3.6 #6

Use a computer algebra system to graph $f$ and to find $f'$ and $f''$. Use graphs of these derivatives to find the following. (Enter your answers using interv notation. Round your answers to two decimal places.)

$$f(x) = \frac{x^3 + 5x^2 + 1}{x^4 + x^3 - x^2 + 2}$$

$$f'(x) = \frac{x(-x^5 + 10x^4 + 6x^3 + 4x^2 - 3x - 22)}{(x^4 + x^3 - x^2 + 2)^2}$$

SET $= 0 \longrightarrow x \approx$ 0., 1.054646897, −1.29420384, −9.40824099

Test: $x = -1, 1, 2$

$f'(-1) = -12$

$f'(1) = \frac{4}{9}$

$f'$: 0, 1.05

$f'(2) = -\frac{114}{121}$

Denominator has no real roots

The intervals where the function is increasing.

$(-9.41, -1.29), (0, 1.05)$

The intervals where the function is decreasing.

$(-\infty, -9.41), (-1.29, 0), (1.05, \infty)$

The local maximum values of the function. (Enter your answers as a comma-separated list.)

$f(x) =$ $7.49, 2.35$

The local minimum values of the function. (Enter your answers as a comma-separated list.)

$f(x) =$ $-0.056, 0.5$

The inflection points of the function.

$(x, y) = (-13.81, -0.05)$ (smallest $x$-value)

$(x, y) = (-1.55, 5.64)$

$(x, y) = (-1.03, 5.39)$

$(x, y) = (0.6, 1.52)$

$(x, y) = (1.48, 1.93)$ (largest $x$-value)

The intervals where the function is concave up.

$(-13.81, -1.55), (-1.03, 0.60), (1.48, \infty)$

**8.** 0/10 points

Use a computer algebra system to graph $f$ and to find $f'$ and $f''$. Use graphs of these derivatives to find the following.

$f(x) = \sqrt{x + 5\sin(x)} \qquad x \le 20$

Intervals of inc/dec; local extrema, IP's & concavity (3-decimal-place precision)

#8 $f(x) = \sqrt{x+5\sin(x)}$

$\mathcal{D}(f) = \{x \mid x+5\sin(x) \geq 0\}$

$fp := D(f)$

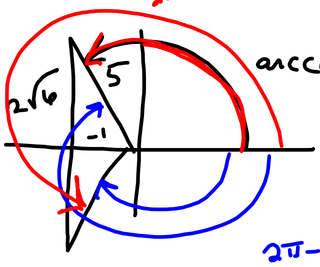
$$fp := x \mapsto \frac{1+5\cdot\cos(x)}{2\cdot\sqrt{x+5\cdot\sin(x)}} = f'$$

Graphing $f(x)^2 = x+5\sin(x)$ is key. Graphers tend to choke.

