Sec.3.3

p.181: Definition of Increasing/Decreasing Functions;   Theorem 3.5

p.182: Guidelines for Finding Intervals on Which a Function is Increasing/Decreasing; Example 1
Strictly monotonic function.

$f'(x)$: $-\infty$ -1 0 $1/2$ 1 2 ∞

p.183: Theorem 3.6 - the First Derivative Test;   p.184 – 185: Examples 2 – 4

p.187: In Exercises 19–40, (a) find the critical numbers of f, if any, (b) find the open intervals on which the function is increasing or decreasing, (c) apply the First Derivative Test to identify all relative extrema

let $x+3=0 \to x=-3$ $f(-3)=-1$

34. $f(x) = |x+3| - 1$

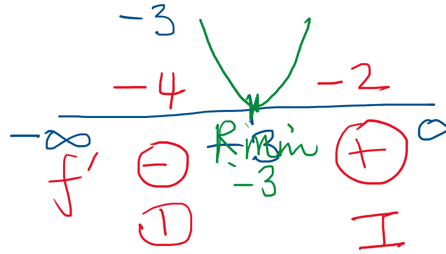
See 2.1

$$f'(-3) = \lim_{x\to-3}\frac{f(x)-f(-3)}{x-(-3)} = \lim_{x\to-3}\frac{[|x+3| \cancel{-1}] \cancel{-(-1)}}{x+3} = \lim_{x\to-3}\frac{|x+3|}{x+3}$$ DNE

$$|a| = \begin{cases} a, & a \ge 0 \\ -a & a < 0 \end{cases}$$

$$= \begin{cases} \frac{-(x+3)}{x+3} = -1, & for\ x < -3 \quad x \to -3^- \\ \frac{x+3}{x+3} = 1, & for\ x > -3 \quad x \to -3^+ \end{cases}$$

-3^- -3^+ -2 -3



1) C.#.
2) I/D
3) R.min?
R.max?

$f'(-3) = DNE \to C.\#: x = -3$

x	$f(x)$	$f'(x)$	$Conclusion$
$(-\infty,-3)$		$-$	$Decreasing$
$x=-3$	-1		$R.min\ @\ (-3,-1)$
$(-3,\infty)$		$+$	$Increasing$

p.187: In Exercises 41–48, consider the function on the interval $(0, 2\pi)$. (a) Find the open intervals on which the function is increasing or decreasing. (b) Apply the First Derivative Test to identify all relative extrema.

42. $f(x) = \sin x \cos x + 5$

$0 < x < 2\pi$ $\times 2$ $+2\pi = \frac{4\pi}{2}$

$0 < 2x < 4\pi$

$f'(x) = (cosx)(cosx) + sinx(-sinx) = cos^2x - sin^2x = cos2x$

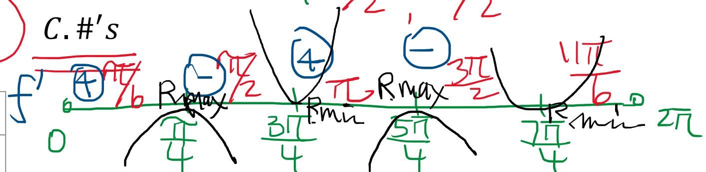
$\frac{9\pi}{2}, \frac{5\pi}{2}$

$\frac{3\pi}{2}, \frac{7\pi}{2}$

let $f'(x) = 0$: $cos2x = 0 \to 2x = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2} \to$

$\times\frac{1}{2}$

$x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$ $C.\#'s$



$f'(\frac{\pi}{6}) = \cos(2\times\frac{\pi}{6}) = \cos\frac{\pi}{3} = +$

$f'(\frac{\pi}{2}) = \cos(2\times\frac{\pi}{2}) = \cos\pi = -$

$f'(\pi) = \cos(2\pi) = +$

$f'(\frac{3\pi}{2}) = \cos(2\times\frac{3\pi}{2}) = \cos 3\pi = -$

$f'(\frac{11\pi}{6}) = \cos(2\times\frac{11\pi}{6}) = \cos\frac{11\pi}{3} = \cos\frac{5\pi}{3} = +$

x	$f(x)$	$f'(x)$	$Conclusion$
$(0,\frac{\pi}{4})$		$+$	$Increasing$
$x=\frac{\pi}{4}$	$5\frac{1}{2}$		$R.Max\ @\ (\frac{\pi}{4}, 5\frac{1}{2})$
$(\frac{\pi}{4},\frac{3\pi}{4})$		$-$	$Decreasing$
$x=\frac{3\pi}{4}$	$4\frac{1}{2}$		$R.Min\ @\ (\frac{3\pi}{4}, 4\frac{1}{2})$
$(\frac{3\pi}{4},\frac{5\pi}{4})$		$+$	$Increasing$
$x=\frac{5\pi}{4}$	$5\frac{1}{2}$		$R.Max\ @\ (\frac{5\pi}{4}, 5\frac{1}{2})$
$(\frac{5\pi}{4},\frac{7\pi}{4})$		$-$	$Decreasing$

$x=\frac{5\pi}{4}$	$5\frac{1}{2}$		*R. Max* @ $(\frac{5\pi}{4}, 5\frac{1}{2})$ ✓
$(\frac{5\pi}{4}, \frac{7\pi}{4})$		$-$ ✓	*Decreasing*
$x=\frac{7\pi}{4}$	$4\frac{1}{2}$		*R. Min* @ $(\frac{7\pi}{4}, 4\frac{1}{2})$ ✓
$(\frac{7\pi}{4}, 2\pi)$		$+$ ✓	*Increasing*

$$f'\left(\frac{11\pi}{6}\right)=\cos\left(2\times\frac{11\pi}{6}\right)=\cos\frac{11\pi}{3}=\cos\frac{5\pi}{3}=+$$

$$\frac{11\pi}{3}=\underbrace{\cancel{\frac{6\pi}{3}}}_{2\pi}+\frac{5\pi}{3}=$$

$$f\left(\frac{\pi}{4}\right)=\sin\frac{\pi}{4}\cos\frac{\pi}{4}+5=\frac{\sqrt{2}}{2}\times\frac{\sqrt{2}}{2}+5=\frac{1}{2}+5=5\frac{1}{2}$$

$$f\left(\frac{3\pi}{4}\right)=\sin\frac{3\pi}{4}\cos\frac{3\pi}{4}+5=\frac{\sqrt{2}}{2}\left(-\frac{\sqrt{2}}{2}\right)+5=-\frac{1}{2}+5=4\frac{1}{2}$$

$$f\left(\frac{5\pi}{4}\right)=\sin\frac{5\pi}{4}\cos\frac{5\pi}{4}+5=\left(-\frac{\sqrt{2}}{2}\right)\left(-\frac{\sqrt{2}}{2}\right)+5=\frac{1}{2}+5=5\frac{1}{2}$$

$$f\left(\frac{7\pi}{4}\right)=\sin\frac{7\pi}{4}\cos\frac{7\pi}{4}+5=\left(-\frac{\sqrt{2}}{2}\right)\left(\frac{\sqrt{2}}{2}\right)+5=-\frac{1}{2}+5=4\frac{1}{2}$$