## Chapter 18

1. This is a unit conversion. Current is Coulombs/second, and $1e^{-} = 1.6x10^{-19}C$.
   Find number of electrons.

2. This is s a conversion problem. Current is Coulombs per second. You are given amperes x hours. Convert to charge.

3. Current = $\frac{Coulombs}{second}$. Change μs to seconds and find the charge on 1200 sodium ions, if each ion has a charge of +1e. Solve for current.

4. Use Ohm's Law on found on page 498.

5. Use Ohm's law and solve for V.

6. a) Find resistance using given current and voltage.
   b) Convert the given current to Coulombs/sec and then Coulombs/sec for 15 minutes.

7. a) Use Ohm's Law and solve for I.
   b) Current = $\frac{Coulombs}{second}$. Change minutes to seconds and solve for charge in couloumbs.

8. Use Ohm's Law to solve for current, and then Current = $\frac{Coulombs}{second}$ to solve for charge per second. This now becomes a unit problem. Convert the given minutes to seconds. There are $1.6x10^{-19}$ Coulombs of charge on each electron. Solve for electrons.

9. Change cm to meters and find the resistance of the line between the bird's feet. Use that and the given current to calculate V.

10. First, calculate the resistance.
    a) Reduce the given voltage by 15%, use your calculated resistance and calculate a new current.
    b) Reduce your calculated resistance by 15% and calculate a new resistance.

11. For the first part, use the given volts and current to solve for resistance. For the second part, you know energy = power x time. Change minutes to seconds and solve for energy in joules.

12. See equation 18-3 on page 500.

13. Change mm to meters and use the length and resistivity equation to solve for resistance.

14. Calculate the resistance of each using the given quantities.

15. Use equation 18-3 on page 500 and Table 18-1 on page 501.
Let $R_{(copper)} = R_{(tungsten)}$ and solve for the diameter of the tungsten wire.
The lengths will cancel out because they are equal.

16. Using $\ell$ for the length of each wire, $\pi r_1^2$ for the area of the copper and $\pi r_2^2$ for the area of tungsten, set the resistance of copper = the resistance of tungsten.
Solve for $r_1$ in terms of $r_2$.

19. See example 18-7 on page 502.

26. Change kW to Watts.

27. Change mA to Amperes.

28. Use P-IV

29. a) Use power equations found of page 503.

31. There are three power equations on page 503. Use whichever one works to answer these three questions.

32. Use a power equation to find the resistance of the element. You can assume the resistance stays the same, so solve for power at the lower voltage. More power means brighter.

34. This is a units problem. Start with $0.110/kWhr.
Change hours to years and kW to Watts. Then solve for dollars.

36. Power = energy/time. Solve for energy.

37. Figure 18-20 is on page 506. Calculate how many amperes each bulb draws.
Currents add directly.

41. Power is energy per time and P = IV. Using this information, derive an equation for current using the variables given. Substitute and solve for current, but notice that the immersion heater is only 60% efficient. Then use Ohm's Law to solve for resistance.
Now use Ohm's Law and solve for resistance.

42. Find $I_{rms}$ using Ohm's Law and the $V_{rms}$ given. See Example 18-2 page 508 or equation 18-8a for an equation to find peak I ($I_o$) from $I_{rms}$.

43. Use Ohm's Law and equation 18-8a to find each.

56. This is a conversion problem. 1 Ampere is 1 Coulomb per second.

57. Change hp to Watts and use a power equation.

71. a) Use power equations to find resistance.
b) See the Homework Hint for problem #6 from chapter 14, page 404, but use 75% of the power given in the problem.
c) Using the original value for power given and the time calculated in part (b) to convert $\frac{\cos t}{kWhr}$ to cost in cents.

