Electric Circuits Unit Review

1. The flow of charge per unit time defines:
   a) power (b) current c) voltage d) resistance

2. A current of 3.60 A flows for 15.3 s through a conductor. Calculate the number of electrons that pass through a point in the conductor in this time. $Q = ne$ $I = \frac{Q}{t}$ $I = \frac{ne}{t}$ $n = \frac{It}{e} = 3.44 \times 10^{20}$ electrons

3. How long would it take 2.0×10^{20} electrons to pass through a point in a conductor if the current was 10.0 A? $I = \frac{ne}{t} \Rightarrow t = \frac{ne}{I} = \frac{(2.0\times10^{20})(1.6\times10^{-19})}{10} = 3.2\,s$

4. Calculate the current if a charge of 5.60 C passes through a point in a conductor in 15.4 s. $I = \frac{Q}{t} = \frac{5.60}{15.40}$

5. How many electrons pass through the appliance in # 8 every minute? $n = \frac{It}{e} = \frac{(0.36)(60)}{1.6\times10^{-19}} = 1.35 \times 10^{20}$ electrons $= 0.36\,A$

6. In an electric circuit, 6.25×10^{18} electrons flows past one point in 0.10 seconds. What is the current? $I = \frac{ne}{t} = 10\,A$

7. A 12 V battery is connected to a 20 Ω resistor. How much charge flows through the battery in 3.5 seconds? $V = IR \rightarrow I = \frac{12}{20} = 0.6\,A$ $I = \frac{Q}{t} \Rightarrow Q = It = (0.6)(3.5) = 2.1\,C$

8. A 12 V battery is connected to a 60 Ω resistor. How much charge will flow through the resistor in 20 seconds? $I = \frac{12}{60} = 0.2\,A$ $Q = It = (0.2)(20) = 4\,C$

9. What is the potential difference across a conductor to produce a current of 8.00 A if there is a resistance of 7.20 Ω? $V = IR = (8.00)(7.20) = 57.6\,V$

10. When an electric appliance is connected to a 120 V power line, there is a current through the appliance of 18.3 A. What is its resistance? $R = \frac{V}{I} = \frac{120}{18.3} = 6.56\,V$

11. What potential difference is required across an electrical appliance to produce a current of 20.0 A when there is a resistance of 6.00 Ω? $V = IR = (20.0)(6.0) = 120.\,V$

12. What is the current through a 400 W electric appliance when it is connected to a 120 V power line? $P = IV$ $I = \frac{P}{V} = \frac{400}{120} = 3.3\,A$

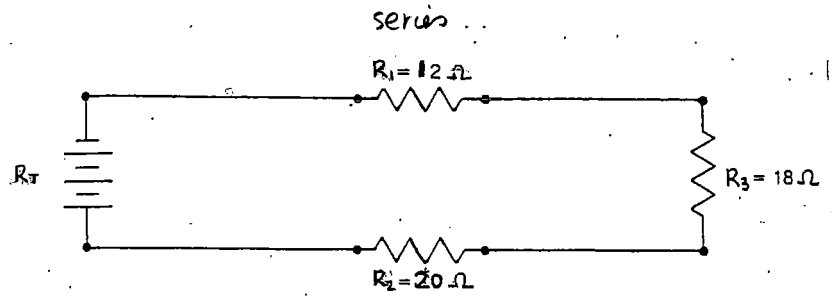
13. Find the total resistance for each of the following:

a)

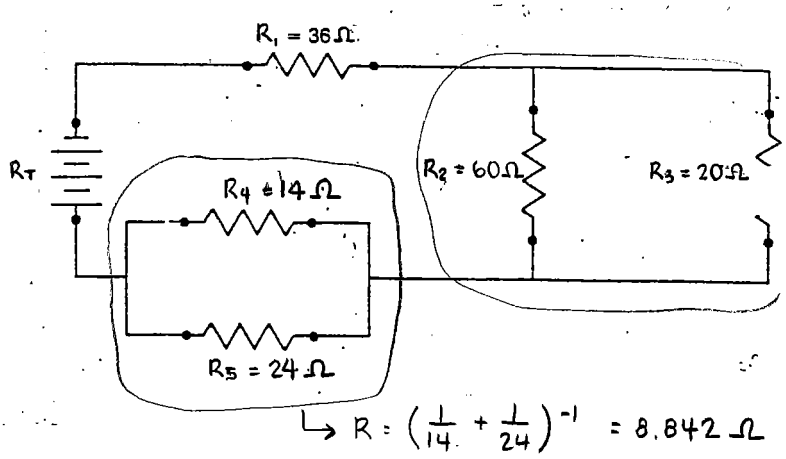
$R_T = R_1 + R_2 + R_3$

$= 12 + 20 + 18$

$R_T = 50\,\Omega$



b)



