Instructions:

i. Use only black or blue non-erasable ink.
ii. Write your name, student number, section and teacher's name at the upper right hand corner of every page of your answer sheets.
iii. There are two parts in this exam. You will submit answers to Part I and Part II separately.
iv. Do not use the reverse side of your answer sheets for your solutions. Anything written at the back will be considered scratchwork.
v. No calculator is allowed.
vi. Answer each problem completely. Answers in fractional form must be in simplest form. Place your final answer in a box.
vii. All mobile devices must be turned off.
viii. Failure to comply with any of these instructions may earn corresponding deductions.

Part I. [1 problem, 4 questions, 100 pts total plus 15 pts bonus]

1. In the given circuit below, the current through the 10-Volt source is 2.5mA. If unknown voltage source is supplying 200 mW of power, find
   a. (60 pts) Vs
   b. (20 pts) Vu and Iu
   c. (20 pts) the total supplied power
   d. (15 pts) Based on your answer in (b), what ideal circuit element(s) could be used to model the unknown element? Show how the element is connected by drawing the circuit.

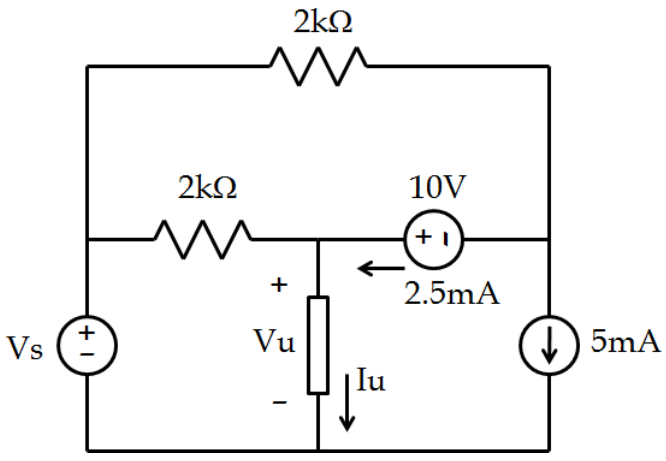

Fig. 1 Circuit for Part I Problem 1

Part II. [4 problems, 100 pts total]

1. [25 pts] A photovoltaic (PV) panel [also known as solar panel] is rated 12 V 80 W. A home PV system is rated 12 V direct current (DC), 1.2kW.
   a. How many units of PV panels shall be needed for this system?
   b. Will the individual panels be connected in: (i) series; (ii) parallel; or (iii) combination of series and parallel? If the panels will be connected as combination of series and parallel, describe how many panels are in series to form a string of panels, and how many strings shall be connected in parallel.
   c. The DC output of the PV system has to be converted to alternating current (AC) at a conversion efficiency of 95%. How much AC power will be available for household use?
   d. A similar but much larger PV system is installed in a mall. On a clear sunny day, it produces 1 MW (AC) power. From 7 am to 7 pm, the PV system produces 1 MW. Otherwise, the PV system does not produce anything. From 9 am to 10 pm, the mall requires 1 MW of power. Otherwise, the mall requires nothing. During periods when the PV system produces nothing, the mall buys power from the electric utility at Php 10/ kW-Hr. During periods when the PV system produces power but is not used by the mall, the mall can sell that power to the utility at Php 12/kW-Hr. In a 24-hour period, how much is the electric bill of the mall (due to be paid to the electric utility)?

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2. [25 pts] Use the circuit in Fig.2.
   a. For Fig.2a, write the expression for the power across R_{load}.
   b. For Fig.2b, write the expression for the power across R_{load}.
   c. What should be the value of I_s [in terms of V_s and other parameters] such that the power across the load (R_{load}) in the two circuits are equal?

