上 海 交 通 大 学 试 卷

（ 2023~ 2024~1Academic Year/Fall Semester ）

Class No._____ _ Name in English or Pinyin: _____

Student ID No._____ Name in Hanzi(if applicable): _____

ECE2150J/VE215 Introduction to Circuits

Mid-term Exam

10:00 – 11:40 am 7th November 2023

The exam paper has 11 pages in total.

You are to abide by the University of Michigan-Shanghai Jiao Tong University Joint Institute (UM-SJTU JI) honor code. Please sign below to signify that you have kept the honor code pledge.

THE UM-SJTU JI HONOR CODE

I accept the letter and spirit of the honor code:

I have neither given nor received unauthorized aid on this examination, nor have I concealed any violations of the Honor Code by myself or others.

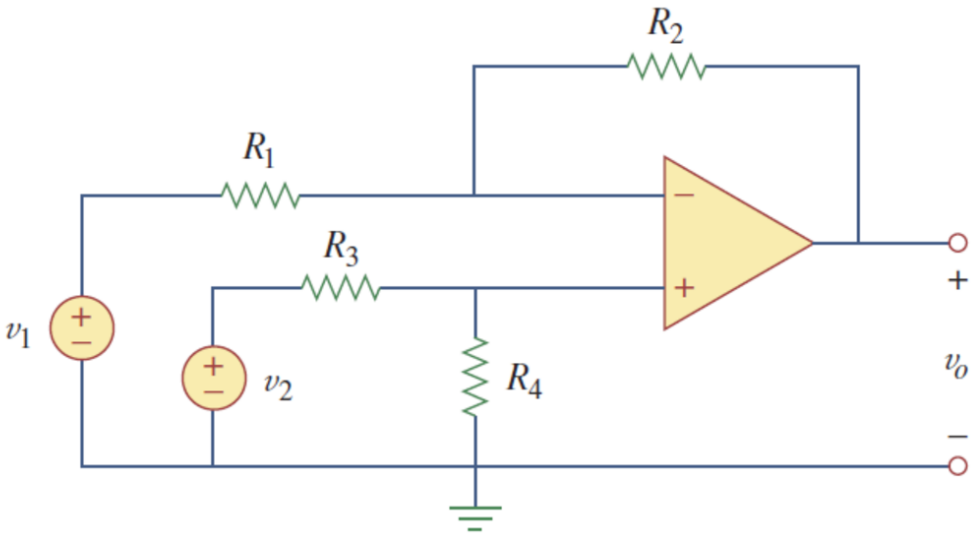
Signature:_____

Please enter grades here:

Exercises No. **题号**	**Points** **得分**	**Grader's Signature** **流水批阅人签名**
1		
2		
3		
4		
5		
6		
7		
Total 总分		

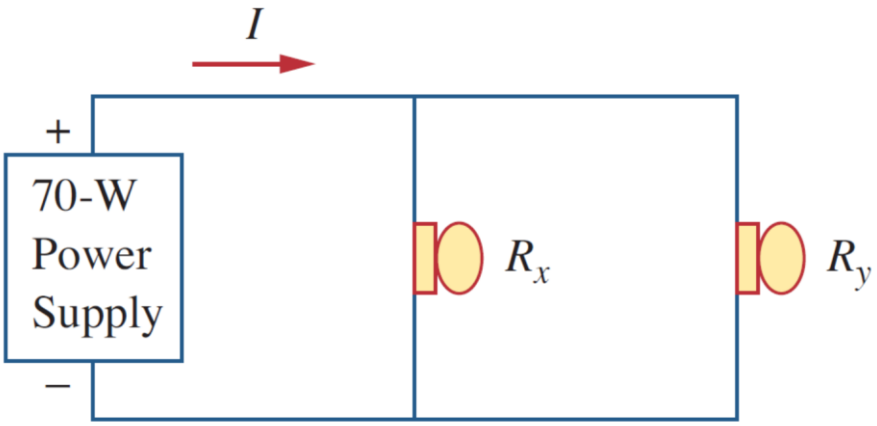
Q1. For the difference amplifier circuit, please derive the equation below. (8 points)

$$v_o = \left(\frac{R_2}{R_1} + 1\right)\frac{R_4}{R_3 + R_4}v_2 - \frac{R_2}{R_1}v_1$$