$\hookrightarrow R = \left(\frac{1}{14} + \frac{1}{24}\right)^{-1} = 8.842\,\Omega$

$R_{4\&5} = 8.842\,\Omega$

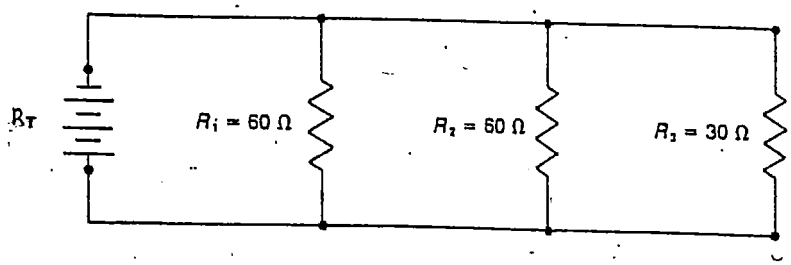
$R_{2\&3} = \left(\frac{1}{60} + \frac{1}{20}\right)^{-1} = 15\,\Omega$

$R_T = 36 + 8.842 + 15$

(R_1)

$R_T = 59.8\,\Omega$

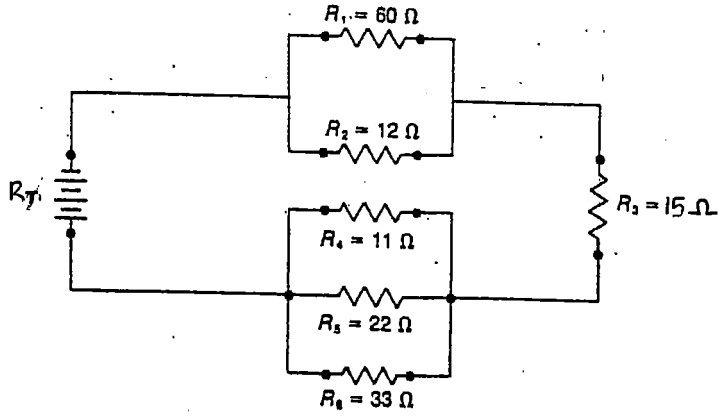
c)



$R_T = \left(\frac{1}{60} + \frac{1}{60} + \frac{1}{30}\right)^{-1}$

$R_T = 15\,\Omega$

d)



$R_{1\&2} = \left(\frac{1}{60} + \frac{1}{12}\right)^{-1} = 10\,\Omega$

$R_{4\text{-}6} = \left(\frac{1}{11} + \frac{1}{22} + \frac{1}{33}\right)^{-1} = 6\,\Omega$

$R_T = 15 + 10 + 6$

(R_3)

$R_T = 31\,\Omega$

14. Solve the following circuits (find the current, voltage and resistance for reach element in the circuit).

a) $R_T = \left(\frac{1}{6} + \frac{1}{30}\right)^{-1} + 15$

$= 5 + 15$

$= 20\,\Omega$

$I_T = \frac{V_T}{R_T} = \frac{120}{20} = 6\,A$

$I_3 = I_T$ (in series)

