Lesson 4 Homework Solutions
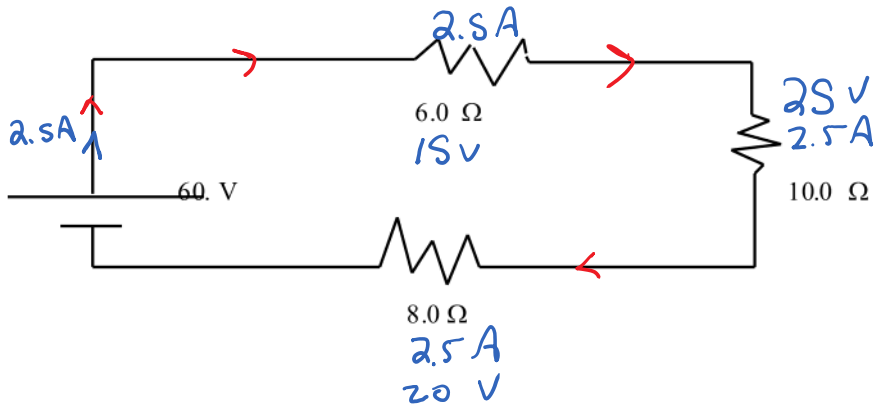
May 12, 2020   8:52 PM

Exercises

1. Find all unknown voltages and currents(2.5 A,15V; 2.5A, 25V; 2.5 A, 20. V)
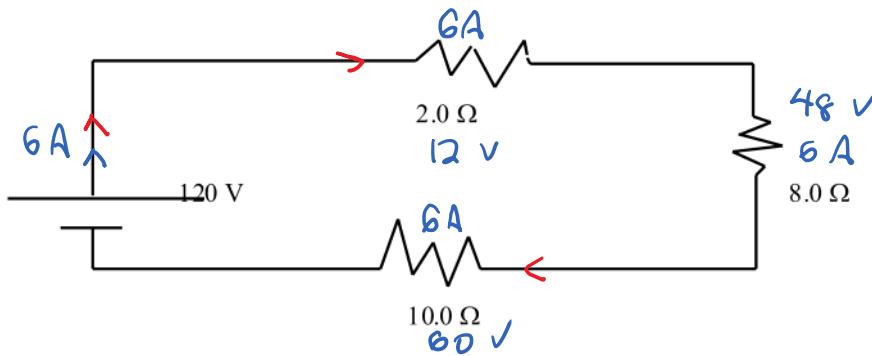
2.5A

6.0 Ω
15v

2.5A   2.5A

60. V

25 v
2.5A

10.0 Ω

8.0 Ω
2.5 A
20 V

$R_T = 6 + 10 + 8$

$R_T = 24$

$I = \dfrac{V}{R_T} = \dfrac{60}{24} = 2.5A$

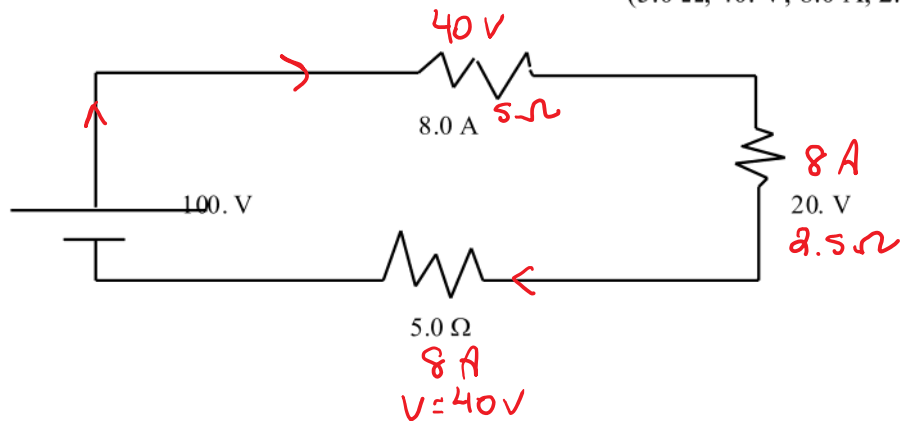2. Find all unknown voltages and currents (6.0 A,12 V; 6.0 A, 48 V; 6.0 A,60. V)

