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QUALIFICATION : **BACHELOR OF SCIENCE**	
QUALIFICATION CODE: **07BOSC**	LEVEL: **6**
COURSE: **ELECTRICAL CIRCUIT AND ELECTRONIC**	COURSE CODE: **ECE602S**
DATE: **NOVEMBER 2024**	SESSION: **1**
DURATION: **3 HOURS**	MARKS: **100**

FIRST OPPORTUNITY: EXAMINATION PAPER

EXAMINER: **MR. MARKUS HITILA**

MODERATOR: **DR. VAINO INDONGO**

INSTRUCTIONS

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

PERMISSIBLE MATERIALS:

1. Scientific Calculator

This paper consists of five pages including this front page

Question 1 **[10]**

The current through and voltage across an element is shown in Figure 1. Find the resulting power and sketch the power delivered to the element for t > 0.

$$i(t) = \begin{cases} 2t & 0 < t < 15s \\ -3t + 75 & 15s < t < 25s \end{cases}$$

$$v(t) = \begin{cases} 30V & 0 < t < 10s \\ -5t + 80 & 10s < t < 15s \\ 5V & 15s < t < 25s \end{cases}$$

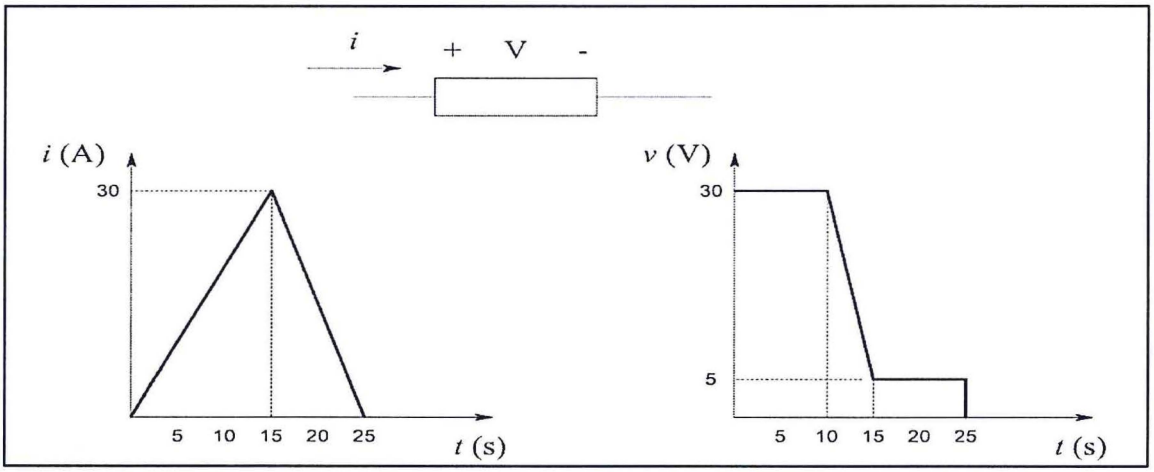


Figure 1: Characteristic of current and voltage of the element

Question 2 **[30]**

The circuit shown in Figure 2 has two inputs, v_s and i_s, and one output v_o. The output is related to the inputs by the equation

$$v_o = ai_s + bv_s$$

where *a* and *b* are constants to be determined. Determine the values *a* and *b* by

a) Writing and solving mesh equations (10)

b) Writing and solving node equations (10)

c) Using superposition (10)

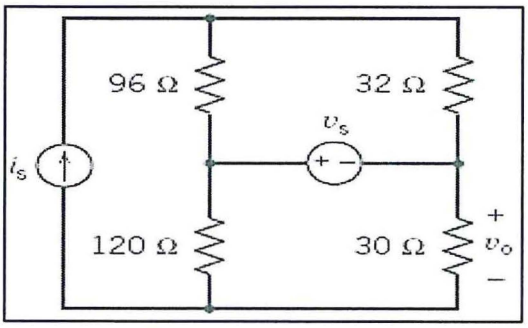


Figure 2: Circuit Diagram

Question 3 **[20]**

Find the value of for maximum power transfer in the circuit in Fig. 3 and the maximum power that can be transferred to this load L_R

