

Math 115 HW #1

Due Friday, September 4

Reading: Find your old (or *any*) calculus book and review the sections on

- Exponentials and logarithms
- Integration techniques (including some that you may not have studied)
- Limits

Computer Assignment: Nothing to hand in. Come to the Math Question Center (MQC) for help/advice.

- Purchase and download your copy of Chapter 12 of Stewart's *Calculus*.
- Explore *Mathematica* a little bit. Suggestion: Help Menu -> Welcome Screen -> Getting Started.
- Exercise: use *Mathematica* to generate some evidence that

$$\sum_{k=1}^{\infty} \frac{1}{k^2} = \frac{\pi^2}{6}.$$

Homework: Due Friday, September 4 in class.

1. The ratio $\log_3(x)/\log_2(x)$ is constant, i.e., it is equal to some number C for all x . What is C ?
2. Let $f(x) = \ln(x+1) - \ln(x)$.
 - By differentiating $f(x)$, show that $f(x)$ is a decreasing function of x .
 - What is the limit of $f(x)$ as $x \rightarrow \infty$? (Hint: express $f(x)$ as $\ln(g(x))$, and figure out what happens to $g(x)$ as $x \rightarrow \infty$)
 - Find a simple way of writing the function $h(x) = 1/(e^{f(x)} - 1)$.

3. Integrating by parts, compute

$$\int x e^{-x} dx \quad \text{and} \quad \int x^2 e^{-x} dx.$$

Show your work. You may use *Mathematica* (or another device or table) to check your answers.

4. Compute (showing all work)

$$\int_e^{e^2} \frac{1}{x \ln(x)} dx \quad \text{and} \quad \int_0^1 e^x \sqrt{e^x + 1} dx.$$

5. Let $f(x) = \frac{x}{x^2+1}$.
 - Compute $\int f(x) dx$.
 - Is $\int_0^{100} f(x) dx$ a large number or a small number? Compute it to four decimal places.
 - What happens to $\int_0^x f(x) dx$ as $x \rightarrow \infty$?
6. (*Extra Credit*) Repeat all parts of Problem #5 with the function $f(x) = \frac{1}{x^2+1}$.