Mth 31, Homework 4 on sections 3.2, 3.3

Due by Wed, Oct 8.

Write all your working out and answers neatly by hand on your own notepaper. Please use lots of space and as many pages as you want, so I can include corrections or comments. You do not need to write the questions, but it is very important that you show clearly any work you had to do to get your answers. Each question is worth 3 points.

For the following questions use the differentiation formulas

$$\frac{d}{dx}c = 0, \quad \frac{d}{dx}x^n = nx^{n-1}, \quad \frac{d}{dx}e^x = e^x, \quad \frac{d}{dx}\sin x = \cos x, \quad \frac{d}{dx}\cos x = -\sin x$$

and the sum, difference, product and quotient rules.

Section 3.2 The product and quotient rules

(1) Let $g(x) = (x^3 + 1)(x^2 - 1)$.

- **(a)** Find $g'(x)$ using the product rule for differentiation and simplifying.
- **(b)** Find $g'(x)$ by first multiplying out the product and then differentiating.
- **(c)** Check that you get the same answer in (a) and (b).

(2) Let $f(x) = x^3 e^x$ and find: **(a)** $f'(x)$ **(b)** $f''(x)$

(3) Suppose

$$g(x) = xf(x), \quad f(4) = -2, \quad f'(4) = 3$$

and use this information to find $g'(4)$.

(4) Use the quotient rule to differentiate $\dfrac{x+2}{x+3}$

Section 3.3 Derivatives of trigonometric functions

(5) Compute:

- **(a)** $\dfrac{d}{dx}\left(4\sin x - 3\cos x + 2\right)$
- **(b)** $\dfrac{d}{dt}\left(\sin t \cos t\right)$
- **(c)** $\dfrac{d}{d\theta}\left(\cos^2\theta\right)$

(d) $\dfrac{d}{dx}\left(5\tan x\right)$

(Remember that $\cos^2\theta$ means $(\cos\theta)^2$.)

(6) Let

$$f(\theta) = \frac{\sin\theta}{1+\cos\theta}$$

and find $f'(\theta)$

(7) What is the equation of the tangent line to $y = x + 1 + \sin x$ at the point $(0, 1)$.

(8) Let $h(x) = x\sin x$ and find $h^{(4)}(x)$. This is the fourth derivative.

(9) Estimate

$$\lim_{x\to 0}\frac{x}{\sin x}$$

numerically by using some x values close to 0. (Make sure your calculator is in radians mode.)

If you get stuck on a question or aren't sure if you understand it:

- Go over the relevant class notes and section in the textbook.
- Check if you get the right answer for a similar odd-numbered question in the textbook (answers at the back of the book).
- Ask me about it after class.
- Come to my office hours: Mon 11:30 - 12:30, Wed 11:30 - 12:30 in CP 317.
- Go to the Math Tutorial Lab in-person in CP 303 or online.