

1. [7] TRUE/FALSE: Let f and g be functions. Circle T in each of the following cases if the statement is *always* true. Otherwise, circle F.

T F $x + \frac{1}{x} = \frac{x^2 + 1}{x}$

T F $\sqrt{x} = x^{-2}$

T F If $\lim_{x \rightarrow a} g(x) = 0$ then $\lim_{x \rightarrow a} \frac{f(x)}{g(x)}$ does not exist.

T F If f is a continuous function, $f(0) = 2$, and $f(4) = -2$, then $f(2)$ is between -2 and 2 .

T F If f is continuous at a , then f is differentiable at a .

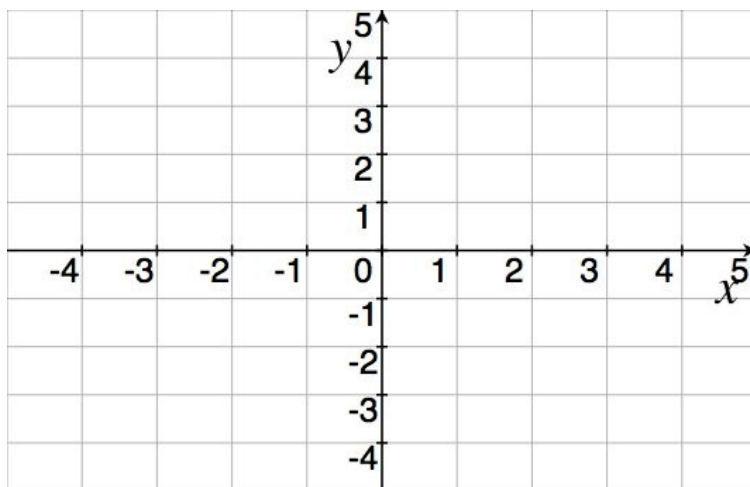
T F $(e^x)' = xe^{x-1}$.

T F $x^2 = 2x$.

Show your work for the following problems. The correct answer with no supporting work will receive NO credit (this includes multiple choice questions).

2. [5] (Quiz2 #2) Draw a graph for a function $\alpha(x)$, that satisfies all of the following:

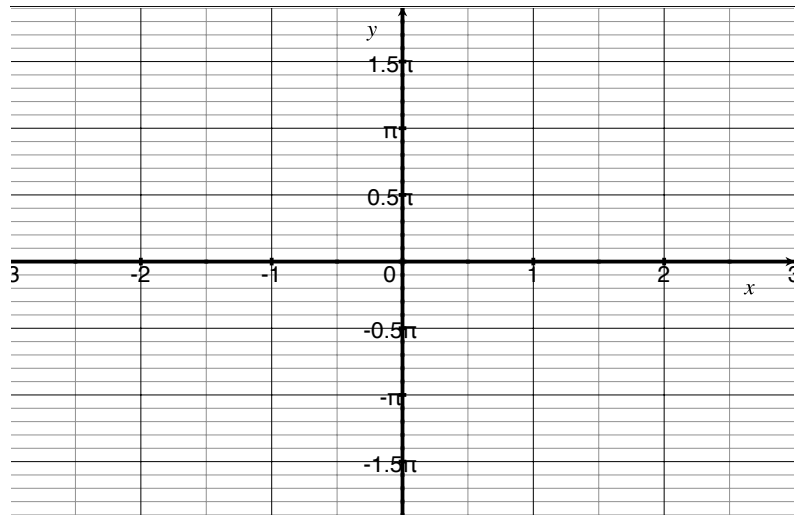
- (a) $\lim_{x \rightarrow \infty} \alpha(x) = 2$,
 (b) α is not continuous at $x = -3$,
 (c) $\alpha(2) = 3$
 (d) $\alpha'(0)$ is negative



3. Let f be the piece-wise defined function:

$$f(x) = \begin{cases} \pi x + \frac{\pi}{2} & \text{if } x < 0, \\ 2 \arctan(x) & \text{if } 0 < x, \end{cases}$$

- (a) [3] (Quiz1 #1a)
Carefully graph f on the axis provided.



- (b) [3] (§2.8 #6) On the axis below, sketch the graph of $\frac{df}{dx}$.