6A

2.0 Ω
12 v

6 A   6A

120 V

48 v
6 A

8.0 Ω

6A

10.0 Ω
60 v

$R_T = 2 + 8 + 10 = 20\ \Omega$

$I_T = \dfrac{V_T}{R_T} = \dfrac{120}{20}$

$I_T = 6.0\ A$

3. Find all unknown voltages, currents and resistances

(5.0 Ω, 40. V; 8.0 A, 2.5 Ω; 8.0 A, 40 V)

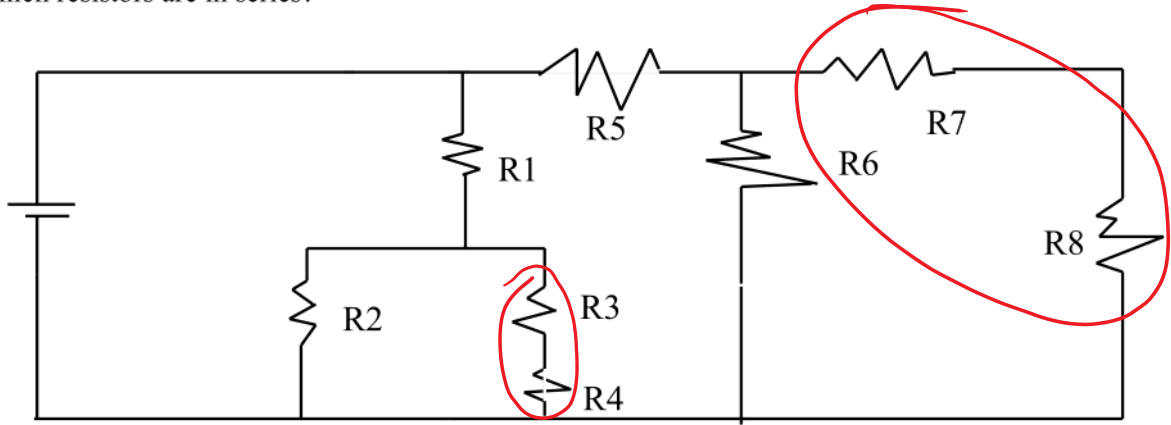40 v

8.0 A   5Ω

100. V

8 A
20. V
2.5Ω

5.0 Ω
8 A
V = 40v

$R = \dfrac{V}{I}$

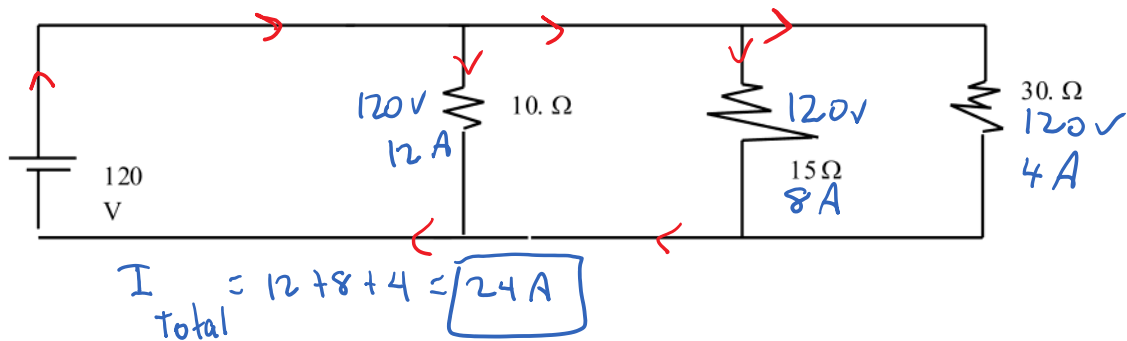4. Which resistors are in series?

