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Math 31A Lecture Notes: Concavity

Review:

on (a, b) is increasing on (a, b)

on (a, b) is a critical point

on (a, b) is decreasing on (a, b)

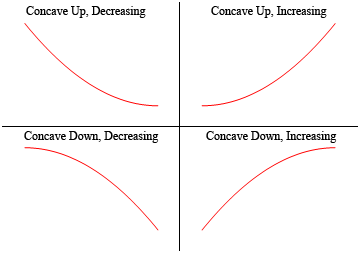
Theorem 1; *First derivative test*:

* c is a critical point of and changes sign from + to – is a local maximum
* c is a critical point of and changes sign from – to + is a local minimum

Definition; *Global min/max*:

If is a global max/min on [a, b], then c is either a critical point or or .

Concavity

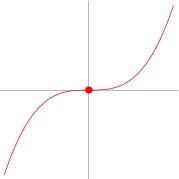


Definition; *Concavity*: Let be differentiable on (a, b)

* is concave up if is increasing on (a, b)
* is concave down if is decreasing on (a, b)

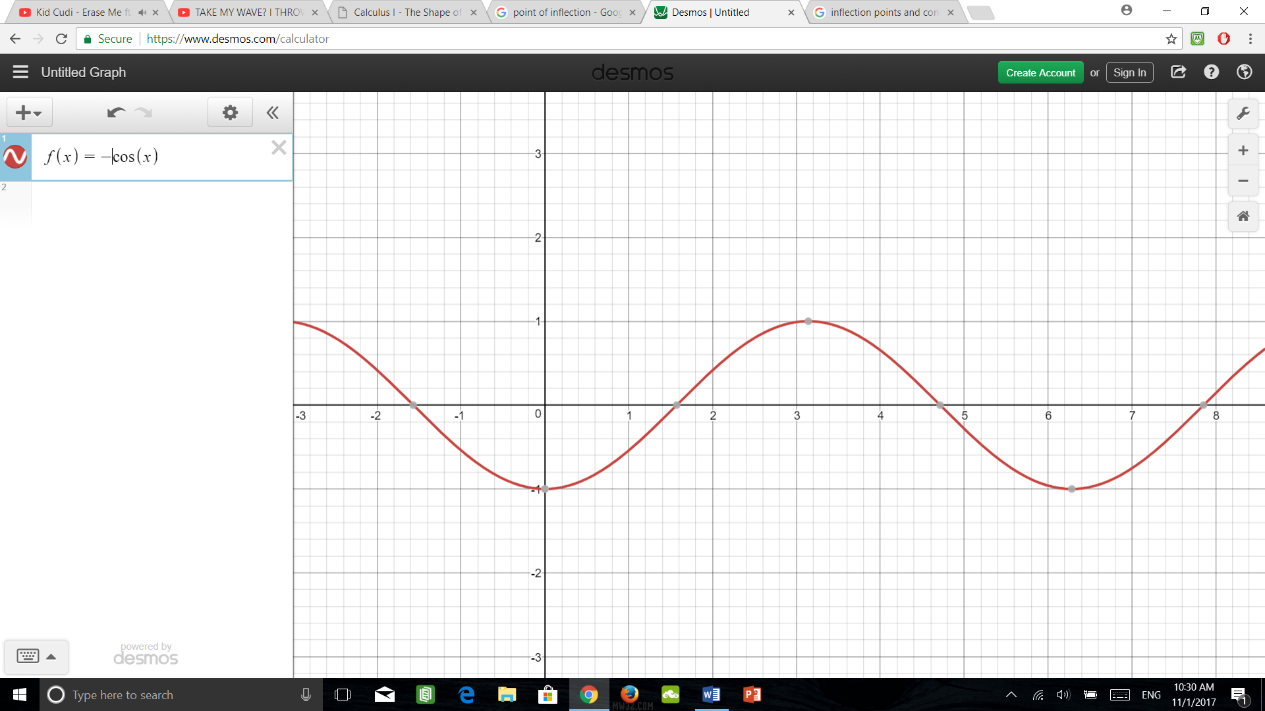
Theorem 1; *The Test for Concavity*: Assume exists on (a, b)

