration is zero?

(A) -5.19 (B) 0.74 (C) 1.32 (D) 2.55 (E) 8.13





3-5 Derivatives of the Trig Functions

Learning Objectives:

I can calculate the derivates of the trig functions.

I can write the equation of the normal line to a curve.

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Derivatives of the Trig Functions

$$\frac{d}{dx}(\sin x) = \cos x \qquad \frac{d}{dx}(\cos x) = -\sin x$$

$$\frac{d}{dx}(\tan x) = \sec^2 x \qquad \frac{d}{dx}(\cot x) = -\csc^2 x$$

$$\frac{d}{dx}(\sec x) = \sec x \cdot \tan x \qquad \frac{d}{dx}(\csc x) = -\csc x \cdot \cot x$$

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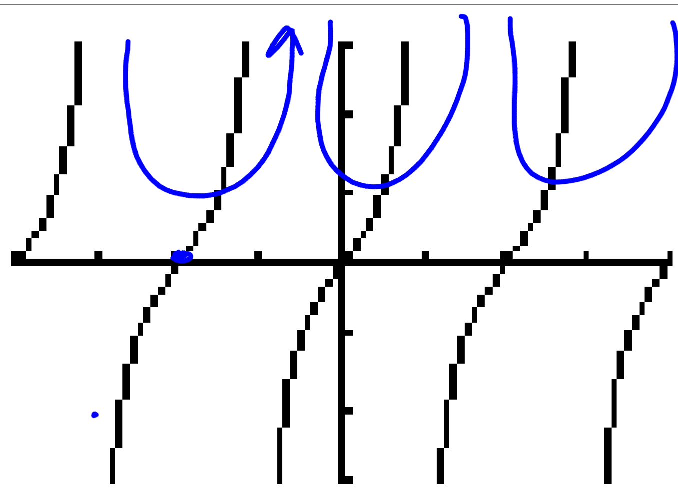

Ex1. Find the derivative

1.) $f(x) = \cos x + \sin x - \tan x + x^2$

$f' = -\sin x + \cos x - \sec^2 x + 2x$

2.) $y = x^2 \cos x$

f g

$y' = f' \cdot g + f \cdot g'$

$f = x^2$

$f' = 2x$

$g = \cos x$

$g' = -\sin x$

$y' = 2x \cos x + x^2 \cdot -\sin x$

$y' = 2x\cos x - x^2 \sin x$

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3.) $y = \dfrac{x^3}{\sin x}$ f g

$$y' = \frac{f'g - fg'}{g^2}$$

$f = x^3$

$f' = 3x^2$

$g = \sin x$

$g' = \cos x$

$$\boxed{y' = \frac{3x^2 \sin x - x^3 \cos x}{\sin^2 x}}$$

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Develop the rule for the derivative y=tanx using quotient rule