$V_3 = I_3 R_3 = (6)(15) = 90V$

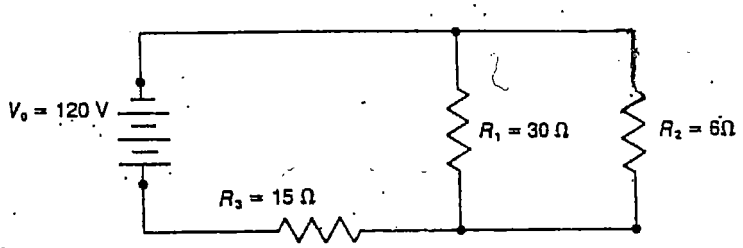
$V_{1\&2} = V_T - V_3$

$= 120 - 90$

$= 30V$

$I_1 = \frac{V_1}{R_1} = \frac{30}{30} = 1\,A$

$I_2 = \frac{V_2}{R_2} = \frac{30}{6} = 5A$



$V_T = 120V$ $V_1 = 30V$ $V_2 = 30V$ $V_3 = 90V$

$I_T = 6A$ $I_1 = 1A$ $I_2 = 5A$ $I_3 = 6A$

$R_T = 20\,\Omega$ $R_1 = 30\Omega$ $R_2 = 6\Omega$ $R_3 = 15\Omega$

$V_T = 18V$ $V_1 = 6V$ $V_{2,3} = 3V$ $V_3 = 3V$ $V_4 = 9V$

b) $I_T = 4A$ $I_1 = 4A$ $I_2 = 3A$ $I_3 = 1A$ $I_4 = 4A$

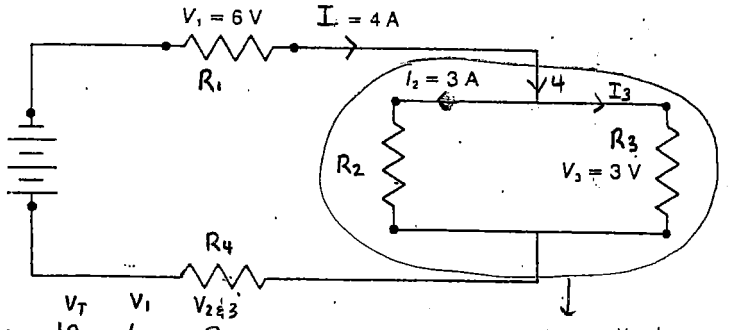
$R_T = 4.5\Omega$ $R_1 = 1.5\Omega$ $R_2 = 1\Omega$ $R_3 = 3\Omega$ $R_4 = 2.25\Omega$

$R_1 = \frac{V_1}{I_1} = \frac{6}{4} = 1.5\Omega$ $R_2 = \frac{V_2}{I_2} = \frac{3}{3} = 1\Omega$ $V_T = 18\,V$

$I_T = I_1$ (in series) $R_T = \frac{V_T}{I_T} = \frac{18}{4} = 4.5\Omega$

$I_4 = I_T$ (in series)

$I_3 = \underset{I_1}{4A} - \underset{I_2}{3A} = 1A$ $R_3 = \frac{V_3}{I_3} = \frac{3}{1} = 3\Omega$



$V_4 = 18 - 6 - 3$

$= 9V$

$R_4 = \frac{V_4}{I_4} = \frac{9}{4} = 2.25\Omega$

15. What is the total resistance of the circuit?
What is the current through the 100 Ω resistor?

$$R_T = \underbrace{\left(\frac{1}{68} + \frac{1}{220}\right)^{-1}}_{R_1 \quad R_2} + 300 + \underbrace{\left(\frac{1}{33} + \frac{1}{470}\right)^{-1}}_{R_4 \quad R_5}$$

