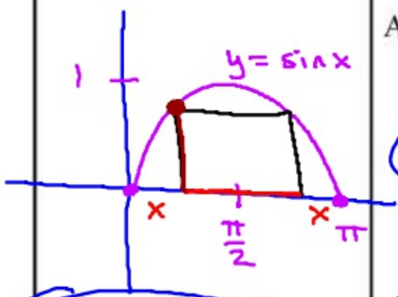
Extreme Values Critical Points	Determine the maximum and minimum velocity of the function given 2) $\boxed{v(t) = t^3 - 3t^2 + 4}$ [0, 4] $v'(t) = 3t^2 - 6t$ $0 = 3t^2 - 6t$ $0 = 3t(t-2)$ $t = 0 \quad t = 2$ $v(0) = 4$ $v(2) = 8 - 12 + 4 = 0$ $v(4) = 64 - 48 + 4 = 20$ Max velocity $t = 4$ min velocity $t = 2$ Determine the maximum and minimum acceleration of the function given 5) $v(t) = 4t^2 - 6t^3$ [0, 3] $a(t) = 8t - 18t^2$ $a'(t) = 8 - 36t$ $0 = 8 - 36t$ $36t = 8$ $t = \frac{8}{36} = \frac{2}{9}$ $a(0) = 0$ $a\left(\frac{2}{9}\right) = 8\left(\frac{2}{9}\right) - 18\left(\frac{2}{9}\right)^2$ $= \frac{16}{9} - \frac{72}{81}$ $= \frac{144}{81} - \frac{72}{81}$ $= \frac{72}{81} = \frac{8}{9}$ $a(3) = 24 - 18(9) = 24 - 162$ $= -138$

→ Maximize
Minimize

What you'll Learn About:
How to use derivatives to solve real world problems

A) A rectangle is to be inscribed under one arch of the sine curve. What is the largest area the rectangle can have, and what dimensions give that area.



$A'(.5) = .920$
$A'(1) = -1.066$
$A'(3) = 2.547$

Maximize Area of Rectangle

$A = lw$

$l = \pi - 2x$

$w = \sin x$

$l = \pi - 2(.710)$
$w = \sin(.710)$

$A = (\pi - 2x)\sin x$

$A = \pi \sin x - 2x \sin x$

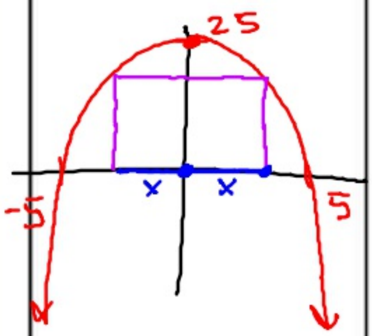
$A'(x) = \pi \cos x - [2x(\cos x) + 2\sin x]$

$0 = \pi \cos x - 2x\cos x - 2\sin x$

$x = .710$ $\quad x = 2.431$

$\boxed{A = (\pi - 2(.710))(\sin .710)}$

B) A rectangle is to be inscribed between the curve $y = 25 - x^2$ and the x-axis. What is the largest area the rectangle can have, and what dimensions give that area.



$A = bh$

$h = 25 - x^2$

$b = 2x$

$A = 2x(25 - x^2)$

$A = 50x - 2x^3$

$\boxed{A'(x) = 50 - 6x^2}$

$0 = 50 - 6x^2$

$\frac{6x^2}{6} = \frac{50}{6}$

$\sqrt{x^2} = \sqrt{\frac{25}{3}}$

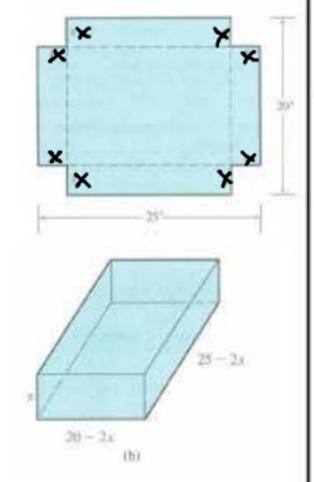
$x = \pm \frac{5}{\sqrt{3}}$ C.P.

$x = 5/\sqrt{3}$

$A''(x) = -12x$

$A''\left(\frac{5}{\sqrt{3}}\right) = -12\left(\frac{5}{\sqrt{3}}\right) < 0$

Local max b/c $A''\left(\frac{5}{\sqrt{3}}\right) < 0$



An open-top box is to be made by cutting congruent squares of side length x from the corners of a 20 by 25 inch sheet of tin and bending up the sides. How large should the squares be to make the box hold as much as possible? What is the resulting volume?

Maximize Volume: $V = lwh$

$V = (25-2x)(20-2x)(x)$

$V = (25-2x)(20x-2x^2)$

$V = 500x - 50x^2 - 40x^2 + 4x^3$

$V = +4x^3 - 90x^2 + 500x$

$V'(x) = 12x^2 - 180x + 500$

$0 = 12x^2 - 180x + 500$

Graph and find x-int

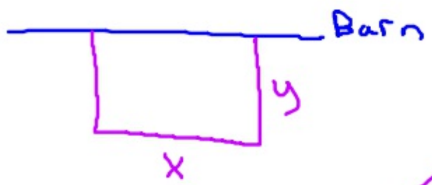
$x = 3.681$

$x = 11.319$

P.226-228
6, 7, 9
10, 21

You have 40 feet of fence to enclose a rectangular garden along the side of a barn. What is the maximum area that you can enclose?

$\boxed{Area = (20)(10)}$



Perimeter $= x + 2y$

$40 = x + 2y$

$40 - 2y = x$

$40 - 2(10) = x$

Area = bh

$A = xy$

$A = (40-2y)y$ ✓

$A = 40y - 2y^2$

$\boxed{A'(y) = 40 - 4y}$

$0 = 40 - 4y$

$y = 10$

$A''(y) = -4 < 0$

$y = 10$ local max