# 6.200 Midterm

Fall 2026

Name: _____

Kerberos/Athena Username: _____@mit.edu

5 questions 1 hour, 50 minutes

- Please **WAIT** until we tell you to begin.
- Write your name and kerberos **ONLY** on the front page.
- This exam is closed-book, but you may use one 8.5" × 11" sheet of handwritten notes (both sides) as a reference. This sheet must be **handwritten** directly on the page (not printed).
- You may **NOT** use any electronic devices (no computers, calculators, phones, etc.) except for a multimeter.
- Enter all answers in the boxes provided. Work on other pages with QR codes may be taken into account when assigning partial credit provided you indicate (near the answer box) where that work can be found.
- You may remove sheets from the exam if you wish, but we must receive **all** sheets with QR codes back from you at the end of the exam. **Please do not write on the QR codes.**
- If you finish the exam more than 10 minutes before the end time, please quietly bring your exam to us at the front of the room. If you finish within 10 minutes of the end time, please remain seated so as not to disturb those who are still finishing their exams.
- You may not discuss the details of the exam with anyone other than course staff until overall exam grades have been released.

*Worksheet (intentionally blank)*

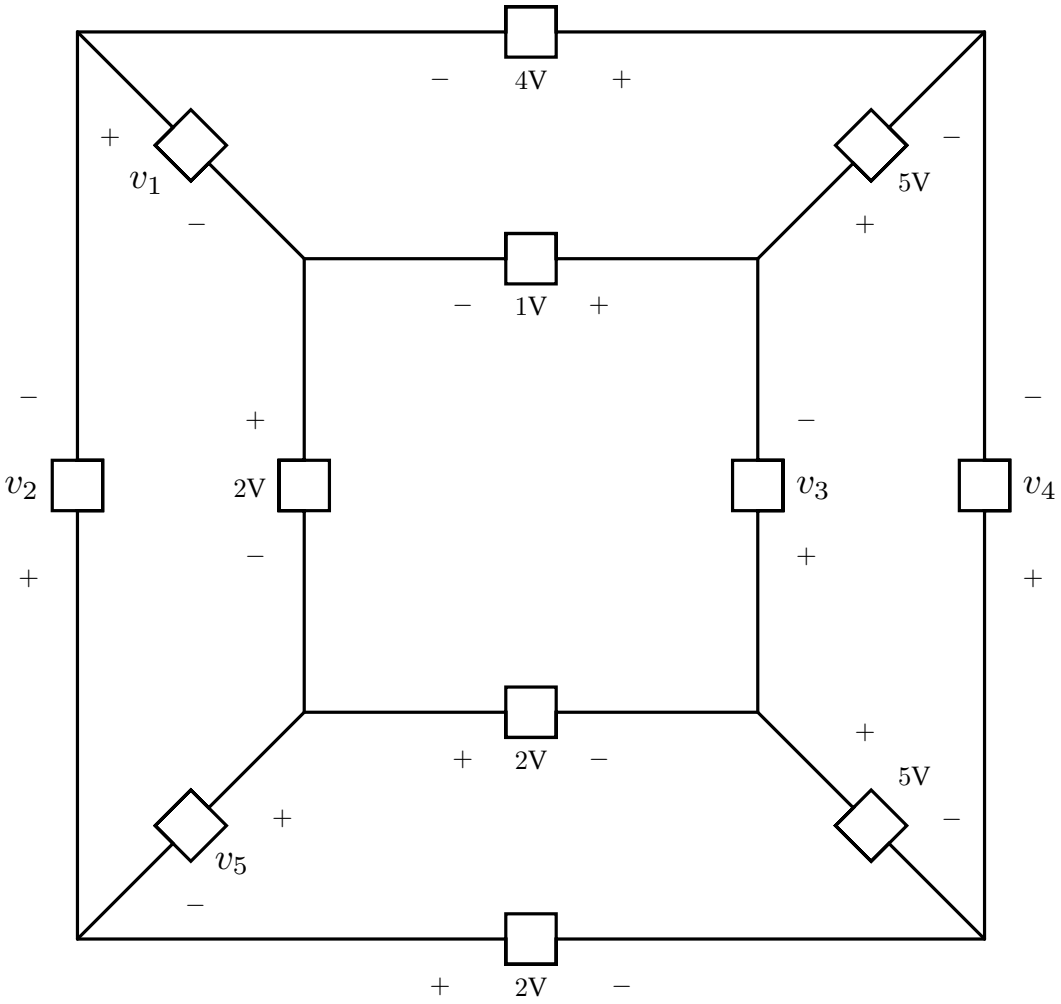
*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

# 1 Short Circuits

## 1.1 Part 1

Solve for the unknown voltages $v_1$, $v_2$, $v_3$, $v_4$, and $v_5$ in the circuit below, where each box represents an arbitrary component:

