1. (HGM calc 2.4.1) The temperature, H, in degrees Celsius, of a cup of coffee placed on the kitchen counter is given by $H = f(t)$, where t is minutes since the coffee was put on the counter.

(A) What does $f(20) = 90$ mean? (give units)
(B) What does $f'(20) = -10$ mean? (give units)

2. Is the function

$$f(x) = x|x|$$

differentiable everywhere? (show your work)

3. (HGM calc 2.6.13) A magnetic field, B, is given as a function of the distance, r from the center of a wire as follows:

$$B(r) = \begin{cases} \frac{r}{r_0} B_0 & \text{for } r \leq r_0 \\ \frac{r_0}{r} B_0 & \text{for } r > r_0. \end{cases}$$

(A) Is B continuous at $r = r_0$? (Show your work).
(B) Is B differentiable at $r = r_0$? (Show your work)
(C) Sketch a graph of B against r.

4. Given the function

$$g(t) = \begin{cases} 2 + \sin(2\pi\ e^t) & \text{for } t \leq 0 \\ 2(3^t) & \text{for } t > 0. \end{cases}$$

(A) Is the function g continuous in $t = 0$?
(B) Is the function g differentiable in $t = 0$?

5. (HGM calc 3.3.53) The quantity, q, of a certain skateboard sold depends on the selling price, p, in dollars, so we write $q = f(p)$. You are given that

$$f(140) = 15000$$

and

$$f'(140) = -100.$$

(A) What do $f(140) = 15000$ and $f'(140) = -100$ tell you about the sales of skateboards?

(B) The total revenue, R earned by the sale of skateboards is given by

$$R = pq.$$

Find

$$\frac{dR}{dp}|_{p=140}$$

(C) What is the sign of $\frac{dR}{dp}|_{p=140}$? If the skateboards are currently selling for 140, what happend to revenue if the price is increased to 141?

6. For what intervals is

$$h(x) = x2^{bx}, \quad \text{where} \quad b > 1 \text{ is a constant,}$$

both increasing and concave down?

7. Find the equation of the tangent line to

$$f(x) = (x-2)^4$$

at $x = 3$.

8. Give an example of a function f with negative, but everywhere increasing slope. What is the sign of f''?

9. If

$$\frac{d}{dt}(tf(t)) = 2 + f(t),$$

what is $f'(t)$?

10. Suppose $f(x)$ is increasing and concave up everywhere and $f(A) = 4$, $f'(A) = 2.2$, $h = 0.05$. Estimate the values of $f(A-h)$ and $f(A+h)$. Hint: Use the definition of the derivative.

11. Given the table

x	f(x)	f'(x)
1	2	-1
2	3	5

Assume that the function f is invertible and differentiable everywhere. Find $(f^{-1})'(2)$.