73. Use equation 18-3 on page 500 and solve for length in terms of d and the variables given. Then use the density equation (Hint: V = AL) and solve for L in terms of d and the variables given. Set your two equations equal to each other and solve for d. Then use either equation to solve for L.

| Chapter 19 |
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1. a ) Solve for the total resistance. Then use the two resistors and Ohm's Law to find the current. Use the equation for terminal voltage ($V_{ab}$) on page 5521 and solve Emf.
   b ) Solve for the total resistance and using the two resistors and Ohm's Law to find the current. Use the equation for terminal voltage ($V_{ab}$) on page 521 and solve Emf.

2. When batteries are connected in series, their potentials add. Since the batteries are identical, we can say $4(\mathcal{E}\text{-}Ir) = V = IR$. Solve for r.

3. Use the terminal voltage equation and solve for r. Then use the 60 A and 2.0 V in Ohm's Law to solve for the total resistance for the circuit (which will include both $R_{starter} + r$). Then solve for $R_{starter}$.

5. Resistors in series add directly. Resistors in parallel add as inverses.

6. Resistors in series add directly. Resistors in parallel add as inverses.

7. Find the total resistance and using Ohm's Law, calculate the current. Then use Ohm's Law again to find the voltage drop across each resistor.

8. Calculate the total resistance twice; once when wired in series and once in parallel.

9. Change 1.4kΩ to Ω.

13. a) Assume the lights are identical. The voltage drop across each will be the same.
    b) Use Ohm's Law and the voltage calculated in part (a) to get resistance. Use the appropriate power equation for power dissipation.

15. Voltage drops across identical bulbs are the same, and the sum of voltages in a series circuit must equal the voltage source. Calculate the voltage drop across each bulb and use a power equation to solve for resistance.

17. The two resistors to the left of the battery are in parallel with one another. The third resistor is in series with these and the battery.

18. Calculate the resistance of each bulb. Then calculate the net resistance of both if they are wired in parallel.

19. a) and b). See step (iii) from problem 20 and Example 19-7 page 528.
    c) The voltage in the battery remains constant. Consider what happens to the current when the switch is closed, and then used P=IV to answer this question.
    d) Follow steps i-iii from problem #20 and solve this part twice: once for the current in each resistor when the switch is closed, and once for the current in each resistor when the switch is open.

20. If you leave resistance kΩ all the current values will be in mA. This problem will take take 4 steps.
    i) Find the net resistance of the circuit.
    ii) Using the net resistance and the total voltage, find the current coming out of the battery.
    iii) See Example 19-7 on page 528 and remember these three things:
        a) The voltage drop across any resistor = the current x that resistance
        b) When current crosses a resistor in series, voltage drops but the current remains the same.
        c) When current goes across resistors in parallel, voltage stays the same and the current splits.
    iv) Potential difference = the current going across the net resistance between A and B times the net resistance between A and B.

21. a) and b) See step (iii) from problem 20 and Example 19-7 page 528. If you have trouble answering this question qualitatively, make up numbers and solve the problem.

25. a) Use the top loop and the Loop rule. Currents are given in example 19-8 page 530.
    b) For the 80V battery, the terminal voltage is the potential difference between points g and e. For the 45V battery, the terminal voltage is the potential difference between points d and b. This is because the 1Ω resistors next to each represent the resistance of the battery.

28. Use Example 19-8 on pages 566 and 567.

36. Use Example 19-8 on pages 566 and 567.

37. Capacitors wired in parallel add directly, and capacitors wired in series add as the inverse.

40. Maximum = parallel and minimum = series.

41. $C_2$ and $C_3$ are in series with one another, and together, they are parallel to $C_1$. Capacitors wired in parallel add directly, and capacitors wired in series add as the inverse.

42. Charge for each capacitor is found using $Q = CV$. Capacitors $C_2$ and $C_3$ are in series, and the charge on the series is the same as the charge across each individual capacitor. Find the net charge across C1 and add that to the net charge across $C_2$ and $C_3$.

44. b) and c) Find the equivalent capacitance and solve for Q.

70. Find the voltage drop across each wire using Ohm's Law. The sum of the voltage drops across the entire circuit must equal the source voltage.