

CHAPTER 2

VOLTAGE, CURRENT, AND RESISTANCE

BASIC PROBLEMS

SECTION 2-2 Electrical Charge

1. $Q = (\text{charge per electron})(\text{number of electrons}) = (1.6 \times 10^{-19} \text{ C/e})(50 \times 10^{31} \text{ e}) = \mathbf{80 \times 10^{12} \text{ C}}$
2. $(6.25 \times 10^{18} \text{ e/C})(80 \times 10^{-6} \text{ C}) = \mathbf{5 \times 10^{14} \text{ e}}$
3. The magnitude of the charge on a proton (p) is equal to the magnitude of the charge on the electron (e). Therefore, $(1.6 \times 10^{-19} \text{ C/p})(29 \text{ p}) = \mathbf{4.64 \times 10^{-18} \text{ C}}$
4. $(1.6 \times 10^{-19} \text{ C/p})(17 \text{ p}) = \mathbf{2.72 \times 10^{-18} \text{ C}}$

SECTION 2-3 Voltage

5. (a) $V = \frac{W}{Q} = \frac{10 \text{ J}}{1 \text{ C}} = \mathbf{10 \text{ V}}$ (b) $V = \frac{W}{Q} = \frac{5 \text{ J}}{2 \text{ C}} = \mathbf{2.5 \text{ V}}$ (c) $V = \frac{W}{Q} = \frac{100 \text{ J}}{25 \text{ C}} = \mathbf{4 \text{ V}}$
6. $V = \frac{W}{Q} = \frac{500 \text{ J}}{100 \text{ C}} = \mathbf{5 \text{ V}}$
7. $V = \frac{W}{Q} = \frac{800 \text{ J}}{40 \text{ C}} = \mathbf{20 \text{ V}}$
8. $W = VQ = (12 \text{ V})(2.5 \text{ C}) = \mathbf{30 \text{ J}}$
9. $V = \frac{W}{Q} = \frac{2.5 \text{ J}}{0.2 \text{ C}} = \mathbf{12.5 \text{ V}}$

SECTION 2-4 Current

10. $I = \frac{Q}{t} = \frac{0.2 \text{ C}}{10 \text{ s}} = \mathbf{20 \text{ mA}}$
11. (a) $I = \frac{Q}{t} = \frac{75 \text{ C}}{1 \text{ s}} = \mathbf{75 \text{ A}}$ (b) $I = \frac{Q}{t} = \frac{10 \text{ C}}{0.5 \text{ s}} = \mathbf{20 \text{ A}}$ (c) $I = \frac{Q}{t} = \frac{5 \text{ C}}{2 \text{ s}} = \mathbf{2.5 \text{ A}}$
12. $I = \frac{Q}{t} = \frac{0.6 \text{ C}}{3 \text{ s}} = \mathbf{0.2 \text{ A}}$

$$13. \quad I = \frac{Q}{t}; \quad t = \frac{Q}{I} = \frac{10 \text{ C}}{5 \text{ A}} = 2 \text{ s}$$

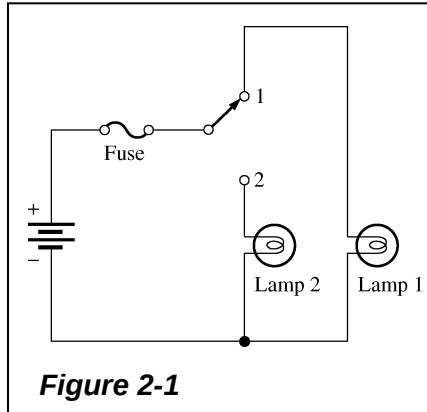
$$14. \quad Q = I \times t = (1.5 \text{ A})(0.1 \text{ s}) = 0.15 \text{ C}$$

