CHAPTER 2
VOLTAGE, CURRENT, AND RESISTANCE

BASIC PROBLEMS

SECTION 2-2 Electrical Charge

1. Q = (charge per electron)(number of electrons) = $(1.6 \times 10^{-19}$ C/e)$(50 \times 10^{31}$e) = $\mathbf{80 \times 10^{12}}$ **C**

2. $(6.25 \times 10^{18}$ e/C)$(80 \times 10^{-6}$ C) = $\mathbf{5 \times 10^{14}}$ **e**

3. The magnitude of the charge on a proton (p) is equal to the magnitude of the charge on the electron (e). Therefore, $(1.6 \times 10^{-19}$ C/p)(29 p) = $\mathbf{4.64 \times 10^{-18}}$ **C**

4. $(1.6 \times 10^{-19}$ C/p)(17 p) = $\mathbf{2.72 \times 10^{-18}}$ **C**

SECTION 2-3 Voltage

5. (a) $V = \dfrac{W}{Q} = \dfrac{10\,\text{J}}{1\,\text{C}} =$ **10 V** (b) $V = \dfrac{W}{Q} = \dfrac{5\,\text{J}}{2\,\text{C}} =$ **2.5 V** (c) $V = \dfrac{W}{Q} = \dfrac{100\,\text{J}}{25\,\text{C}} =$ **4 V**

6. $V = \dfrac{W}{Q} = \dfrac{500\,\text{J}}{100\,\text{C}} =$ **5 V**

7. $V = \dfrac{W}{Q} = \dfrac{800\,\text{J}}{40\,\text{C}} =$ **20 V**

8. $W = VQ$ = (12 V)(2.5 C) = **30 J**

9. $V = \dfrac{W}{Q} = \dfrac{2.5\,\text{J}}{0.2\,\text{C}} =$ **12.5 V**

SECTION 2-4 Current

10. $I = \dfrac{Q}{t} = \dfrac{0.2\,\text{C}}{10\,\text{s}} =$ **20 mA**

11. (a) $I = \dfrac{Q}{t} = \dfrac{75\,\text{C}}{1\,\text{s}} =$ **75 A** (b) $I = \dfrac{Q}{t} = \dfrac{10\,\text{C}}{0.5\,\text{s}} =$ **20 A** (c) $I = \dfrac{Q}{t} = \dfrac{5\,\text{C}}{2\,\text{s}} =$ **2.5 A**

12. $I = \dfrac{Q}{t} = \dfrac{0.6\,\text{C}}{3\,\text{s}} =$ **0.2 A**

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

14. $Q = I \times t$ = (1.5 A)(0.1 s) = **0.15 C**

SECTION 2-5 Resistance

15. A: Blue, gray, red, silver: **6800 Ω ± 10%**
    B: Orange, orange, black, silver: **33 Ω ± 10%**
    C: Yellow, violet, orange, gold: **47,000 Ω ± 5%**

16. A: R_{min} = 6800 Ω – 0.1(6800 Ω) = 6800 Ω – 680 Ω = **6120 Ω**
    R_{max} = 6800 Ω + 680 Ω = **7480 Ω**
    B: R_{min} = 33 Ω – 0.1(33 Ω) = 33 Ω – 3.3 Ω = **29.7 Ω**
    R_{max} = 33 Ω + 3.3 Ω = **36.3 Ω**
    C: R_{min} = 47,000 Ω – (0.05)(47,000 Ω) = 47,000 Ω – 2350 Ω = **44,650 Ω**
    R_{max} = 47,000 Ω + 2350 Ω = **49,350 Ω**

17. (a) 1st band = **red**, 2nd band = **violet**, 3rd band = **brown**, 4th band = **gold**
    (b) 330 Ω; **orange, orange, brown, (B)**
    2.2 kΩ: **red, red, red (D)**
    39 kΩ: **orange, white, orange (A)**
    56 kΩ: **green, blue, orange (L)**
    100 kΩ: **brown, black, yellow (F)**

18. (a) **36.5 Ω ± 2%**
    (b) **2.74 kΩ ± 0.25%**
    (c) **82.5 kΩ ± 1%**

19. (a) Brown, black, black, gold: **10 Ω ± 5%**
    (b) Green, brown, green, silver: 5,100,000 Ω ± 10% **= 5.1 MΩ ± 10%**
    (c) Blue, gray, black, gold: **68 Ω ± 5%**

20. (a) 0.47 Ω ± 5%: **yellow, violet, silver, gold**
    (b) 270 kΩ ± 5%: **red, violet, yellow, gold**
    (c) 5.1 MΩ ± 5%: **green, brown, green, gold**

