Circuit theorems 001

Problem has been graded.

A linear system has two inputs, v_a and v_b,
and one output, v_{out} .
When $v_a = v_1$ and $v_b = v_2$, then $v_{out} = v_3$.
When $v_a = v_4$ and $v_b = v_5$, then $v_{out} = v_6$.

What is v_{out}, when $v_a = v_7$ and $v_b = v_8$?

Given Variables:

v1 : 3 V
v2 : 6 V
v3 : 12 V
v4 : 3 V
v5 : 4 V
v6 : 48 V
v7 : 3 V
v8 : 2 V

Calculate the following:

vout (V) :

> Hint: Use the fact that the system is linear

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What is v_{out}, when $v_a = v_7$ and $v_b = v_8$?

v1 = 8 V

v2 = 0 V

v3 = 56 V

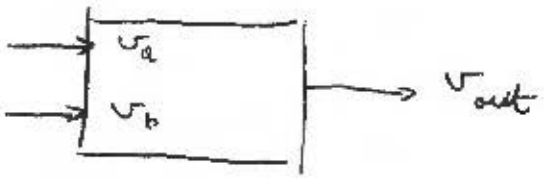
v4 = 0 V

v5 = -9 V

v6 = 45 V

v7 = 5 V

v8 = 8 V



$$a \cdot v_a + b v_b = v_{out}$$

$$\begin{cases} a \cdot 8 + b \cdot 0 = 56 \\ a \cdot 0 + b(-9) = 45 \end{cases}$$

$$\Rightarrow \begin{cases} a = \frac{56}{8} = 7 \\ b = \frac{45}{-9} = -5 \end{cases}$$

$$\Rightarrow a \cdot v_a + b v_b = 7 \cdot 5 + (-5) \cdot 8$$
$$= -5\ V$$

$$\boxed{v_{out} = -5\ V}$$