Quiz 3 Solution

Electrical Circuits 1

TE1002

Tecnológico de Monterrey

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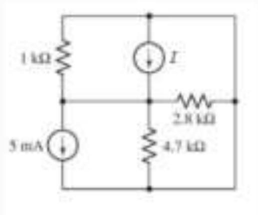
Name____

NOTE: This is a multi-part question. Once an answer is submitted, you will be unable to return to this part.
Consider the given circuit where $I = 9$ mA.



1.

Determine the power absorbed by each resistor. (You must provide an answer before moving to the next part.)

Resistor	$P_{absorbed}$
1 kΩ	*6.4919 ± 2%* mW
4.7 kΩ	*1381.2531 ± 2%* μW
2.8 kΩ	*2318.532 ± 2%* μW

Explanation:

Define the center node as +v; the other node is then the reference terminal.

Applying KCL to the given circuit, we get

$$9 \times 10^{-3} - 5 \times 10^{-3} = \frac{v}{1000} + \frac{v}{4700} + \frac{v}{2800}$$

Solving, we get

$$v = 2.5479 \text{ V}$$

The power absorbed by the resistors are

Resistor		$P_{absorbed}$
1 kΩ	v^2/1 kΩ	6.4919 mW
4.7 kΩ	v^2/4.7 kΩ	1381.2531 μW
2.8 kΩ	v^2/2.8 kΩ	2318.532 μW

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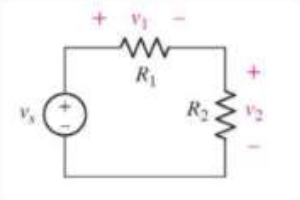


2.

- [ ] $v_1 = v_s \frac{R_1}{R_1+R_2}$
- [ ] $v_2 = v_s \frac{R_2}{R_1+R_2}$
- [ ] $v_2 = v_s \frac{R_1}{R_1+R_2}$
- [ ] $v_1 = v_s \frac{R_2}{R_1+R_2}$

Applying KVL to the given circuit,

$$-v_s + v_1 + v_2 = 0$$

Define a clockwise current *I*. Then $v_1 = IR_1$ and $v_2 = IR_2$.

Therefore,

$$-v_s + IR_1 + IR_2 = 0$$

$$-v_s + I(R_1 + R_2) = 0$$

$$I = \frac{v_1}{R_1}$$

$$v_s = (R_1 + R_2)\frac{v_1}{R_1}$$

$$v_1 = v_s \frac{R_1}{(R_1+R_2)}$$

Similarly,

$$v_2 = IR_2$$

Hence, we can write

$$v_s = (R_1 + R_2)\frac{v_2}{R_1}$$

$$v_2 = v_s \frac{R_2}{(R_1+R_2)}$$

The derived expressions for the given circuit are

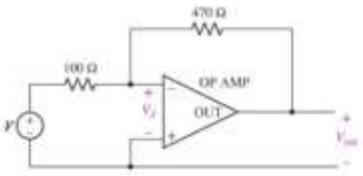
$$v_1 = v_s \frac{R_1}{(R_1+R_2)}$$

and

$$v_2 = v_s \frac{R_2}{(R_1+R_2)}$$

3.

The circuit shown in the figure given below includes a device known as an op amp. This device has two unusual properties in the circuit shown: (1) $V_d = 0$ V, and (2) no current can flow into either input terminal (marked "–" and "+" inside the symbol), but it can flow through the output terminal (marked "OUT"). This seemingly impossible situation—in direct conflict with KCL—is a result of power leading to a device that is not included in the symbol. Based on this information, calculate V_{out} if $V = 11$ V.



The voltage V_{out} is

Explanation:

Define the current I flowing out of the "+" reference terminal of the 11 V source. This current also flows through the 100-Ω and 470-Ω resistors since no current can flow into the input terminals of the op amp. Then,

$$-11 + 100I + 470I + V_{out} = 0$$

Further, since $V_d = 0$, we can also write

$$-11 + 100I = 0$$

Solving, we get

$$V_{out} = 11 - 570I = 11 - 570\left(\frac{11}{100}\right) = -51.7\text{ V}$$

The voltage V_{out} is –51.7 V.