21. (a) Red, gray, violet, red, brown: 28,700 Ω ± 1% = **28.7 kΩ ± 1%**
    (b) Blue, black, yellow, gold, brown: **60.4 Ω ± 1%**
    (c) White, orange, brown, brown, brown: 9310 ± 1% = **9.31 kΩ ± 1%**

22. (a) 14.7 kΩ ± 1%: **brown, yellow, violet, red, brown**
    (b) 39.2 Ω ± 1%: **orange, white, red, gold, brown**
    (c) 9.76 kΩ ± 1%: **white, violet, blue, brown, brown**

23. (a) 220 = **22 Ω** (b) 472 = **4.7 kΩ**
    (c) 823 = **82 kΩ** (d) 3K3 = **3.3 kΩ**
    (e) 560 = **56 Ω** (f) 10M = **10 MΩ**

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.

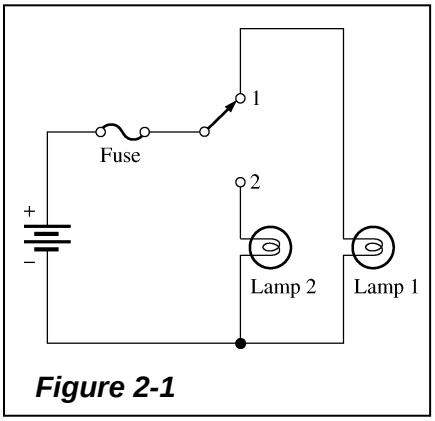

Figure 2-1

SECTION 2-7 Basic Circuit Measurements

27. See Figure 2-2(a).

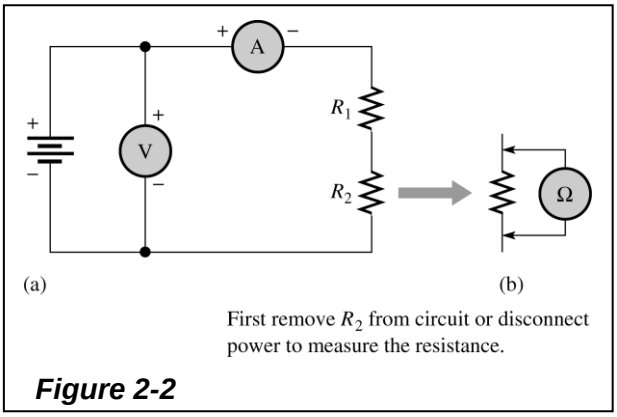

Figure 2-2

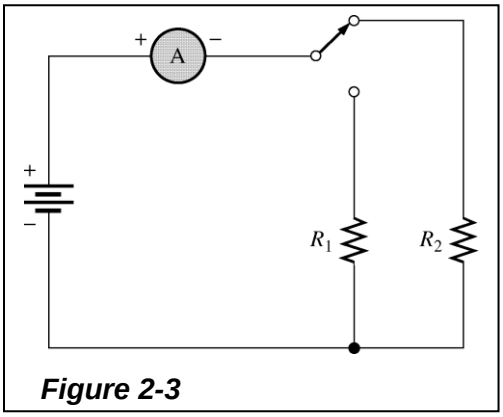

Figure 2-3

28. See Figure 2-2(b).

29. Position 1: V1 = **0 V**, V2 = $\boldsymbol{V_S}$
Position 2: V1 = $\boldsymbol{V_S}$, V2 = **0 V**

30. See Figure 2-3.

31. On the 600 V DC scale: **250 V**

32. R = (10)(10 Ω) = **100 Ω**

33. (a) 2(100 Ω) = **200 Ω**
(b) 15(10 MΩ) = **150 MΩ**
(c) 45(100 Ω) = **4500 Ω**

34. See Figure 2-4.

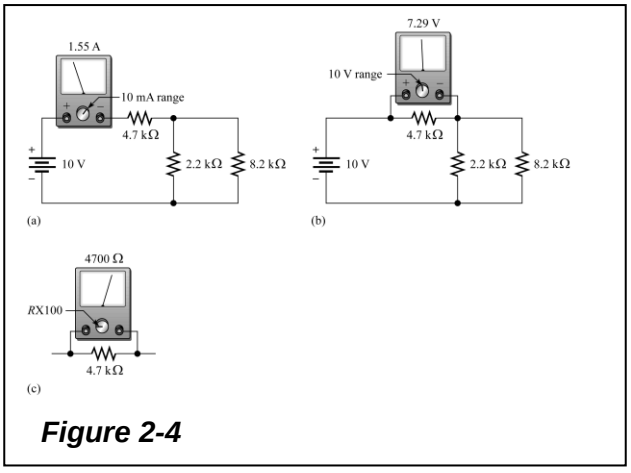

Figure 2-4

ADVANCED PROBLEMS

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

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

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

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

Q = (number of electrons) / (number of electrons/coulomb)

