

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 handwritten notes (both sides). Do not share notes.
- Give your answers in exact form, except as noted in particular problems.
- Graphing calculators are not allowed.
- In order to receive credit, you must **show all of your work**. If you do not indicate the way in which you solved a problem, you may get little or no credit for it, even if your answer is correct. You may use any of the 20 integrals on p. 506 of the text without deriving them. Show your work in evaluating any other integrals, even if they are on your note sheet.
- Place

a box around your answer

 to each question.
- If you need more room, use the backs of the pages and indicate that you have done so.
- Raise your hand if you have a question.
- This exam has 10 pages, plus this cover sheet. Please make sure that your exam is complete.

Question	Points	Score
1	12	
2	12	
3	8	
4	8	
5	8	
6	12	

Question	Points	Score
7	10	
8	10	
9	10	
10	10	
Total	100	

1. (12 total points) Evaluate the following integrals.

(a) (6 points) $\int x(x-1)^{2008} dx$

(b) (6 points) $\int t^8 \ln(t^3) dt$

2. (12 total points) Evaluate the following integrals.

(a) (6 points) $\int \frac{dt}{t(1+\sqrt{t})}$

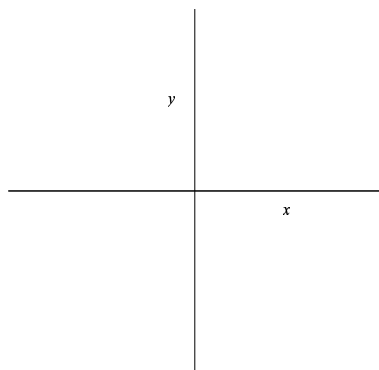
(b) (6 points) $\int_0^2 x\sqrt{1-(x-1)^2} dx$

3. (8 points) Consider the improper integral

$$\int_1^5 \frac{dx}{x^2 \sqrt{25-x^2}}.$$

Evaluate this integral or explain why it does not converge.

4. (8 points) Consider the region bounded by the line $y = \frac{3}{2}x$, the parabola $y = x^2 - 1$, and lying above the x -axis. Sketch this region and find its area.



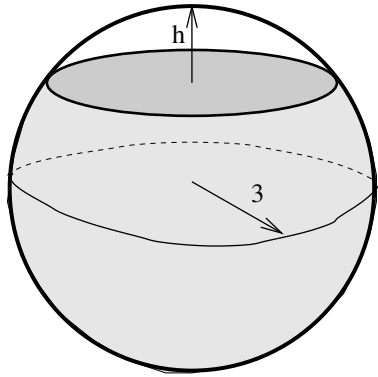
5. (8 points) Find

$$\lim_{x \rightarrow 0} \frac{\int_0^x \cos(t^2) dt}{x}.$$

6. (12 total points) The region between the curve $y = e^{-x^3}$ and the lines $y = 0$, $x = 1$, and $x = t$ is rotated about the vertical line $x = 1$. Here $t > 1$ is not further specified.
- (a) (8 points) Write down an integral for the volume of the resulting solid. **Do not evaluate this integral.**

- (b) (4 points) The volume from part (a) is a function of t ; call it $V(t)$. Find the derivative $V'(2)$.

7. (10 points) Let S be the solid pictured below. It is obtained by removing a cap of height h from a ball of radius 3. Find the volume of S . You may assume that $h < 3$.

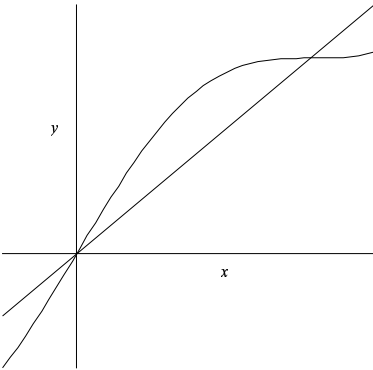


8. (10 total points) A spring has a natural length of 10 cm. The spring is now allowed to hang vertically, with the top end attached to a rigid support and the other end attached to a mass of 1 kg. This causes the spring to stretch 3 cm, to a length of 13 cm.

(a) (4 points) Find the spring constant k . The acceleration due to gravity is 9.8 m/sec^2 .

(b) (6 points) A small child pulls down on the mass, stretching the string to 15 cm. How much work does the child do?

9. (10 points) Let R be the region bounded by the curves $y = x + \sin x$ and $y = x$ between $x = 0$ and $x = \pi$, as shown below. Find the centroid of R .



10. (10 total points) In a country of population $P(t)$ (t in years) with β births per year per unit of population, δ deaths per year per unit of population and constant net immigration rate of I people per year, the population satisfies the differential equation

$$\frac{dP}{dt} = (\beta - \delta)P + I.$$

In the country of Krakozhia, there are about 17 births and 7 deaths per thousand population per year. The net immigration **out** of the country is 4500 people per year. On June 7, 1998, the population of Krakozhia was 12 million.

- (a) (7 points) Solve the differential equation above modeling the population of Krakozhia.

- (b) (3 points) Use your answer in part (a) to determine the population of Krakozhia today. Give a decimal answer. (Make sure your answer is reasonable; Krakozhia is still a small country.)