Name:

SID:

Problem 1 _____ Points of 20

Problem 2 _____ Points of 20

Problem 3 _____ Points of 20

Problem 4 _____ Points of 20

Problem 5 _____ Points of 20

Score   _____ %

- Closed book, closed notes

- One pocket calculator permitted (no PDAs, laptops, cell phones, or other electronic devices)

- Show derivations to get partial credit in case of numerical errors

- Cross out incorrect attempts (no partial credit for ambiguous derivations)

- Write results into boxes

- Take off hats or caps and leave backpacks and electronic devices in isle

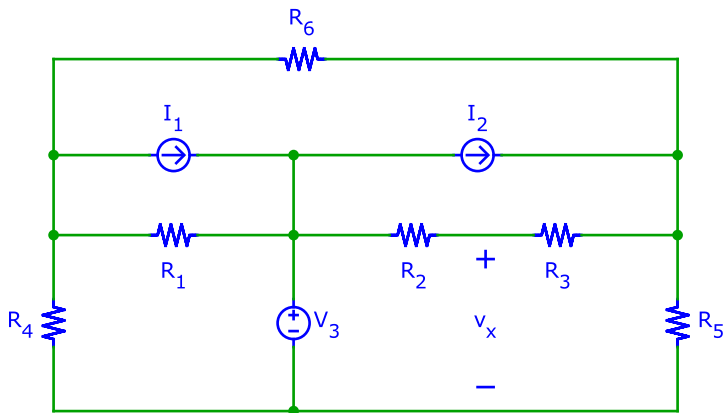- Verify that an assistant receives your completed exam!

1. Calculate the value of current i_x. Parameter $I_1 = $ mA, $V_2 = $ V, $V_3 = $ V, $R_1 = $ kΩ, $R_2 = $ kΩ, $R_3 = $ kΩ and $R_4 = $ kΩ.

$i_x = $

20 pts.

0
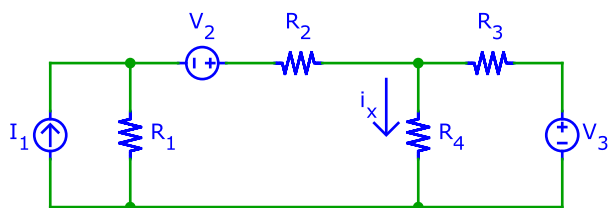
2. Find the value of the voltage v_x. Parameter $I_1 = \quad$ mA, $I_2 = \quad$ mA, $V_3 = \quad$ V, $R_1 = \quad$ kΩ, $R_2 = \quad$ kΩ, $R_3 = \quad$ kΩ, $R_4 = \quad$ kΩ, $R_5 = \quad$ kΩ and $R_6 = \quad$ kΩ.

$v_x = \quad$ 20 pts.
1

3. Opamp circuits with high closed-loop gain require large resistor ratios. On integrated circuits these take up significant area and are therefore costly. The circuit below uses a so-called T-network to reduce the required resistor ratio.

Calculate the value of resistor R_3 such that $v_o/v_i =$. Use $R_1 =$ kΩ, $R_2 = R_4 =$ kΩ and $R_5 =$ kΩ.

$R_3 =$ 20 pts.
                2
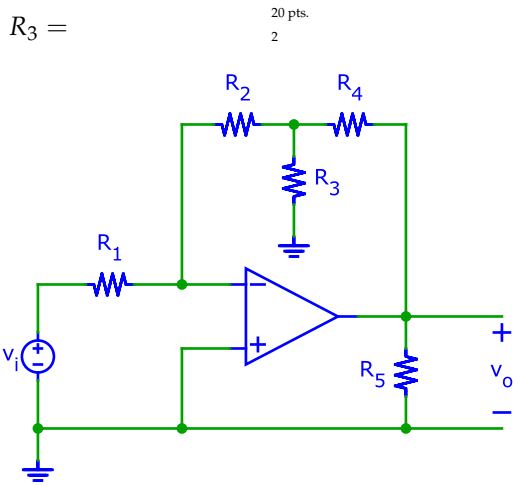
4. The output voltage of a temperature sensor element is

$$v_t(T) = -2\frac{\text{mV}}{^\circ C} \times T$$

where T is the temperature in degrees Celsius.

Design a thermometer circuit with output voltage

$$v_o(T) = 10\frac{\text{mV}}{^\circ C} \times T$$

using the sensor, resistors, and ideal opamps. Your circuit should produce the correct output independent of the output resistance R_o of the temperature sensor, which is in the range $50\,\text{k}\Omega \ldots 100\,\text{k}\Omega$. Draw the schematic diagram in the space provided below. Specify the values of all resistors (except R_o).

20 pts.

2

5. Suppose you stand barefoot on a wet floor with a hand-held digital voltmeter (DVM) in one hand. You insert one probe of the DVM into the hot output of a 110 V outlet and touch the other probe with your free hand.

<div style="text-align: center; color: red;">Hypothetical experiment—don't try this!</div>

a) Draw a circuit schematic of the situation. Use only circuit elements—sources and resistors—and their correct symbols. Do not draw pictures of elements. Assign reasonable values to all circuit components.

10 pts.

3

b) Would you get hurt? Explain!

10 pts.

4

Password: