

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.
- Give your answers in exact form. Do not give decimal approximations.
- Graphing calculators are not allowed. Do not share notes.
- 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 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	14	
2	14	
3	8	
4	8	
5	8	
6	6	

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

1. [14 points total] Evaluate the following indefinite integrals.

(a) [7 points]  $\int x^2 \sin(x^3) dx$

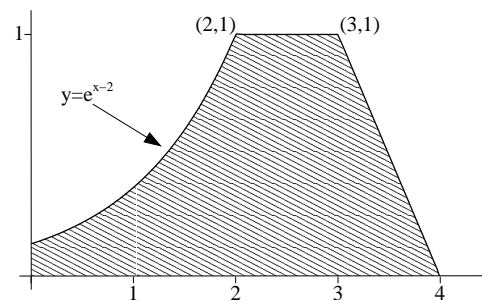
(b) [7 points]  $\int \ln(p^2 - 2p) dp$

2. [14 points total] Evaluate the following definite integrals.

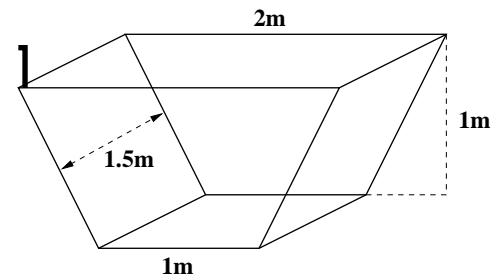
(a) [7 points]  $\int_0^3 \frac{x^3 + 6}{x^2 + 3x + 2} dx$

(b) [7 points]  $\int_2^4 \frac{dx}{2x^2\sqrt{x^2 - 3}}$

3. [8 points] A solid is obtained by rotating the area shown about the  $y$ -axis. The curve that forms the inside of the solid is the graph of  $y = e^{x-2}$ . Express the volume of the solid as an integral formula. SET UP ONLY. DO NOT EVALUATE THE INTEGRALS.



4. [8 points] A water tank is completely filled with water (specific weight  $1000\text{kg/m}^3$ ). Front and back are  $1.5\text{m}$  apart and have the shape of a trapezoid (width at bottom  $1\text{m}$ , at top  $2\text{m}$ , and height  $1\text{m}$ ), see picture. The outlet of the water tank is  $0.25\text{m}$  higher than the top of the tank. Set up an integral for the work required to pump all the water out of the tank through the outlet. Recall that acceleration due to gravity is  $g = 9.8\text{m/sec}^2$ . SET UP ONLY. DO NOT EVALUATE THE INTEGRAL.



5. [8 points] Find the solution to the differential equation

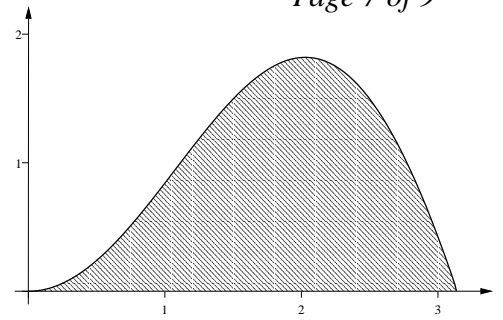
$$\frac{dz}{dt} = (4 + z^2)t$$

with the initial condition  $z(0) = 2$ .

6. [6 points] Let  $g(y) = 2y^2 - 5y + 2$ . Set up an integral for the length of the parabola  $x = g(y)$  between the points  $(-1, 1)$  and  $(0, 2)$ . SET UP ONLY. DO NOT EVALUATE THE INTEGRAL.

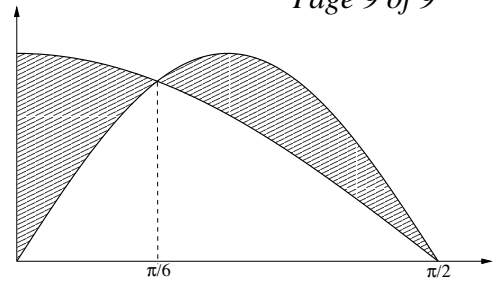
7. [8 points] A bathtub contains 300 liters of bathing water in which 0.05kg of salt are dissolved. Pure water is added to the bathtub at a rate of 10 liters per minute. The thoroughly mixed water drains from the tub at the same rate. How long does it take until half of the salt has left the tub?

8. [10 points] Find the  $x$ -coordinate of the center of mass of the region between the curves  $y = 0$  and  $y = x \sin x$ , and between  $x = 0$  and  $x = \pi$ .



9. [8 points] For what values of  $a$  is  $\int_0^{\infty} x e^{ax} dx$  convergent? Evaluate the integral where it converges.

10. [8 points] Find the area between the curves  $y = \cos x$  and  $y = \sin 2x$  for  $0 \leq x \leq \pi/2$ .



11. [8 points total] Consider the function  $E(x) = \frac{2}{\sqrt{\pi}} \int_0^{x^2} e^{-t^2} dt$ .
- (a) [4 points] Compute  $E'(x)$ .
- (b) [4 points] For what values of  $x$  is  $E(x)$  increasing?