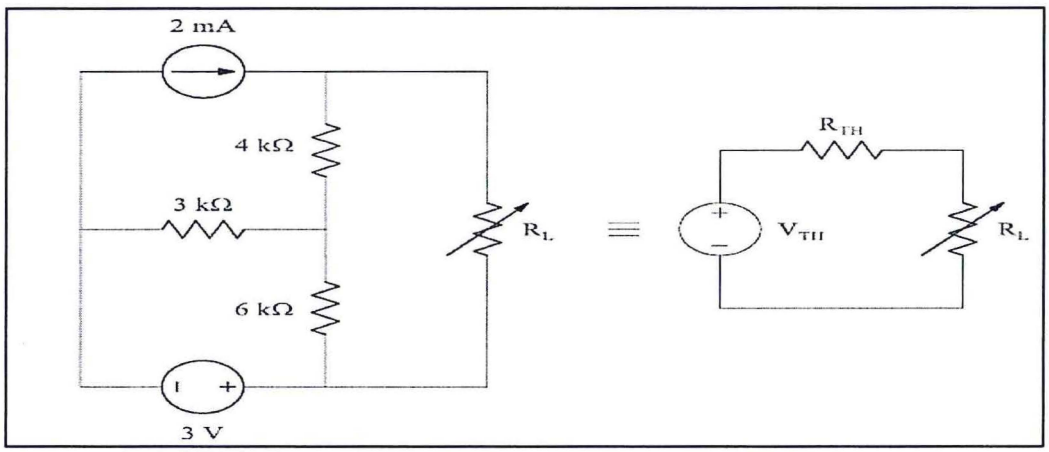


Figure 3: Circuit Diagram

Question 4 **[20]**

4.1. One method of checking calculations involving interconnected circuit elements is to see that the total power delivered equals the total power absorbed (conservation-of-energy principle). With this thought in mind, check the interconnection in Fig.4 below and state whether it satisfies this power check. The current and voltage values for each element are given in Table. (10)

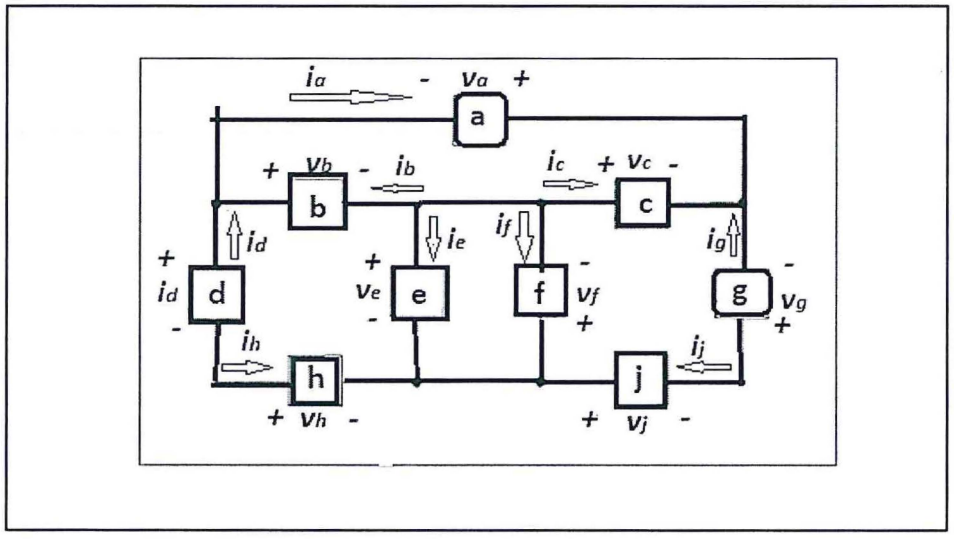


Figure 4: Circuit

Table 1: Data

Element	Voltage (V)	Current (mA)
a	1.6	80
b	2.6	60
c	-4.2	-50
d	1.2	20
e	1.8	30
f	-1.8	-40
g	-3.6	-30
h	3.2	-20
j	-2.4	30

4.2. A current source and a voltage source are connected in series with a resistor as shown in Figure 4. Suppose that $Vs = 10\ V$, $Is = 2\ A$, and $R = 5\Omega$. (10)

a) Calculate the voltage v across the resistor and the power absorbed by the resistor. (2)

b) Calculate the voltage v_1 across the current source and the power supplied by the sources. (4)

c) Change the voltage source voltage to $Vs = 5\ V$ and recalculate the voltage, v, across the resistor and the power absorbed by the resistor. (4)

