1.14) Incandescent lamb $100\ W \times 1000h = 100\ kWh$

Fluorescent lamb $12\ W \times 1000h = 12\ kWh$

$100 - 12 = 88\ kWh$ (less energy)

$88\ kWh \times 7.2\ cents/kWh = \boxed{633.6 \text{ cents cheaper}}$

1.22) Device 1 $\Rightarrow P = i.v = 15.(-1) = \boxed{-15\ W \text{ (delivering)}}$

Device 2 $\Rightarrow P = 5.1 = \boxed{5W \text{ (absorbing)}}$

Device 3 $\Rightarrow P = 10\ 2 = \boxed{20\ W \text{ (absorbing)}}$

Device 4 $\Rightarrow P = (-10)(-1) = \boxed{10\ W \text{ (absorbing)}}$

Device 5 $\Rightarrow P = 20(-3) = \boxed{-60\ W \text{ (delivering)}}$

Device 6 $\Rightarrow P = 20\ 2 = \boxed{40\ W \text{ (absorbing)}}$

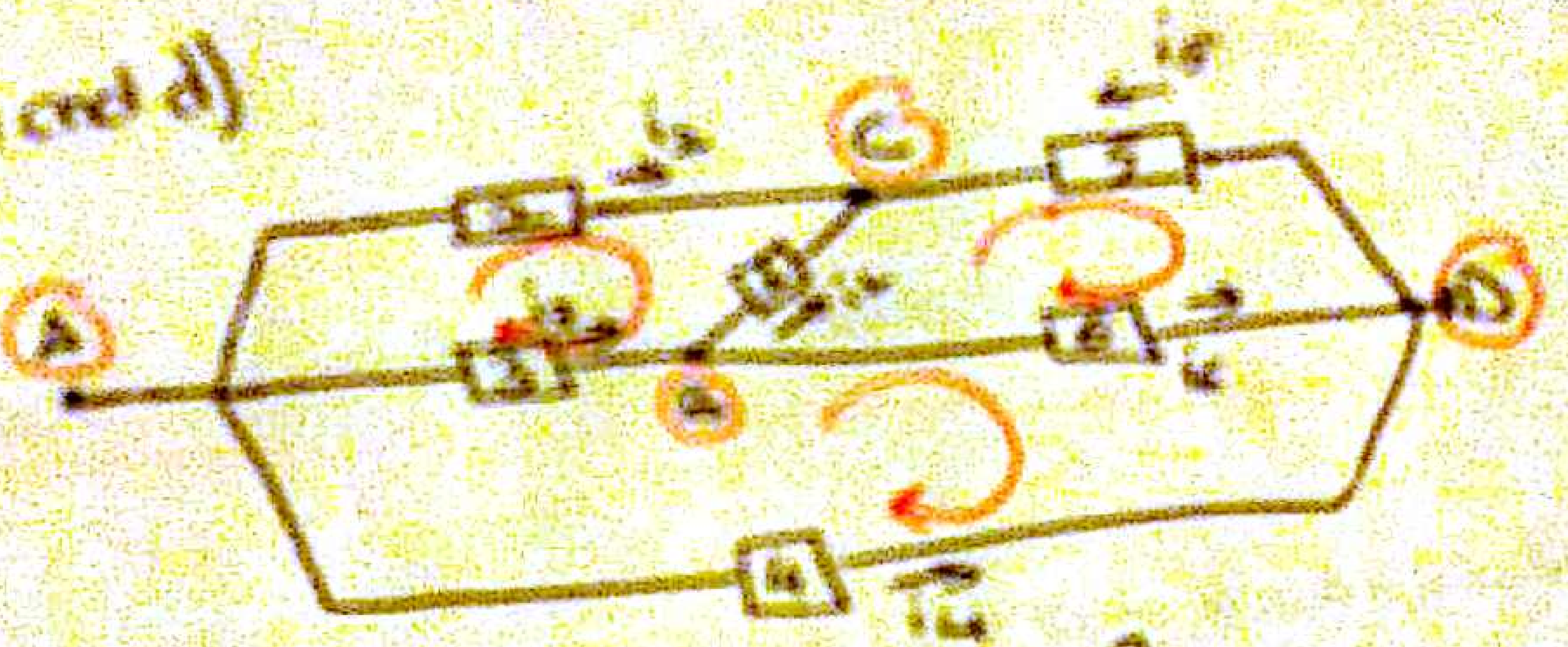
Power balance

$\boxed{-15 - 60 + 5 + 20 + 10 + 40 = 0 \checkmark}$

2.5) $V = IR_x \Rightarrow R_x = \frac{V}{I} = \frac{100\text{ V}}{0.01\text{ A}} = \boxed{10\text{k}\Omega}$

$P = VI = 100 \times 0.01 = \boxed{1\text{ W}}$

2.15) a) and d)



