

1. (5pts) Find  $f$  if  $f'(x) = \frac{1}{x} + 5x$  and  $f(2) = 4$ .

2. (10pts) Evaluate using the Fundamental Theorem of Calculus, part 2:

a)  $\int_1^4 \frac{1}{\sqrt{x}} dx =$

b)  $\int_0^{\ln 5} e^{3x} dx =$

3. (3pts) Write as a single integral:

$$\int_1^5 f(x) dx - \int_1^3 f(x) dx + \int_5^7 f(x) dx =$$

4. (2pts) Simplify using part 1 of the Fundamental Theorem of Calculus:

$$\frac{d}{dx} \int_0^x \tan t \, dt =$$

5. (4pts) Use properties of integrals to show that  $2 \leq \int_0^2 3^x \, dx \leq 18$ .

6. (5pts) Use the “area” interpretation of the integral to find  $\int_{-3}^3 (|x| - 1) \, dx$ . Draw a picture.

*The rules: you may use your book and notes on this take-home quiz. Your work is to be entirely your own: you may not talk to anybody else about the quiz problems. Turn the exam in on Thursday, Dec. 9th.*

7. (9pts) Let  $f(x) = x^2 - x$ .

- a) Find the Riemann sum for  $f$  on  $[0, 3]$  using 6 subintervals and midpoints as sample points.
- b) Draw the graph of the function with the appropriate rectangles (big and beautiful, okay?) and state what the Riemann sum in a) represents.
- c) Compute  $\int_0^3 (x^2 - x) dx$  using the Fundamental Theorem of Calculus. Is the number in a) close to the actual integral?

8. (3pts) Explain how you know without evaluating anything that  $\int_{1/2}^1 \ln x dx \leq 0$ .

9. (4pts) Write in sigma notation.

$$\frac{1}{3} - \frac{2}{4} + \frac{3}{5} - \frac{4}{6} + \cdots + \frac{21}{23} - \frac{22}{24} =$$

10. (5pts) This problem is about the integral  $\int_{-1}^2 \frac{1}{x^2} dx$ .

a) Explain why you cannot use the Fundamental Theorem of Calculus to compute it.

b) Ignore a) for a moment and compute the integral using the FTC anyway. You should get a negative number. Looking at the function, how do you know your answer cannot be correct (hence, something is wrong with applying the FTC)?

**Bonus.** (5pts) A broken bone a day keeps the doctor in pay! At time  $t = 2$  we find Wile E. Coyote at height 40m above ground and ascending vertically at velocity 15m/s. Use antiderivatives to find his position function. What is the highest altitude he reaches? Assume the acceleration of gravity is a constant 10m/s<sup>2</sup>.