4. Which resistors are in series?

Ans: (R7 and R8), (R3 and R4)

6. Find all voltage drops and currents   (120 V, 12A; 120V,8.0A;120V,4.0A)

$$I = \frac{V}{R}$$

120 V   10. Ω   120v   30. Ω
12 A   15 Ω   120 v
     8 A   4 A

$$I_{Total} = 12 + 8 + 4 = \boxed{24 \, A}$$

8. Find all voltage drops and currents (120. V,0.833 A;120.V, 6.67 A; 120. V,1.67 A)

120 V   100. Watt   120v   200. Watt   120v
I = .833A   6.67 A   800. Watt   blender   I = 1.67 A

light   microwave

$$P = VI \quad\quad I = \frac{P}{V}$$

Circuit diagram (top):

120. V battery connected to parallel branches:
- 100. Watt (light)
- 800. Watt (microwave)
- 200. Watt (blender)

Handwritten: 120 V, 100W

---
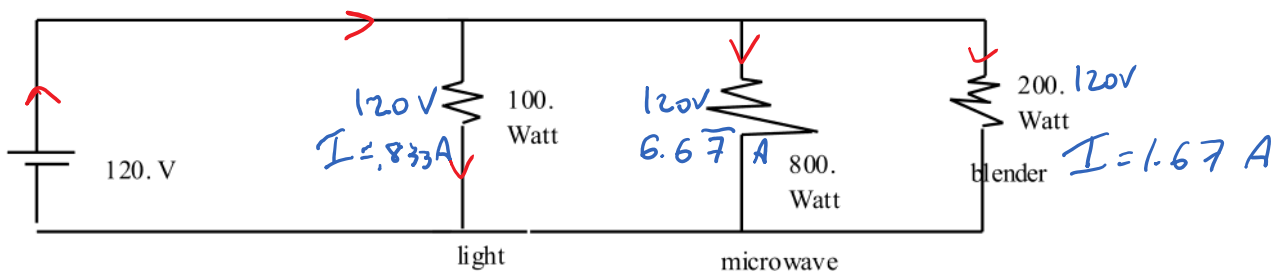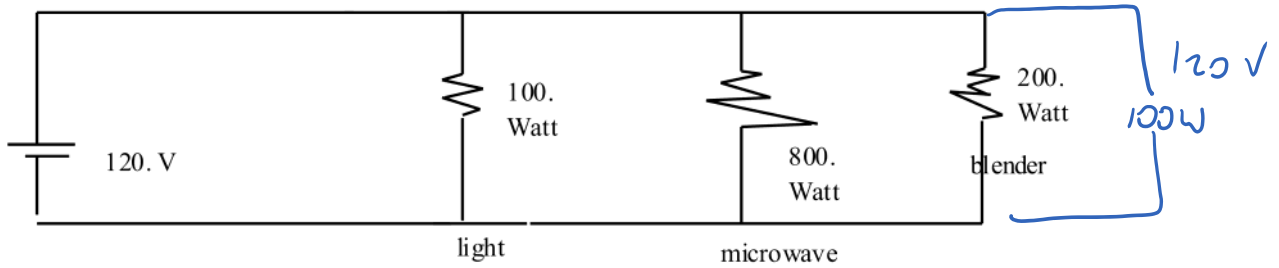
9.   i) In household circuit #8, find the total current if we make the following changes to the circuit.

ii) Indicate (yes or no) if these changes would cause the circuit breaker to trip (this happens when the total current exceeds 15.0 A)

