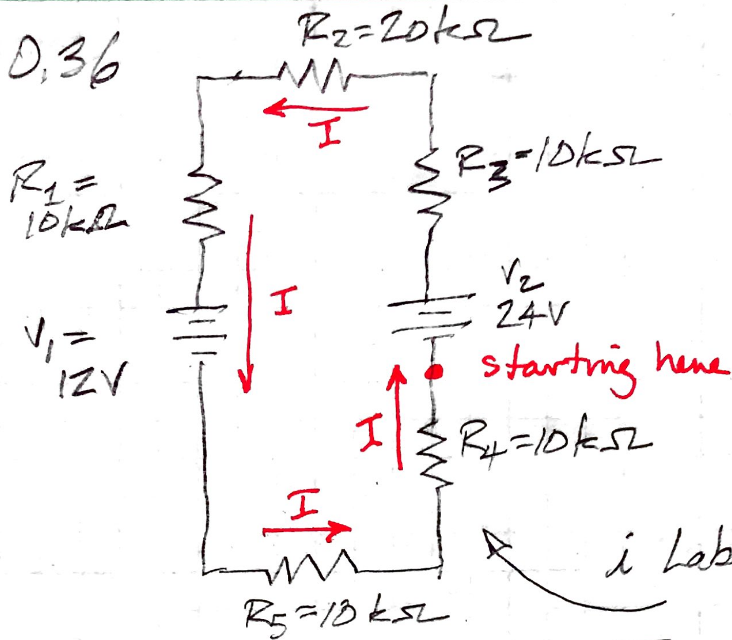
10.36



a) Find voltage across each resistor. To do these, we need to find current, which is relatively easy, given that there's just one loop & no junctions.

i Label current & guess direction ✓

ii Trace through circuit:

$+24 - 10000I - 20000I - 10000I - 12 - 10000I - 10000I = 0$

(R_3, R_2, R_1, R_5, R_4)

Simplify: $12V - 60000I = 0$

$12 = 60000I$

$I = \frac{12}{60000} = \boxed{2.0e{-}4A = 0.20\ mA}$

Oh, but they want the Voltage across each resistor:

$V_1 = IR_1 = (2e{-}4)(10000) = 2.0$ Volts

$V_2 = IR_2 = (2e{-}4)(20000) = 4.0$ Volts

$V_3 = 2.0V$

$V_4 = 2.0V$

$V_5 = 2.0V$

b. Power dissipated & Power supplied?

$P_{supplied} = IV = (2e{-}4A)(24V) = \boxed{4.8e{-}3\ Watts}$

$P_{dissipated} = IV$ for each resistor, or I^2R, or $\frac{V^2}{R}$

$P_1 = I^2R_1 = (0.0002)^2(10000) = \boxed{4e{-}4W}$

$P_2 = \boxed{8e{-}4W}$

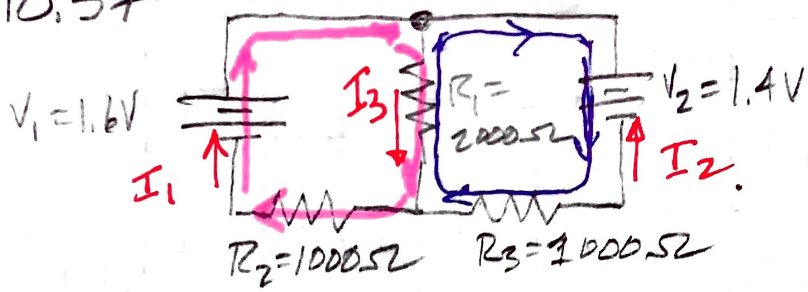
$P_3 = \boxed{4e{-}4W}$

$P_4 = \boxed{4e{-}4W}$

$P_5 = \boxed{4e{-}4W}$

If you add these up we're only dissipating half the Power supplied by the 24 V battery. The other battery, 12V, w/ current running "backwards" through it, is dissipating $P = -IV = \boxed{2.4e{-}3W}$.

10.37



a) Find current through each resistor.

1. Identify current branches, labels, & directions.
2. Use node (junction) rule to get an equation.

$$\Sigma I_{in} = \Sigma I_{out}$$
$$I_1 + I_2 = I_3$$

No more junction eqns will help, so additional equations (total of 3 eqns to solve the 3 unknowns) must be loop rule equations.

3. Use loop rule to get eqns.

Clockwise around left loop:
$$1.6V - 2000 I_3 - 1000 I_1 = 0$$
Clockwise around right loop:
$$-1.4V + 1000 I_2 + 2000 I_3 = 0$$

4. Use 3 simultaneous eqns & solve, by hand or w/ calculator:

$$\left.\begin{aligned} 1 I_1 + 1 I_2 - 1 I_3 &= 0 \\ 1000 I_1 + 0 I_2 + 2000 I_3 &= 1.6 \\ 0 I_1 + 1000 I_2 \; 2000 I_3 &= 1.4 \end{aligned}\right\} \text{solving}$$

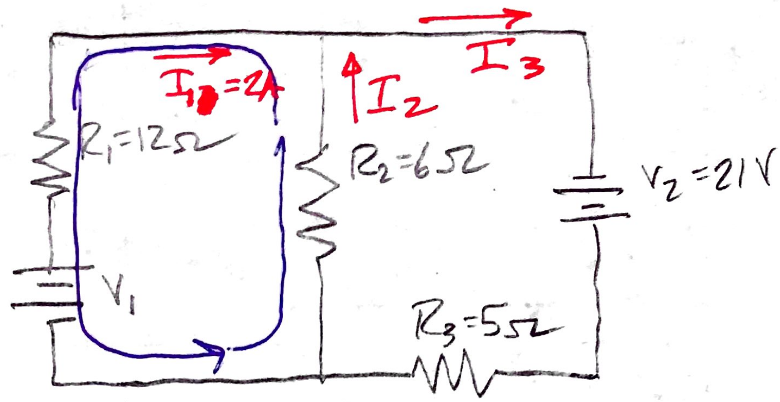
$$\boxed{I_1 = 4.0e{-4}A,\ I_2 = 2.0e{-4}A,\ I_3 = 6.0e{-4}A}$$

c) Power dissipated by each circuit = power produced.

Either added up all the $P = I^2R$ values, or add up the $P = IV$ for the batteries. (easier!)

$$P_{total} = I_1V_1 + I_2V_2$$
$$= (4.0e{-4}A)(1.6V) + (2.0e{-4}A)(1.4V)$$
$$= \boxed{9.2e{-4}\ \text{Watts}}$$

10.38



Solve using same strategy:

Junction Rule: $I_1 + I_2 = I_3$

$2 + I_2 = I_3$

$0I_1 + 1I_2 - 1I_3 = -2$ ✓

Loop Rule:

Left loop (counterclockwise)

$-6I_2 + 12I_1 - V_1 = 0$

$12I_1 - 6I_2 + 0I_3 = V$ ✓

Right Loop (clockwise)

$21V - 5I_3 - 6I_2 = 0$

$0I_1 - 6I_2 - 5I_3 = -21$ ✓

$$\left[\begin{array}{ccc|c} 0 & 1 & -1 & -2 \\ 12 & -6 & 0 & V \\ 0 & -6 & -5 & -21 \end{array}\right]$$

Can't resolve these symbolically in calculator, so solve by hand or w/ matrix

$I_1 = 2.0$ (given)

$I_2 = 1.0$

$I_3 = 3.0A$

$V_1 = 18V$