Instructions
Read all of the instructions and all of the questions before beginning the exam.

There are 4 problems in this exam. The total score is 100 points. Points are given next to each problem to help you allocate time. Do not spend all your time on one problem.

Unless otherwise noted on a particular problem, you must show your work in the space provided, on the back of the exam pages or in the extra pages provided at the back of the exam.

Draw a BOX or a CIRCLE around your answers to each problem.

Be sure to provide units where necessary.

GOOD LUCK!
“Everything will turn out right... the world is built on that.”
— Mikhail Bulgakov, The Master and Margarita

**Problem 1** Warm-up

a) Solve for $v_{out}$. (12.5 points)

**Solution:**
"I took one course in existential philosophy at, uh, at New York University, and on, uh, on the final... they gave me ten questions, and, uh, I couldn't answer a single one of 'em. You know? I left 'em all blank... I got a hundred."

- Sandy Bates, Stardust Memories

**Problem 2 Nodal (35 points)**

Provide a solution to the circuit below USING NODAL analysis. Use the node numbers and labels provided.

In the box below, provide your answer with equations in this form or lose points (v\textsubscript{1} refers to the voltage at node 1, etc):

\[
\begin{align*}
\_\_\_ v_1 & \quad + \quad \_\_\_ v_2 & \quad + \quad \ldots \quad + \quad \_\_\_ v_n & = \quad \_\_\_.
\end{align*}
\]

\[\ldots\]

**Solution:**
**Problem 3** Mesh (27.5 points)

Provide a solution to the circuit below USING MESH analysis. Use the mesh variables and labels provided.

In the box below, provide your answer with equations in this form or lose points (i1 refers to mesh current 1, etc:

\[ \text{____} i_1 + \ldots + \text{____} i_n = \text{____} \]

**Solution:**

<table>
<thead>
<tr>
<th>\text{____} i_1</th>
<th>+</th>
<th>\ldots</th>
<th>+</th>
<th>\text{____} i_n</th>
<th>=</th>
<th>\text{____}</th>
</tr>
</thead>
</table>

\[ \text{____} i_1 + \ldots + \text{____} i_n = \text{____} \]
"I don't see much sense in that," said Rabbit.
"No," said Pooh humbly, "there isn't. But there was going to be when I began it. It's just that something happened to it along the way."

-Winnie the Pooh

Problem 4 Equivalent circuits (12.5 points)

a) Provide the simplest equivalent circuit for the grey box (measured from terminals a and b).

Solution:
b) Provide the simplest equivalent circuit for the grey box (measured from terminals a and b). (12.5 points)

**Solution:**