This is same as Figure 2.13

b) Node A: $-i_2 - i_3 - i_4 = 0$ Node C: $i_2 + i_5 + i_1 = 0$

Node B: $i_3 - i_1 - i_6 = 0$ Node D: $-i_5 + i_6 + i_4 = 0$

c) $i_1 = -20\text{mA}$, $i_2 = -12\text{mA}$, $i_3 = 50\text{mA}$

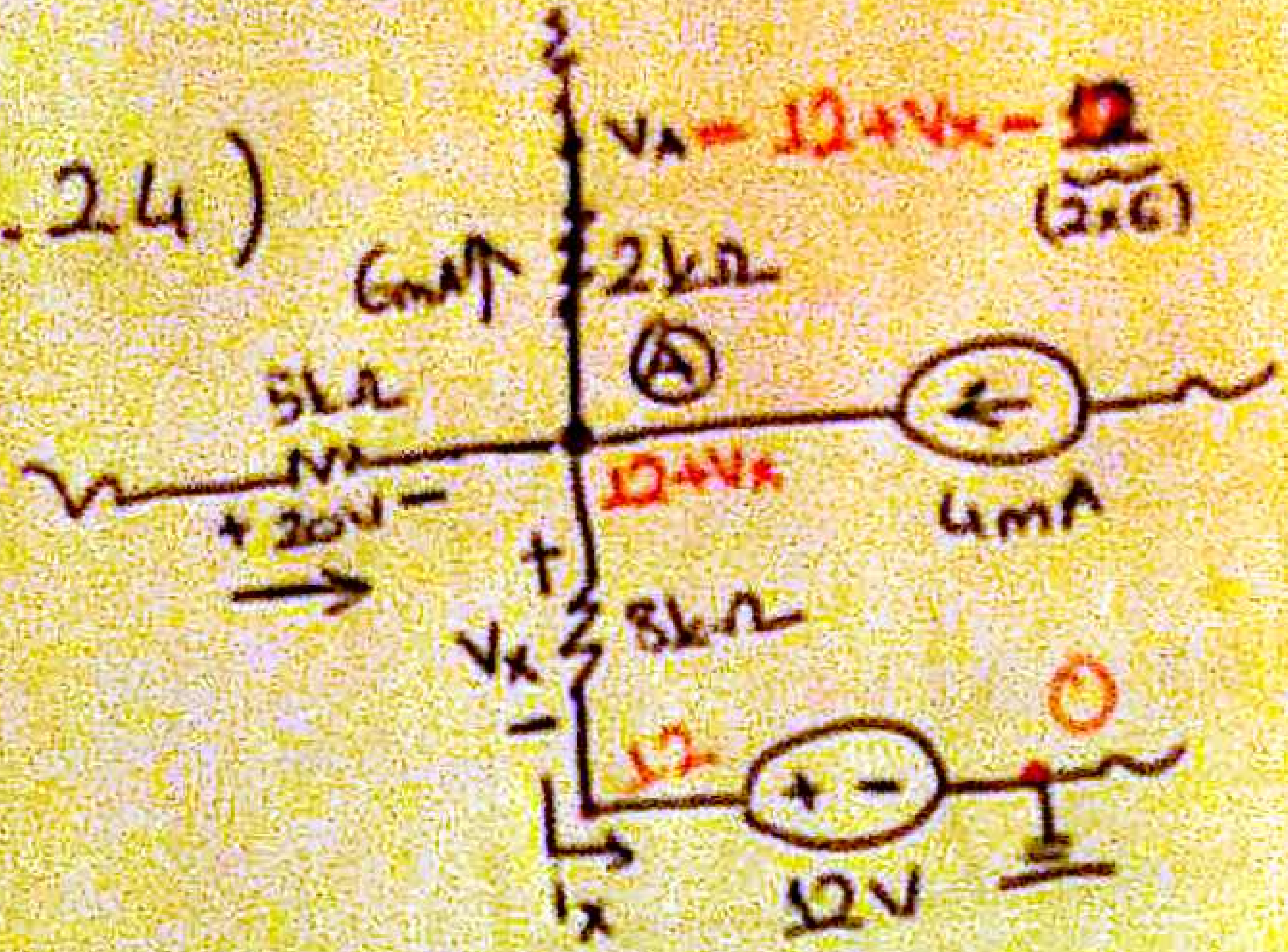
Using Node A $\boxed{i_4 = -i_2 - i_3 = +12\text{ mA} - 50\text{ mA} = \text{[redacted] A} \; -38\text{ mA}}$

Using Node B $\boxed{i_6 = i_3 - i_1 = \text{[redacted]} = 70\text{mA}}$

Using Node C $\boxed{i_5 = -i_2 - i_1 = 32\text{ mA}}$

Check Node D $\boxed{-32 + 70 - 38 = 0}$ ✓

2.24)



a) Applying KCL @ node (A)

$-6mA + 4mA + \frac{20V}{5k\Omega} - i_x$

$\rightarrow \boxed{i_x = 2mA}$

[redacted]