SECTION 2-5 Resistance

15. A: Blue, gray, red, silver: **6800 $\Omega \pm 10\%$**
 B: Orange, orange, black, silver: **33 $\Omega \pm 10\%$**
 C: Yellow, violet, orange, gold: **47,000 $\Omega \pm 5\%$**
16. A: $R_{\min} = 6800 \text{ } \Omega - 0.1(6800 \text{ } \Omega) = 6800 \text{ } \Omega - 680 \text{ } \Omega = \mathbf{6120 \text{ } \Omega}$
 $R_{\max} = 6800 \text{ } \Omega + 680 \text{ } \Omega = \mathbf{7480 \text{ } \Omega}$
 B: $R_{\min} = 33 \text{ } \Omega - 0.1(33 \text{ } \Omega) = 33 \text{ } \Omega - 3.3 \text{ } \Omega = \mathbf{29.7 \text{ } \Omega}$
 $R_{\max} = 33 \text{ } \Omega + 3.3 \text{ } \Omega = \mathbf{36.3 \text{ } \Omega}$
 C: $R_{\min} = 47,000 \text{ } \Omega - (0.05)(47,000 \text{ } \Omega) = 47,000 \text{ } \Omega - 2350 \text{ } \Omega = \mathbf{44,650 \text{ } \Omega}$
 $R_{\max} = 47,000 \text{ } \Omega + 2350 \text{ } \Omega = \mathbf{49,350 \text{ } \Omega}$
17. (a) 1st band = **red**, 2nd band = **violet**, 3rd band = **brown**, 4th band = **gold**
 (b) 330 Ω : **orange, orange, brown, (B)**
 2.2 k Ω : **red, red, red (D)**
 39 k Ω : **orange, white, orange (A)**
 56 k Ω : **green, blue, orange (L)**
 100 k Ω : **brown, black, yellow (F)**
18. (a) **36.5 $\Omega \pm 2\%$**
 (b) **2.74 k $\Omega \pm 0.25\%$**
 (c) **82.5 k $\Omega \pm 1\%$**
19. (a) Brown, black, black, gold: **10 $\Omega \pm 5\%$**
 (b) Green, brown, green, silver: 5,100,000 $\Omega \pm 10\% = \mathbf{5.1 \text{ M}\Omega \pm 10\%}$
 (c) Blue, gray, black, gold: **68 $\Omega \pm 5\%$**
20. (a) 0.47 $\Omega \pm 5\%$: **yellow, violet, silver, gold**
 (b) 270 k $\Omega \pm 5\%$: **red, violet, yellow, gold**
 (c) 5.1 M $\Omega \pm 5\%$: **green, brown, green, gold**
21. (a) Red, gray, violet, red, brown: 28,700 $\Omega \pm 1\% = \mathbf{28.7 \text{ k}\Omega \pm 1\%}$
 (b) Blue, black, yellow, gold, brown: **60.4 $\Omega \pm 1\%$**
 (c) White, orange, brown, brown, brown: 9310 $\pm 1\% = \mathbf{9.31 \text{ k}\Omega \pm 1\%}$
22. (a) 14.7 k $\Omega \pm 1\%$: **brown, yellow, violet, red, brown**
 (b) 39.2 $\Omega \pm 1\%$: **orange, white, red, gold, brown**
 (c) 9.76 k $\Omega \pm 1\%$: **white, violet, blue, brown, brown**
23. (a) 220 = **22 Ω** (b) 472 = **4.7 k Ω**
 (c) 823 = **82 k Ω** (d) 3K3 = **3.3 k Ω**
 (e) 560 = **56 Ω** (f) 10M = **10 M Ω**
24. **500 Ω** , equal resistance on each side of the contact.

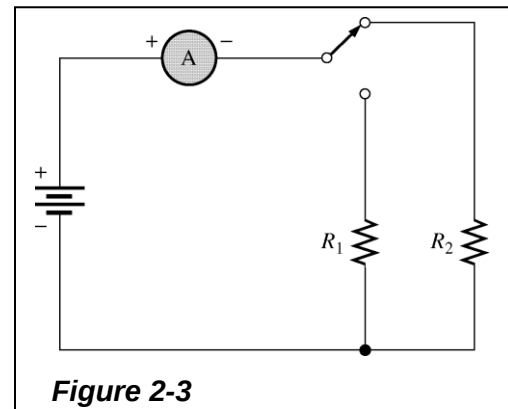
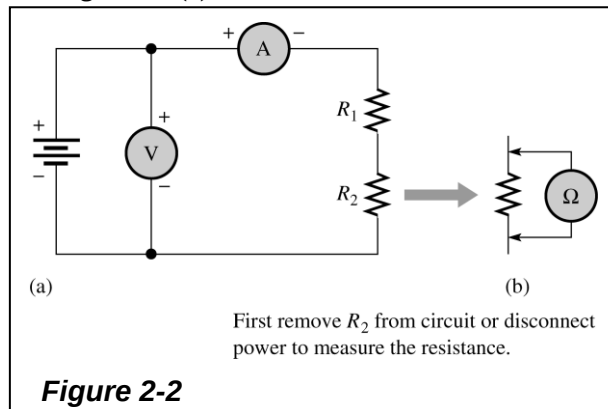
SECTION 2-6 The Electric Circuit

