Section 3.1 #17. Find critical numbers of $h(x) = \sin^2 x + \cos x$ for $0 < x < 2\pi$ $(0, 2\pi)$

$h'(x) = 2\sin x \cos x - \sin x = 0$

$\sin x(2\cos x - 1) = 0 \Rightarrow \sin x = 0 \Rightarrow x = \pi$ (The only one in $(0, 2\pi)$)

$2\cos x - 1 = 0 \Rightarrow \cos x = \frac{1}{2} \Rightarrow x = \frac{\pi}{3}, \frac{5\pi}{3}$

$h'(x)$ is defined for all x. The only critical numbers are $x = \pi, \frac{\pi}{3}, \frac{5\pi}{3}$.

#24. $f(x) = x^3 - 12x$ on $[0,4]$: $f'(x) = 3x^2 - 12$

$f'(x) = 0 \Rightarrow 3x^2 - 12 = 0 \Rightarrow x = \pm 2$ critical numbers

only $x = 2$ is in $[0,4]$

$f(2) = 2^3 - 12 \cdot 2 = -16$

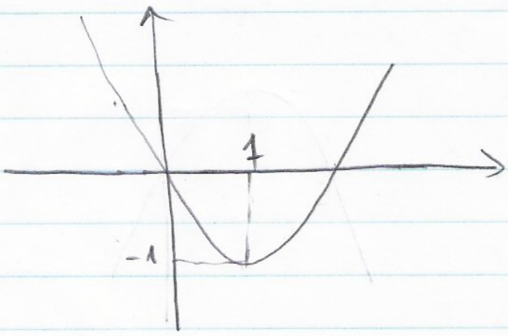
$f(0) = 0^3 - 12 \cdot 0 = 0$

$f(4) = 4^3 - 12 \cdot 4 = 16$

The absolute max is 16, attained at $x = 4$.

The absolute min is -16, attained at $x = 2$.

#39. $f(x) = x^2 - 2x \longrightarrow$



$f'(x) = 2x - 2 = 0$

$\Rightarrow x = 1$ is critical

and $f(1) = -1$

a) on $[-1,2]$: $f(-1) = (-1)^2 - 2(-1) = 3 \rightarrow$ max

$f(2) = 2^2 - 2 \cdot 2 = 0$

$f(1) = -1 \rightarrow$ min

b) on $(1,3]$: $f(3) = 3^2 - 2 \cdot 3 = 3 \rightarrow$ max, no minimum (b/c 1 is open)

c) $(0,2)$: $f(0) = 0$, $f(2) = 0$ } no max b/c 0 & 2 are not open

$f(1) = -1 \rightarrow$ minimum

d) $[1,4]$ $f(1) = -1 \rightarrow$ minimum

$f(4) = 4^2 - 2 \cdot 4 = 8 \rightarrow$ max

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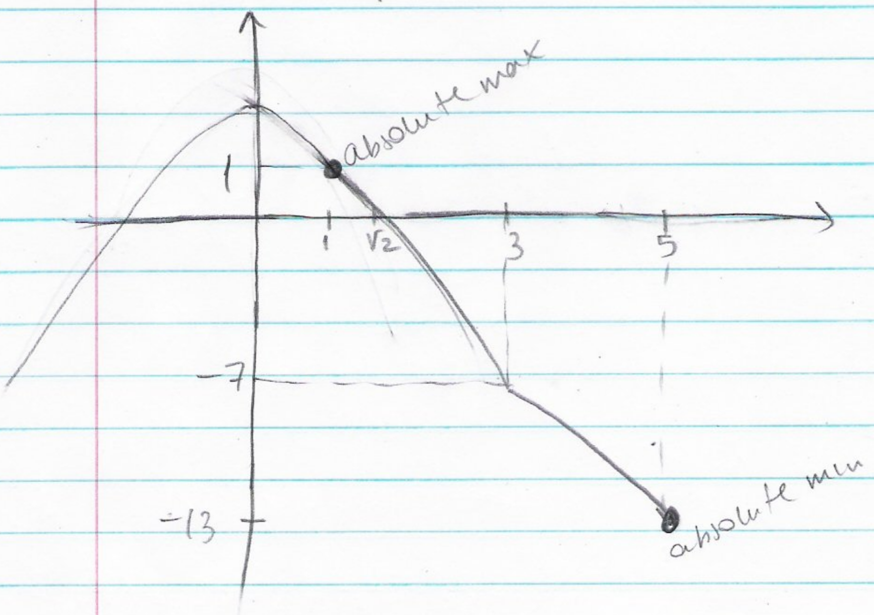
#42. $f(x) = \begin{cases} 2-x^2, & 1 \le x < 3 \\ 2-3x & 3 \le x \le 5 \end{cases}$ on $[1,5]$



max is 1 and is attained at $x=1$

min is -13 and is attained at $x=5$.

#60. Cost $= C(x) = 2x + \dfrac{300{,}00\,00}{x}$ $\quad 1 \le x \le 300$

critical numbers

$C'(x) = 2 - \dfrac{300{,}000}{x^2} = 0 \Rightarrow \dfrac{2x^2 - 300{,}000}{x^2} = 0$

$\Rightarrow x = 0$ (not in domain)

$x = 387$ → not in $[1, 300]$

$\left(2x^2 - 300{,}000 = 0 \right.$
$x^2 = 150{,}000$
$x \cong \pm 387$

So, evaluate at the end points $C(1) = 300{,}002$

$C(300) = 1600 \rightarrow$ minimum at $x = 300$

If $1 \le x \le 400$, then need to look at

$C(1) = 300{,}002$

$\boxed{C(387) = 1549.19 \rightarrow \text{minimum at } x = 387}$

$C(400) = 1550$