Instructions

- Turn off cell phones and watch alarms! Put away cell phones, iPods, etc.
- There are seven (7) questions.
- Do all work in this exam booklet. You may continue work to the backs of pages and the blank page at the end, but if you do so indicate where.
- Do not use any other paper except this exam booklet and the one-page “cheat sheet” that you prepared.
- Organize your work in an unambiguous order. Show all necessary steps.
- Answers given without supporting work may receive 0 credit!
- If you use your calculator to do numerical calculations, be sure to show the setup leading to what you are calculating.
- As you leave, hand your exam booklet to your own instructor or TA at the designated exit door. Be prepared to show your UMass ID card.

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1. (2 × 7% = 14%) The parts of this question are not related!

(a) Approximate the integral \( \int_0^1 \frac{1}{1 + x^3} \, dx \) by using the Trapezoidal Rule with \( n = 4 \) subintervals. Round your answer to 4 decimal places.

(b) Starting with the Maclaurin series for \( e^x \), find a power series expansion of \( x^2 e^{-x} \).
2. \((2 \times 7 = 14\%)\) The acceleration (in \(m/s^2\)) at time \(t\) of a particle moving along a straight line is given by \(a(t) = 2t - 1\).

(a) Determine the velocity \(v(t)\) if \(v(0) = -2\) \((m/s)\).

(b) Calculate the total distance the particle travels—\textit{not} the displacement—over the time interval \(0 \leq t \leq 3\).
3. \((2 \times 6 = 12\%)\) Use techniques of symbolic integration to evaluate:

(a) \(\int \arcsin x \, dx\) (\text{Hint}: Try integration by parts.)

(b) \(\int \frac{1}{e^x + 1} \, dx\)
4. (a) (7%) Find an equation of the tangent line at the point where \( t = 1 \) to the curve having parametric equations

\[
\begin{align*}
    x &= e^{2t}, \\
    y &= t - \ln t.
\end{align*}
\]

(b) (6%) Write parametric equations for the curve that has polar equation \( r = 3 \cos \theta \):

\[
\begin{align*}
    x &= \\
    y &=
\end{align*}
\]
Continuation of # 4.

(c) (7%) Set up and evaluate a definite integral in order to find the area of the region enclosed by the polar curve $r = 3 \cos \theta$. 
5. (a) (7%) Set up (but do not yet evaluate) an improper integral whose value would be the volume of the solid obtained by rotating around the $x$-axis the region
\[ 0 \leq y \leq \frac{1}{x}, \quad x \geq 1. \]

(b) (7%) Now evaluate that improper integral.
6. \((2 \times 6 = 12\%)\) Do the following series converge? Why or why not?

(a) \(\sum_{n=0}^{\infty} \frac{1}{2^n + \sqrt{n}}\)

(b) \(\sum_{n=1}^{\infty} \frac{\ln n}{\ln(n^2 + 1)}\)
7. (a) (7%) Express \( \frac{1}{1 + x^3} \) as the sum of a power series in \( x \). Use \( \sum \) notation.

(b) (7%) Use (a) to express \( \int_0^{1/2} \frac{1}{1 + x^3} \, dx \) as the sum of a series of numbers. Either use \( \sum \) notation or else give at least the first five terms of the series.
This page left blank for additional work.