Name: ______________________  Student ID ____________

Last, First

**Guidelines**

1. Closed book and notes; one 8.5” x 11” page (both sides) of your own notes is allowed.
2. You may use a calculator.
3. Do not unstaple the exam.
4. Show all your work and reasoning on the exam in order to receive full or partial credit.

**Score**

<table>
<thead>
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<th>Problem</th>
<th>Points Possible</th>
<th>Score</th>
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<tr>
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1. Equivalent Circuits [16 points]

(a) [4 pts.] Find the Thevenin equivalent voltage between A and B.

(b) [4 pts.] Find the Thevenin equivalent resistance $R_{TH}$ between terminals A and B.
(c) [4 pts.] The circuit in the dotted box is connected to a 10 kΩ load resistor, as shown below. Find the numerical value of $V_{AB}$.

*Note:* if you couldn’t solve parts (a) and (b), you can assume without loss of credit that $V_{TH} = 2.8$ V and $R_{TH} = 5.5$ kΩ. Of course, these are not the correct answers to parts (a) and (b).

![Circuit Diagram](image)

(d) [4 pts.] For the circuit in part (c), what is the numerical value of the power released from the circuit inside the dotted box, in Watts? You can use the default from part (c), if you were unable to solve the earlier parts.
2. Current-Voltage Characteristics [17 points]

(a) [4 pts.] Find the numerical value of the short-circuit current $I_{OUT} = I_{SC}$, when $V_{AB} = 0$ V.

(b) [4 pts.] Plot the output current $I_{OUT}$ versus the output voltage $V_{OUT}$ on the graph below.
(c) [4 pts.] The circuit in parts (a) and (b) is modified by the addition of a 2 V voltage source, as shown below. Find the numerical value of the open-circuit voltage $V_{oc}$.

![Circuit Diagram](image)

(d) [5 pts.] Plot the output current $I_{OUT}$ versus the output voltage $V_{OUT}$ for the modified circuit on the graph below.

![Graph](image)
3. Linear Resistive Networks [17 points]

(a) [4 pts.] For this part, we connect a 5 V voltage source between node F and node D, with the + side of the source at node D. Nodes B, C, D, and E are connected to the reference node R. Find the voltage \( V_A \) at node A.

(b) [4 pts.] Repeat part (a) with only node C connected to the reference node R.
(c) [4 pts.] For this part, the voltage source is removed and a 5 mA current source replaces the 6 kΩ resistor between nodes B and C. The “arrowhead” end of the current source points toward node B. Only node D is connected to the reference node for this part. Find the voltage $V_F$.

(d) [5 pts.] Repeat part (c), but keep the 6 kΩ resistor connected between nodes B and C for this part.