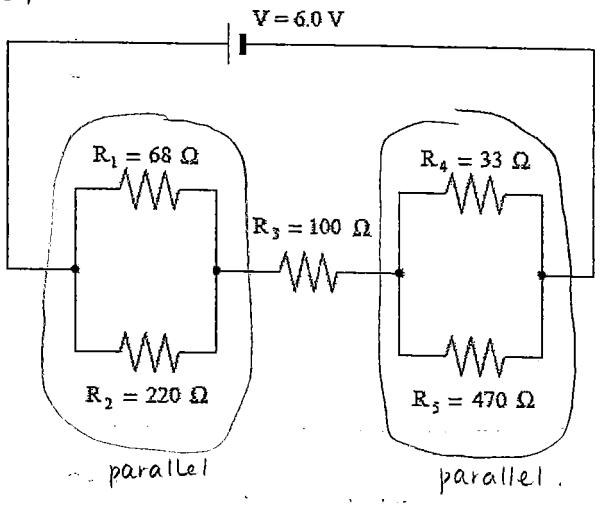
$= 51.94 + 100 + 30.83$

$= 182.77$

$R_T = 183\,\Omega$

$I_T = \frac{V_T}{R_T} = \frac{6.0}{183} = 0.033\,A$

$I_3 = I_T = 0.033\,A$



16. Calculate the current through the 6.0 Ω resistor.

$R_T = 4.0 + 3.0 + \left(\frac{1}{6} + \frac{1}{10} + \frac{1}{15}\right)^{-1}$

$= 4.0 + 3.0 + 3.0$

$= 10.0\,\Omega$

$I_T = \frac{V_T}{R_T} = \frac{40.0}{10.0} = 4.0\,A$

$I_1 = I_2 = I_T$ } in series

Find $V_1 = I_1 R_1$ $V_2 = I_2 R_2$

$= (4.0)(4.0)$ $= (4.0)(3.0)$

$= 16.0V$ $= 12.0V$

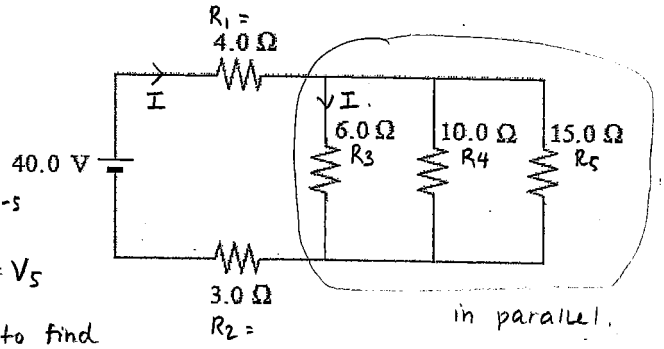
$V_T = V_1 + V_2 + V_{3\text{-}5}$

$40.0 = 16.0 + 12.0 + V_{3\text{-}5}$

$12.0V = V_3 = V_4 = V_5$

↳ use this to find current

$I_3 = \frac{V_3}{R_3} = \frac{12.0}{6.0} = 2.0\,A$



17. In the following circuit, determine the value of resistor R.

R_1 & R_2 are parallel, so $V_1 = V_2 = 5.0V$

$V_T = V_3 + V_{1\&2}$

$18.0 = V_3 + 5.0$

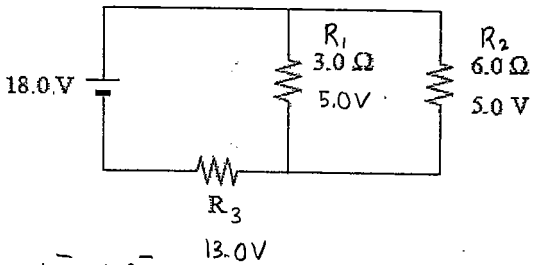
$V_3 = 13.0V$

$I_1 = \frac{V_1}{R_1} = \frac{5.0}{3.0} = 1.\bar{6}\,A$

$I_2 = \frac{V_2}{R_2} = \frac{5.0}{6.0} = 0.8\bar{3}\,A$

$I_T = I_3 = I_1 + I_2$

in series — in parallel.



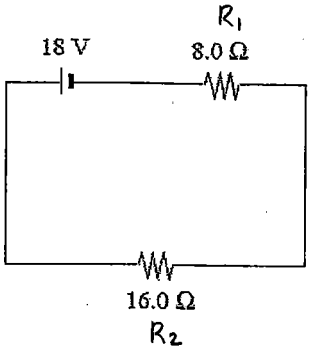
$I_3 = 1.\bar{6} + 0.8\bar{3}$

$= 2.5\,A$

$R_3 = \frac{V_3}{I_3} = \frac{13.0}{2.5}$

$R_3 = 5.2\,\Omega$

18. Calculate the power dissipated by the 8.0 Ω resistor in the circuit.



$$P = IV$$

$$R_T = 8 + 16 = 24\,\Omega$$

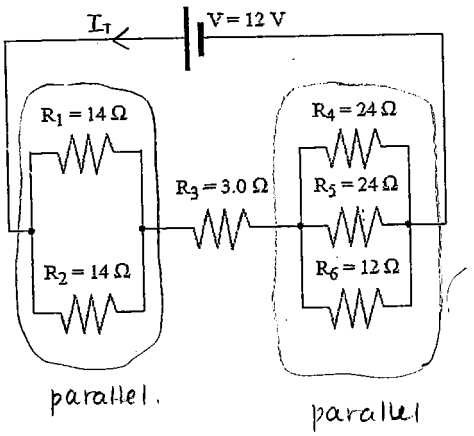
$$I_T = \frac{V_T}{R_T} = \frac{18}{24} = 0.75\,A$$

$$I_1 = I_2 = I_T \quad (\text{in series})$$

$$V_1 = I_1 R_1 = (0.75)(8.0) = 6\,V \qquad P_1 = I_1 V_1 = (0.75)(6) = 4.5\,W$$

19. What is the power dissipated by the 3.0 Ω resistor in the circuit?

$$P = IV$$



$$R_T = \left(\frac{1}{14} + \frac{1}{14}\right)^{-1} + 3.0 + \left(\frac{1}{24} + \frac{1}{24} + \frac{1}{12}\right)^{-1}$$

(R_1, R_2: R_3: R_4, R_5, R_6)

$$= 7.0 + 3.0 + 6.0$$

$$= 16.0\,\Omega$$

$$I_T = \frac{V_T}{R_T} = \frac{12}{16} = 0.75\,A$$

$$I_3 = I_T = 0.75\,A$$

in series

$$V_3 = I_3 R_3 = (0.75)(3) = 2.25\,V$$

$$P_3 = I_3 V_3 = (0.75)(2.25) = 1.6875\,W$$

$$P_3 = 1.70\,W$$