NAME (please print legibly): ____________________________________________
Your University ID Number: ____________________________________________
Indicate your instructor with a check in the box:

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Time</th>
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<tbody>
<tr>
<td>John Olsen</td>
<td>MWF 9:00 - 9:50 AM</td>
</tr>
<tr>
<td>Doug Ravenel</td>
<td>MWF 10:00 - 10:50 AM</td>
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</tbody>
</table>

- The presence of calculators, cell phones, iPods and other electronic devices at this exam is strictly forbidden.

- Show your work and justify your answers. You may not receive full credit for a correct answer if insufficient work is shown or insufficient justification is given.

- Put your answers in the space provided at the bottom of each page or half page.

- You are responsible for checking that this exam has all 11 pages.

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<th>QUESTION</th>
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1. (20 points)

(a) (10 points) Find a partial fraction expansion for the function

\[
\frac{1}{x^3 - x^2 + 2x - 2}
\]

ANSWER:
1. (b) (10 points) Calculate the integral

\[ \int \frac{dx}{x^3 - x^2 + 2x - 2}. \]
2. (20 points) Consider the curve $y = x^{3/2}$

(a) (10 points) Calculate the arc length function starting at $x = 0$. 

ANSWER:
2. (b) (10 points) Calculate the arc length from \( x = 4 \) to \( x = 8 \).
Solution: (a) $y' = \frac{3}{2} \sqrt{x}$, so by substituting $u = 1 + \frac{9}{4}x$ one gets

$$s(t) = \int_0^t \sqrt{1 + \frac{9}{4}x} \, dx$$

$$= \frac{4}{9} \int_1^{1+9t/4} \sqrt{u} \, du$$

$$= \frac{8}{27} u^{3/2} \bigg|_1^{1+9t/4}$$

$$= \frac{8}{27} \left( \frac{1}{4} + \frac{9}{4}x \right)^{3/2} - \frac{8}{27}$$

for $t \geq 0$.

(b) By the definition of the arc length function, $s(4)$ is the arclength from $t = 0$ to $t = 4$ and $s(8)$ is the arclength from $t = 0$ to $t = 8$, so the arc length from $t = 4$ to $t = 8$ is

$$s(8) - s(4) = \frac{8}{27} \left( 19^{3/2} - 10^{3/2} \right) = \frac{8}{27} \left( 19\sqrt{19} - 10\sqrt{10} \right).$$

3. (20 points) Consider region between the curve $y = \sin^2 x$ for $0 \leq x \leq \pi$ and the $x$-axis.

(a) Find the volume of the solid of revolution about the $x$-axis.
3. (b) Find the volume of the solid of revolution about the \( y \)-axis.

**ANSWER:**
4. (20 points)

(a) (10 points) Use integration by parts to find a formula for

\[ \int x^n e^x \, dx \quad \text{in terms of} \quad \int x^{n-1} e^x \, dx \]
(b) (10 points) Use this formula to find
\[ \int x^3 e^x \, dx. \]
5. (20 points) Consider the integral

\[ \int \frac{dx}{\sqrt{4x^2 - 12x}} \]

(a) (5 points) Write the quantity under the square root sign as a sum or difference of two squares.

\text{ANSWER:}

\( \text{ } \)

(b) (5 points) Draw a right triangle in which one of the sides is the square root in the integer and another is a constant.

\text{ANSWER:}

\( \text{ } \)
5. (c) (10 points) Evaluate

\[ \int_{3}^{4} \frac{dx}{\sqrt{4x^2 - 12x}}. \]

ANSWER: