

Physics 30 - Lesson 18A

1) $V_o = 120V$
 $I = 0.75A$

$$R_T = \frac{V}{I} = \frac{120V}{0.75A} = 160\Omega$$

/3 $R_T = ?$ $R = \frac{160\Omega}{8} = 20\Omega \text{ each}$

$$V = IR = 0.75A \cdot 20\Omega = \boxed{15V}$$

2) a) $R_T = \frac{V}{I} = \frac{120V}{6.0A} = 20\Omega$

/4 b) $I = \frac{V}{R} = \frac{V}{R_o + 20}$

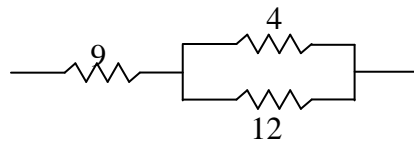
$$R_o = \frac{V}{I} - 20 = \frac{120V}{4.0A} - 20 = \boxed{10\Omega}$$

3) a) $R_T = 10 + 30 + 50 = 90\Omega$

b) $\frac{1}{R_T} = \frac{1}{6} + \frac{1}{5} + \frac{1}{30}$

/5 $\boxed{R_T = 2.5\Omega}$

c)



$$\frac{1}{R} = \frac{1}{4} + \frac{1}{12}$$

$$\boxed{R_o = 3\Omega}$$

$$R_T = 9 + 3 = \boxed{12\Omega}$$

4) $\frac{1}{R_T} = \frac{1}{160} + \frac{1}{160} + \frac{1}{160} + \frac{1}{160} \dots = \frac{n}{160}$

$$R_T = \frac{120}{6.0} = 20\Omega$$

/3 $R_T = \frac{V}{I}$

$$n = \frac{160}{R_T} = \frac{160}{20} = \boxed{8}$$

5) Before $R_B = \frac{V}{I_B} = \frac{6.0V}{3.0A} = 2\Omega$

/4

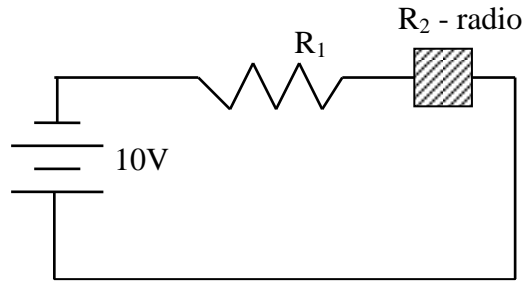
After $R_B + R_A = \frac{V}{I_A}$

$$2.0 + R_A = \frac{6.0V}{2.0A}$$

$$\boxed{R_A = 1.0\Omega}$$

6)

/5



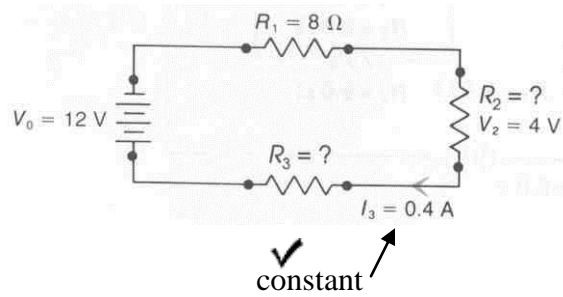
$$R_R = \frac{V}{I} = \frac{6.0V}{0.250A} = 24\Omega$$

$$V_1 = 10V - 6.0V = 4.0V$$

$$R = \frac{V}{I} = \frac{4.0V}{0.250A} = \boxed{16\Omega}$$

7) a)