$solve(fp(x) = 0)$

$2\pi - \arccos(-\frac{1}{5})$

$$-\arctan(2\sqrt{6}) + \pi,\ \arctan(2\sqrt{6}) - \pi$$




$\arccos(-\frac{1}{5}) \approx 1.772154248$

$1+5\cos(x)=0$ for $f'(x)=0$

$\cos(x) = -\frac{1}{5}$

$2\pi + \arccos(-\frac{1}{5}) \approx 8.055339556$

$2\pi + \% \approx 14.33852486$

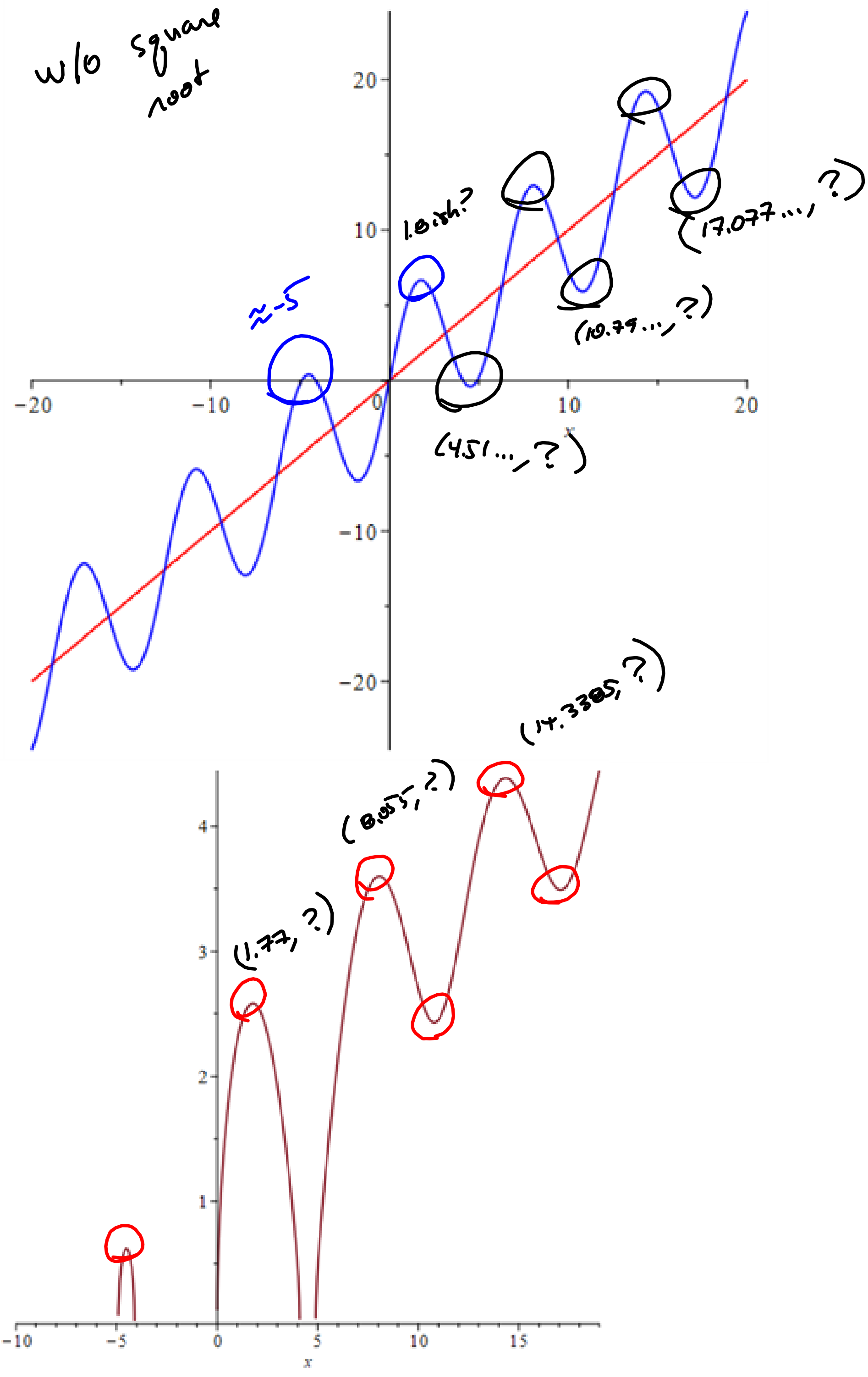
$2\pi - \arccos(-\frac{1}{5})$

$4\pi - \arccos(-\frac{1}{5})$

$6\pi - \arccos(-\frac{1}{5})$

-1.772154248

w/o square root



More drivel on §3.6 #8

$f(x) = \left(x+5\sin(x)\right)^{\frac{1}{2}} \longrightarrow$

https://www.wolframalpha.com/

Can plot/graph, solve, and take derivatives.

$f'(x) = \frac{1}{2}\left(x+5\sin(x)\right)^{-\frac{1}{2}}\left(1+5\cos(x)\right)$

$= \dfrac{1+5\cos(x)}{2\left(x+5\sin(x)\right)^{1/2}}$

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

$= \dfrac{\dfrac{-10\sin(x)\left(x+5\sin(x)\right)^{\frac{1}{2}}}{1}\cdot\dfrac{\left(x+5\sin(x)\right)^{1/2}}{\left(x+5\sin(x)\right)^{1/2}} - \dfrac{\left(1+5\cos(x)\right)^2}{\left(x+5\sin(x)\right)^{1/2}}}{4\left(x+5\sin(x)\right)}$

$= \dfrac{-10\sin(x)\left(x+5\sin(x)\right) - \left(1+5\cos(x)\right)^2}{4\left(x+5\sin(x)\right)^{3/2}}$ SETO HURTS!

$x+5\sin(x)=0$ ? You need that for critical values.

$f'$ & $f''$ can change sign across points where

$f'=0$ or $f'\bigstar$

$f''=0$ or $f''\bigstar$

$\cos(2x) = 2\cos^2(x) - 1$

$= 1 - 2\sin^2(x)$

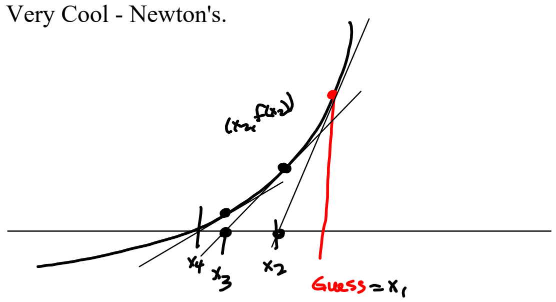
https://harryzaims.com/122/videos/chapter-02/test-2/cheat-sheet-test-2.pdf

Trig Identities: Have these at your fingertips! Review your Trig!

Ownership of the knowledge is another level from completing an assignment.

3.7 - Nothing new, really. Just applications of knowledge already gained.

3.8 - Very Cool - Newton's.




$x_1 =$ guess.

Tangent line to $f(x)$ @ $x = x_1$ :

$$y = f'(x_1)(x - x_1) + f(x_1) \overset{\text{SET}}{=} 0 \longrightarrow$$

$$f'(x_1)x - f'(x_1)x_1 = -f(x_1) \longrightarrow$$

$$f'(x_1)x = f'(x_1)x_1 - f(x_1)$$

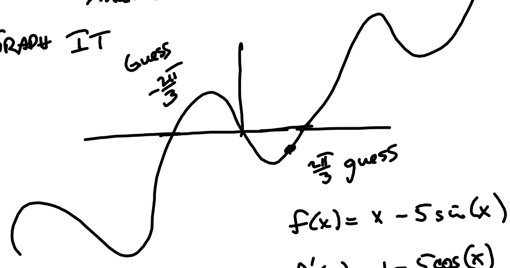
$$x = \frac{f'(x_1)x_1}{f'(x_1)} - \frac{f(x_1)}{f'(x_1)} = x_1 - \frac{f(x_1)}{f'(x_1)} \equiv x_2$$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)}$$

$$\boxed{x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}}$$ Newton's Method

Solve Find all roots of $x - 5\sin(x)$ that are greater than zero, using newton's method

GRAPH IT




$$f(x) = x - 5\sin(x)$$

$$f'(x) = 1 - 5\cos(x)$$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} = x_n - \frac{x - 5\sin(x_n)}{1 - 5\cos(x_n)}$$

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