

Name: _____

Directions: Complete all questions and **show all applicable work.** Partial credit will be given.

1.) [20 pts]

1. Create a linear approximation of the function

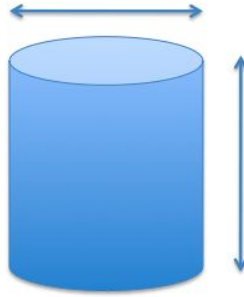
$$f(x) = x^2 + 1$$

at the point $x = 1$.

2. On what interval can the error be expected to be less than 0.4?
3. Graph $f(x)$ and the approximation on a single graph, showing the interval.

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2.) [20pts] Water is pouring into an empty vertical cylinder at a rate of 3 cubic feet per minute. If the cylinder's capacity is 24 cubic feet and its radius is 4 feet, (A) how fast is the surface rising? (B) When will the tank reach 2.5 feet high? Note: $V = \pi r^2 h$

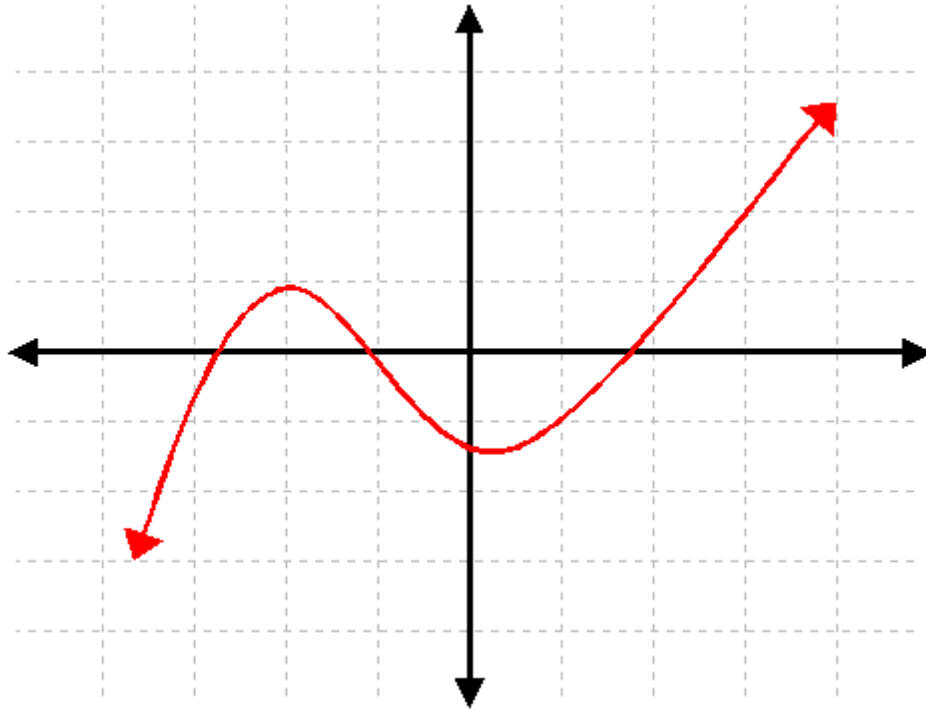


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3.) [20pts] Given the function $f(x) = x^3 - 3x$, *without* a graph find all local maximums and minimums on the interval $[-3,3]$. Be sure to describe your reasoning (eg. the 2nd derivative test).

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4.) [20pts]



Using the graph above of $f(x)$ answer the follow (assume each grid cell is 1 unit and round all values to the nearest integer):

- (a) On what interval(s) is $f'(x)$ positive?
- (b) On what interval(s) is $f'(x)$ negative?
- (c) On what interval(s) is $f'(x) = 0$?
- (d) On what interval(s) is $f''(x)$ positive?
- (e) On what interval(s) is $f''(x)$ negative?
- (f) On what interval(s) is $f''(x) = 0$?
- (g) What are the critical values on the domain $[-3, 3]$?
- (h) On the range $[-3, 3]$ find all local and absolute maximums and minimums. Label each.

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5.) [20pts] Compute each of the following limits showing your work:

(a) $\lim_{x \rightarrow \infty} xe^x$

(b) $\lim_{x \rightarrow \infty} \frac{e^x}{x^2}$

(c) $\lim_{x \rightarrow \infty} x^{\frac{1}{x}}$