Phys 132 - Fund Phys 2 - Homework 7
Due Mon, Feb 12, 2007

Name: Solutions

1. How many electrons flow through a battery that delivers a current of 3.0 A for 12 s?

a) 4
b) 36
c) 4.8×10^{15}
d) 6.4×10^{18}
e) 2.2×10^{20}

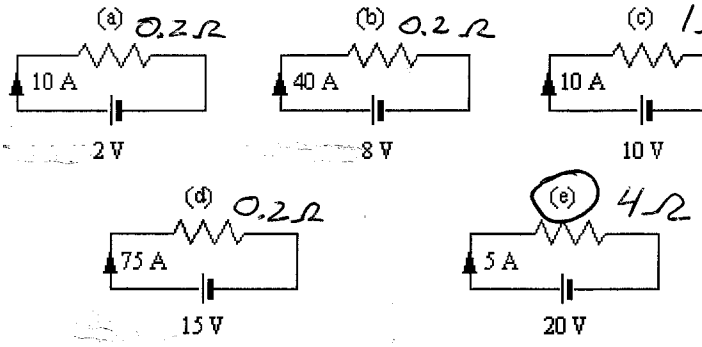
$Q = I\Delta t = (3.0\,A)(12\,s) = 36\,C$

$N = \frac{Q}{e} = \frac{36\,C}{1.6\times10^{-19}\,C} = 2.25\times10^{20}$ electrons

2. The potential difference across the ends of a wire is doubled in magnitude. If Ohm's law is obeyed, which one of the following statements concerning the resistance of the wire is true?

a) The resistance is one half of its original value.
b) The resistance is twice its original value.
c) The resistance is not changed.
d) The resistance increases by a factor of four.
e) The resistance decreases by a factor of four.

3. Which one of the following circuits has the largest resistance?



4. When a light bulb is connected to a 4.5 V battery, a current of 0.16 A passes through the bulb filament. What is the resistance of the filament?

a) 440 Ω
b) 28 Ω
c) 9.3 Ω
d) 1.4 Ω
e) 0.72 Ω

$R = \frac{V}{I} = \frac{4.5\,V}{0.16\,A} = 28.1\,\Omega$

5. Determine the length of a copper wire that has a resistance of 0.172 Ω and cross-sectional area of 1×10^{-4} m^2. The resistivity of copper is 1.72×10^{-8} Ω • m.

a) 0.1 m
b) 10 m
c) 100 m
d) 1000 m
e) 10 000 m

$R = \frac{\rho L}{A} \rightarrow L = \frac{RA}{\rho} = \frac{(0.172\,\Omega)(1\times10^{-4}\,m^2)}{1.72\times10^{-8}\,\Omega\cdot m} = 1000\,m$

6. Complete the following statement: The unit *kilowatt* • *hour* measures
   a) current.
   (b) energy.
   c) power.
   d) potential drop.
   e) voltage.

It is energy as sold by the power company.

7. A 40-W and a 60-W light bulb are designed for use with the same voltage. What is the ratio of the resistance of the 60-W bulb to the resistance of the 40-W bulb?
   a) 1.5
   (b) 0.67
   c) 2.3
   d) 0.44
   e) 3.0

$P = \frac{V^2}{R} \rightarrow R = \frac{V^2}{P} \rightarrow \frac{R_{60}}{R_{40}} = \frac{40}{60} = 0.67$

8. A computer monitor uses 2.0 A of current when it is plugged into a 120 V outlet. The monitor is never turned off. What is the yearly cost of operating the monitor if the cost of electricity is \$0.12/kWh?
   a) \$14
   b) \$21
   c) \$98
   d) \$170
   (e) \$250

$P = IV = (2.0\,A)(120\,v) = 240\,W$

$Energy = P\Delta t = (240\,W)(1\,year)\left(\frac{1\,kW}{1000\,W}\right)\left(\frac{8766\,hr}{1\,year}\right) = 2104\,kWh$

9. A 4-A current is maintained in a simple circuit with a total resistance of 2 Ω. How much energy is dissipated in 3 seconds?
   a) 3 J
   b) 6 J
   c) 12 J
   d) 24 J
   (e) 96 J

$P = I^2R = (4\,A)^2(2\,\Omega) = 32\,W$

$Energy = P\Delta t = (32\,w)(3\,s) = 96\,J$

10. Which one of the following statements concerning resistors **in series** is true?
    a) The voltage across each resistor is the same.
    (b) The current through each resistor is the same.
    c) The power dissipated by each resistor is the same.
    d) The rate at which charge flows through each resistor depends on its resistance.
    e) The total current through the resistors is the sum of the current through each resistor.