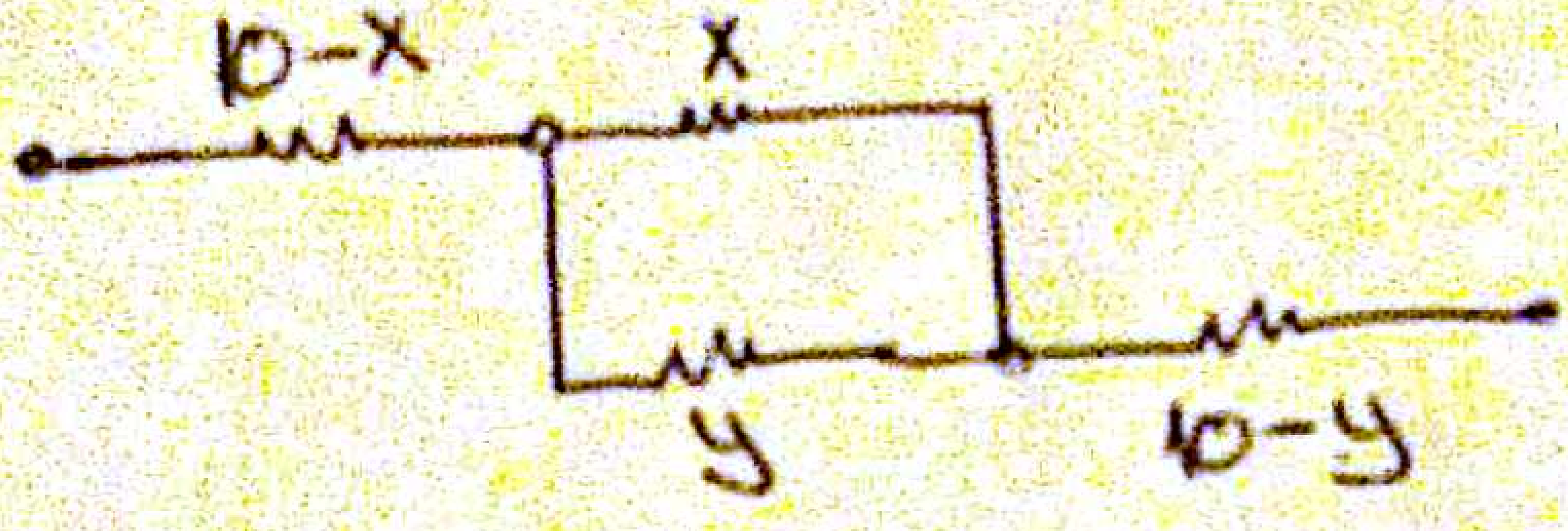
$\Rightarrow V_x = 8k\Omega \underbrace{(2mA)}_{i_x} = \boxed{16V}$

b) $\boxed{2mA - 4mA + 6mA - 4mA = 0}$ ✓

c) Referring Figure $V_A = 12 + V_x - 6mA \times 2k\Omega$

$\boxed{V_A = V_x = 16V}$

2.37) The given circuit can be written in the following form



We can calculate R_{eq} in terms of x and y

$$R_{eq} = 20 - (x+y) + \frac{xy}{(x+y)}$$

Defining $p = x+y$ and $x = p-y$

$$R_{eq} = 20 - (p) + \frac{(p-y)\,y}{p}$$

$$= 20 - (p-y) - \frac{y^2}{p}$$

Because of physical limitations $x, y > 0$, ~~and~~ so $(p-y) > 0$ and $\frac{y^2}{p} > 0$. Then the maximum value for $\boxed{R_{eq_{max}} = 20}$

2.37) cont.

To find the min. value of R_{eq}, we need to find the max. value of the following expression