- (c) [6] Estimate the following, if possible:
(WebHW1 #9, WebHW2 #1, WebHW4 #9, §2.3 #2)

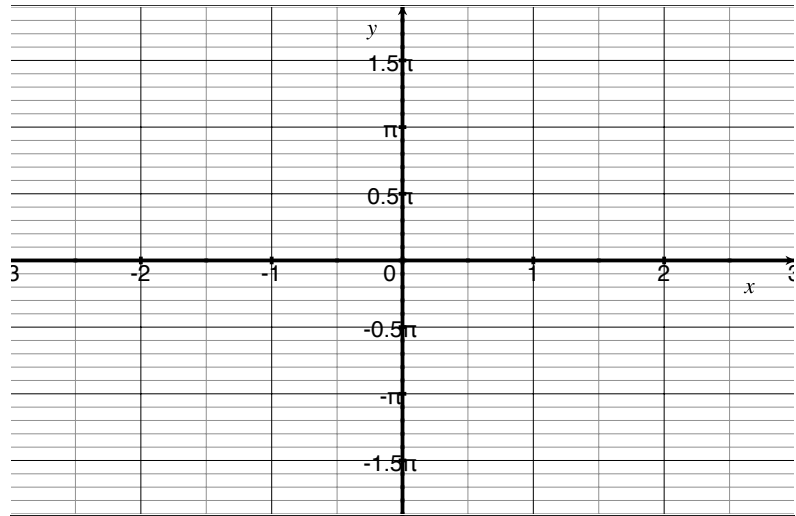
$$f(1)$$

$$\lim_{x \rightarrow 0} f(x)$$

$$\lim_{x \rightarrow 0^-} f(x)$$

$$\lim_{x \rightarrow \infty} f(x)$$

$$\lim_{x \rightarrow -2} (2f(x) - \pi)$$



4. [12] Find the limit if it exists, or explain why it does not exist.

(Lecture 4/7)

$$\lim_{x \rightarrow 0} x^2 \sin\left(\frac{\pi}{x}\right)$$

(§2.5 #36)

$$\lim_{x \rightarrow \pi} \frac{2}{x-3} + \cos(x)$$

(§2.6 #20)

$$\lim_{x \rightarrow \infty} \frac{x - x\sqrt{x}}{2x^{\frac{3}{2}} + 3x - 5}$$

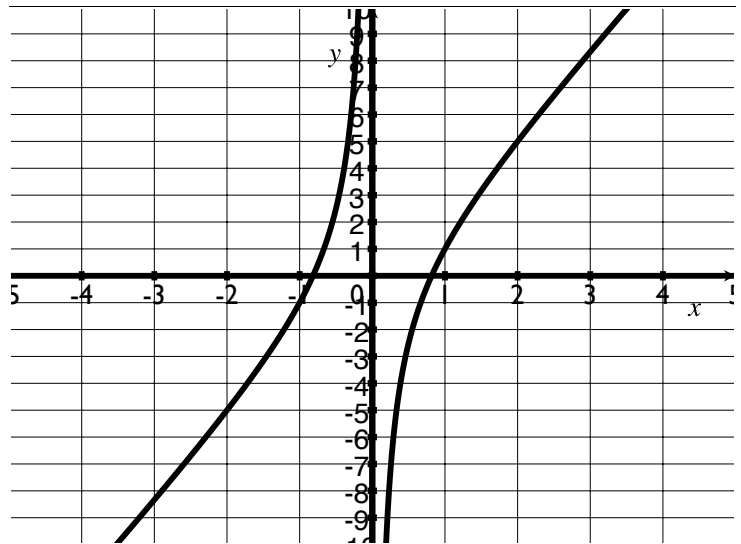
(practice #4)

$$\lim_{x \rightarrow 2^+} \ln(x-2)$$

5. Consider $g(x) = \frac{3x^2 - 2}{x}$
graphed to the right.

(a) [4] (PolyExp Wks #1)

Find $\frac{dg}{dx}$



(b) [2] Find $g'(1)$

(c) [3] (Quiz2 #3) Find the equation of the line tangent to g when $x = 1$.

6. Choose *ONE* of the following. Clearly identify which of the two you are answering and what work you want to be considered for credit.

No, doing both questions will not earn you extra credit.

- (a) [5] (Story Wks #6) The shuttle Discovery launched the Hubble Space Telescope April 24th 1990.

The shuttle's distance traveled from liftoff ($t = 0$) to jettisoning the rocket boosters ($t = 126$ s) was well modeled by the function:

$$0.0003255t^4 - 0.03009667t^3 + 11.805t^2 - 3.083t$$

- i. [2] Find a function that describes the velocity of the shuttle.
 - ii. [1] Find a function that describes the acceleration of the shuttle.
 - iii. [2] Identify when the maximum acceleration is obtained by the shuttle in the first 126 seconds.
- (b) [5] (PracticeExam) The total cost of repaying a student loan at an interest rate of $r\%$ per year is $C = f(r)$.
- i. [2] What is the meaning of the derivative $f'(r)$? What are its units?
 - ii. [1] What does the statement $f'(10) = 1200$ mean?
 - iii. [2] Is $f'(r)$ always positive or does it change sign? Justify your answer.