Q26.4

Resistance through B+C is twice that across A. So the current through B+C is less than that through A because the potential drop across B+C is the same as that across A. Therefore each of B and C are less bright than A/2.

V_A is the same as V_{B+C}, so $V_B = V_C < V_A$.

If A is unscrewed, B and C are each half as bright as A, except that $R_B + R_C > R_A$, so I_{B+C} is still less than I_A. So in practice, B & C are still less bright than A/2.

If either B or C are unscrewed, then B (or C) and A are equally bright.

26.10

(a) $P = \frac{V^2}{R} \Rightarrow V = \sqrt{PR}$

$$= \sqrt{(5.0\ W)(15{,}000\ \Omega)}$$

$$= 274\ V$$

(b) $P = \frac{V^2}{R} = \frac{(120\ V)^2}{9{,}000\ \Omega} = 1.6\ W$

(c) $V_{1\,max} = \sqrt{P_1 R_1} = \sqrt{2}\,10\ V$

$V_{2\,max} = \sqrt{P_2 R_2} = \sqrt{3}\,10\ V$

$V = V_1 + V_2 = I(R_1 + R_2) = (250\ \Omega)\, I$

Now $V_{1\,max} = \sqrt{2}\,10\,V = R_1 I^2$

$V_{2\,max} = \sqrt{3}\,10\,V = R_2 I^2$

So $I = \left(\frac{\sqrt{2}}{10}\right)^{1/2} A$ max for (1)

$I = \left(\frac{\sqrt{3}}{15}\right)^{1/2} A$ max for (2)

Clearly, $V_{max} = (250\ \Omega) \times (\sqrt{2}/10)^{1/2} = 94.02\ V$

26.16

Ohm's law ⇒ voltage drop across the $6.00\ \Omega$ resistor is $V = IR = (4.00\,A)(6.00\,\Omega) = 24.0\,V$.

The voltage drop across the $8.00\,\Omega$ resistor is the same, since the two are in parallel.

Thus, I through the $8.00\,\Omega$ resistor is

$$I = V/R = 24.0\,V/8.00\,\Omega$$
$$= 3.00\,A$$

The current through the $25.0\,\Omega$ resistor is the sum of these two: $7.00\,A$.

The voltage drop across the $25.0\,\Omega$ resistor is $V = IR = (7.00\,A)(25.0\,\Omega) = 175.0\,V$, and the total voltage drop across the top branch of the circuit is $175 + 24.0 = 199\,V$, which is also the voltage drop across the $20.0\,\Omega$ resistor. The current through the $20.0\,\Omega$ resistor is then $I = V/R = 199\,V/20\,\Omega = 9.95\,A$.

26.25

(a) $I_R = 6.00\,A - 4.00\,A = 2.00\,A$.

(b) Using a Kirchhoff loop around the outside of the circuit, $28.0\,V - (6.00\,A)(3.00\,\Omega) - (2.00\,A)R = 0$

$$R = 5.00\,\Omega$$

(c) Counterclockwise loop in the bottom half,

$$\mathcal{E} - (6.00\,A)(3.00\,\Omega) - (4.00\,A)(6.00\,\Omega) = 0$$
$$\mathcal{E} = 42.0\,V$$

(d) If the circuit is broken at point x, the current in the 28 V battery is $I = \frac{\Sigma\mathcal{E}}{\Sigma R} = \frac{28.0\,V}{3.00\,\Omega + 5.00\,\Omega} = 3.50\,A$.

26.40

An uncharged capacitor is placed into a circuit.

(a) At the instant the circuit is completed, there is no voltage over the capacitor, since it has no charge.

(b) All the voltage of the battery is lost over the resistor, so $V_R = \mathcal{E} = 245\ \text{V}$.

(c) There is no charge on the capacitor.

(d) The current through the resistor is

$$i = \frac{\mathcal{E}}{R_{total}} = \frac{245\ \text{V}}{7000\ \Omega} = 0.0327\ \text{A}.$$

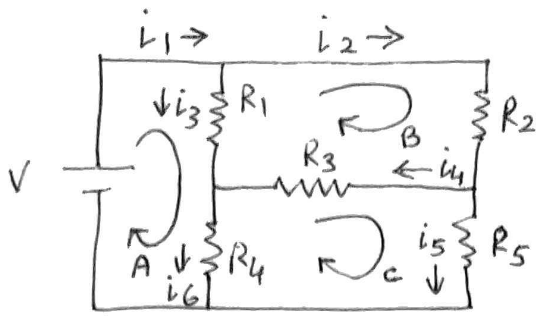
(e) After a long time has passed,

the voltage over the capacitor

balances the emf: $V_C = 245\ \text{V}$.

Voltage over R is zero.

$\boxed{26.66}$



Nodes:

$$i_1 = i_2 + i_3 \quad (1)$$
$$i_2 = i_4 + i_5 \quad (2)$$
$$i_3 + i_4 = i_6 \quad (3)$$
$$i_5 + i_6 = i_1 \quad (4)$$

Loops:

$$V - i_3 R_1 - i_6 R_4 = 0 \quad (5)$$
$$-i_2 R_2 - i_4 R_3 + i_3 R_1 = 0 \quad (6)$$
$$i_4 R_3 - i_5 R_5 + i_6 R_4 = 0 \quad (7)$$
$$-i_2 R_2 - i_5 R_5 + i_6 R_4 + i_3 R_1 = 0 \quad (8)$$

Simplify:

$$14 - i_3 - 2 i_6 = 0 \quad (9)$$
$$-2 i_2 - i_4 + i_3 = 0 \quad (10)$$
$$i_4 - i_5 + 2 i_6 = 0 \quad (11)$$
$$-2 i_2 - i_5 + 2 i_6 + i_3 = 0 \quad (12)$$

$\Rightarrow$

$\boxed{i_1 = 10A}$

$\boxed{i_2 = 4A}$

$\boxed{i_3 = 6A}$

$\boxed{i_4 = -2A}$

$\boxed{i_5 = 6A}$

$\boxed{i_6 = 4A}$