$$f(x,y) = \underbrace{(p-y)}_{x} + \frac{y^2}{p}$$

$0 \leq x \leq 10$

$0 \leq y \leq 10$

$0 \leq x+y = p \leq 20$

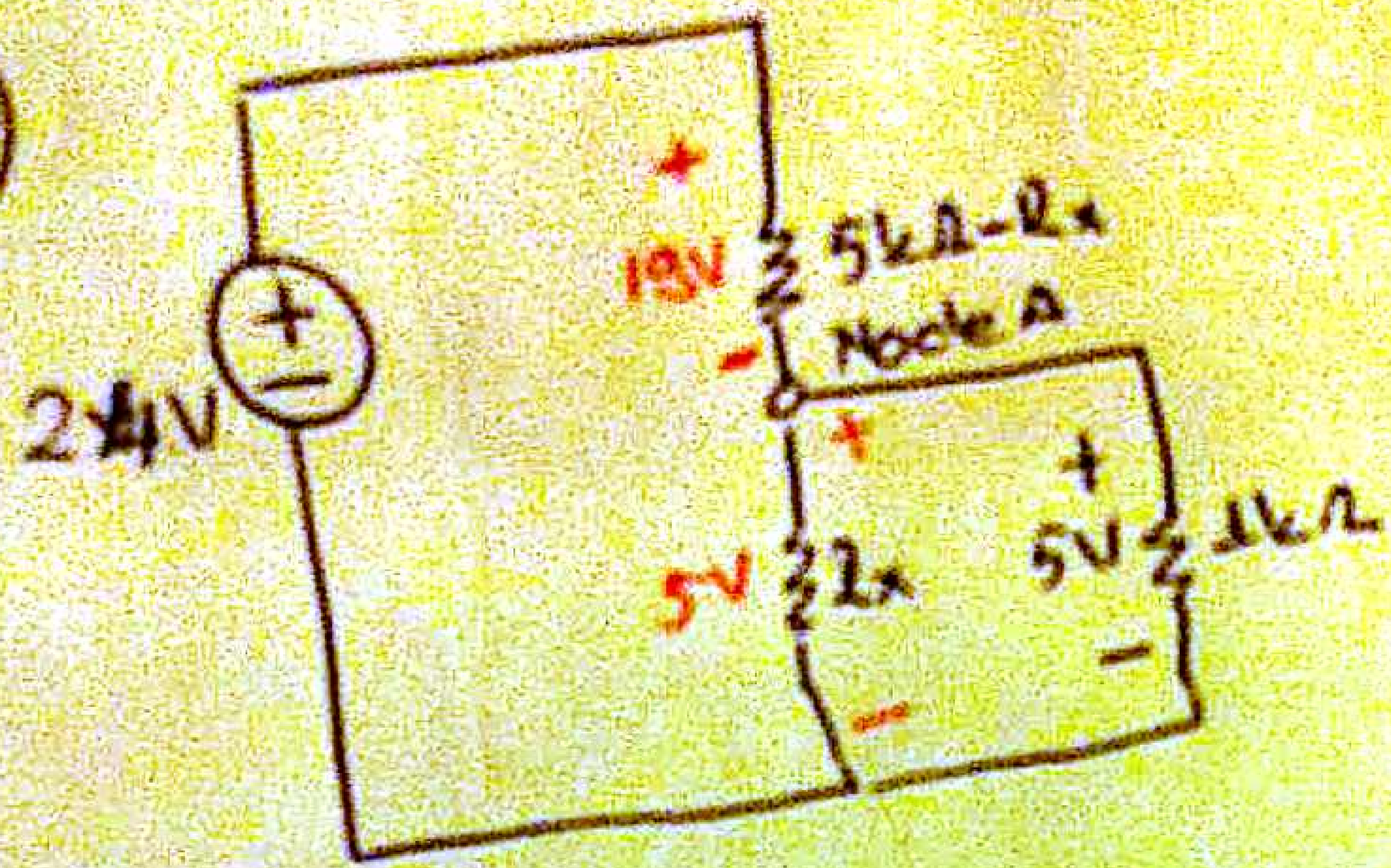
Choosing $x=10$, $y=10$, we get

$$f(10,10) = 15$$

Then $\boxed{R_{eq_{min}} = 20 - 15 = 5}$

$$5 \leq R_{eq} \leq 20$$

2.44)



KCL @ Node A

$$\frac{19}{(5-R_x)} - \frac{5V}{R_x} - \frac{5}{1} = 0$$

$$\Rightarrow \quad 5R_x^2 - R_x - 25 = 0$$

The positive root of the equation

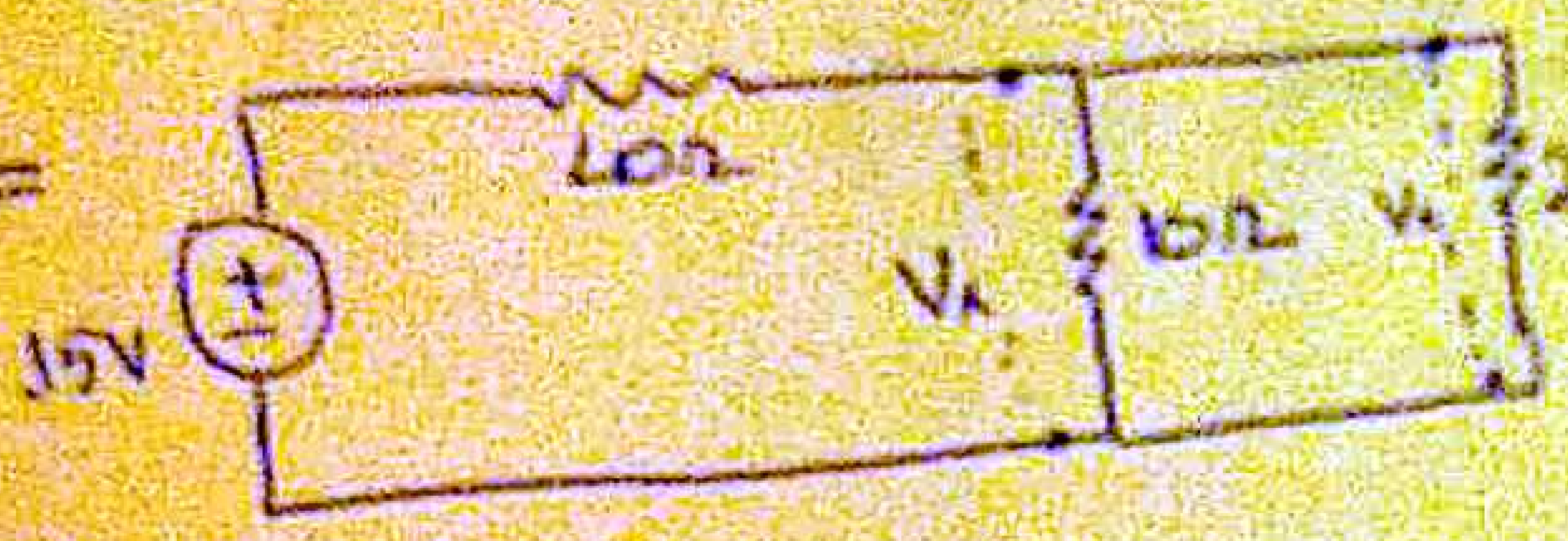
$$R_x \cong 2.34\,k\Omega$$

2-53) Use circuit reduction to find v_x in figure

→ These two resistors are parallel

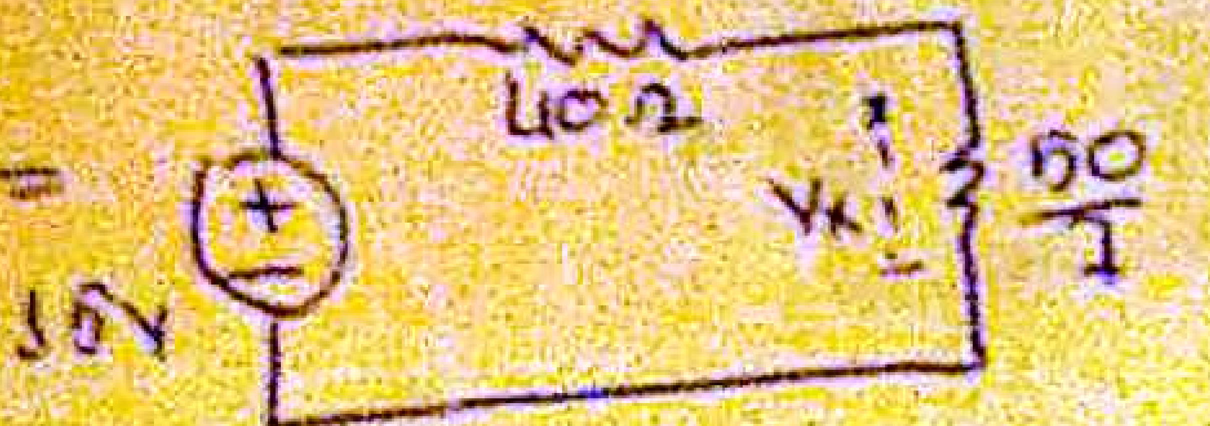
First step: Source transformation and parallel resistances