Q2. As a design engineer, you are asked to design a lighting system consisting of a 70 W power supply and two light bulbs as shown below. You must select the two bulbs from the following three available bulbs. The system should be designed for minimum cost such that lies within the range I = 1.2A ± 5%. (10 points)

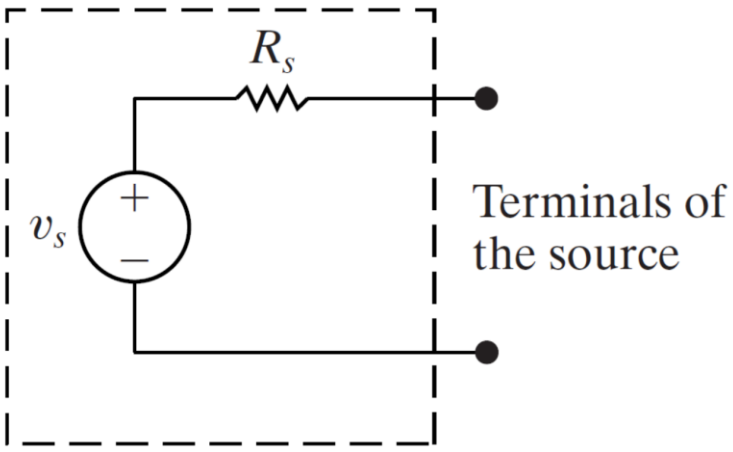
R_1 = 80 Ω, cost ¥5; R_2 = 90 Ω, cost ¥7.5; R_3 = 100 Ω, cost ¥6.5



Q3. The circuit model of a dc voltage source is shown below. The following voltage measurements are made at the terminals of the source: (1) With the terminals of the source open, the voltage is measured at 50 mV, and (2) with a 15 MΩ resistor connected to the terminals, the voltage is measured at 48.75 mV. All measurements are made with a digital voltmeter that has a meter resistance of 10 MΩ. (10 points)

(a) What is the internal voltage of the source v_s in millivolts?

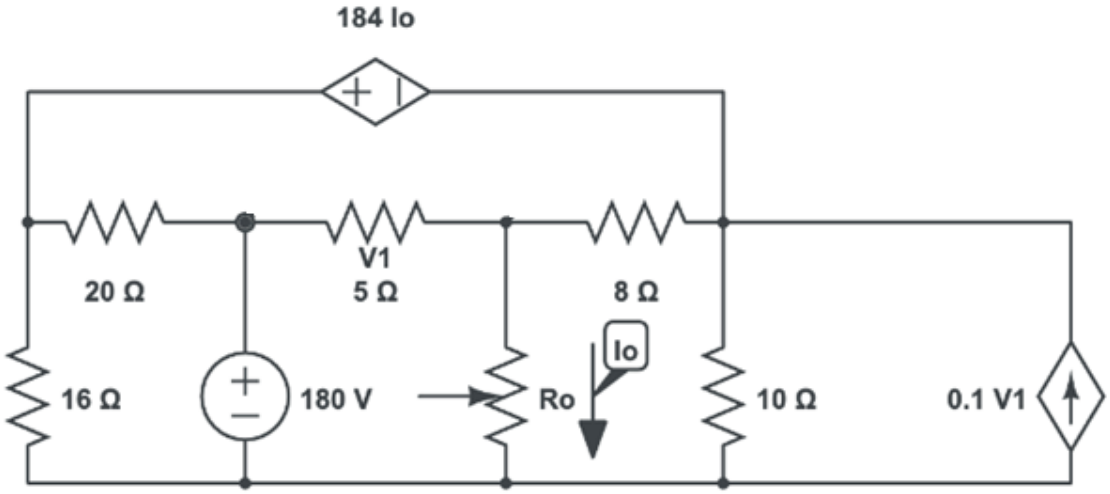
(b) What is the internal resistance of the source R_s in kilo-ohms?



Q4. The rheostat R_o in the circuit below has been adjusted so that the maximum power is delivered to R_o. (18 points)

(a) Find the value of R_o.

(b) Find the maximum power delivered to R_o.