11. Three resistors, 50-Ω, 100-Ω, 200-Ω, are connected in series in a circuit. What is the equivalent resistance of this combination of resistors?
    (a) 350 Ω
    b) 250 Ω
    c) 200 Ω
    d) 120 Ω
    e) 29 Ω

$R_T = R_1 + R_2 + R_3$

$= 50\,\Omega + 100\,\Omega + 200\,\Omega = 350\,\Omega$

12. Two 15-Ω and three 25-Ω light bulbs and a 24 V battery are connected in a series circuit. What is the current that passes through each bulb?

a) 0.23 A
b) 0.51 A
c) 0.96 A
d) 1.6 A
e) The current will be 1.6 A in the 15-Ω bulbs and 0.96 A in the 25-Ω bulbs.

$R_T = 15\Omega + 15\Omega + 25\Omega + 25\Omega + 25\Omega = 105\Omega$

$I = V/R = 24V/105\Omega = 0.229\ A$

13. Three resistors, 6.0-Ω, 9.0-Ω, 15-Ω, are connected in parallel in a circuit. What is the equivalent resistance of this combination of resistors?

a) 30 Ω
b) 10 Ω
c) 3.8 Ω
d) 2.9 Ω
e) 0.34 Ω

$\frac{1}{R_p} = \frac{1}{6\Omega} + \frac{1}{9\Omega} + \frac{1}{15\Omega} = 0.344 \rightarrow R_p = 2.9\Omega$

14. A non-ideal battery has a 6.0-V *emf* and an internal resistance of 0.6 Ω. Determine the terminal voltage when the current drawn from the battery is 1.0 A.

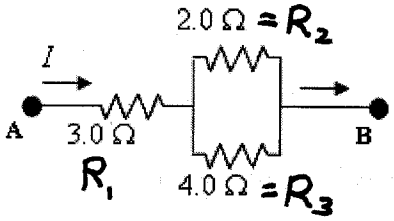
a) 5.0 V
b) 6.0 V
c) 5.4 V
d) 6.6 V
e) 5.8 V

$V_{terminal} = V_0 - IR_{int} = (6.0\ V) - (1.0A)(0.6\Omega)$

$= 5.4\ V$

Use the following to answer questions 15-16:

Three resistors are connected as shown in the figure. The potential difference between points **A** and **B** is 26 V.



	R	I	V
R_1	3Ω	③ 6 A	④ 18 V
R_2	2Ω	⑥ 4A	⑤ 8 V
R_3	4Ω	⑦ 2A	⑤ 8 V
Tot	① 4.33Ω	② 6 A	26 V

15. What is the equivalent resistance between the points **A** and **B**?

a) 3.8 Ω
b) 4.3 Ω
c) 5.1 Ω
d) 6.8 Ω
e) 9.0 Ω

$R_T = R_1 + \underbrace{\frac{1}{\frac{1}{R_2} + \frac{1}{R_3}}}_{\text{Parallel}} = 4.33\Omega$

Series

16. How much current flows through the 2-Ω resistor?

a) 2.0 A
b) 4.0 A
c) 6.0 A
d) 8.7 A
e) 10.0 A

① $R_{Tot} = 4.33\Omega$

② $I_{Tot} = \frac{26V}{4.33\Omega} = 6A$

③ $I_1 = I_{Tot} = 6A$

④ $V_1 = I_1 R_1 = (6A)(3\Omega) = 18V$

⑤ $V_{23} = V_T - V_1 = 26V - 18V = 8V$

⑥ $I_2 = V_2/R_2 = 8V/2\Omega = 4A$