

1. [4] 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 $\sqrt{x} = x^{\frac{1}{2}}$

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

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

T F $\frac{d}{dz} x^2 = 2x$

Show *all* your work (numerically, algebraically, or geometrically) for the following problems. Supporting work is needed to earn credit.

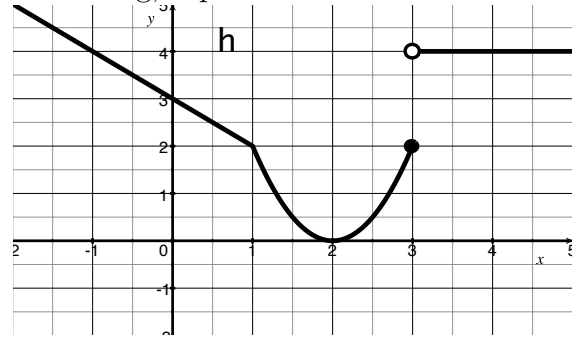
2. (§3.5 #74) Consider the function $f(x) = x^x$.

(a) [1] Explain *why* we cannot use the power rule to find $\frac{dy}{dx}$.

(b) [3] Find $\frac{dy}{dx}$ when $y = x^x$

3. Let h be the piece-wise defined function comprised of two line segments and a parabola shifted horizontally shown below and to the right. Let f be a continuous function with the characteristics described below. Find the following, if possible.

$$\begin{aligned} f(-1) &= -3 \\ f(4) &= 5 \\ f'(-1) &= -2 \\ f'(4) &= 6 \end{aligned}$$



(a) [1] $\frac{d}{dx}(h(x))|_{x=0}$

[3] (Quiz3 #1)

$$(f \circ h)'(-1)$$

[3] (ProductActivity #1)

$$(fh)'(-1)$$

[3] (WebHW7 #7)

$$\frac{d}{dx} \left(\frac{f(x)}{3 + h(x)} \right) \Big|_{x=-1}$$

- (b) [3] (ApproxActivity #3) The linearization of f at $x = -1$

4. Find each of the following.

[3] (WebHW8 #18)

$$(\log_2 \sqrt{x^2 - 6})'$$

[4] (Spring15Exam2 #4)

$$\frac{d}{dy} \left(\frac{\sin(y) + y \cos(y)}{\cos(y)} \right)$$

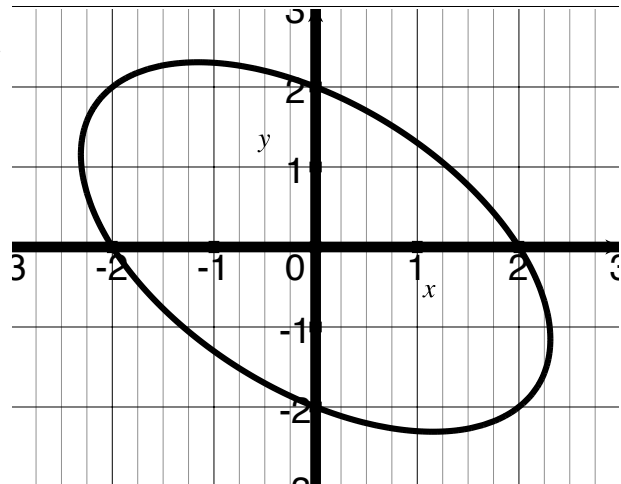
5. Each of the following derivatives is *wrong*. Please explain why and provide the correct derivative.

(a) [3] (WebHW8 #17) $\frac{d}{dx}(2^x) = x2^{x-1}$

(b) [2] (Quiz3 #2) $\frac{d}{dx} \left(\frac{\pi x}{2} \right) = \frac{(2)(\pi) - (\pi x)(1)}{4}$

6. The graph of the equation $x^2 + xy + y^2 = 4$ is shown to the right.

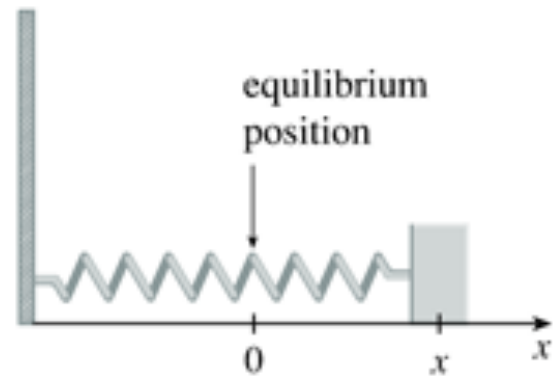
- (a) [4] (WebHW9 #1)
Find $\frac{dy}{dx}$ as a function of x and y .



- (b) [3] (§3.5 #46) Find the equation of the line tangent to the curve at $(2, 0)$.

7. (Spring15Exam2 #6) A mass on a spring vibrates horizontally on a smooth level surface with the equation $x(t) = 10 \cos(2t)$ where t is in seconds and x is in centimeters.

- (a) [2] Find the velocity of the spring at time t .



- (b) [3] When is the spring at rest?

8. 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) (§3.7 #24) A boat is pulled into a dock by a rope attached to the bow of the boat and passing through a pulley on the dock that is 2 m higher than the bow of the boat. The rope is being pulled in at a rate of 1.5m/s.

i. [3] Find an equation relating the speed of the boat to other variables.

ii. [2] How fast is the boat approaching the dock when it is 3 m from the dock?

(b) (§3.7 Example#4) An airplane is flying on a flight path that will take it directly over a radar tracking station. Thus the airplane is still flying *towards* the radar tracking station. It is discovered that this distance from the plane to the radar tracking station is decreasing at a rate of 400 miles per hour.

i. [3] Find an equation relating the *speed* of the airplane to other variables.

ii. [2] How fast is the airplane traveling when the airplane is 10 miles from the radar tracking station?