

## 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.  $I = \frac{Q}{t} = \frac{0.6 \text{ C}}{3 \text{ s}} = \mathbf{0.2 \text{ A}}$

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

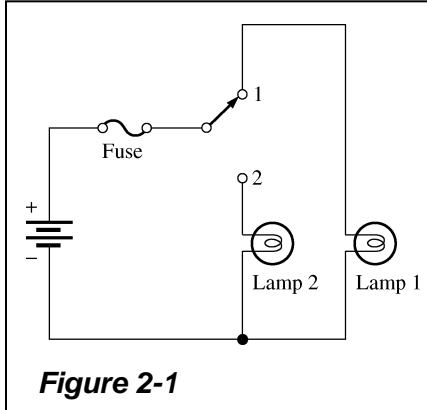
$$14. \quad Q = I \times t = (1.5\text{ A})(0.1\text{ s}) = \mathbf{0.15\text{ C}}$$

## 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:  $R_{\min} = 6800\ \Omega - 0.1(6800\ \Omega) = 6800\ \Omega - 680\ \Omega = \mathbf{6120\ \Omega}$   
 $R_{\max} = 6800\ \Omega + 680\ \Omega = \mathbf{7480\ \Omega}$   
 B:  $R_{\min} = 33\ \Omega - 0.1(33\ \Omega) = 33\ \Omega - 3.3\ \Omega = \mathbf{29.7\ \Omega}$   
 $R_{\max} = 33\ \Omega + 3.3\ \Omega = \mathbf{36.3\ \Omega}$   
 C:  $R_{\min} = 47,000\ \Omega - (0.05)(47,000\ \Omega) = 47,000\ \Omega - 2350\ \Omega = \mathbf{44,650\ \Omega}$   
 $R_{\max} = 47,000\ \Omega + 2350\ \Omega = \mathbf{49,350\ \Omega}$
17. (a) 1st band = **red**, 2nd band = **violet**, 3rd band = **brown**, 4th band = **gold**  
 (b) 330  $\Omega$ : **orange, orange, brown, (B)**  
 2.2 k $\Omega$ : **red, red, red (D)**  
 39 k $\Omega$ : **orange, white, orange (A)**  
 56 k $\Omega$ : **green, blue, orange (L)**  
 100 k $\Omega$ : **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  $\Omega$**                       (b) 472 = **4.7 k $\Omega$**   
 (c) 823 = **82 k $\Omega$**                       (d) 3K3 = **3.3 k $\Omega$**   
 (e) 560 = **56  $\Omega$**                       (f) 10M = **10 M $\Omega$**
24. **500  $\Omega$** , equal resistance on each side of the contact.

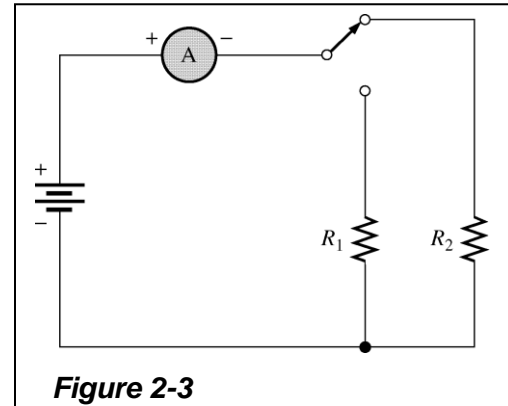
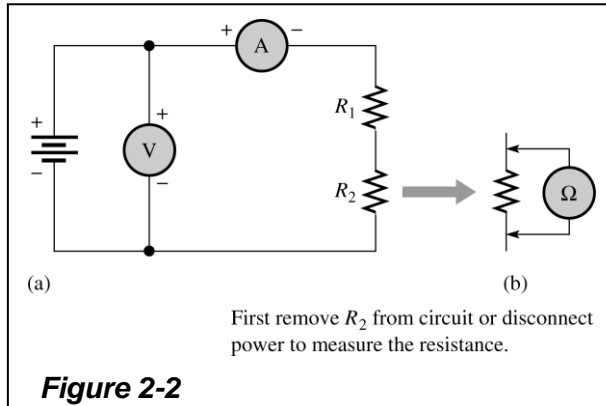
## SECTION 2-6 The Electric Circuit