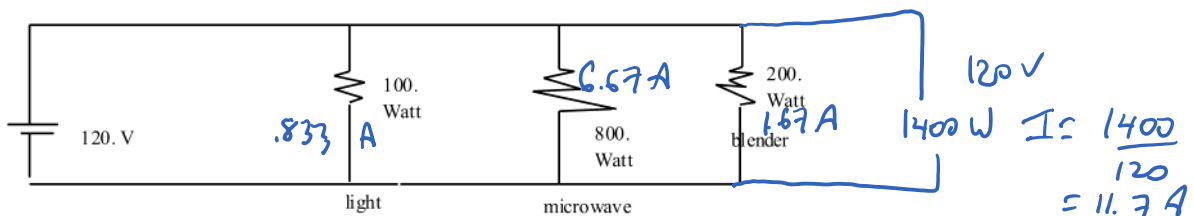a) adding another 100. W light (in parallel)   (no, I_t=10.0 A)

$$I_T = .833 + 6.67 + 1.67 + .833 = 10 \, A \quad \boxed{No}$$

b) removing the 800. W microwave   (no I_t=2.50 A)

Handwritten circuit: 120 V battery, 100 W 120V, 200 W 120V
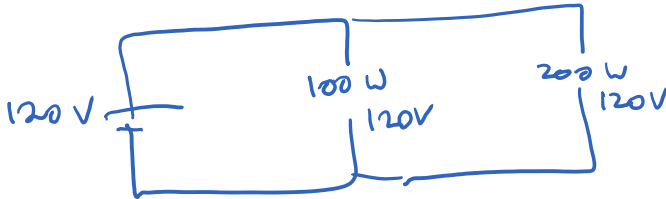
$$I_T = \frac{100}{120} + \frac{200}{120} = 2.5 \, A \quad \boxed{NO}$$

c) adding a 1400. W hair dryer (in parallel)   (yes I_t= 20.8 A)

Handwritten circuit:
- 120. V
- 100. Watt (light) .833 A
- 800. Watt (microwave) 6.67A
- 200. Watt (blender) 1.67 A
- 1400 W: 120 V

$$I = \frac{1400}{120} = 11.7 \, A$$

$$I_T = 20.8 \, A \qquad \text{Yes, this will trip breaker}$$

d) adding a 300. W computer (in parallel)   (no I_t = 11.7 A)

Handwritten circuit:
- 120. V
- 100. Watt (light) .833 A
- 800. Watt .6.67 A
- 200. Watt (blender) 1.67A
- 300W 120 V

$$I = \frac{300}{120} = 2.5 \, A$$

The circuit diagram at top shows a battery of 120. V connected to several components in parallel:

100. Watt light — .833 A

6.67 A
800. Watt microwave

200. Watt blender — 1.67 A

300 W $I = \frac{300}{120} = 2.5 A$
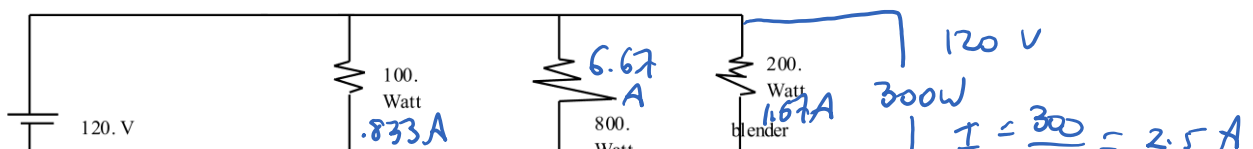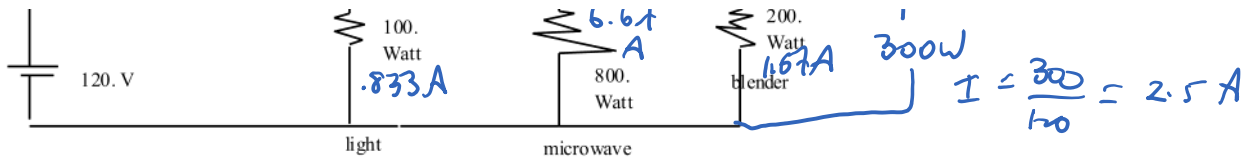
$I_T = 11.7 A$ (NO)

