## Math 190 Homework 6: Due Monday October 24

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*The assignment is due at the beginning of class on the due date. You are expected to provide full solutions, which are laid out in a linear coherent manner. Your work must be your own and must be self-contained. Your assignment must be stapled with your name and student number at the top of the first page.*

**Questions:**

1. For the following problems find the derivative of the given function.
   (a) $5x^4 - \dfrac{2}{\sqrt[3]{x}} + x^e - e^x$
   (b) $x^{3/2}\sin x$
   (c) $\dfrac{\cos x}{e^x}$
2. Find the equation of the tangent line to
$$h(x) = \frac{x^2 e^x}{e^x + 1}$$
at the point $x = \ln(2)$.
3. Consider the function
$$f(x) = x^{1/3}.$$
   (a) Find the domain of $f(x)$.
   (b) Find the derivative of $f(x)$ using power rule. What is the domain of $f'(x)$?
   (c) Find all vertical asymptotes of the derivative $f'(x)$. Include the relevant one sided limits.
   (d) Sketch the graph of $f(x) = x^{1/3}$. Try to draw the tangent line at $x = 0$. What is the slope? Explain this behaviour in connection with your answer from part (c).
4. (a) Recall the derivative of $x^{3/2}\sin x$ from Question 1(b). Using your answer, find the derivative of
$$e^x x^{3/2}\sin x$$
using product rule once.
   (b) To solve the above problem (a) you could have also used the following *triple product rule*:
$$\frac{d}{dx}(fgh) = \frac{df}{dx}gh + f\frac{dg}{dx}h + fg\frac{dh}{dx}.$$
Use the triple product rule to differentiate
$$(3x-1)(4x^2+2)(x^{-3}+\sqrt{x}).$$
5. Not every function is *differentiable* (has a derivative) at every point. Consider the function $f(x) = |x|$. Let us try to investigate the derivative at $x = 0$, that is $f'(0)$. We can use the limit definition of the derivative to write the following
$$f'(0) = \lim_{h\to 0}\frac{f(0+h) - f(0)}{h}.$$
Compute this limit. If it does not exist justify why. Draw the graph of $f(x) = |x|$. What happens when you try to draw a tangent line at $x = 0$. What can you conclude about $f'(0)$ after observing your limit computation?