Chapter 21

Problems & Exercises

1.

(a) 2.75 kΩ

(b) 27.5 Ω

3.

(a) 786 Ω

(b) 20.3 Ω

5.

29.6 W

7.

(a) 0.74 A

(b) 0.742 A

9.

(a) 60.8 W

(b) 3.18 kW

11.

(a) $$R_{\text{s}} = R_1 + R_2$$
$$\Rightarrow R_{\text{s}} \approx R_1 \left(R_1 >> R_2\right)$$

(b) $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R_1 R_2}$,

so that

$$R_{\text{p}} = \frac{R_1 R_2}{R_1 + R_2} \approx \frac{R_1 R_2}{R_1} = R_2 \left(R_1 >> R_2\right).$$

13.

(a) -400 kΩ

(b) Resistance cannot be negative.

(c) Series resistance is said to be less than one of the resistors, but it must be greater than any of the resistors.

14.

2.00 V

16.

2.9994 V

18.

0.375 Ω

21.

(a) 0.658 A

(b) 0.997 W

(c) 0.997 W; yes

23.

(a) 200 A

(b) 10.0 V

(c) 2.00 kW

(d) 0.1000 Ω; 80.0 A, 4.0 V, 320 W

25.

(a) 0.400 Ω

(b) No, there is only one independent equation, so only r can be found.

29.

(a) –0.120 V

(b) -1.41×10^{-2} Ω

(c) Negative terminal voltage; negative load resistance.

(d) The assumption that such a cell could provide 8.50 A is inconsistent with its internal resistance.

31.

$-I_2 R_2 + \mathrm{emf}_1 - \mathrm{I}_2 r_1 + \mathrm{I}_3 R_3 + \mathrm{I}_3 r_2 - \mathrm{emf}_2 = 0$

35.

$I_3 = \mathrm{I}_1 + \mathrm{I}_2$

37.

$\mathrm{emf}_2 - \mathrm{I}_2 r_2 - \mathrm{I}_2 R_2 + \mathrm{I}_1 R_5 + I_1 r_1 - \mathrm{emf}_1 + \mathrm{I}_1 R_1 = 0$

39.

(a) $\mathrm{I}_1 = 4.75$ A

(b) $\mathrm{I}_2 = -3.5$ A

(c) $\mathrm{I}_3 = 8.25$ A

41.

(a) No, you would get inconsistent equations to solve.

(b) $I_1 \neq I_2 + I_3$. The assumed currents violate the junction rule.

42.

30 μA

44.

1.98 kΩ

46.

1.25×10^{-4} Ω

48.

(a) 3.00 MΩ

(b) 2.99 kΩ

50.

(a) 1.58 mA

(b) 1.5848 V (need four digits to see the difference)

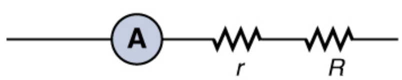
(c) 0.99990 (need five digits to see the difference from unity)

52.

15.0 μA

54.

(a)



(b) 10.02 Ω

(c) 0.9980, or a 2.0×10^{-1} percent decrease

(d) 1.002, or a 2.0×10^{-1} percent increase

(e) Not significant.

56.

(a) −66.7 Ω

(b) You can't have negative resistance.

(c) It is unreasonable that I_G is greater than I_{tot} (see Figure 21.30). You cannot achieve a full-scale deflection using a current less than the sensitivity of the galvanometer.

57.

24.0 V

59.

1.56 kΩ

61.

(a) 2.00 V

(b) 9.68 Ω

62.

Range = 5.00 Ω to 5.00 kΩ

63.

range 4.00 to 30.0 MΩ

65.

(a) 2.50 F

(b) 2.00 s

67.

86.5%

69.

(a) 1.25 kΩ

(b) 30.0 ms

71.

(a) 20.0 s

(b) 120 s

(c) 16.0 ms

73.

1.73×10^{-2} s

74.

3.33×10^{-3} Ω

76.

(a) 4.99 s

(b) 3.87ºC

(c) 31.1 kΩ

(d) No

80.

(a) $P = \frac{V^2}{R} = \frac{\left(1.00\times10^2\right)^2}{2.50\times10^3}\text{w} = 4.00$ W

$\frac{1}{R_{eq}} = \frac{2}{R_1}$

$R_{eq} = \frac{R_1}{2} = 1.25 \times 10^3 \Omega$

(b) $P = \frac{V^2}{R} = \frac{\left(1.00\times10^2\right)^2}{1.25\times10^3}\text{ W} = 8\text{W}$

$R_{eq} = R_1 + R_2 = 2R_1$

(c) $P = \frac{V^2}{R} = \frac{\left(1.00\times10^2\right)^2}{5.00\times10^3}\text{W} = 2\text{W}$

(d) In the parallel case current passes through each branch, so more current is passed through the resistor system. In the series, the higher resistance of the circuit allows less current to flow. $P = IV$ is proportional to the current when the voltage does not change.

(e) The parallel combination delivers more energy in a given time period.