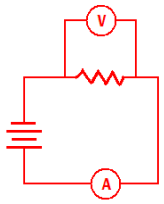
Name: _____Answer Key_____ Date: _____

Honors Physics Test #10 Review

Electric Circuits

1. Read Chapters 18, 19 & 20
2. Terms to know: circuit, current, voltage, potential difference, resistance, Ohm's Law, power, charge, energy, schematic, parallel circuit, series circuit, equivalent resistance, ground, short circuit, open circuit, ammeter, voltmeter, combination circuit, resistance – capacitance circuit.
3. Be able to calculate voltage, current, resistance, power, energy and number of electrons.
4. Sketch a schematic for a simple circuit including a battery and a resistor. Include an ammeter and a voltmeter placed properly.

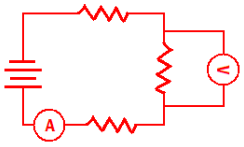


Voltmeter connect in parallel – touch to the sides

Ammeter connect in series – in the flow

5. Sketch a schematic for a series circuit including a battery and three resistors. Include an ammeter capable of reading the total current and a voltmeter capable of reading the voltage drop across the middle resistor.

Resistors in series have only one path for current to flow

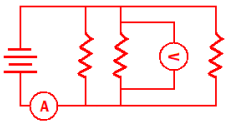


Voltmeter connect in parallel – touch to the sides

Ammeter connect in series – in the flow

6. Sketch a schematic for a parallel circuit including a battery and three resistors. Include an ammeter capable of reading the total current and a voltmeter capable of reading the voltage drop across the middle resistor.

Resistors in parallel have separate paths for current to flow



Voltmeter connect in parallel – touch to the sides

Ammeter connect in series – in the flow

7. How is an ammeter connected into a circuit? How is a voltmeter connected into a circuit?
   An ammeter is connected in series into a circuit, while a voltmeter is connected in parallel into a circuit.
8. If a circuit has a <u>one amp</u> current flowing through it, how many coulombs of <u>charge</u> pass a given point in <u>one second</u>? How many <u>electrons</u> pass that point in one second?

$$q = I\,t = (1\text{ A})(1\text{ s}) = 1\text{ C}$$

$$1C\left(\frac{1e}{1.60\times10^{-19}C}\right) = 6.25\times10^{18}\text{ electrons}$$

I = q/t, rearranged

Convert between coulombs and elementary charges

9. What four factors affect the resistance of a wire? How do they affect it?

   Length, Area, Temperature, Material

   Increase length, increase R Increase Area, decrease R Increase temp, increase R

10. Complete the following statements:
    a. A short, fat, cold wire is a GOOD conductor. (good/bad)
    b. A short, fat, cold wire is a BAD resistor. (good/bad)

Small length, large cross sectional area makes it easier for charges to flow

11. Adding an extra resistor to an existing series circuit will cause
    a. the total current to (increase/decrease/remain the same)
    b. while the total resistance will (increase/decrease/remain the same).
    c. The voltage drops across the remaining resistors will (increase/decrease/remain the same).

$R_{eq} = R_1 + R_2 + \ldots$
More resistors more resistance which decreases total current

$V_{tot} = V_1 + V_2 + \ldots$
Battery is shared by more things

12. Adding an extra resistor to an existing parallel circuit will cause
    a. the total current to (increase/decrease/remain the same)
    b. while the total resistance will (increase/decrease/remain the same).
    c. The voltage drops across the remaining resistors will (increase/decrease/remain the same).

More paths means less total resistance and more total current (extra current goes to new path)

$V_{tot} = V_1 = V_2 = \ldots$
Each R has its own connection

13. Three identical light bulbs are connected to a battery and light up. Then, one of them burns out. What will happen to the other two light bulbs
    a) if the three bulbs were connected in parallel?
    The other two bulbs will remain lit, with the same brightness.

Each bulb has its own path and isn't affected by the others.

    b) if the three bulbs were connected in series?
    The other two bulbs will go out.

Only one path so the circuit is broken and current stops.

Directions: Read each question carefully and record your answers in the space provided. Be sure to show all work! Answers should be in significant figures. You will be graded on proper use of the GUESS method. **These will be the same directions on the test. Practice the GUESS method now.**

14. A potential drop of 50. volts is measured across a 250 ohm resistor. What is the power developed in the resistor?

$$P = \frac{V^2}{R} = \frac{(50.V)^2}{250\Omega} = 10.W$$

15. A 1.00 meter length of nichrome wire with a cross-sectional area of 7.85×10^{-7} meters^2 is connected to a 1.5 volt battery.
    a. Calculate the resistance of the wire.

