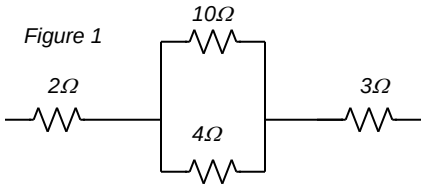
Physics

Unit 9: Electric Circuits

1. *What is emf, kWh, rms, current, resistance, resistivity, and potential difference?*
2. *How do you use ammeters and voltmeters?*
3. *Know what factors your body's sensitivity to electricity?*
4. *Use Kirchhoff's Laws to solve problems.*
5. *A 2-A current flows through a circuit. How much charge passes a point during 1 minute?*
6. *A flashlight bulb is connected to a 3.0 V battery and a current of .020A flows. What is the resistance of the bulb's filament?*
7. *The resistivity of a metal is $3x10^{-8}$ Ωm. The radius of the wire is 2 mm. If the length of the wire is 3 m, what is the resistance of the wire?*
8. *A 2-A current flows through a circuit with a resistance of 5Ω. How much energy is dissipated in 3 s?*
9. *A 2-A current flows through a circuit that consists of a resistor and an ideal battery. If the battery supplies 400 W, how large is the resistor?*
10. *An AC voltage has a rms value of 5.66. Determine the peak value of the voltage?*
11. *Three resistors, 2-Ω, 3-Ω, 4-Ω, are connected in series. What is the equivalent resistance of the series?*
12. *Two 10-Ω and four 30-Ω light bulbs are connected in series with a 9 V battery. What is the current that passes through each bulb?*
13. *Three resistors, 2-Ω, 3-Ω, 4-Ω, are connected in parallel. What is the equivalent resistance of the combination?*
14. *What is the equivalent resistance of figure 1*

Figure 1



15. *A non-ideal battery has a 12.0 V emf and internal resistance of 4Ω. Determine the terminal voltage of the battery when 2 A is drawn.*
16. *An uncharged 10 F capacitor and a resistor are connected in series to a 9 V battery and an open switch to form a simple RC circuit. The switch is closed at t = 0s. The time constant of the circuit is 30 s. A) How big is the resistor and B)what is the maximum charge on the capacitor?*

5. $I = \frac{q}{t}$
   $2A = \frac{q}{60\ s}$
   $\boldsymbol{q = 120\ C}$
6. $V = IR$
   $3\ V = (0.02\ A)R$
   $\boldsymbol{R = 150\ \Omega}$
7. $R = \rho\left(\frac{L}{A}\right)$
   $A = \pi r^2 = \pi(0.002\ m)^2 = 1.256 \times 10^{-5}\ m^2$
   $R = (3 \times 10^{-8}\ \Omega m)\left(\frac{3\ m}{1.256 \times 10^{-5}\ m^2}\right) = \boldsymbol{7.16 \times 10^{-3}\ \Omega}$
8. $P = I^2R$
   $P = (2\ A)^2(5\ \Omega) = 20\ W$
   $P = \frac{W}{t}$
   $20\ W = \frac{W}{3\ s}$
   $\boldsymbol{W = 60\ J}$
9. $P = I^2R$
   $400\ W = (2\ A)^2R$
   $\boldsymbol{R = 100\ \Omega}$
10. $V_{rms} = \frac{V}{\sqrt{2}}$
    $5.66\ V = \frac{V}{\sqrt{2}}$
    $\boldsymbol{V = 8.0\ V}$
11. $R_S = R_1 + R_2 + R_3$
    $R_S = 2\ \Omega + 3\ \Omega + 4\ \Omega = \boldsymbol{9\ \Omega}$
12. $R_S = R_1 + R_2 + R_3 + R_4 + R_5 + R_6$
    $R_S = 2 \cdot (10\ \Omega) + 4 \cdot (30\ \Omega) = 140\ \Omega$
    $V = IR$
    $9\ V = I(140\ \Omega)$
    $\boldsymbol{I = 6.43 \times 10^{-2}\ A}$
13. $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
    $\frac{1}{R_P} = \frac{1}{2\ \Omega} + \frac{1}{3\ \Omega} + \frac{1}{4\ \Omega}$
    $\frac{1}{R_P} = \frac{6}{12\ \Omega} + \frac{4}{12\ \Omega} + \frac{3}{12\ \Omega} = \frac{13}{12\ \Omega}$
    $\boldsymbol{R_P = \frac{12}{13}\ \Omega}$
14. *Combine Parallel (middle)*
    $\frac{1}{R_P} = \frac{1}{10\ \Omega} + \frac{1}{4\ \Omega} = \frac{7}{20\ \Omega}$
    $R_P = \frac{20}{7}\Omega$
    Combine Series
    $R_S = 2\ \Omega + \frac{20}{7}\ \Omega + 3\ \Omega = \boldsymbol{\frac{55}{7}\ \Omega}$
15. *Internal*
    $V = IR = (2\ A)(4\ \Omega) = 8\ V$
    Terminal
    $terminal = emf - internal$
    $12\ V - 8\ V = \boldsymbol{4\ V}$
16. *a.* $\tau = RC$
    $30\ s = R(10\ F)$
    $\boldsymbol{R = 3\ \Omega}$
    b. $Q = CV$
    $Q = (9\ V)(10\ F) = \boldsymbol{90\ C}$