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1. (6 P) How much energy in Joules does a 20 V battery has if it contains 5 C of charges?

$$V = \frac{J}{C} \Rightarrow J = VC \quad J = (20V)(5C) = 100 \quad \boxed{100 \text{ Joules}}$$

2. (6 P) A car electric heater consumes 120W of power and works with 12 V. How much current does it draw from the source?

$$P = 120W \quad V = 12V \quad I = \frac{P}{V} = \frac{120W}{12V} = 10A \quad \boxed{10 \text{ AMPS}}$$

3. (18 P) Complete the table below by determining the resistor values and tolerances from the color codes and by applying the color-codes for the values and tolerances of the given resistors.

BAND A	BAND B	BAND C	BAND D	VALUE	TOLERANCE
BROWN	YELLOW	BROWN	NONE	140 Ω	20%
RED	ORANGE	BLACK	GOLD	23 Ω	5%
GREEN	BROWN	GOLD	SILVER	5.1 Ω	10%
ORANGE	BLACK	GREEN	SILVER	3.0 M Ω	10%
RED	GREEN	GOLD	NONE	2.5 Ω	20%
ORANGE	ORANGE	BROWN	GOLD	330 Ω	5%

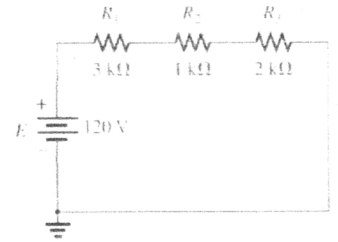
4. (5 P) A 10K Ω resistor has a tolerance of 10%. What is the range of resistance value?

$$\boxed{9K\Omega - 11K\Omega}$$

$$10 \times 10^3 \cdot 0.1 = 1 \times 10^3 = 1000$$

$$\begin{array}{r} 10,000 \\ + 1,000 \\ \hline 11,000 \end{array} \quad \begin{array}{r} 10,000 \\ - 1,000 \\ \hline 9,000 \end{array}$$

5. (15 P) Calculate V_1 , V_2 , and V_3 in the circuit below.



$$V = 120V$$

$$R_1 = 3k\Omega$$

$$R_2 = 1k\Omega$$

$$R_3 = 2k\Omega$$

$$V_1 = I \cdot R_1 = (20mA)(3k\Omega) = 60V$$

$$V_2 = I \cdot R_2 = (20mA)(1k\Omega) = 20V$$

$$V_3 = I \cdot R_3 = (20mA)(2k\Omega) = 40V$$

$$R_T = 3k\Omega + 1k\Omega + 2k\Omega = 6k\Omega$$

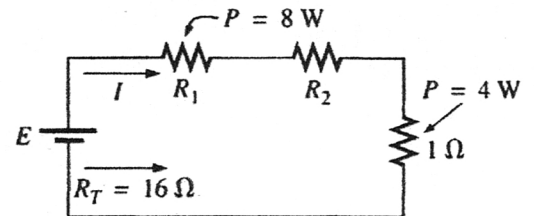
$$I = \frac{V}{R_T} = \frac{120V}{6k\Omega} = 20mA$$

$$V_1 = 60V$$

$$V_2 = 20V$$

$$V_3 = 40V$$

6. (25 P) Find R_1 , R_2 , I , and E in the figure below



$$R_T = 16\Omega$$

$$R_3 = 1\Omega$$

$$P_1 = 8W$$

$$P_3 = 4W$$

$$P = \frac{V^2}{R} \Rightarrow V^2 = P \cdot R$$

$$V_3 = \sqrt{P_3 \cdot R_3}$$

$$= \sqrt{4 \cdot 1}$$

$$= \sqrt{4}$$

$$V_3 = 2V$$

$$P = VI \Rightarrow I = \frac{P_3}{V_3}$$

$$= \frac{4W}{2V} = 2A$$

$$I = 2A$$

$$E = 32V$$

$$R_1 = 2\Omega$$

$$R_2 = 13\Omega$$

$$E = IR_T = (2A)(16\Omega) = 32V$$

$$R_1 = \frac{P_1}{I^2} = \frac{8W}{(2A)^2} = \frac{8}{4} = 2\Omega$$

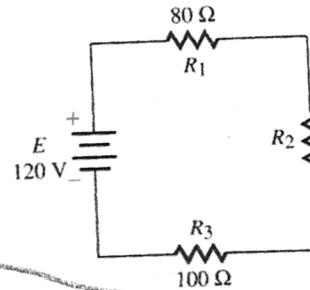
$$R_1 + R_2 + R_3 = R_T \Rightarrow$$

$$R_2 = R_T - R_1 - R_3 = 16\Omega - 2\Omega - 1\Omega = 13\Omega$$

7. (25 P) The total power dissipated in the circuit of Figure below is 60 Watts. Find

- The current in the circuit
- The resistance of R_2
- The voltage across each resistor

Hint: Find current I in the circuit using total power delivered by 120V source.



$$\begin{aligned}
 P_T &= 60W & A \quad I &= \frac{60W}{120V} = 0.5A \\
 E &= 120V \\
 R_1 &= 80\Omega \\
 R_3 &= 100\Omega & B \quad R_T &= \frac{120V}{0.5A} = 240\Omega \\
 & & R_2 &= 240\Omega - 80\Omega - 100\Omega = 60\Omega \\
 & & C \quad V_1 &= (0.5A)(80\Omega) = 40V \\
 & & V_2 &= (0.5A)(60\Omega) = 30V \\
 & & V_3 &= (0.5A)(100\Omega) = 50V
 \end{aligned}$$

8. (10P) An electric pencil sharpener rated 240mW, 6V is connected to a 9-V battery as shown in the Figure below. Calculate the value of the series resistor R_x needed to power the sharpener. Hint: the pencil sharpener will be damaged if consumes more than 240mW.

$$\begin{aligned}
 P &= \frac{V^2}{R} \Rightarrow \\
 R &= \frac{V^2}{P} = \frac{(9V)^2}{240mW} = \boxed{337.5\Omega}
 \end{aligned}$$