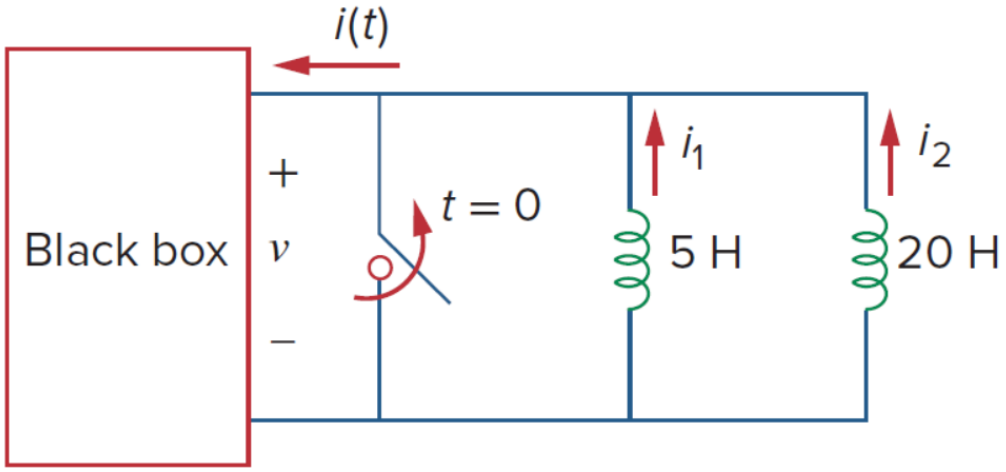
Q5. Inductors are initially charged and are connected to the black box at t = 0. If $i_1(0) = 6$ A, $i_2(0) = -3$ A, and $v(t) = 50e^{-100t}$ mV when $t \geq 0$, please answer (a)-(d). (16 points)

(a) The energy initially stored in each inductor.

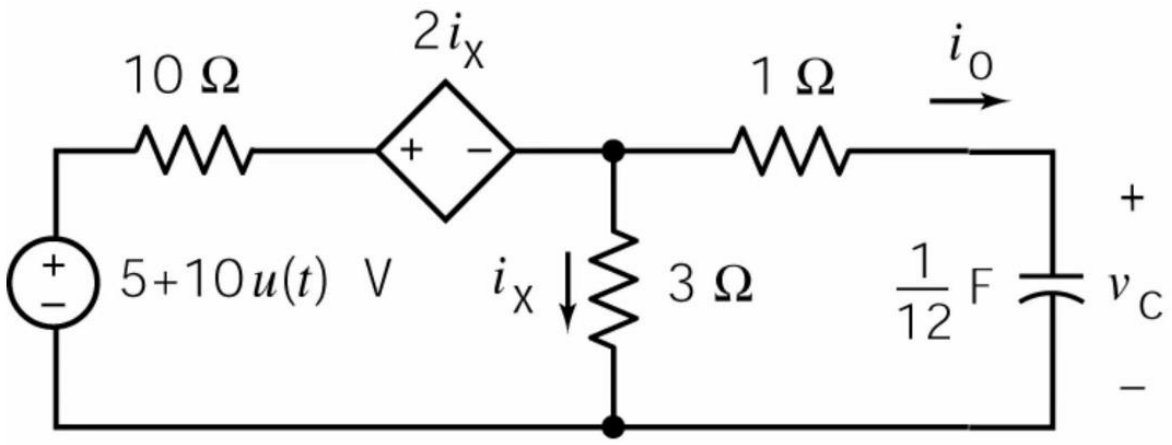
(b) The total energy delivered to the black box from t = 0 to $t = \infty$.

(c) $i_1(t)$ and $i_2(t)$ when $t \geq 0$.

(d) $i(t)$, $t \geq 0$.



Q6. Please determine a capacitor current i_0 when t > 0. (18 points)



Q7. In the following circuit, the switch SW1 has been in left position for a long time. At t = 0, the switch moves instantaneously to the right position. Please answer the following questions. (20 points)

(a) Find the Norton equivalent resistance R_N between port a and b.

(b) Find $I(0+)$ and $I'(0+)$.

(c) Find $I(t)$ for $t > 0$.