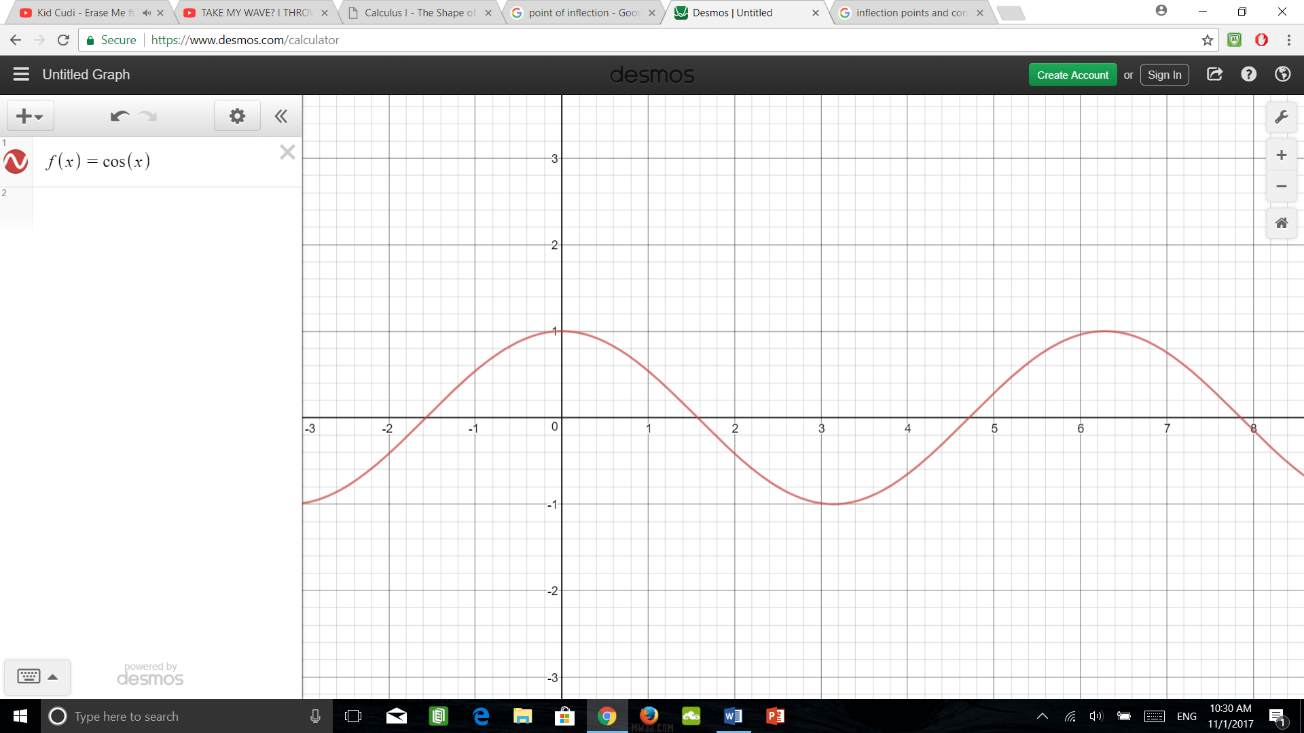
* If for , then is concave up on (a, b)
* If for , then is concave down on (a, b)

Definition; *Point of Inflection*: is a point of inflection of if the concavity of changes at .

Theorem 2; *Test for Inflection Points*: If or does not exist and changes sign at , then has a point of inflection at .