25. There is current through **Lamp 2**.
 26. See Figure 2-1.

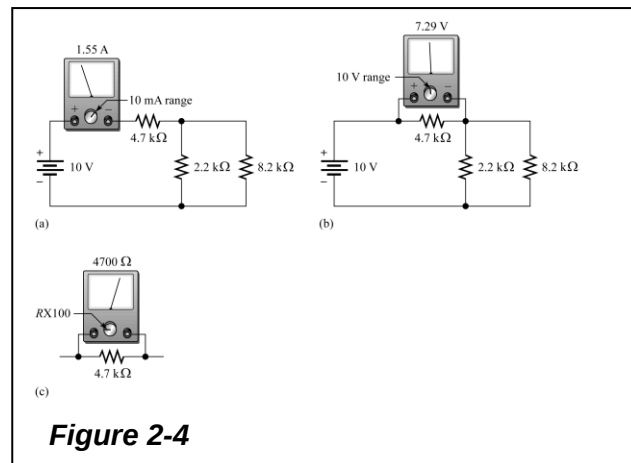


SECTION 2-7 Basic Circuit Measurements

27. See Figure 2-2(a).



28. See Figure 2-2(b).
 29. Position 1: $V_1 = 0 \text{ V}$, $V_2 = V_S$
 Position 2: $V_1 = V_S$, $V_2 = 0 \text{ V}$
 30. See Figure 2-3.
 31. On the 600 V DC scale: **250 V**
 32. $R = (10)(10 \Omega) = \mathbf{100 \Omega}$
 33. (a) $2(100 \Omega) = \mathbf{200 \Omega}$
 (b) $15(10 \text{ M}\Omega) = \mathbf{150 \text{ M}\Omega}$
 (c) $45(100 \Omega) = \mathbf{4500 \Omega}$
 34. See Figure 2-4.



ADVANCED PROBLEMS

35. $I = \frac{Q}{t}$

$$Q = I \times t = (2 \text{ A})(15 \text{ s}) = 30 \text{ C}$$

$$V = \frac{W}{Q} = \frac{1000 \text{ J}}{30 \text{ C}} = 33.3 \text{ V}$$

36. $I = \frac{Q}{t}$

$$Q = (\text{number of electrons}) / (\text{number of electrons/coulomb})$$

$$Q = \frac{574 \times 10^{15} \text{ e}}{6.25 \times 10^{18} \text{ e/C}} = 9.184 \times 10^{-2} \text{ C} \quad I = \frac{Q}{t} = \frac{9.184 \times 10^{-2} \text{ C}}{250 \times 10^{-3} \text{ s}} = 0.367 \text{ A}$$

37. Total wire length = 100 ft

$$\text{Resistance per 1000 ft} = (1000 \text{ ft})(6 \Omega/100 \text{ ft}) = 60 \Omega$$

Smallest wire size is **AWG 27** which has 51.47 $\Omega/1000 \text{ ft}$

38. (a) 4R7J = **4.7 $\Omega \pm 5\%$**

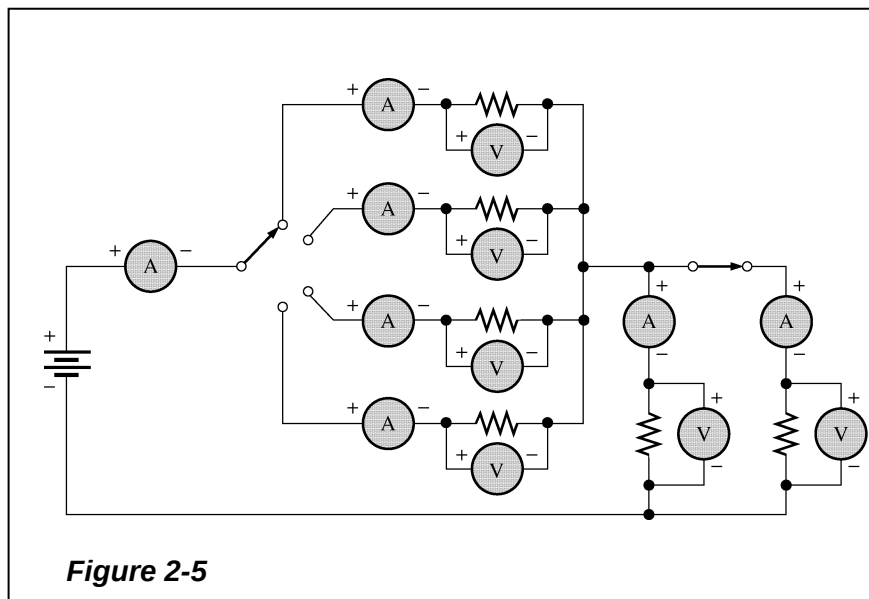
(b) 560KF = **560 $\text{k}\Omega \pm 1\%$**

(c) 1M5G = **1.5 $\text{M}\Omega \pm 2\%$**

39. The circuit in (b) can have both lamps on at the same time.

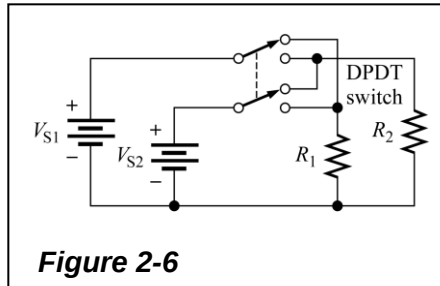
40. There is always current through R_5 .

41. See Figure 2-5.



42. See Figure 2-5.

43. See Figure 2-6.



44. See Figure 2-7.