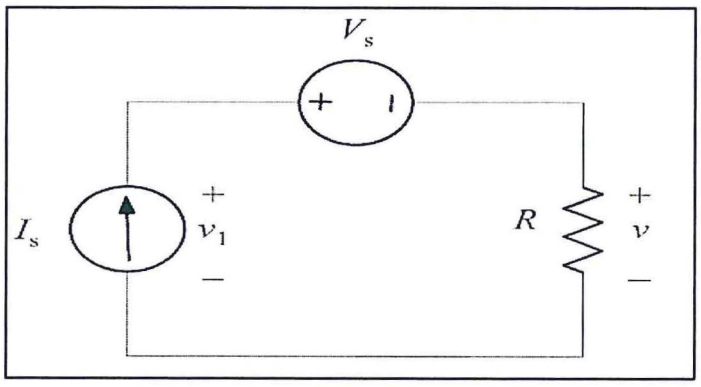


Figure 4: Circuit

Question 5 **[20]**

5.1. In the op-amp circuit shown, find the currents i_o and i_x. (10)

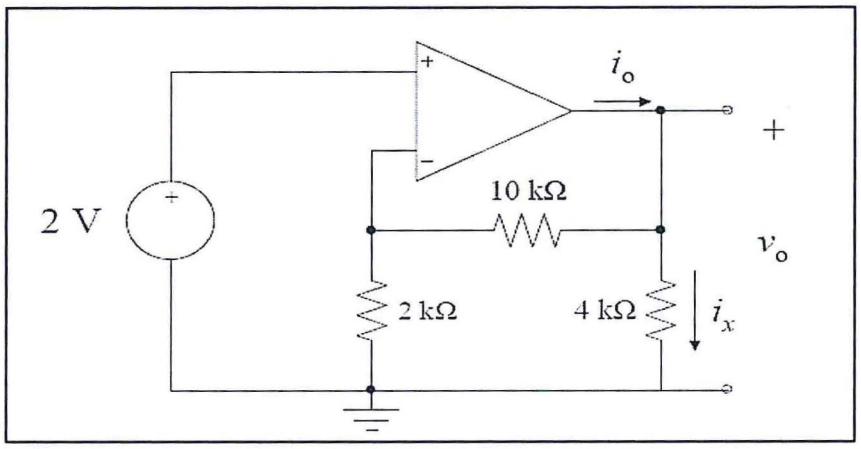
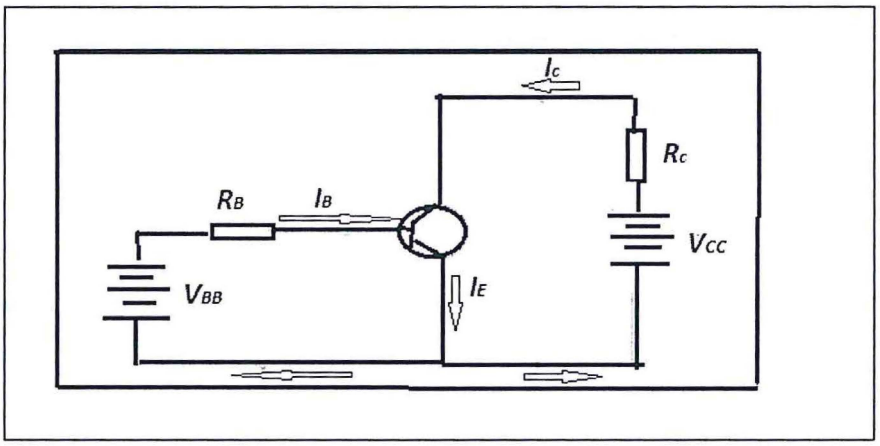


Figure 5: op-amp circuit

5.2. Draw the static I-V characteristic of a diode. Name and indicate on the graph the two operating regions and all relevant points. (5)

5.3. Define a rectifier and name two types of rectifiers. (2)

5.4. The circuit diagram of a bipolar junction transistor, which is made of silicon is shown below. Given that $V_{BB} = 5.7V, R_B = 50k\Omega, V_{CC} = 10V, R_C = 970\Omega, \beta = 100$. Find the collector emitter voltage V_{CE} (3)



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