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

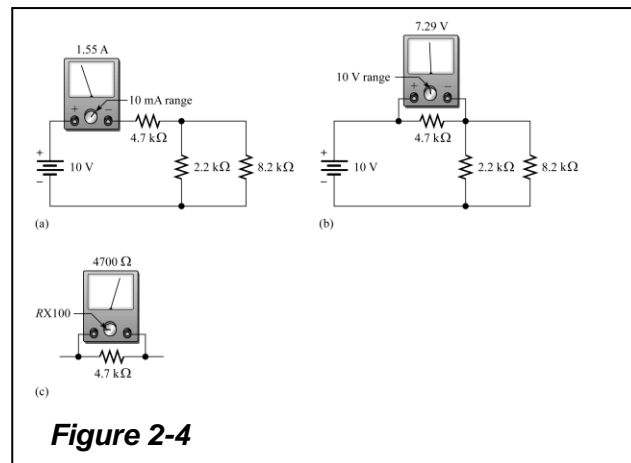


## SECTION 2-7 Basic Circuit Measurements

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.  $R = (10)(10 \Omega) = 100 \Omega$   
 33. (a)  $2(100 \Omega) = 200 \Omega$   
 (b)  $15(10 \text{ M}\Omega) = 150 \text{ M}\Omega$   
 (c)  $45(100 \Omega) = 4500 \Omega$



34. See Figure 2-4.

## ADVANCED PROBLEMS

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

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

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

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

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

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

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  $\Omega \pm 5\%$**

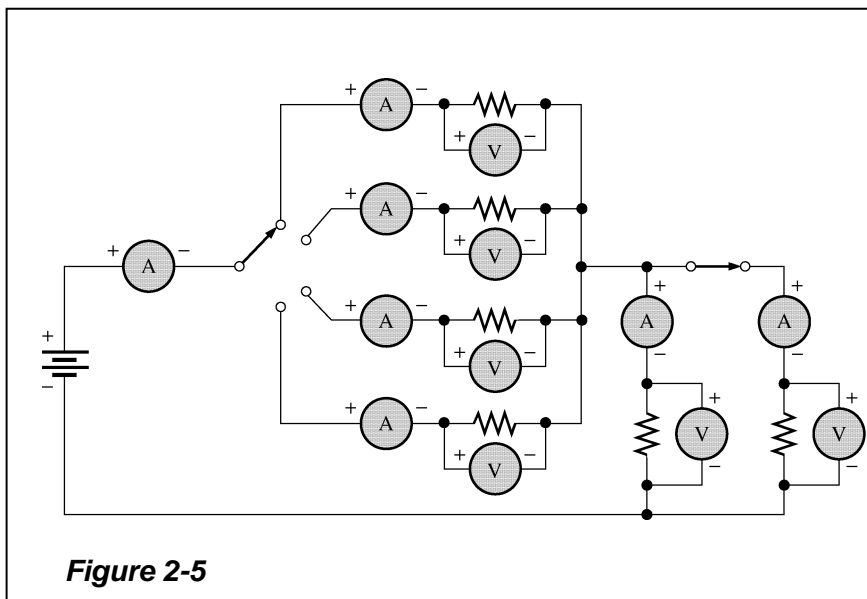
(b) 560KF = **560  $\text{k}\Omega \pm 1\%$**

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

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

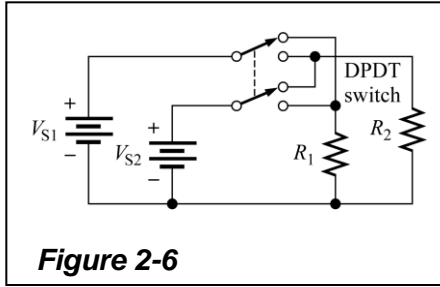
40. There is always current through  $R_5$ .

41. See Figure 2-5.



42. See Figure 2-5.

43. See Figure 2-6.



44. See Figure 2-7.