Second step: Two series resistances



Resistance 10Ω and 25Ω are parallel so the potential difference Then we can reduce them into one resistance still have same potential difference V_x

Third step: Parallel Resistances



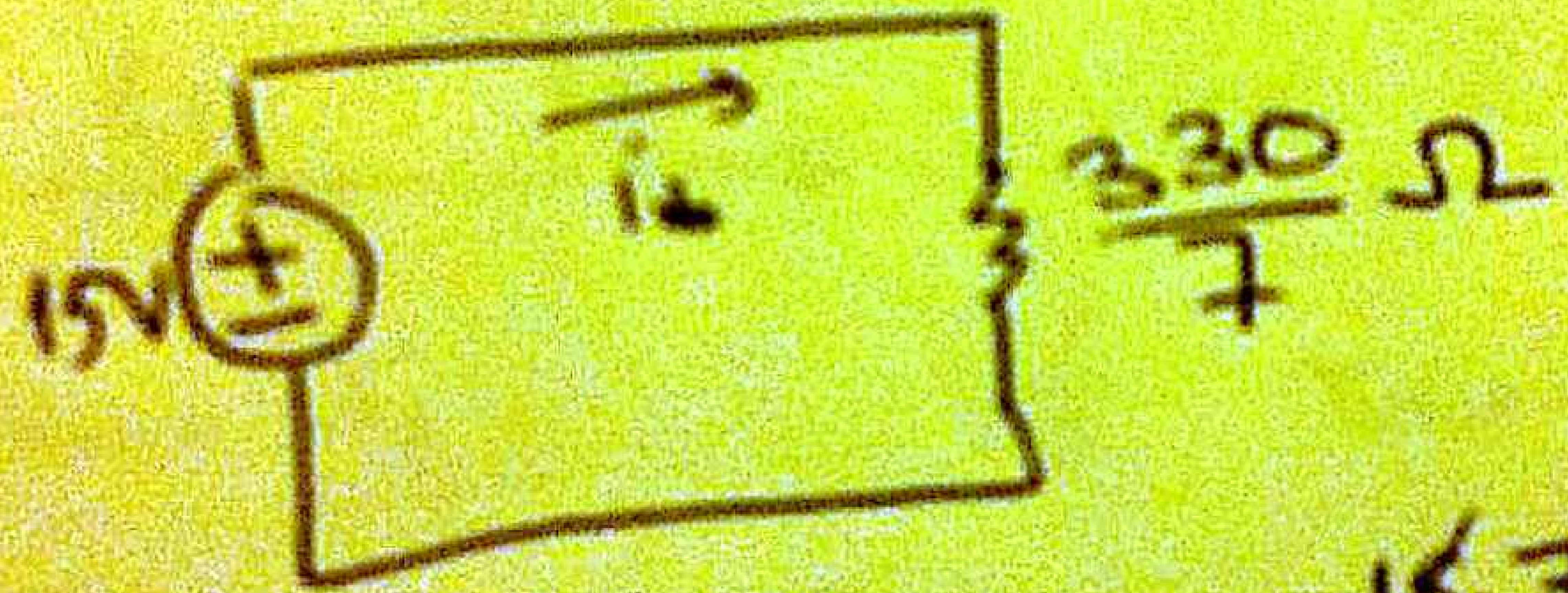
Fourth step: Voltage division

$$V_x = \frac{\frac{50}{7}}{\left(40 + \frac{50}{7}\right)} \cdot 15 = \frac{5\cancel{0}}{3\cancel{3}\cancel{0}_{11}} \cdot \cancel{15}^{5} = \frac{25}{11}\ \text{V}$$

P.S: You can solve this question in different way. For example, you can transform the source after second step and apply current division and Ohm's law

2.53) cont.

