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>
</tr>
</thead>
<tbody>
<tr>
<td>Dan-Andrei Geba</td>
<td>MWF 10:00 - 10:50</td>
</tr>
<tr>
<td>Giorgis Petridis</td>
<td>MWF 13:00 - 13:50</td>
</tr>
<tr>
<td>Eyvindur Ari Palsson</td>
<td>MW 14:00 - 15:15</td>
</tr>
</tbody>
</table>

- The presence of electronic devices (including calculators), books, or formula cards/sheets 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.
- Clearly circle or label your simplified final answers.
- You are responsible for checking that this exam has all 7 pages.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>VALUE</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>
1. (10 points) Find the explicit solution for the initial value problem

\[ \frac{dy}{dx} = x^2 + x^2y^2, \quad y(0) = 1. \]
2. **(10 points)** Solve the initial value problem

\[
\frac{dy}{dt} + \frac{y}{2} - \frac{e^{t/3}}{2} = 0, \quad y(0) = \frac{6}{5}.
\]
3. (10 points) Consider the RC circuit which has

\[ R = 2 \, \Omega, \quad C = \frac{1}{8} \, F, \quad \text{and} \quad E(t) = 5 \, V. \]

If \( q(0) = 7 \) coulombs, determine the current in the circuit for \( t \geq 0 \).
4. (10 points) A 200-gal tank initially contains 100 gal of pure water. Brine enters the tank through two faucets: one containing 0.2 lb/gal of salt flows in at the rate of 1 gal/min, while the second one containing 0.1 lb/gal of salt flows in at the rate of 3 gal/min. The well-stirred mixture flows out of the tank at the rate of 2 gal/min. How much salt is in the tank just before the solution overflows?
5. (10 points) Find the rank for the matrix

\[
A = \begin{bmatrix}
5 & 2 & -5 \\
9 & 4 & -7 \\
4 & 1 & -7 \\
\end{bmatrix}
\]

by computing its reduced row-echelon form.
6. (10 points) Solve the following linear system of equations:

\[
\begin{align*}
3x_1 + x_2 + x_3 + 6x_4 &= 14 \\
x_1 - 2x_2 + 5x_3 - 5x_4 &= -7 \\
4x_1 + x_2 + 2x_3 + 7x_4 &= 17
\end{align*}
\]