Example 1: Points of inflection and concavity of on





Concave down: :

Points of inflection: :

Concave up: :

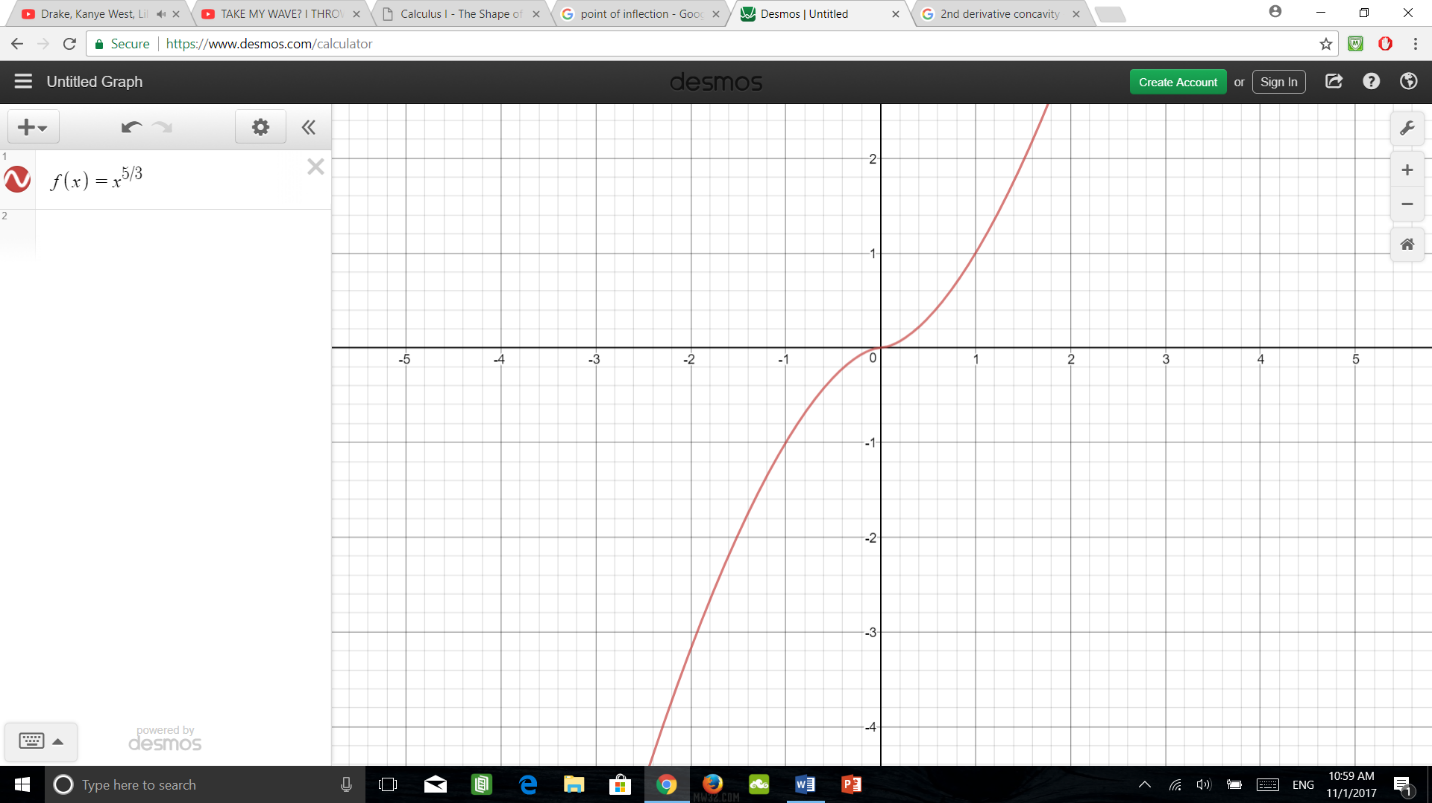
Example 2: Find points of inflection of and determine the intervals of concavity

Step 1: Solve

Hence, for and

Step 2: Determine sign of

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Interval | Test Value | Sign of | Behavior of | Concavity |
|  |  | - | Image result for 2nd derivative concavity | Concave down |
|  |  | - | Image result for 2nd derivative concavity | Concave down |
|  |  | + | Image result for 2nd derivative concavity | Concave up |

Example 3: Find the points of inflection of

Hence, by the test for inflection points, is an inflection point of