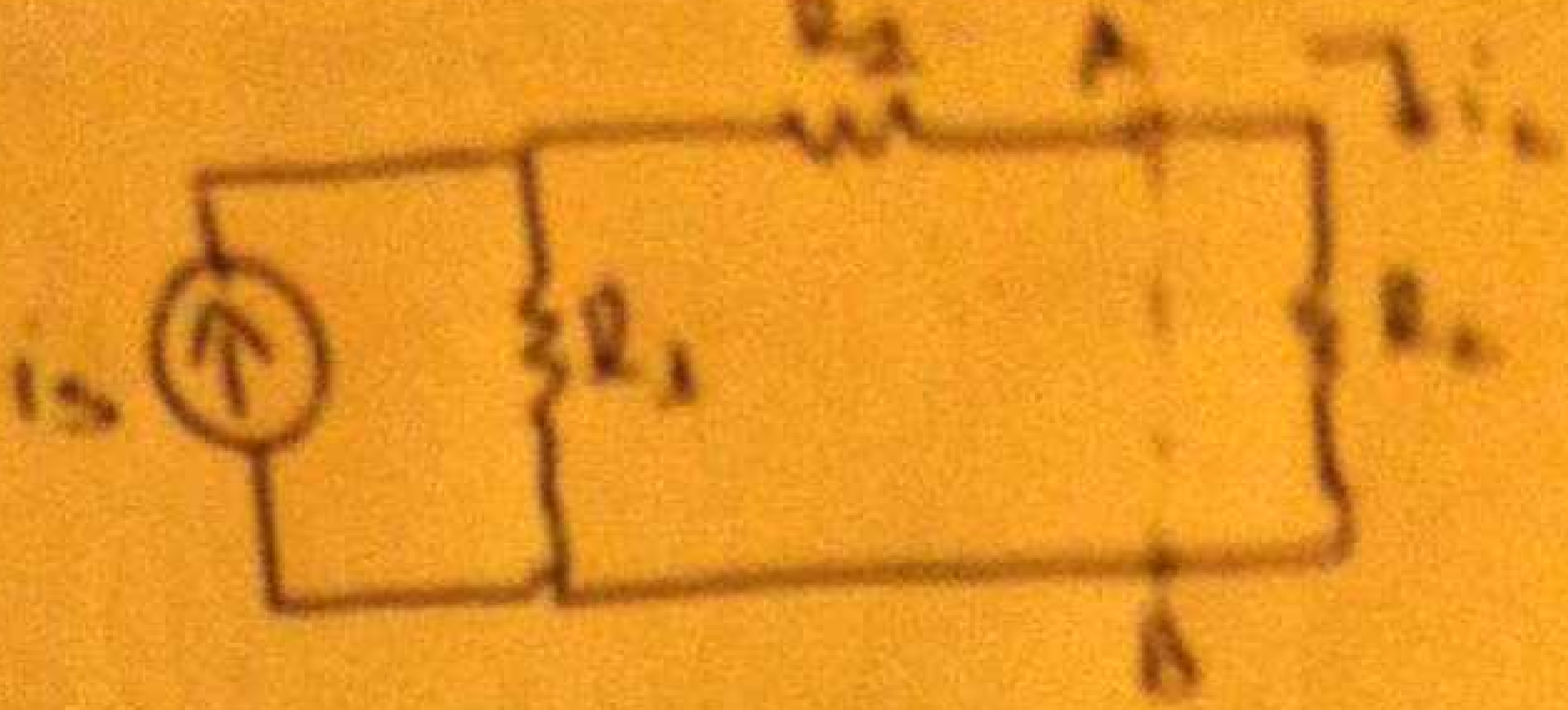
<u>Fifth Step</u>

=


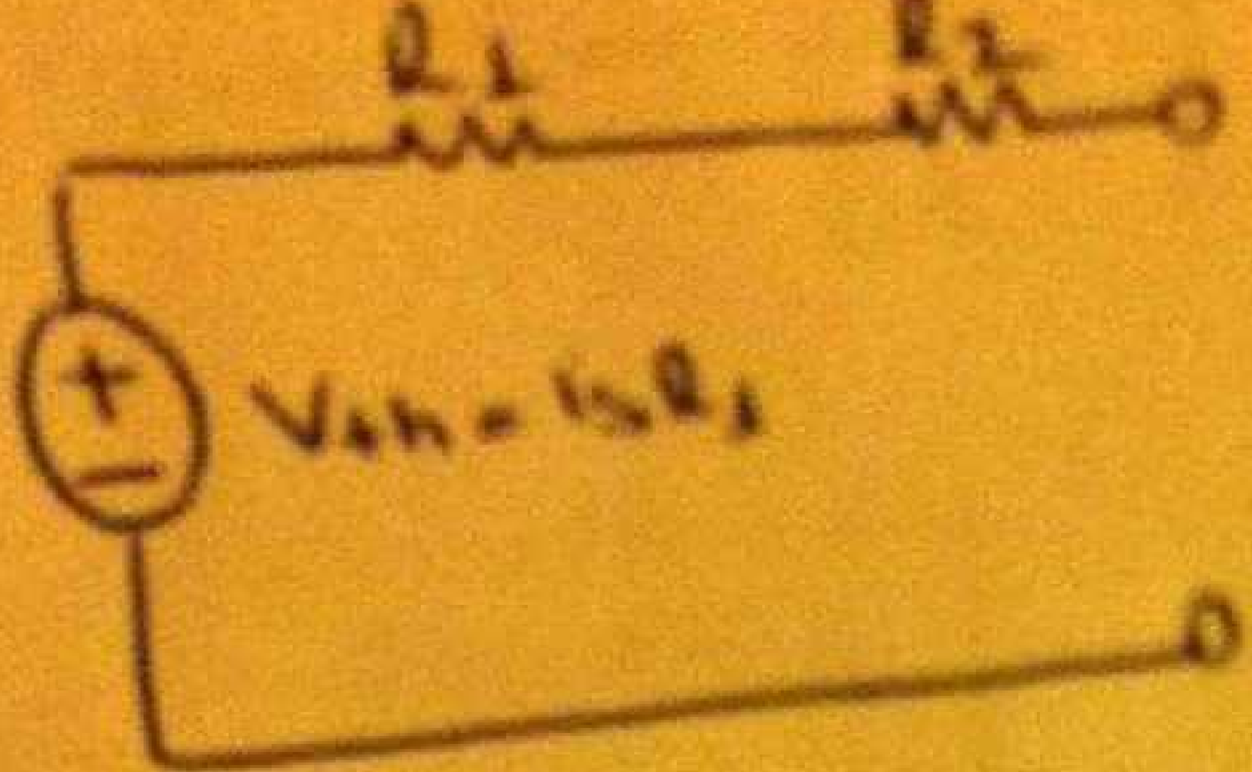
$$i_t = \frac{15}{\frac{330}{7}} = \frac{\cancel{15}\cdot 7}{\cancel{330}_{22}} = \frac{7}{22}$$

