

Show work for credit. Don't abuse a calculator.

1. A bug is crawling along the curve $y = \arctan(2x)$ so that as the bug passes through the point $\left(\frac{1}{2}, \frac{\pi}{4}\right)$ its y -coordinate increases at a rate of 0.01 cm/s.

- How fast is the x -coordinate increasing?
- How distance from the bug to the origin changing at this instant?

2. Two sides b and c of a triangle have lengths 3 and 4. The third side is growing at a rate of 0.2 units per second. How fast is the angle between b and c changing when the third $a = 6$?
Recall that the law of cosines involves the formula $a^2 = b^2 + c^2 - 2bc \cos \theta$.

3. Sketch the graph of a function defined for all values in $[1, 6]$ that has no global maximum nor minimum, one local minimum, one local maximum and three critical numbers.

4. Find the inflection points of $y = \arctan(x^2 + x)$.

5. Suppose $f(x) = (x+2)^2(x-7)^3(x-11)^4$. On what intervals is f increasing? Write your answer using interval notation.

6. Use your calculator to examine the graph of $f(x) = \tan x + 5 \sin x$ as well as the graphs of $f'(x)$ and $f''(x)$.
- How many local extrema are in each period?
 - How many intervals of increase are in each period?
 - How many inflection points are in each period?

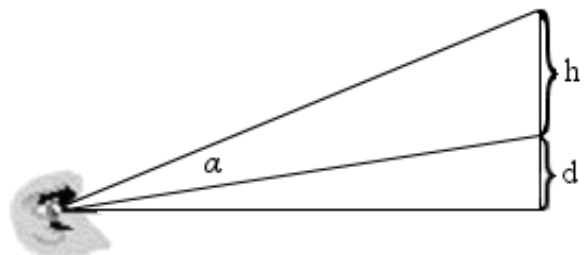
7. Find $\lim_{x \rightarrow 0} \frac{e^{5x} - 1 - \sin x}{x^2 + x}$ using L'Hospital's rule, if appropriate.

8. For what values of a and b is the following true: $\lim_{x \rightarrow 0} \frac{\sin 6x}{x^3} + a + \frac{b}{x^2} = 0$?

9. If $y = x^2 - x + 1$, what value will minimize the product xy on the interval $[0, 2]$?-

10. Find the points on the ellipse $9x^2 + y^2 = 9$ which are farthest from the point $(0, 3)$.

11. A painting in an art gallery has height h and is hung so that the lower edge is a distance d above the eye of the observer. How far from the wall should the viewer stand so as to maximize the angle α the painting subtends at the viewer's eye?



12. Use Newton's method to approximate $\sqrt[3]{1729}$ accurate to 8 decimal places. Start with $x_1 = 8$ and show the iteration formula and the iterates up to convergence.