Calculus I Students,

Test 4 will be Thursday and Friday April 29/April 30. To be prepared, you should have done or should do the following:

1. Watched all the videos on Chapter 5.
   https://www.telstarbob.net/bbrown/Math1540_daily_sch_Spring_2021SWST.htm
   (Same list for Augusta)
2. Completed all the homework for Chapter 4.
3. Work the practice test by yourself.
   http://telstarbob.net/bbrown/Math1540OL/CalculusITest4Practice2.pdf
4. Watch Practice test 4 video if you need help on any problem.
   https://www.youtube.com/watch?v=WZ2B1bEKVIg&feature=youtu.be
5. Ask me any questions or even request a Zoom Video Tutoring Session if you need additional help.
6. Understand summation notation such as

   $$\sum_{k=1}^{4} 2\cos\frac{\pi}{k}, \qquad \sum_{k=0}^{4} 2(k+1)$$

7. Calculate the area under a curve using approximations (see practice test)
8. Understand and use the two versions of the Fundamental Theorem of Calculus:

The First Fundamental Theorem of Calculus

If f is a continuous function at every point on the interval $[a,b]$ *and F* Is any antiderivative of f on [a, b], then

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

The Second Fundamental Theorem of Calculus

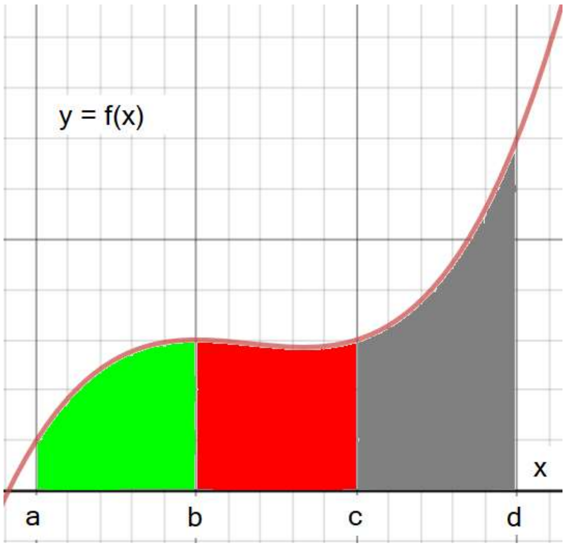
If f is continuous function on $[a,b]$ *then* $F(x) = \int_a^x f(t)\,dt$ *is continuous on* $[a,b]$ *and differentiable on* (a,b) *and its derivative is* $f(x)$

$$F'(x) = f(x)$$

In the second theorem, if the upper limit is not x, but g(x), then you must use the chain rule and multiply by g’(x).

$$If\ \ F(x) = \int_a^{g(x)} f(t)\ dt,\ \ then\ \ F'(x) = f(g(x))\, g'(x)$$

9. Understand $\int_a^b f(x)dx = -\int_b^a f(x)dx$
10. Given the function pictured below, understand the properties of definite integrals:



$$If\ a < b < c < d, then \int_a^d f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx + \int_c^d f(x)dx$$

11. Understand how to calculate indefinite integrals using substitutions.

Steps To Integrate $\int g'(x)f(g(x))dx$

1. *Choose Substitution* $u = g(x)$
2. *Calculate* $\frac{du}{dx} = g'(x), du = g'(x)dx$
3. *Substitute* $du = g'(x)dx$ *in integral above*
4. *Integrate with respect to u*
5. *Substitute* $u = g(x)$

Note that a wise substitution is u = g(x) if g'(x) appears in the integral. See practice test and practice test video.

12. If you are calculating a definite integral and using substitutions, you must change the lower and upper limits using the substitution.

Definite Integrals & Substitution
Change Limits of Integration Using $u = g(x)$

$$\int_a^b g'(x)f(g(x))dx = \int_{g(a)}^{g(b)} f(u)du$$

13. To calculate the area between two curves u(x) and l(x) where u(x) is always above l(x).

$$A = \int_a^b u(x) - l(x)\ dx$$

All of these ideas are illustrated in the Practice Test.

On the test, you may have this study guide as well as the derivative and anti-derivative tables at the end of this note.

Differentiation Rules

$$\frac{d}{dx}x^n = nx^{n-1}$$

$$\frac{d}{dx}\ln x = \frac{1}{x}$$

$$\frac{d}{dx}\sin x = \cos x$$

$$\frac{d}{dx}\cos x = -\sin x$$

$$\frac{d}{dx}\tan x = \sec^2 x$$

$$\frac{d}{dx}\csc x = -\csc x \cot x$$

$$\frac{d}{dx}\sec x = \sec x \tan x$$

$$\frac{d}{dx}\cot x = -\csc^2 x$$

$$\frac{d}{dx}e^x = e^x$$

$$\frac{d}{dx}a^x = (\ln a)a^x$$

$$\frac{d}{dx}\sin^{-1} x = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\cos^{-1} x = \frac{-1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\tan^{-1} x = \frac{1}{1+x^2}$$