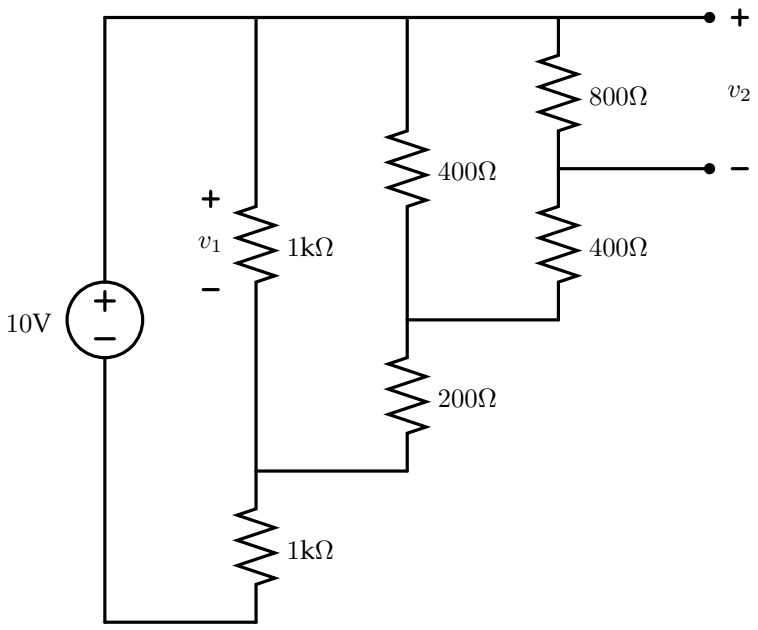



$v_1 =$ $v_2 =$ $v_3 =$

$v_4 =$ $v_5 =$

## 1.2 Part 2

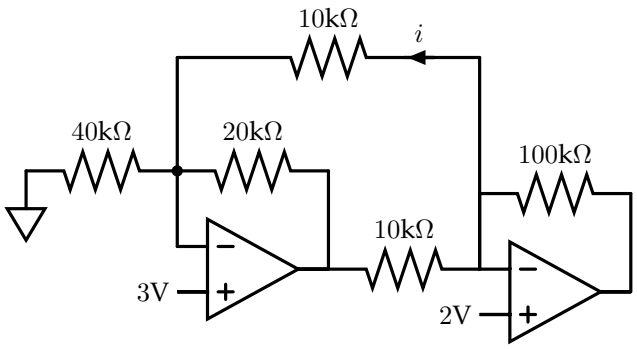
Solve for the voltages $v_1$ and $v_2$ in the circuit below, using any method you prefer:




$v_1 =$ $v_2 =$

## 1.3 Part 3

Solve for the current $i$ in the circuit below. Make the ideal op-amp assumption and ignore limitations on the op-amps' outputs imposed by their power supplies. Assume that all indicated voltages are measured with respect to the same reference node.

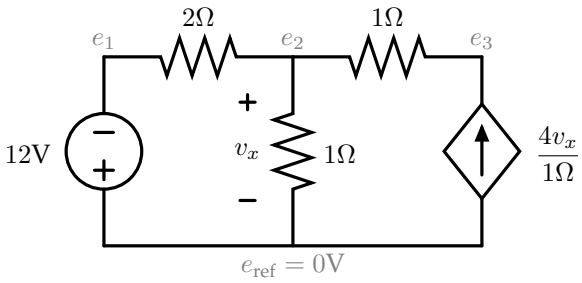



$i =$

# 2 Dependent Sources

## 2.1 Solving Circuits

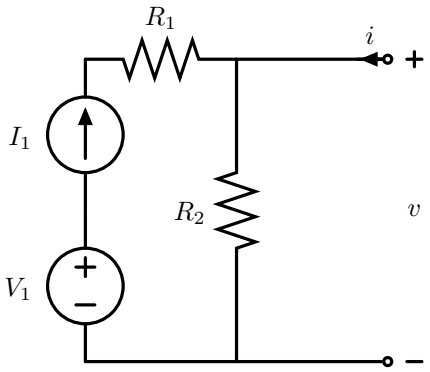
Solve for each of the indicated node potentials in the circuit below.

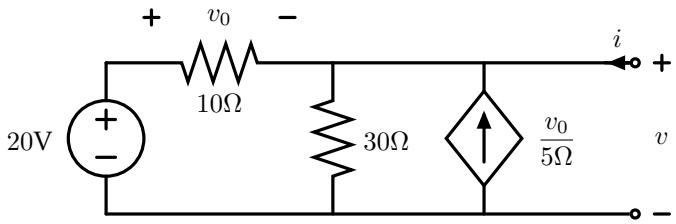



$e_1 =$ $e_2 =$ $e_3 =$

## 2.2 Equivalent Circuits

Find values of $V_1$, $I_1$, $R_1$, and $R_2$ that make the following two circuits equivalent (in terms of the $i/v$ relationship at the indicated port). If any value works for a given variable, write `ANY` in the box. If multiple specific values work, you only need to provide one.