$$P = V \cdot i = 15 \cdot \frac{7}{22} = \boxed{\frac{105}{22}\,W}$$

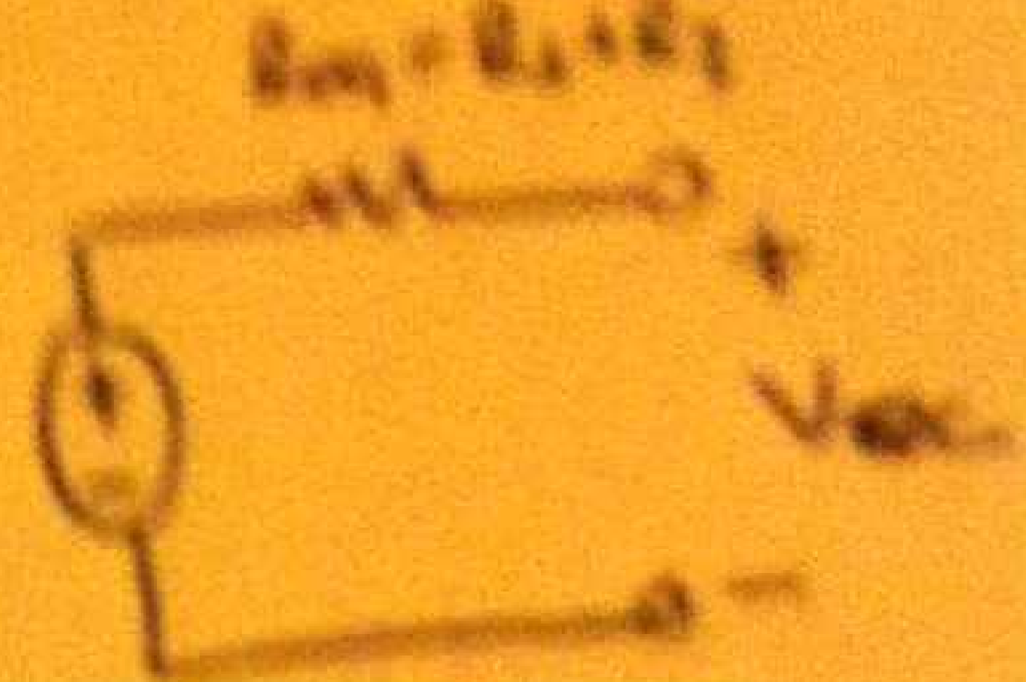
3.36) a)



