Exam 1 Review 8am Section
Supplemental Instruction
Iowa State University

Leader: Tess
Course: Math 267
Instructor: Pollack
Date: 2/2/2016

Exam 1 Information:
Carver 0001 Friday, Feb. 5th 8-8:50am.

Sections Covered: 1.1, 1.2, 2.1-2.5 (No homogeneous DE from 2.5), 3.1 (No series circuits), and population dynamics from 3.2.

Integral Review

<table>
<thead>
<tr>
<th>Integral</th>
<th>Solution</th>
<th>Integral</th>
<th>Solution</th>
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<tbody>
<tr>
<td>∫ e^udu</td>
<td>e^u + C</td>
<td>∫ 1/(u^2 + a^2) du</td>
<td>1/(u^2 + a^2) du</td>
</tr>
<tr>
<td>∫ 1/u du</td>
<td>cscu cotu du</td>
<td>∫ ln(u) du</td>
<td>secu du</td>
</tr>
<tr>
<td>∫ a^udu</td>
<td>1/√(a^2 - u^2) du</td>
<td>∫ sin(u) du</td>
<td>sinu du</td>
</tr>
<tr>
<td>∫ sec^2u du</td>
<td>u^n du</td>
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Additional Methods:
- U-Substitution → find u and du and sub into equation Ex) ∫ 2x/x^2+1 dx
- Integration by Parts → ∫ u dv = uv - ∫ v du Ex) ∫ xe^x dx

Method Review

<table>
<thead>
<tr>
<th>Method</th>
<th>General Form</th>
<th>Example DE</th>
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<tr>
<td></td>
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<td>ye^x dy/dx = e^−y + e^(−2x−y)</td>
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<tr>
<td></td>
<td></td>
<td>(x + 1) dy/dx = e^x(1 + y)</td>
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<td></td>
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<td>(1 + 3/y + x) dy/dx + y = 3/x - 1</td>
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<td></td>
<td></td>
<td>y(x + y + 1)dx + (x + 2y)dy = 0</td>
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<td>dy/dx - y = e^x y^2</td>
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1. Solve the following IVP:

\[ x \frac{dy}{dx} + y = y^2 x^2 \ln x; \quad y(1) = 4 \]
2. Determine if the following DE is exact, if not determine the integrating factor and solve for general solution:

   \[ x^2 y \, dx + y(x^3 + e^{3y})dy = 0 \]
3. Consider the following autonomous DE: \( \frac{dp}{dx} = P(3 - P)(2 + P) \)
   a. Determine the critical Points
   b. Create a phase portrait and classify points as stable, unstable or semi-stable

4. A small metal bar, whose initial temperature was 20°C, is dropped into a large container of boiling water.
   a. How long will it take the bar to reach 90°C if it is known that its temperature increases 2°C in 1 second?
5. Solve the following DE and give the general solution:

\[(1 + 3y\sec^2 y + 4y^4) \frac{dy}{dx} + \frac{3yx^2}{(x^3 + 2)} = 0\]

6. A model for the population \( P(t) \) in a Rabbit Population is given by the IVP

\[\frac{dP}{dt} = 0.1P(1 + \frac{P}{25000}); \quad P(0) = 5000\]

Where \( t \) is measured in months.

a. What is the limiting value of the rabbit population?

b. At what time will the population be equal to one-half of this limiting value?