/5



$$R_2 = \frac{V_2}{I_2} = \frac{4V}{0.4A} = \boxed{10\Omega}$$

$$V_3 = V_o - V_1 - V_2$$

$$V_3 = V_o - I_1 R_1 - V_2$$

$$V_3 = 12V - (0.4)(8) - 4$$

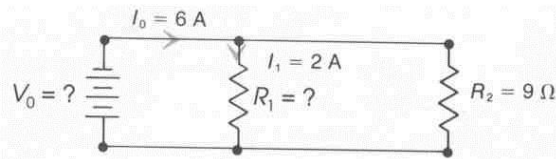
$$\boxed{V_3 = 4.8V}$$

$$R_3 = \frac{V_3}{I_3} = \frac{4.8V}{0.4A}$$

$$\boxed{R_3 = 12\Omega}$$

7) b)

/5



$$I_o = I_1 + I_2$$

$$I_2 = 6.0 - 2.0 = 4.0A$$

$$\boxed{I_2 = 4.0A}$$

$$V_2 = I_2 R_2 = 4.0A(9\Omega) = 36V$$

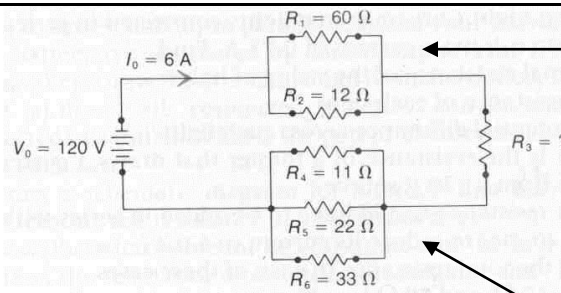
$$\boxed{V_2 = 36V} \rightarrow \boxed{V_o = 36V}$$

$$R_1 = \frac{V_1}{I_1} = \frac{36V}{2A} = \boxed{18\Omega}$$

$$R_T = \frac{V_o}{I_o} = \frac{36V}{6A}$$

$$\boxed{R_T = 6\Omega}$$

7) c)



$$\frac{1}{R_A} = \frac{1}{12} + \frac{1}{60} \quad \checkmark$$

$$R_A = 10\Omega \quad \checkmark \quad \checkmark$$

$$V_A = I \cdot R = (6.0A)(10\Omega)$$

$$V_A = 60V = V_1 = V_2$$

/12

$$R_T = \frac{V_o}{I_o} = \frac{120V}{6A} = 20\Omega \quad \checkmark \quad \checkmark$$

$$R_3 = 20 - R_A - R_B = 20 - 10 - 6 \quad \checkmark \quad \checkmark$$

$$R_3 = 4\Omega$$

$$\frac{1}{R_B} = \frac{1}{11} + \frac{1}{22} + \frac{1}{33} \quad \checkmark$$

$$R_B = 6\Omega \quad \checkmark \quad \checkmark$$

$$V_B = IR = 6.0A(6.0\Omega) = 36V \quad \checkmark \quad \checkmark$$

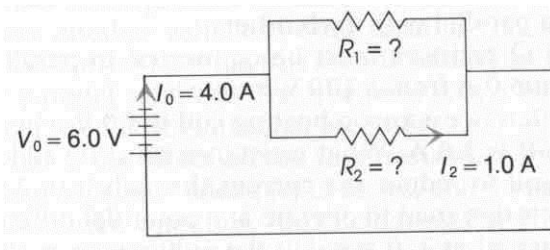
$$V_4 = V_5 = V_6 = 36V$$

$$I_1 = \frac{V_1}{R_1} = \frac{60V}{60\Omega} \quad \checkmark \quad \checkmark \quad I_2 = \frac{60V}{12\Omega} \quad \checkmark \quad \checkmark$$

$$I_4 = \frac{36V}{11\Omega} \quad \checkmark \quad \checkmark \quad I_5 = \frac{36V}{22\Omega} \quad \checkmark \quad \checkmark \quad I_6 = \frac{36V}{33\Omega}$$

$$I_1 = 1.0A \quad I_2 = 5.0A \quad I_4 = 3.27A \quad I_5 = 1.64A \quad I_6 = 1.09A$$

