

Name: Key  
 Combination Circuit Problems

Complete the following combination circuit problems by filling in the charts. Use the following relationships to help you solve the problems.

Series Circuit

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

$$I_T = I_1 = I_2 = I_3 = \dots$$

$$V_T = V_1 + V_2 + V_3 + \dots$$

Parallel Circuit

$$1/R_T = 1/R_1 + 1/R_2 + 1/R_3 + \dots$$

$$I_T = I_1 + I_2 + I_3 + \dots$$

$$V_T = V_1 \pm V_2 \pm V_3 + \dots$$

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

$$P = IV = \frac{V^2}{R}$$

1. Complete the chart.

	R ( $\Omega$ )	I (Amps)	V (volts)	P (watts)
A	3 $\Omega$	④ 0.333A	⑤ 1V	⑧ 0.333w
B	9 $\Omega$	④ 0.333A	⑥ 3V	⑨ 1.00w
C	⑩ 15 $\Omega$	④ 0.333A	⑦ 5V	⑩ 1.667w
Total	27 $\Omega$	③ 0.333A	9 V	③ 3watts

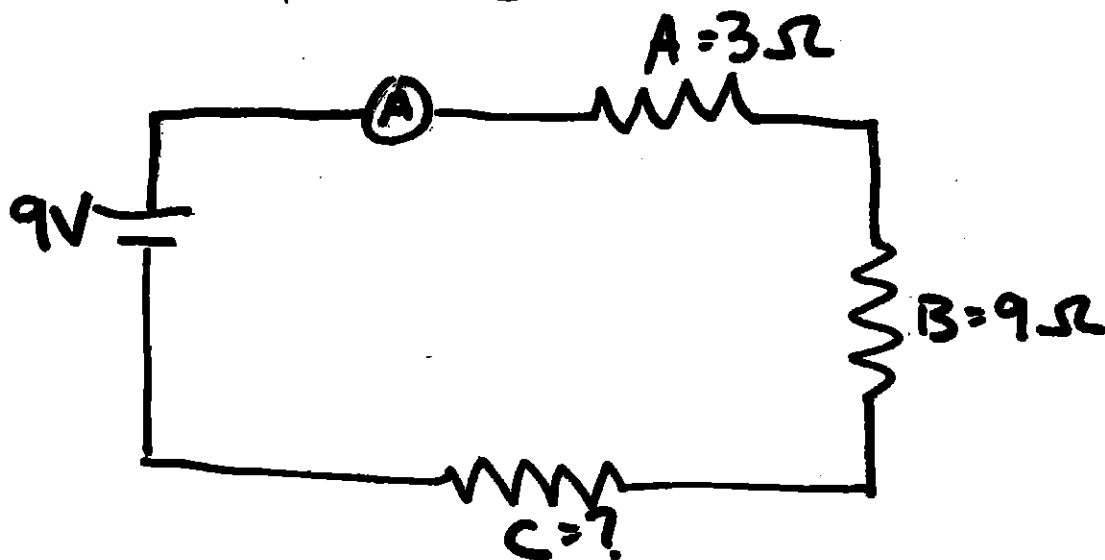
} 3 watts

①  $R_T = R_A + R_B + R_C$

$27 = 3 + 9 + R_C$   
 $R_C = 15 \Omega$

②  $I_T = \frac{V_T}{R_T} = \frac{9V}{27\Omega} = .333A$

③  $P_T = I_T \times V_T = (.333A)(9V) = 3 \text{ watts}$  or  $P = \frac{V^2}{R} = \frac{(9)^2}{27} = 3$



④ Series:  $I_T = I_A = I_B = I_C = 0.333A$

⑤  $V_A = I_A \times R_A = (.333A)(3\Omega) = 1V$

⑥  $V_B = I_B \times R_B = (.333A)(9\Omega) = 3V$

⑦  $V_C = I_C \times R_C = (.333A)(15\Omega) = 5V$

⑧  $P_A = I_A \times V_A = (.333A)(1V) = .333 \text{ watt}$

⑨  $P_B = I_B \times V_B = (.333A)(3V) = 1 \text{ watt}$

⑩  $P_C = I_C \times V_C = (.333A)(5V) = 1.667 \text{ watt}$

2. Complete the chart.

	R ( $\Omega$ )	I (Amps)	V (volts)	P (watts)
A	14 $\Omega$	(7) .804 A	(6) 11.25 V	(8) 9.045
B	42 $\Omega$	(8) .268 A	(6) 11.25 V	(13) 3.015
C	21 $\Omega$	(4) 1.07 A	(5) 22.5 V	(14) 24.075
D	35 $\Omega$	(10) .179 A	(9) 6.25 V	(15) 1.119
E	7 $\Omega$	(11) .893 A	(9) 6.25 V	(16) 5.581
Total	(1) 37.3 $\Omega$	(2) 1.07 A	40 V	(3) 42.86 watts

$$10.5 + 21 + 5.83 = 37.3 \Omega$$

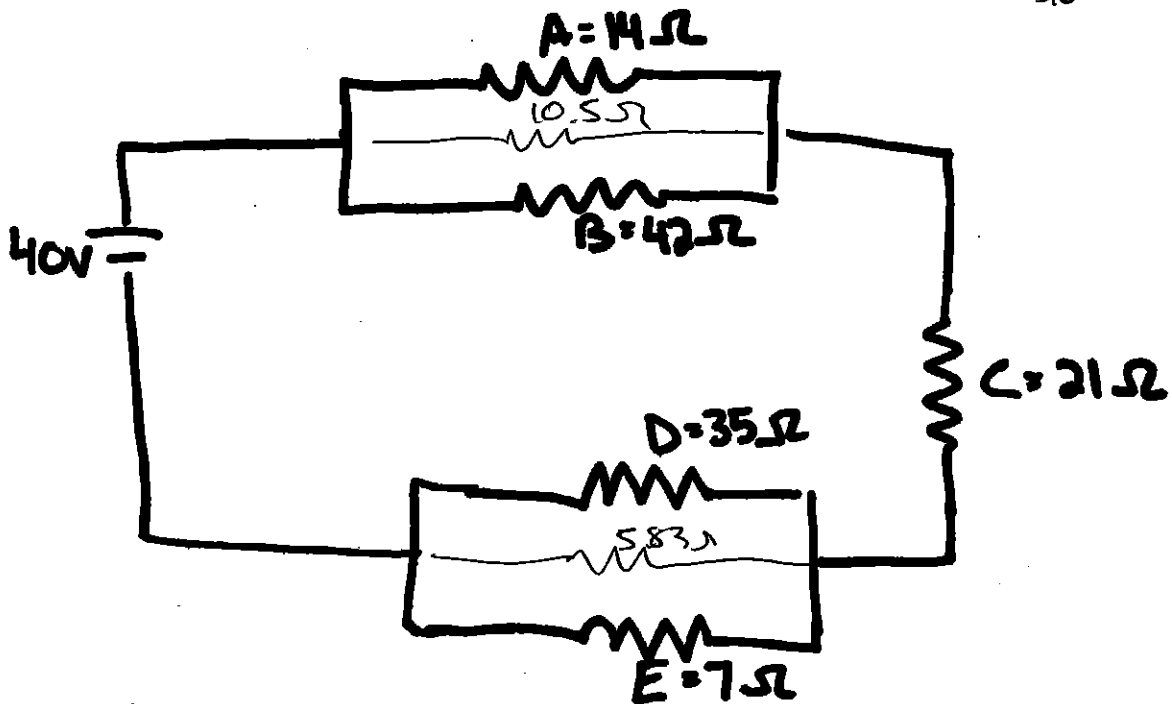
$$\textcircled{1} R_T = R_{A/B} + R_C + R_{D/E}$$

$$\frac{1}{R_{A/B}} = \frac{1}{14} + \frac{1}{42} = \frac{3}{42} + \frac{1}{42} = \frac{4}{42}$$

$$R_{A/B} = \frac{42}{4} = 10.5 \Omega$$

$$\frac{1}{R_{D/E}} = \frac{1}{35} + \frac{1}{7} = \frac{1}{35} + \frac{5}{35} = \frac{6}{35}$$

$$R_{D/E} = 5.83 \Omega$$



$$\textcircled{2} I_T = \frac{V_T}{R_T} = \frac{40V}{37.3\Omega} = 1.07 A$$

$$\textcircled{3} P_T = I_T \times V_T = 1.07 \times 40 = 42.86 \text{ Watts}$$

$$\textcircled{4} \text{Series Circuit } I_T = I_{A/B} = I_C = I_{D/E} = 1.07 A$$

$$\textcircled{5} V_C = I_C \times R_C = 1.07 A \times 21 \Omega = 22.5 \text{ Volts}$$

$$\textcircled{6} V_A = V_B = V_{A/B} \quad V_{A/B} = I_{A/B} \cdot R_{A/B} = (1.07 A)(10.5 \Omega) = 11.25 V$$

$$\textcircled{10} I_D = \frac{V_D}{R_D} = \frac{6.25}{35} = .179 A$$

$$\textcircled{11} I_E = \frac{6.25}{7} = .893 A$$

$$\textcircled{7} I_A = \frac{V_A}{R_A} = \frac{11.25}{14} = .804 A$$

$$\textcircled{8} I_B = \frac{V_B}{R_B} = \frac{11.25}{42} = .268 A$$

$$\textcircled{9} V_{D/E} = V_D = V_E$$

$$V_{D/E} = I_{D/E} \cdot R_{D/E}$$

$$V_{D/E} = (1.07 A)(5.83 \Omega) = 6.25 V$$

#13-17  $P = I \times V$

①  $R_T = R_A + R_{BCDE}$   
 $= 3\Omega + 2.13\Omega = \boxed{5.13\Omega}$

3. Complete the chart.

	R ( $\Omega$ )	I (Amps)	V (volts)	P (watts)
A	3 $\Omega$	④ 0.883 A	⑤ 2.65 V	③ 2.34 W
B	10 $\Omega$	⑪ 0.0855 A	⑩ 0.855 V	⑭ 0.073 W
C	5 $\Omega$	⑫ 0.1709 A	⑩ 0.855 V	⑮ 0.146 W
D	4 $\Omega$	⑧ 0.256 A	⑨ 1.025 V	⑯ 0.262 W
E	3 $\Omega$	⑦ 0.627 A	⑥ 1.88 V	⑰ 1.18 W
Total	① 5.13 $\Omega$	③ 0.883 A	② 4.53 V	4 Watts

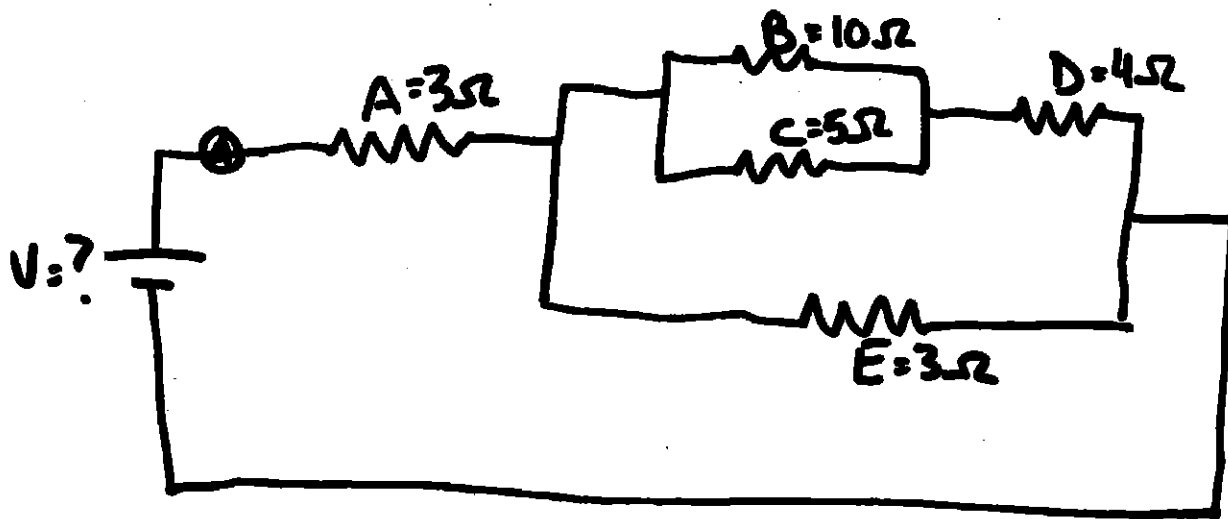
$\frac{1}{R_{BC}} = \frac{1}{R_B} + \frac{1}{R_C} = \frac{1}{10} + \frac{1}{5} = \frac{3}{10}$

$R_{BC} = 3.33\Omega$

$R_{BCD} = R_{BC} + R_D = 3.33\Omega + 4\Omega = 7.33\Omega$

$\frac{1}{R_{BCDE}} = \frac{1}{R_{BCD}} + \frac{1}{R_E} = \frac{1}{7.33} + \frac{1}{3}$

$R_{BCDE} = 2.13\Omega$



②  $P_T = \frac{V_T^2}{R_T}$

$V_T = \sqrt{P_T \cdot R_T}$   
 $V = \sqrt{(5.13)(4)}$   
 $V_T = \boxed{4.53V}$

③  $I_T = \frac{V_T}{R_T} = \frac{4.53V}{5.13\Omega} = 0.883A$

④ Series:  $I_T = I_A = I_{BCDE} = 0.883A$

⑤  $V_A = I_A \cdot R_A = (0.883A)(3\Omega) = 2.65V$

⑥ Series:  $V_T = V_A + V_{BCDE}$

$4.53V = 2.65V + V_{BCDE}$

Parallel:  $V_{BCDE} = V_{BCD} = V_E = 1.88V$

⑦  $I_E = \frac{V_E}{R_E} = \frac{1.88V}{3\Omega} = 0.627A$

⑧ Parallel:  $I_{BCDE} = I_{BCD} + I_E$

$0.883A = I_{BCD} + 0.627$

$I_{BCD} = 0.256A = I_{BC} = I_D$

⑨  $V_D = I_D \cdot R_D = (0.256A)(4\Omega) = 1.025V$

⑩ Series:  $V_{BCD} = V_{BC} + V_D$

$1.88V = V_{BC} + 1.025V$

$V_{BC} = 0.855V$

Parallel:  $V_{BC} = V_B = V_C = 0.855V$

⑪  $I_B = \frac{V_B}{R_B} = \frac{0.855V}{10\Omega} = 0.0855A$

⑫  $I_C = \frac{V_C}{R_C} = \frac{0.855V}{5\Omega} = 0.1709A$

4. Complete the chart.

	R ( $\Omega$ )	I (Amps)	V (volts)	P (watts)
A	5 $\Omega$	⑩ .5 A	⑪ 2.5 V	⑭ 1.25 watts
B	7 $\Omega$	⑩ .5 A	⑬ 3.5 V	⑮ 1.75 watts
C	4 $\Omega$	⑮ 1.5 A	⑨ 6 V	⑯ 9 watts
D	4 $\Omega$	⑥ 1 A	⑦ 4 V	⑰ 4 watts
E	4 $\Omega$	⑥ 1 A	⑧ 4 V	⑱ 4 watts
F	2 $\Omega$	④ 2 A	⑤ 4 V	⑲ 8 watts
Total	① 7 $\Omega$	② 2 A	14 V	③ 28 watts

⑨ Series:  $V_T = V_{ABC} + V_{DE} + V_F$

$14V = V_{ABC} + 4 + 4$

$V_{ABC} = 6V$

Parallel:  $V_{ABC} = V_{AB} = V_C = 6V$

⑩  $I_C = \frac{V_C}{R_C} = \frac{6V}{4\Omega} = 1.5A$

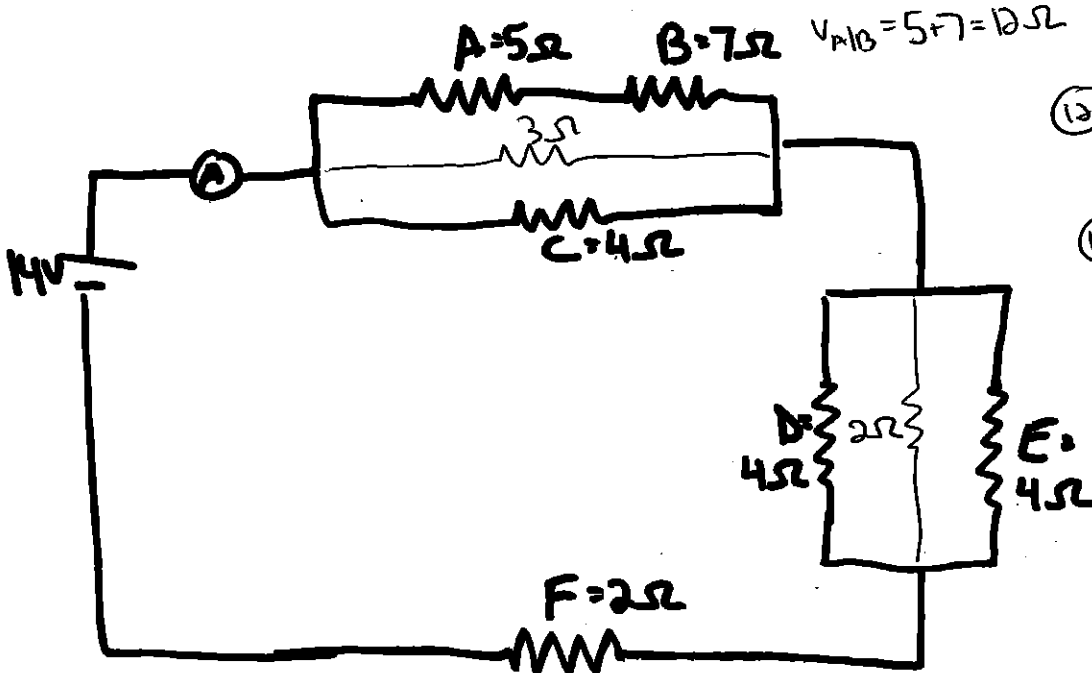
⑪ Parallel Circuit:  $I_T = I_{AB} + I_C$

$2A = I_{AB} + 1.5A$

$I_{AB} = .5A =$

$I_{AB} = I_B =$

Series .5 A



$V_{AB} = 5 + 7 = 12V$

⑫  $V_A = I_A \cdot R_A = (.5A)(5\Omega) = 2.5V$

⑬  $V_B = I_B \cdot R_B = 7\Omega \cdot .5A = 3.5V$

①  $R_T = R_{ABC} + R_{DE} + R_F$

$\frac{1}{R_{ABC}} = \frac{1}{R_{AB}} + \frac{1}{R_C} = \frac{1}{12} + \frac{1}{4} = \frac{1}{12} + \frac{3}{12} = \frac{4}{12}$

$R_{ABC} = 3\Omega$

$\frac{1}{R_{DE}} = \frac{1}{R_D} + \frac{1}{R_E} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4}$   $R_{DE} = 2\Omega$

$R_T = R_{ABC} + R_{DE} + R_F = 3 + 2 + 2 = 7\Omega$

②  $I_T = \frac{V_T}{R_T} = \frac{14}{7} = 2A$

③  $P_T = I_T \cdot V_T = 2 \cdot 14 = 28 \text{ watts}$

④ Series:  $I_T = I_{ABC} = I_{DE} = I_F = 2A$

⑤  $V_F = I_F \cdot R_F = 2A \cdot 2\Omega = 4V$

⑥  ~~$V_{DE} = I_{DE} \cdot R_{DE} = 2A \cdot 2\Omega = 4V$~~   $I_{DE} = I_D + I_E$  -  $I_D = I_E = 1A$  - equal resistors