$\Rightarrow$



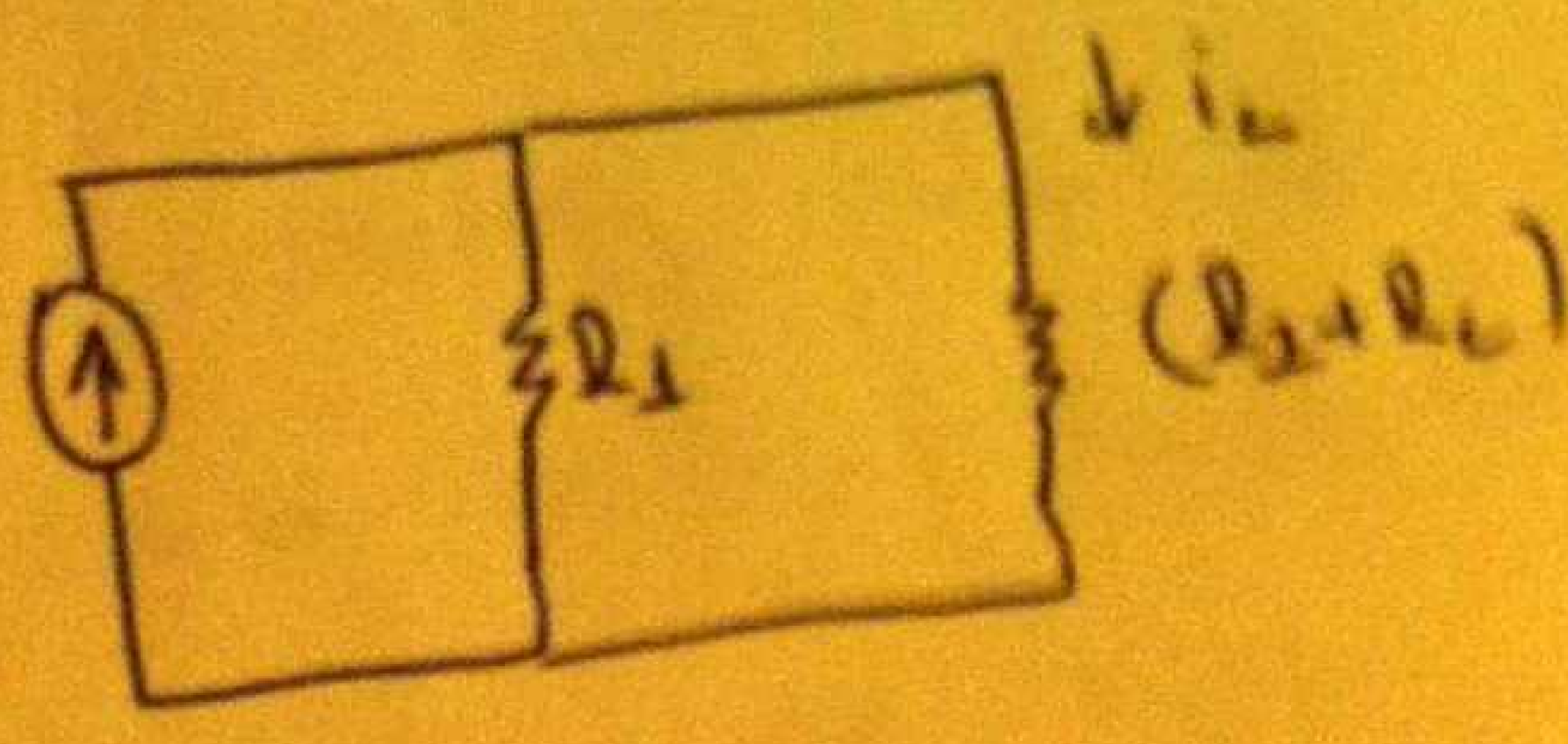
$\Rightarrow$ $V_{th} = i_s R_1$



$$\boxed{V_{oc} = V_{th} = i_s R_1 \qquad i_{sc} = \frac{V_{th}}{R_1 + R_2} = \frac{i_s R_1}{R_1 + R_2}}$$

b) $$i_L = \frac{V_{th}}{R_{eq} + R_L} = \boxed{\frac{i_s R_1}{R_1 + R_2 + R_L}}$$

c)

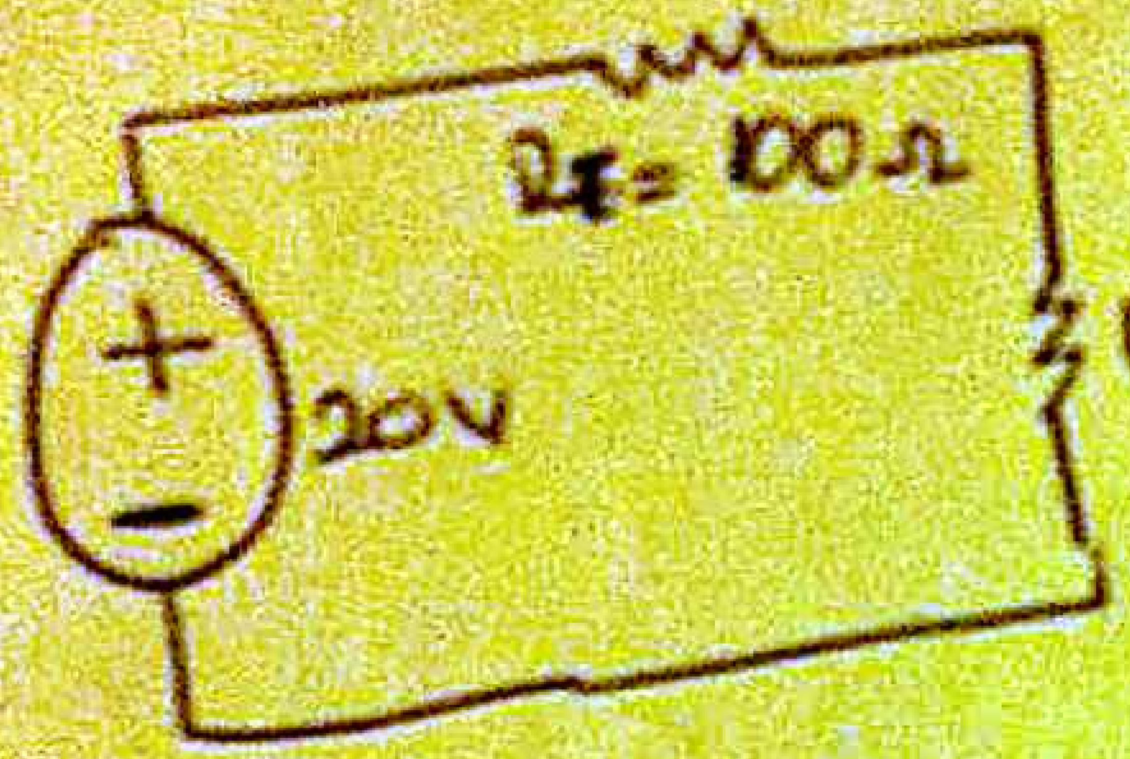


using current division

$$\boxed{i_L = \frac{R_1}{(R_1 + R_2 + R_L)} i_s}$$

3.43) This question is the application of (eq 3-27) in the book

$$i = \left(-\frac{1}{100}\right)v + \frac{\overset{\rightarrow V_t}{20}}{\underset{\rightarrow R_t}{100}}$$



Voltage division

$$V = \frac{1000}{(1000+100)} \cdot 20$$

$$\boxed{V = \frac{200}{11}}$$

OR

Simply, using $V = iR_L$, we can write current as $i = \frac{V}{R_L}$. Substituting "i" into given equation, we get $5V + 500\frac{V}{R_L} = 100$. Substituting $R_L = 1000\,\Omega$ and solving for V, we obtain

$$\boxed{V = \frac{200}{11}}$$