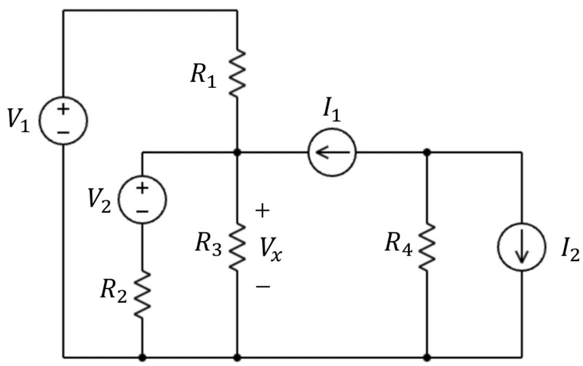
Consider the circuit below. You are not given the values of V_1, V_2 and I_2. However, you are told the values of the other components and that of V_x.

(a) What is the new value of V_x when all the source values (i.e., V_1, V_2, I_1 and I_2) are doubled? We will call this new value V_{x1}.

(b) What is the new value of V_x when only I_1 is doubled and the other sources are what they were originally? We will call this new value V_{x2}.

$R_1 = 15\Omega$
$R_2 = 5\Omega$
$R_3 = 15\Omega$
$R_4 = 7\Omega$
$I_1 = 2A$
$V_x = 15$



a. Generally,

$$V_x = aV_1 + bV_2 + cI_1 + dI_2 \quad \text{from linearity and superposition}$$

If all sources are doubled,

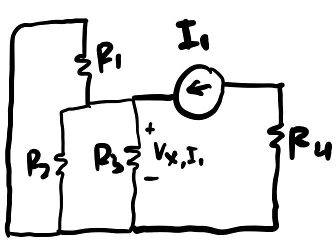
$$V_{x1} = a(2V_1) + b(2V_2) + c(2I_1) + d(2I_2) = 2(aV_1 + bV_2 + cI_1 + dI_2)$$
$$= 2V_x$$
$$= 2 \cdot 15$$
$$\boxed{V_{x1} = 30V}$$

b. If only I_1 is doubled

$$V_{x2} = aV_1 + bV_2 + c(2I_1) + dI_2 = (aV_1 + bV_2 + cI_1 + dI_2) + cI_1$$
$$= V_x + cI_1$$

find the contribution of I_1 using superposition

when only I_1 is on,



$$V_{x,I_1} = \underbrace{I_1 \left(\frac{R_1 // R_2}{R_1 // R_2 + R_3} \right)}_{c} R_3$$

$$V_{x,I_1} = 2 \left(\frac{\frac{15}{4}}{\frac{15}{4} + 15} \right) 15$$
$$= 2 \left(\frac{15}{15 + 60} \right) 15$$
$$= 2 \cdot \frac{1}{5} \cdot 15$$
$$= 6V \Rightarrow cI_1$$

$$V_{x2} = V_x + cI_1$$
$$= 15 + 6$$
$$\boxed{V_{x2} = 21V}$$