⑦  $V_D = I_D \cdot R_D = 1A \cdot 4\Omega = 4V$

⑧  $V_E = I_E \cdot R_E = 1A \cdot 4\Omega = 4V$

#16-22:  $P = I \times V$

①  $R_T = R_A + R_{BCDEFG}$   
 $R_T = 3\Omega + 2.73\Omega = 5.73\Omega$

5. Complete the chart.

	R ( $\Omega$ )	I (Amps)	V (volts)	P (watts)
A	3 $\Omega$	④ 3.14 A	⑤ 9.42 V	⑬ 29.58 W
B	3 $\Omega$	⑥ 1.43 A	⑦ 4.29 V	⑭ 6.13 W
C	6 $\Omega$	⑧ 0.715 A	⑨ 4.29 V	⑮ 3.07 W
D	6 $\Omega$	⑧ 0.715 A	⑩ 4.29 V	⑮ 3.07 W
E	4 $\Omega$	⑫ 1.71 A	⑬ 5.16 V	⑯ 6.66 W
F	12 $\Omega$	⑫ 0.43 A	⑬ 5.16 V	⑰ 2.22 W
G	2 $\Omega$	⑫ 1.71 A	⑬ 3.42 V	⑱ 5.85 W
Total	① 5.73 $\Omega$	② 3.14 A	18 V	③ 56.6 watts

$\frac{1}{R_{CD}} = \frac{1}{R_C} + \frac{1}{R_D} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6}$

$R_{CD} = \frac{6}{2} = 3\Omega$

$R_{BCD} = R_B + R_{CD} = 3\Omega + 3\Omega = 6\Omega$

$\frac{1}{R_{EF}} = \frac{1}{R_E} + \frac{1}{R_F} = \frac{1}{4} + \frac{1}{12} = \frac{4}{12}$

$R_{EF} = \frac{12}{4} = 3\Omega$

$R_{EFG} = R_{EF} + R_G = 3\Omega + 2\Omega = 5\Omega$

$\frac{1}{R_{BCDEFG}} = \frac{1}{R_{BCD}} + \frac{1}{R_{EFG}} = \frac{1}{6} + \frac{1}{5} = \frac{11}{30}$

$R_{BG} = \frac{30}{11} = 2.73\Omega$

②  $I_T = \frac{V_T}{R_T} = \frac{18V}{5.73\Omega} = 3.14A$

③  $P_T = I_T \times V_T = 3.14A \times 18V = 56.6 \text{ watts}$

④ Series:  $I_T = I_A = I_{BCDEFG} = 3.14A$

⑤  $V_A = I_A \times R_A = (3.14)(3) = 9.42V$

⑥ Series:  
 $V_T = V_A + V_{BCDEFG}$   
 $18V = 9.42 + V_{BCDEFG}$   
 $V_{BCDEFG} = 8.58V$

Parallel:  $V_{BCDEFG} = V_{BCD} = V_{EFG} = 8.58V$

$I_{BCD} = \frac{V_{BCD}}{R_{BCD}} = \frac{8.58V}{6\Omega} = 1.43A$   
 $= I_B = I_{CD}$

⑦  $V_B = I_B \times R_B = (1.43A)(3\Omega) = 4.29V$

⑧  $I_{CD} = 1.43A$ , since  $R_C = R_D$ , the current will be split evenly  
 $I_C = I_D = 0.715A$

⑨  $V_C = I_C \times R_C = 6\Omega \times 0.715A = 4.29V$

⑩  $V_D = I_D \times R_D = 6\Omega \times 0.715A = 4.29V$

⑭  $I_E = \frac{V_E}{R_E} = \frac{5.16V}{4\Omega} = 1.29A$

⑮  $I_F = \frac{V_F}{R_F} = \frac{5.16V}{12\Omega} = 0.43A$

⑪ Parallel:  $I_{BCDEFG} = I_{BCD} + I_{EFG}$   
 $3.14A = 1.43A + I_{EFG}$

$I_{EFG} = 1.71A = I_G$   
 ⑫  $V_G = I_G \times R_G = 1.71 \times 2\Omega = 3.42V$

⑬  $V_{EFG} + V_G = 8.58V$   
 $V_{EFG} = 5.16V = V_E = V_F$