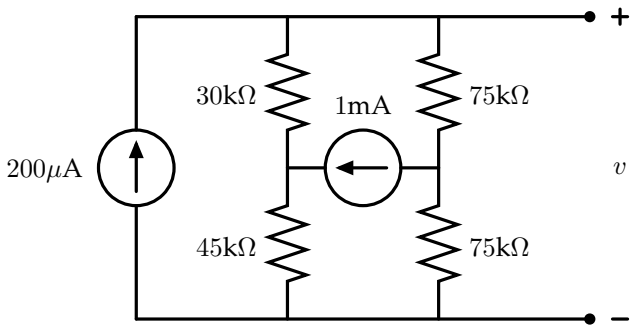

$V_1 =$ ____ $I_1 =$ ____

$R_1 =$ ____ $R_2 =$ ____

# 3 Sources

## 3.1 Currents

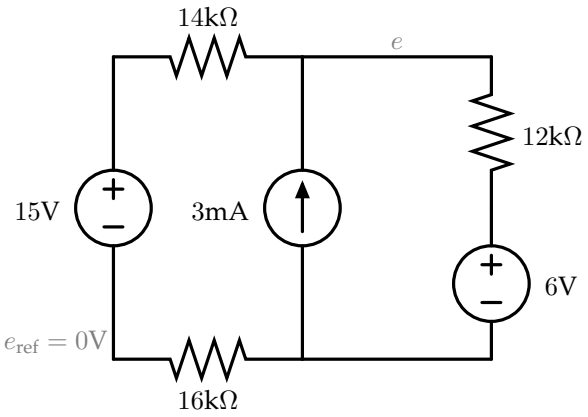
Solve for $v$ in the circuit below using any method you prefer.




$v =$

## 3.2 Multiple Sources

Find the node potential $e$ (measured relative to the indicated reference node) in the circuit below. You do not need to find the other node potentials.



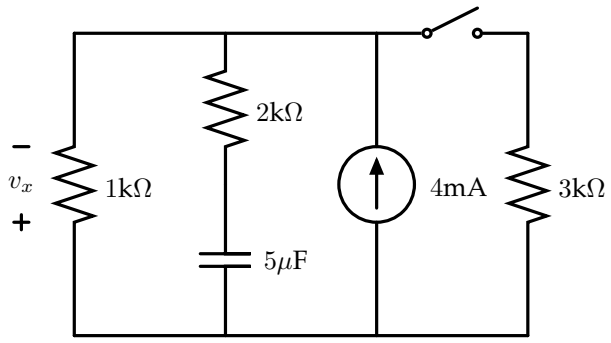

$e =$

*Worksheet (intentionally blank)*

# 4 Time After Time

## 4.1 No Cap

Consider the following circuit, where the switch is closed for $t < 0$ and opened for $t \geq 0$.




Determine the following values.

$v_x(t = 0^-) =$

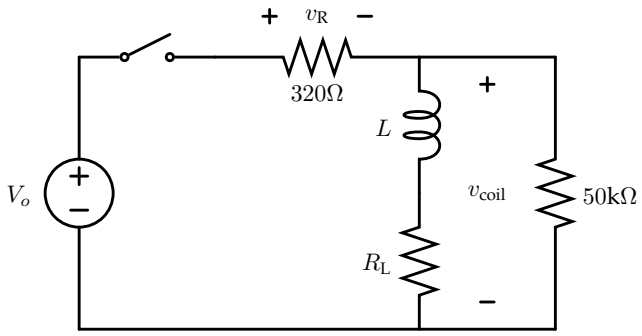
$v_x(t = 0^+) =$

$v_x(t = \infty) =$

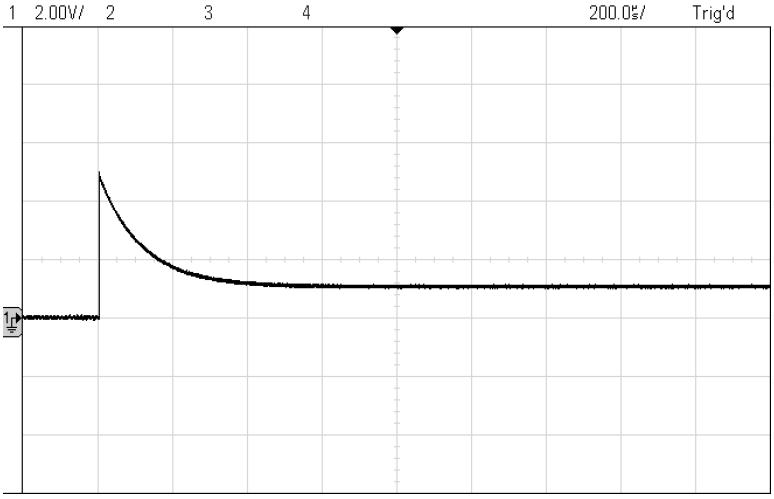
Give the general expression for $v_x(t > 0)$, with numerical values from the circuit:

## 4.2 Scope Creep

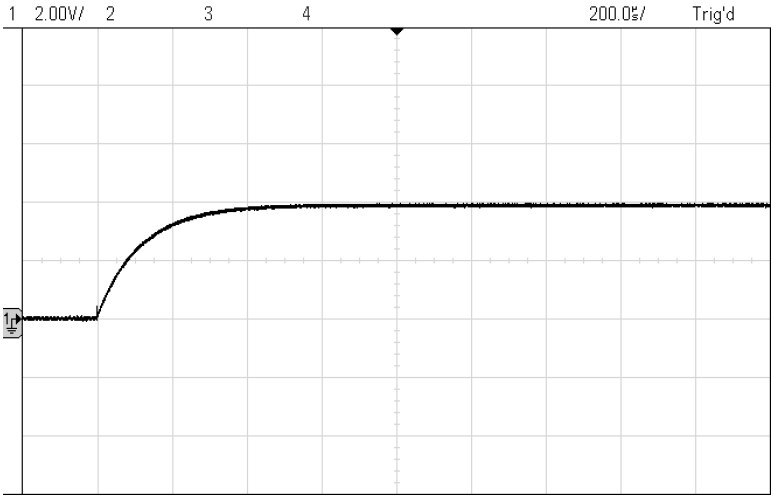
Your friend was working in the lab late one night and they built the following circuit using a carefully wound coil (here modeled as an inductor and a resistor in series), and after a long while with the switch open, they closed the switch.




They saved screenshots of their scope's outputs during this experiment, measuring $v_R$ and $v_{coil}$. However, the way they organize the files on their computer is a mess, so they forgot which was which. Here are their two screenshots:




`circuit_graph_final_final_real_A.png`




`circuit_graph_final_final_real_B.png`

Which graph is which? Enter "A" or "B" in each box:

Graph [ ] is the graph of $v_{\text{R}}$. Graph [ ] is the graph of $v_{\text{coil}}$.

Your friend also did some work to characterize the circuit, but oh no, they lost the paper they did their work on. Help them out. Using the graph(s), estimate the values of $V_o$, $L$, and $R_{\text{L}}$. Work in the space below the boxes will be considered for partial credit.

$V_o \approx$ [ ] $L \approx$ [ ] $R_{\text{L}} \approx$ [ ]

Your friend did one final experiment. After leaving the switch closed for a long time, they opened the switch at time $t_0$ and noticed changes in both $v_{\text{R}}$ and $v_{\text{coil}}$. But alas, they can't remember what changed, so they once again ask you for help. Determine the values of $v_{\text{R}}$ and $v_{\text{coil}}$ in the instant after the switch is opened.

$v_{\text{R}}(t_0^+) =$ [ ] $v_{\text{coil}}(t_0^+) =$ [ ]

# 5 Mystery Circuit

In the pink envelope at your table (which should be labeled with the same number that is printed on the bottom of this exam near the QR codes), you will find a breadboard containing the circuit we'll use for this problem. The breadboard contains an RP2040 microcontroller (the same one we've used in lab), as well as a green PCB with two output wires on it. There is a switch on the battery case that you can use to turn things on, and an orange LED on the PCB should light up when you power it on.

Even though there are some complex things in this circuit, we can model the whole thing (from the perspective of those two exposed wires) as consisting only of linear components. But note that turning off the power is *not* equivalent to zeroing out the sources in the circuit.

Your goal in this problem is to determine: if we were to connect a $700\Omega$ resistor between those two output terminals and measure the voltage drop across it, what would that voltage drop be? Of course, you will not be able to solve for this value exactly and you don't have a calculator, so reasonable approximations are OK.

You may make any measurements you wish, but note that solving the problem does not require making any measurements on the RP2040, nor any measurements internal to the circuit on the green PCB.

There is also a resistor in the breadboard, which is currently not connected to the rest of the circuit (it's just there as an extra component in case you want it). This resistor's resistance is **not** $700\Omega$.

Enter your answer below (as a single number with units), and then in the box on the facing page (page 17), include a description of what measurements you made (and the values you found), as well as how you used those results to arrive at your answer.

When you are finished, please **turn off the power**, put your circuit back in the envelope, and **leave the envelope at your table**.

Predicted voltage drop across a $700\Omega$ resistor connected between the terminals:

Measurements and reasoning:

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*

*Worksheet (intentionally blank)*