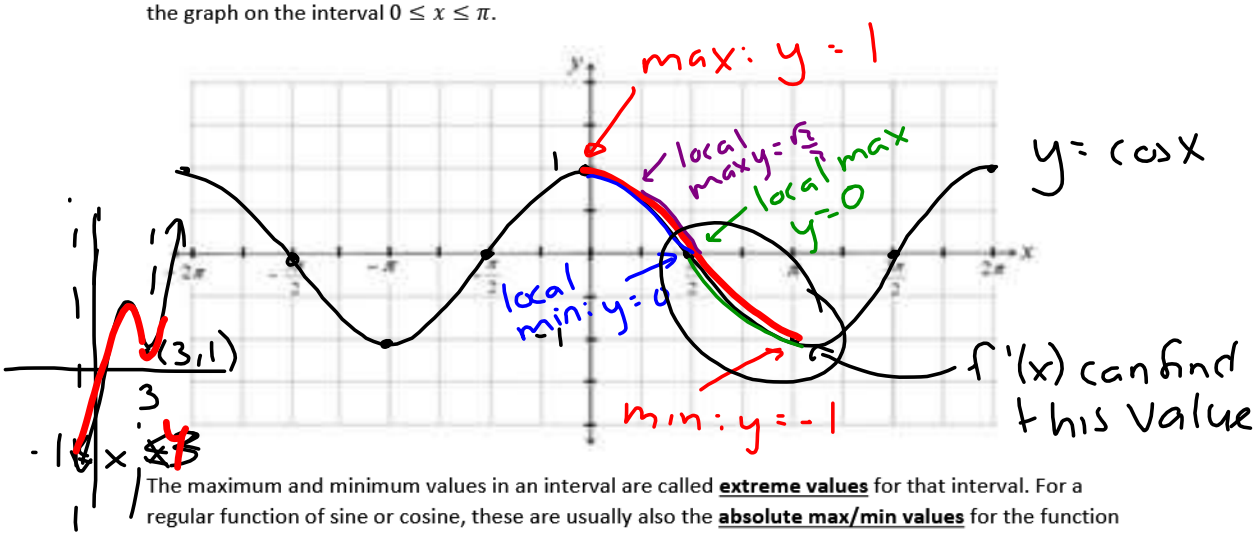
MCV 4U 5.4 Derivatives of Sine and Cosine Functions
Examining Composite Functions and Extreme Values

December 5, 2018

Graph y = cos x on the axes below. State the absolute maximum and the absolute minimum value for the graph on the interval $0 \leq x \leq \pi$.



The maximum and minimum values in an interval are called **extreme values** for that interval. For a regular function of sine or cosine, these are usually also the **absolute max/min values** for the function (the largest and smallest possible values of y that that function can ever have). **Local maxima or** minima are values that are the largest or smallest on a given interval, but are not the absolute max/min for the entire function. How can we adjust our interval for y = cos x so that it would include:

1. An absolute maximum, but a local minimum? $0 \leq x \leq \frac{3\pi}{2}$

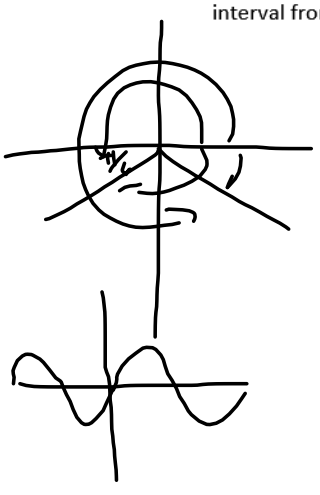
2. An absolute minimum, but a local maximum? $\frac{\pi}{2} \leq x \leq \pi$

3. Both a local maximum and a local minimum? $\frac{\pi}{4} \leq x \leq \frac{\pi}{2}$

The idea of extreme values becomes more relevant when we are talking about composite functions, since we don't necessarily know what their graphs look like. For an unfamiliar function, what would you do to locate the turning points on the graph? (Hint: What is the tangent slope at a turning point?)

- find the derivative, set it equal to zero to get x-coord. of turning point.

Example: For the function $f(x) = \frac{1}{2}x - cosx$, state the coordinates of the turning points on the interval from $-2\pi \leq x \leq 2\pi$.



$f'(x) = \frac{1}{2} + \sin x$

$0 = \frac{1}{2} + \sin x$

$-\frac{1}{2} = \sin x$

$\frac{7\pi}{6}, \frac{11\pi}{6} = x$

$-\frac{\pi}{6}, -\frac{5\pi}{6}$

$f\left(\frac{7\pi}{6}\right) = \frac{7\pi}{12} + \frac{\sqrt{3}}{2}$

Now use Desmos to graph f(x) = x sin 2x. Locate the local extreme values on the interval $-\pi \leq x \leq \pi$.

How would your answer change if I asked you to determine the local extreme values on the interval $\frac{\pi}{2} \leq x \leq \pi$?

Use your answer to the previous question to decide what other points you will need to consider to solve problems involving extreme values algebraically, ~~and then try it with f(x) = xsin2x.~~

Summary:

When you are asked to find the local max/min (extreme values, extrema) on an interval, you need to:

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Homework: p. 256 #1, 2bdf, 3 – 11, 14