

Your Name

Your Signature

Student ID #

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Quiz Section

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Professor's Name

TA's Name

- This exam is closed book. You may use one  $8\frac{1}{2} \times 11$  sheet of notes. Do not share notes.
- On calculator problems, do not round off your computations until the last step.
- Graphing calculators are not allowed.
- In order to receive credit, you must show your work. Do not do computations in your head. Instead, write them out on the exam paper.
- Place a box around **YOUR FINAL ANSWER** to each question.
- If you use a trial and error (or guess and check) method when an algebraic method is available, you will not receive full credit.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

Problem	Total Points	Score
1	15	
2	15	
3	8	
4	6	
5	8	
6	6	

Problem	Total Points	Score
7	8	
8	6	
9	6	
10	10	
11	12	
Total	100	

1. [15 points total] Evaluate the following indefinite integrals. Show all work.

(a) [5 points]  $\int x \tan^{-1} x \, dx.$

(b) [5 points]  $\int \frac{dx}{x^2 + 10x + 34}.$

(c) [5 points]  $\int \frac{t + 5}{\sqrt{t^2 - 4}} \, dt.$

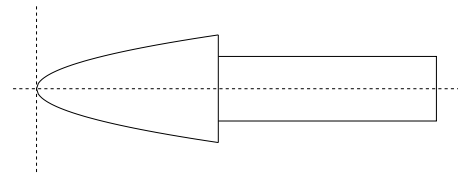
2. [15 points total] Evaluate the following definite integrals. Show all work.

(a) [5 points]  $\int_0^{\pi/2} \sin^3 x \cos x \, dx.$

(b) [5 points]  $\int_{-1}^5 |x^2 - 4| \, dx.$

(c) [5 points]  $\int_0^1 x \sqrt{1-x} \, dx.$

3. [8 points] You want to attach a sign to a wall using only one nail (to minimize the damage to the wall). The sign is a metallic plate of uniform thickness, and consists of two parts: The left part looks like the region between the curve  $y = -\frac{1}{2}\sqrt{x}$ , the curve  $y = \frac{1}{2}\sqrt{x}$ , and the line  $x = 25\text{cm}$ . The second part is a rectangle of height 6cm and length 30cm.



Where do you need to put the nail so that the sign is balanced? Give your answer in cm measured from the left end of the sign.

4. [6 points] Find the derivative to  $F(x) = \int_{\sin x}^x e^{t^2} dt$ .

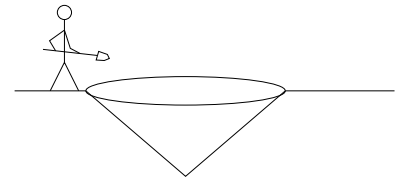
5. [8 points] A particle is travelling along a straight line. Its velocity at time  $t \geq 1$  is given by

$$v(t) = \frac{t-2}{t^2+t}.$$

- (a) [4 points] Find the total distance travelled during the time interval from  $t = 1$  to  $t = 5$ .
- (b) [4 points] Compute the displacement between the positions of the particle at times  $t = 1$  and time  $t = 5$ .

6. [6 points] Use Simpson's Rule with  $n = 6$  to approximate the **arc length** of  $y = x^5$  from  $x = 0$  to  $x = 3$ . Round your final answer to three decimals.

7. [8 points] Matt is digging a conical hole 20 feet across and 10 feet deep. How much work is done lifting the dirt out of the hole? Assume the soil has a density of  $75 \text{ lb/ft}^3$ .

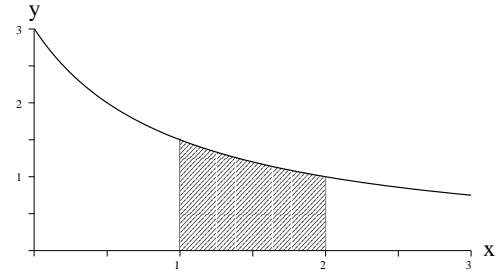


8. [6 points] Find the area under the curve  $y = \frac{\ln x}{x^2}$  from  $x = e$  to  $x = \infty$ .

9. [6 points] Find the solution to  $y' = \frac{9x^2 - \sin x}{\cos y + 5e^y}$ , with  $y(0) = \pi$ .

10. [10 points] Suppose a bootleg copy of *The Matrix:Reloaded* gets put on the Internet and people download illegal copies of it. Mathematicians working for the movie studio have determined that the number of downloaded copies,  $y$ , as a function of time can be described using the differential equation  $\frac{dy}{dt} = k(m - y)$  where  $m$  is 2 billion,  $k$  is some positive constant, and  $t$  is the number of hours since the bootleg became available on the Internet.
- (a) [7 points] After 10 hours, there were 6 million illegal downloaded copies of the movie. Develop the formula for the number of illegal downloaded copies of the movie as a function of time. Note that  $y(0) = 0$ .
- (b) [3 points] How many hours after the release of the movie will there be 1 billion illegal downloaded copies of the movie?

11. [12 points] Suppose we have the region bounded by  $y = \frac{3}{x+1}$ ,  $x = 1$ ,  $x = 2$ , and the  $x$ -axis. The graph is given to the right. **Set up the following integrals. Do not evaluate them.**



- (a) [3 points] Set up an integral with respect to  $x$  that computes the area of the region.
- (b) [4 points] Set up an integral that computes the the volume of the solid when the region is rotated about the  $y$ -axis, by integrating with respect to  $x$ .
- (c) [5 points] Set up an integral, or sum of integrals, that computes the the volume of the solid when the region is rotated about the  $y$ -axis, by integrating with respect to  $y$ .