f

5.) $y = \tan x = \dfrac{\sin x}{\cos x}$ g

$f = \sin x$
$f' = \cos x$

$g = \cos x$
$g' = -\sin x$

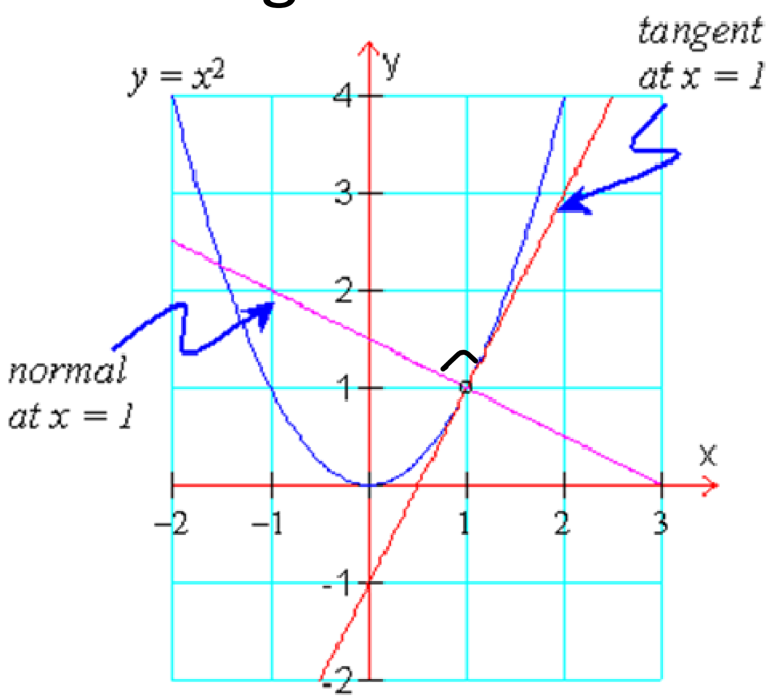
$y' = \dfrac{f'g - fg'}{g^2}$

$y' = \dfrac{\cos x \cdot \cos x - \sin y \cdot -\sin x}{\cos^2 x}$

$= \dfrac{\cos^2 x + \sin^2 x}{\cos^2 x} = \dfrac{1}{\cos^2 x}$

$= \sec^2 x$

Tangent Line vs Normal Line



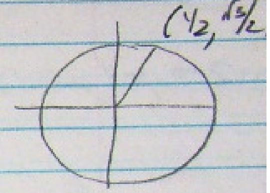
Ex2a.) Find the equation of the tangent line to the curve y=x²sinx at $x = \frac{\pi}{3}$

b.) Find the equation of the normal line to the curve y=x²sinx at $x = \frac{\pi}{3}$

(No Graphing Calculator)

Tangent line to $y = x^2 \sin x$ at $x = \pi/3$. (No G.C.)

$$y' = f'g + fg'$$
$$= 2x \sin x + x^2 \cos x$$
$$y' = 2(\pi/3) \sin(\pi/3) + (\pi/3)^2 \cos(\pi/3)$$
$$y' = \frac{\cancel{2}\pi}{3}\frac{\sqrt{3}}{\cancel{2}} + \frac{\pi^2}{9}\frac{1}{2}$$
$$y' = \frac{\pi\sqrt{3}}{3} + \frac{\pi^2}{18}$$



$$y(\pi/3) = (\pi/3)^2 \sin(\pi/3)$$
$$\frac{\pi^2}{9}\frac{\sqrt{3}}{2} = \frac{\pi^2\sqrt{3}}{18}$$

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

tangent line

$$\boxed{y - \frac{\pi^2\sqrt{3}}{18} = \left(\frac{\pi\sqrt{3}}{3} + \frac{\pi^2}{18}\right)\left(x - \frac{\pi}{3}\right)}$$

$$y = \frac{\pi^2\sqrt{3}}{18} = \frac{-1}{\frac{\pi\sqrt{3}}{3} + \frac{\pi^2}{18}}\left(x - \frac{\pi}{3}\right)$$

normal line

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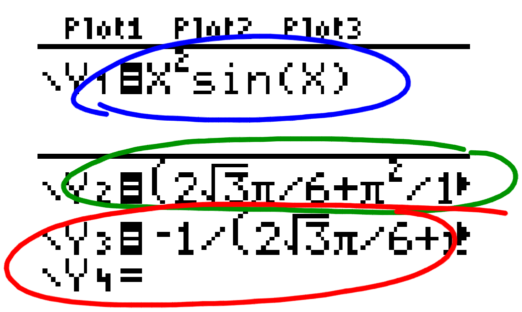

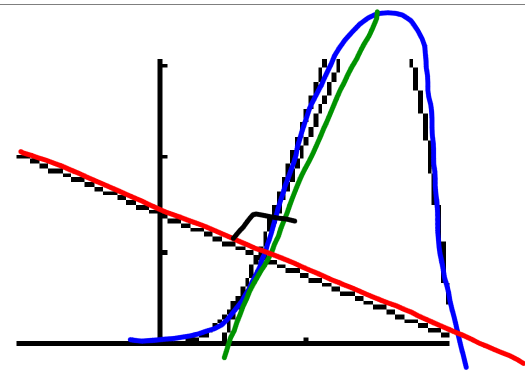

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Homework

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