10. What is the maximum number of the following in a house circuit (note: an outlet has V=120 V, and max current is 15 A)

    a) 100 W light bulbs   b) 250 W TV's

    c ~~b~~) 10 W toothbrushes   d) 800 W toasters
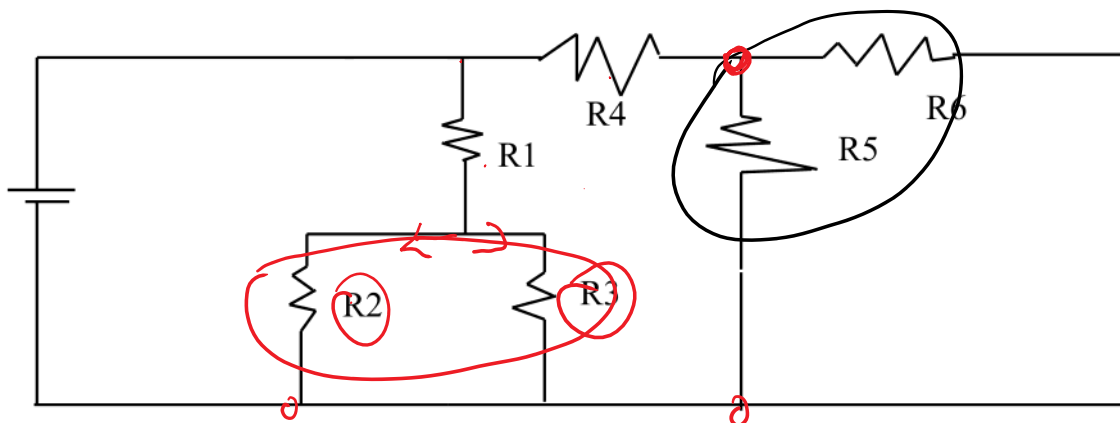
$P = VI$

                (18; 7;180; 2)

a) $I = \frac{P}{V} = \frac{100}{120} = .833 A$ $\frac{15A}{.833} = 18 \leq 17$

b) $I = \frac{250}{120} = 2.08\overline{3} A$ $\frac{15A}{2.083} = 7\ TV's$

c) $I = \frac{10}{120} = .083 A$ $\frac{15A}{.083} = 180 = 179$

d) $I = \frac{800}{120} = 6.67$ $\frac{15A}{6.67} = 2\ toasters$

11. Which resistors are in parallel?

Ans: (R1 and R4), (R2 and R3), (R5 and R6)

14. If we add a resistor in parallel to a parallel circuit, what happens to the total resistance?

    a) it increases

    b) it decreases

    c) it may increase or decrease depending on the value of the resistance we add.

Ans: (b) Bonus: Can you prove it?

$$\frac{1}{R_T} = \frac{1}{10} + \frac{1}{15}$$

Suppose we have a 10 Ω and a 15 Ω in parallel.
Then, Rt = 6Ω

Now, add a 5 Ω resistor:

$$\frac{1}{R_T} = \frac{1}{10} + \frac{1}{15} + \frac{1}{5}$$

$$R_T = 2.73 \ \Omega$$

15

What is the power dissipated in the 8.0 Ω resistor in the circuit as shown?

80.0 V

$R_1 = 12.0 \ \Omega$ $2.9851 \ A$

$V_1 \ 35.821 \ V$

$14.3281 \ V$
$R_3 = 12.0 \ \Omega$

$V = 29.851 \ V$

$R_2 = 10.0 \ \Omega$
$2.9851 \ A$

$R_4 = 8.0 \ \Omega$
$14.3281 \ V$

$$\frac{1}{R_{//}} = \frac{1}{12} + \frac{1}{8}$$

$$R_{//} = 4.8 \ \Omega$$

$$P = \frac{V^2}{R} = 25.7 \ W$$

$$R_T = 12 + 10 + 4.8$$

$$R_T = 26.8 \ \Omega$$

80V

—12 Ω—

4.8 Ω   10 Ω

$$I_T = \frac{V_T}{R_T} = \frac{80}{26.8} = 2.9851 \ A$$