$$\frac{d}{dx}\cot^{-1} x = \frac{-1}{1+x^2}$$

$$\frac{d}{dx}\sec^{-1} x = \frac{1}{x\sqrt{x^2-1}}$$

$$\frac{d}{dx}\csc^{-1} x = \frac{-1}{x\sqrt{x^2-1}}$$

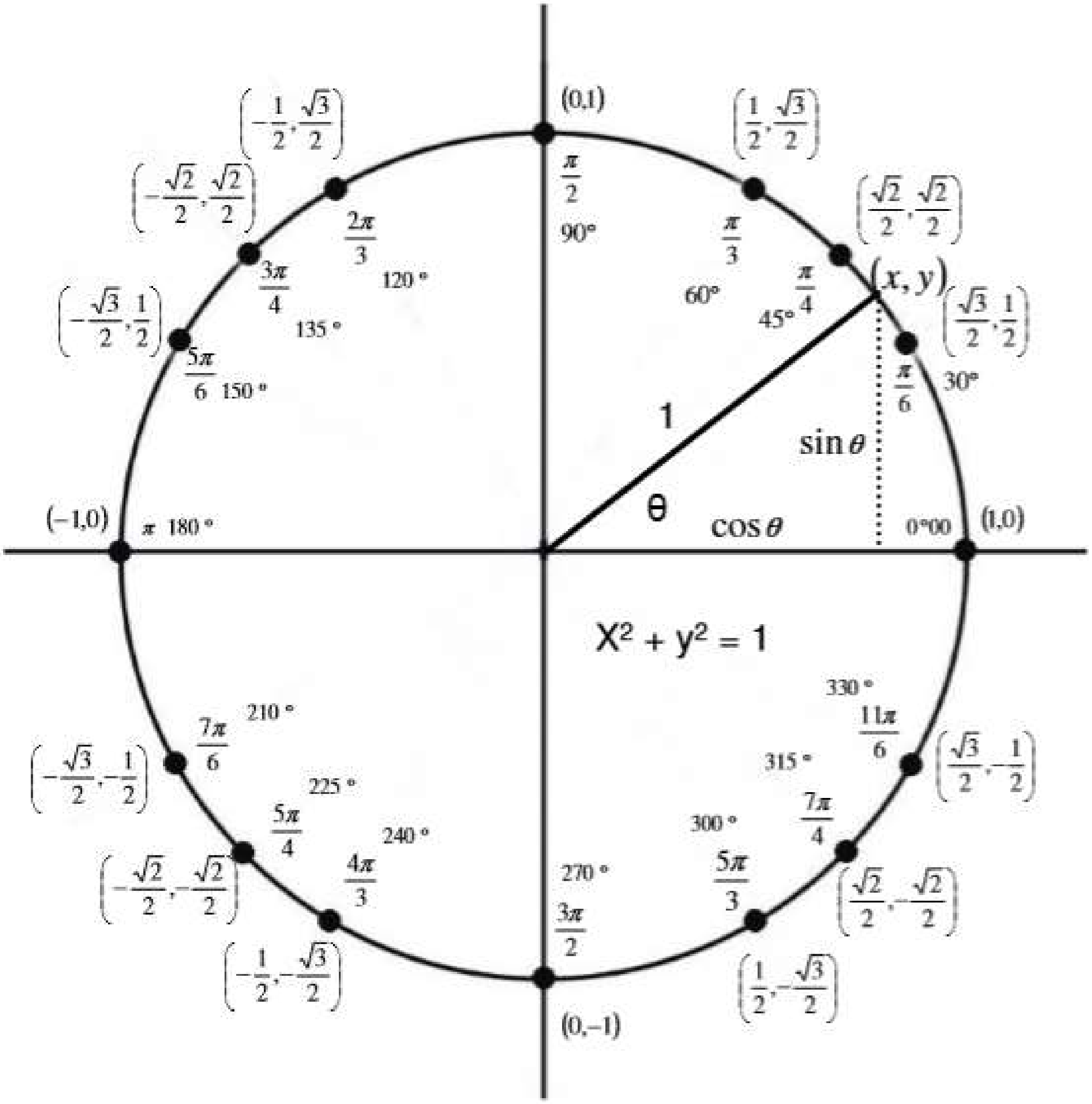
Note: **Remember the Chain Rule! If the variable in the function is not just plain x but is u(x), you must multiply the results by** $\frac{du}{dx}$.

Product Rule: $(uv)' = uv' + vu'$

Quotient Rule: $\left(\frac{u}{v}\right)' = \frac{vu' - uv'}{v^2}$

TABLE 4.2 Antiderivative formulas, k a nonzero constant

	Function	General antiderivative		Function	General antiderivative
1.	x^n	$\frac{1}{n+1}x^{n+1} + C, \quad n \neq -1$	**8.**	e^{kx}	$\frac{1}{k}e^{kx} + C$
2.	$\sin kx$	$-\frac{1}{k}\cos kx + C$	**9.**	$\frac{1}{x}$	$\ln \lvert x \rvert + C, \quad x \neq 0$
3.	$\cos kx$	$\frac{1}{k}\sin kx + C$	**10.**	$\frac{1}{\sqrt{1 - k^2x^2}}$	$\frac{1}{k}\sin^{-1} kx + C$
4.	$\sec^2 kx$	$\frac{1}{k}\tan kx + C$	**11.**	$\frac{1}{1 + k^2x^2}$	$\frac{1}{k}\tan^{-1} kx + C$
5.	$\csc^2 kx$	$-\frac{1}{k}\cot kx + C$	**12.**	$\frac{1}{x\sqrt{k^2x^2 - 1}}$	$\sec^{-1} kx + C, \quad kx > 1$
6.	$\sec kx \tan kx$	$\frac{1}{k}\sec kx + C$	**13.**	a^{kx}	$\left(\frac{1}{k \ln a}\right)a^{kx} + C, \quad a > 0, \; a \neq 1$
7.	$\csc kx \cot kx$	$-\frac{1}{k}\csc kx + C$			



The Unit Circle