7) d)



$$I_1 = I_o - I_2$$

$$I_1 = 4.0 - 1.0 \quad \checkmark$$

$$I_1 = 3.0A \quad \checkmark \quad \checkmark$$

$$R_1 = \frac{V_1}{I_1} = \frac{6V}{3.0A} \quad \checkmark \quad \checkmark$$

$$R_1 = 2.0\Omega$$

/5

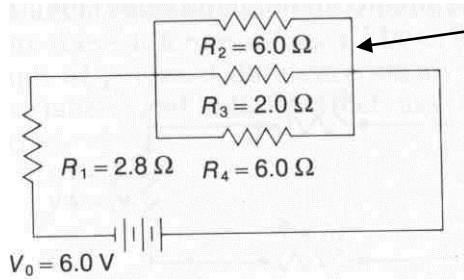
$$V_o = V_1 = V_2 = 6.0V \quad \checkmark \quad \checkmark$$

$$R_2 = \frac{V_2}{I_2} = \frac{6.0V}{1.0A} \quad \checkmark \quad \checkmark$$

$$R_2 = 6\Omega$$

7) e)

/6



$$I_2 = \frac{V_2}{R_2} = \frac{1.8V}{6.0V} \quad \checkmark \checkmark$$

$$I_2 = 0.3A$$

$$I_4 = I_2 = 0.3A$$

$$\frac{1}{R_A} = \frac{1}{60} + \frac{1}{20} + \frac{1}{60} \quad \checkmark \checkmark$$

$$R_A = 1.2\Omega \quad \checkmark$$

$$R_T = R_1 + R_A = 2.8 + 1.2 = 4\Omega$$

$$V_A = V_o - V_1 = 6.0 - (2.8)(1.5)$$

$$V_A = V_a = V_3 = V_4 = 1.8V$$

$$I_3 = \frac{1.8V}{2} = 0.9A \quad \checkmark \checkmark$$

$$I_3 = 0.9A$$

$$I_o = \frac{V}{R} = \frac{6.0V}{4\Omega} \quad \checkmark \checkmark$$

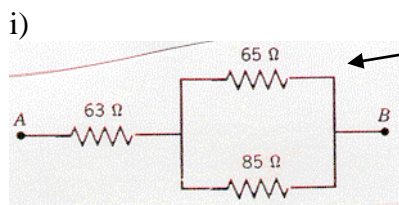
$$I_o = 1.5A$$

$$I_1 = 1.5A$$

(series)

8)