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3. [25 pts] Using Node-Voltage method, perform the following:
   a. From Fig. 3a, calculate Voc
   b. From Fig. 3b, calculate Isc

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4. [25 pts] Using Mesh-Current method for Fig. 4, perform the following:
   a. Determine Voc = f(Ia, Ib, Ic) (*note: simply write the expression*)
   b. Write three independent equations (*note: fill-in the blanks below; in your answer sheet, your final answer should take the form below with the blanks filled-in*)

_____ I_a + _____ I_b + _____ I_c = 0	(1)
_____ I_b + _____ I_c = 4	(2)
_____ I_b + _____ I_c = 0	(3)

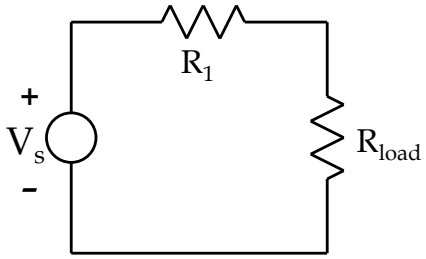

Fig. 2a Circuit for Part II Problem 2a

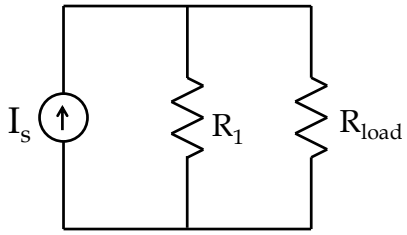

Fig. 2b Circuit for Part II Problem 2b

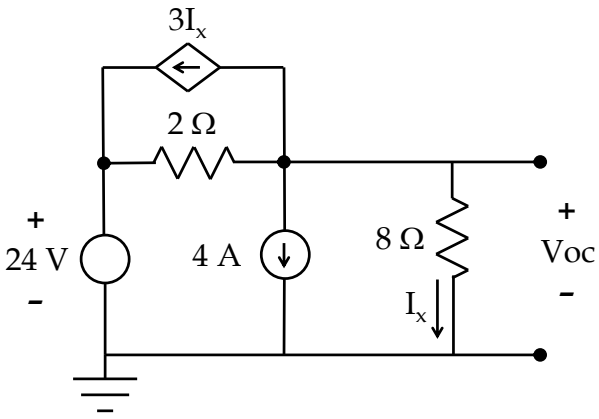

Fig. 3a Circuit for Part II Problem 3a

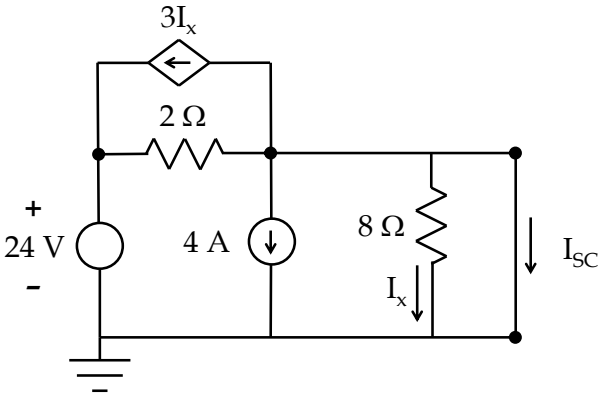

Fig. 3b Circuit for Part II Problem 3b

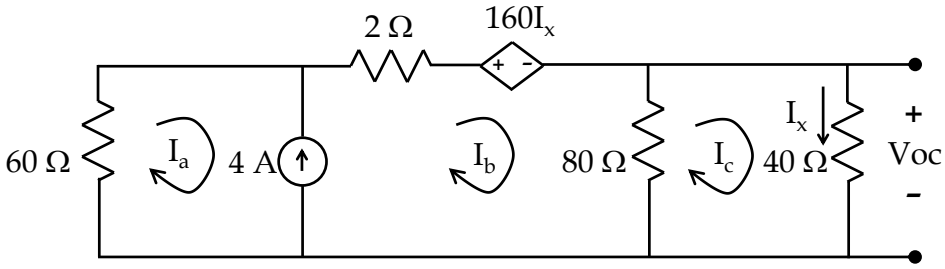

Fig. 4 Circuit for Part II Problem 4