$Q = \dfrac{574\times10^{15}\text{ e}}{6.25\times10^{18}\text{e/C}} = 9.184\times10^{-2}\text{ C} \quad I = \dfrac{Q}{t} = \dfrac{9.184\times10^{-2}\text{C}}{250\times10^{-3}\text{s}} =$ **0.367 A**

37. Total wire length = 100 ft
Resistance per 1000 ft = (1000 ft)(6 Ω/100 ft) = 60 Ω
Smallest wire size is **AWG 27** which has 51.47 Ω/1000 ft

38. (a) 4R7J = **4.7 Ω ± 5%**
(b) 560KF = **560 kΩ ± 1%**
(c) 1M5G = **1.5 MΩ ± 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.

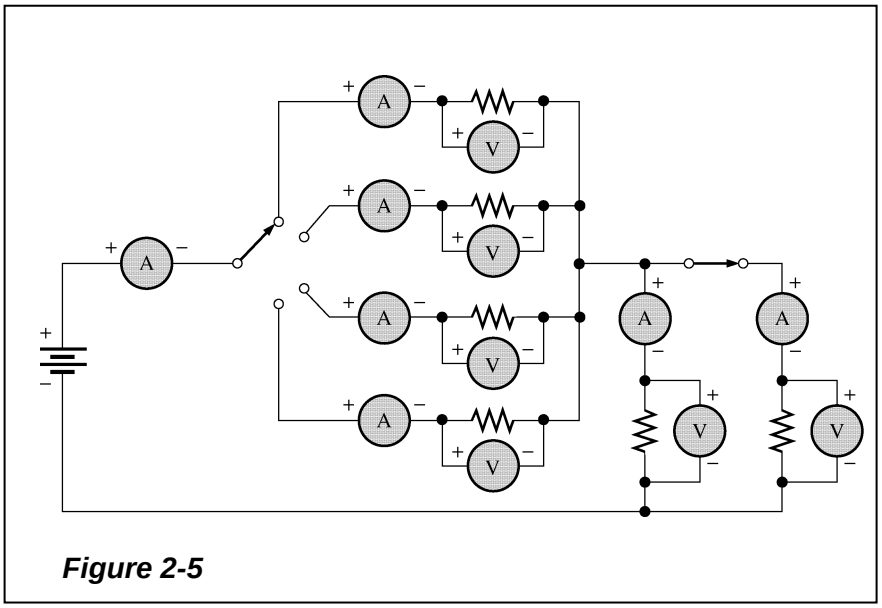

Figure 2-5

42. See Figure 2-5.

43. See Figure 2-6.

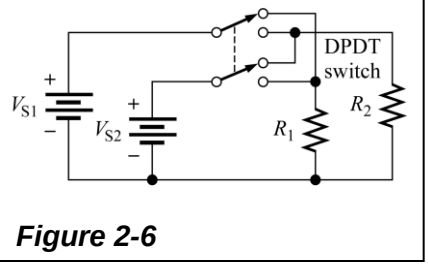

Figure 2-6

44. See Figure 2-7.

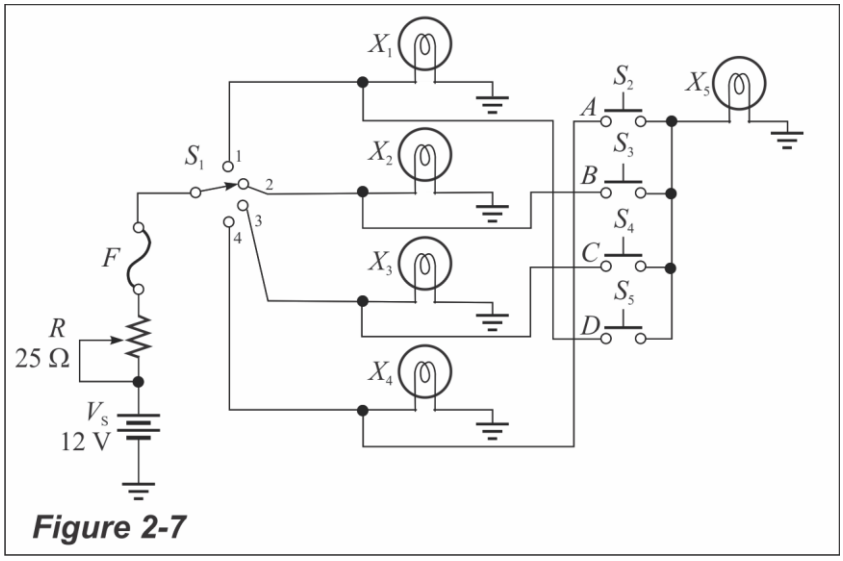

Figure 2-7