/3



$$\frac{1}{R_A} = \frac{1}{65} + \frac{1}{85}$$

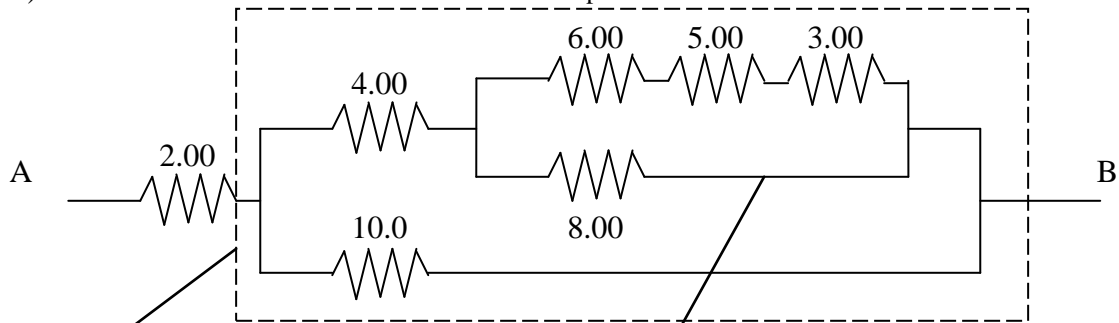
$$R_A = 36.8\Omega \quad \checkmark$$

$$R_T = 63 + 36.8$$

$$R_T = 100\Omega \quad \checkmark \checkmark \checkmark$$

ii) redraw the circuit to see what is series and what is parallel

/6



$$\frac{1}{R_B} = \frac{1}{4.00 + R_A} + \frac{1}{10.0}$$

$$R_B = 4.76 \quad \checkmark \checkmark$$

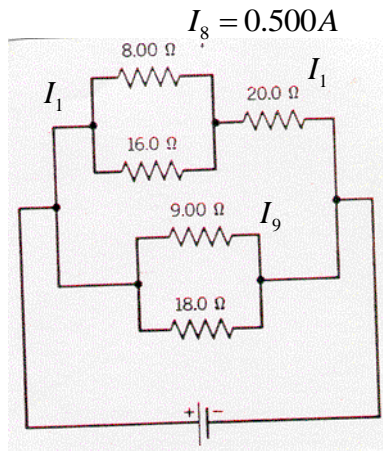
$$R_T = 2.00 + R_B = 2.00 + 4.76$$

$$R_T = 6.76\Omega \quad \checkmark \checkmark$$

$$\frac{1}{R_A} = \frac{1}{8.00} + \frac{1}{6.00 + 5.00 + 3.00}$$

$$R_A = 5.09\Omega \quad \checkmark \checkmark$$

9)



/10

$$V_8 = I_8 R_8 = 0.500(8.00)$$

$$V_8 = V_{16} = 4.00V$$

$$I_{16} = \frac{V_{16}}{R_{16}} = \frac{4.00V}{16} = 0.25A$$

$$I_{20} = I_1 = I_{16} + I_8 = 0.250 + 0.500$$

$$I_{20} = 0.750A$$

$$V_{20} = I_{20} R_{20} = 0.750(20) = 15V$$

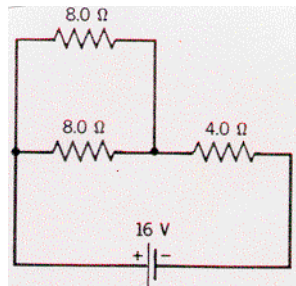
$$V_{9.0} = V_8 + V_{20} = 4.00V + 15.0V$$

$$V_9 = 19.0V$$

$$I_9 = \frac{V_9}{R_9} = \frac{19.0V}{9.0V} = 2.1A$$

$$I_9 = 2.1A$$

10)



/5

$$I_o = \frac{V_o}{R_T} = \frac{16V}{4.0 + 4.0} = 2.0A$$

$$I_3 = I_o = 2.0A$$

since $I_1 = I_2$ (Resistance is the same)

and $I_1 + I_2 = I_o$

$$\therefore I_1 = I_2 = 1.0A$$

$$\frac{1}{R_A} = \frac{1}{8.0} + \frac{1}{8.0}$$

$$R_A = 4.0\Omega$$

11)

$$R_T = 0.015 + 0.015 = 0.030\Omega$$

/5

$V_o = V_9 - V_8 \leftarrow$ wired opposite to each other

$$V_o = 9V - 8V$$

$$V_o = 1.0V$$

$$I = \frac{V_o}{R_T} = \frac{1.0V}{0.030\Omega}$$

$$I = 33.3A$$

12)

$$R_T = 0.030\Omega$$

/4

$V_o = V_9 + V_8 \leftarrow$ wired in addition to each other

$$V_o = 9V + 8V$$

$$V_o = 17V$$

$$I = \frac{V_o}{R_T} = \frac{17V}{0.030\Omega}$$

$$I = 567A$$

13)

2 each

/8

- A. If X is open, no current can flow into the circuit. No lights are on.
- B. With X and Z closed, all of the lights are on.
- C. With X closed and Z open the two lights in the middle are on, while the light in series with Z is off.
- D. When switch Y is closed it acts to “short” the circuit, i.e. the current bypasses all the lights since the current flows through the path of least resistance. Therefore, none of the lights are on.