Resistivity is listed on the reference tables.

$$R = \frac{\rho L}{A} = \frac{(150. \times 10^{-8}\,\Omega \cdot m)(1.00m)}{7.85 \times 10^{-7} m^2} = 1.91\ \Omega$$

    b. Determine the current in the wire.

$$I = \frac{V}{R} = \frac{1.5V}{1.91\Omega} = .79\ A$$

16. A light bulb attached to a 120 volt source of potential difference draws a current of 1.25 amperes for 35.0 seconds. Calculate how much electrical energy is used by the bulb.

$$W = IVt = (1.25A)(120V)(35.0s) = 5300J$$

17. A 4.0 Ω resistor, an 8.0 Ω resistor, and a 12.0 Ω resistor are connected in with a 24.0 volt battery.

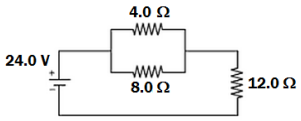
a. Calculate the equivalent resistance.

Series	Parallel
$R_{eq} = R_1 + R_2 + R_3$ $R_{eq} = 4.0\,\Omega + 8.0\,\Omega + 12.0\,\Omega$ $= 24.0\Omega$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ $\frac{1}{R_{eq}} = \frac{1}{4.0\Omega} + \frac{1}{8.0\Omega} + \frac{1}{12.0\Omega}$ $R_{eq} = 2.2\Omega$

b. Calculate the current in each resistor.

Series	Parallel
$I_T = \frac{V_T}{R_T} = \frac{24.0V}{24.0\Omega} = 1.00A$ $I_T = I_1 = I_2 = I_3 = 1.00A$	$I_1 = \frac{V}{R} = \frac{24.0V}{4.0\Omega} = 6.0A$ $I_2 = \frac{V}{R} = \frac{24.0V}{8.0\Omega} = 3.0A$ $I_3 = \frac{V}{R} = \frac{24.0V}{12.0\Omega} = 2.00A$

18. Calculate the equivalent resistance of the combination circuit shown.



Honors!

Parallel:

$\frac{1}{R_{eq}} = \frac{1}{R_{eq}} + \frac{1}{R_{eq}} = \frac{1}{4.0\Omega} + \frac{1}{8.0\Omega}$

$R_{eq} = 2.7\Omega$

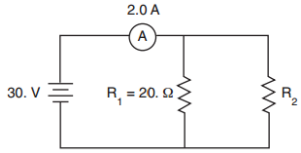
Series:

$R_{eq} = R_1 + R_2 = 2.7\Omega + 12.0\Omega = 14.7\Omega$

Calculate the R_{eq} of smaller parallel segment first and then the series segment.

19. A 20. ohm resistor, R_1, and a resistor of unknown resistance, R_2, are connected in parallel to a 30. volt source, as shown in the circuit diagram below. An ammeter in the circuit reads 2.0 A.

a. Calculate the equivalent resistance of the circuit.



$$R_{eq} = \frac{V_T}{I_T} = \frac{30V}{2.0A} = 15\Omega$$

b. Calculate the resistance of resistor R_2.

$\frac{1}{R_2} = \frac{1}{R_{eq}} - \frac{1}{R_1} = \frac{1}{15\Omega} - \frac{1}{20.\Omega}$

$R_2 = 60.\Omega$

20. How much time is required for an operating 100 watt light bulb to dissipate 10 joules of electrical energy?

(A) 1 s (B) 1,000 s (C) 10 s (D) 0.1 s

$t = \frac{W}{P} = \frac{10J}{100W}$

21. A metal wire has length L and cross sectional area A. The resistance of the wire is directly proportional to

(A) $L + A$ (B) $\frac{A}{L}$ (C) $\frac{L}{A}$ (D) $L \times A$

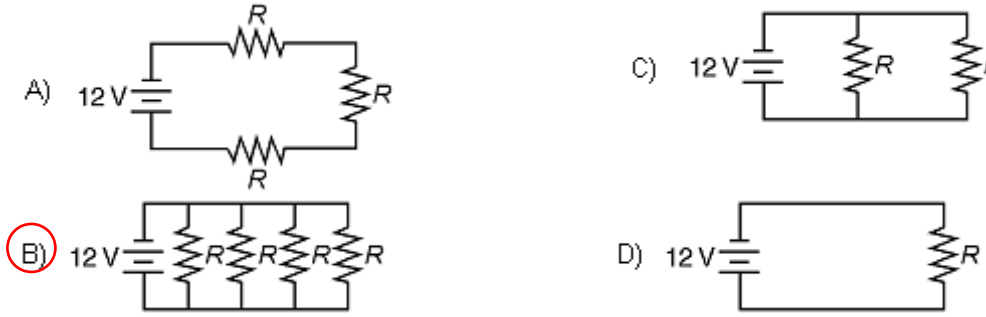
$R = \frac{\rho L}{A}$

22. The watt • second is a unit of

(A) power (B) energy (C) potential difference (D) electric field strength

$W = P \cdot t$

23. Identical resistors (R) are connected across the same 12 volt battery. Which circuit uses the *greatest* power?



Parallel is always better than series.

The more paths you have the easier it is.

24. A manufacturer recommends that the longer the extension cord used with an electric drill, the thicker (heavier gauge) the extension cord should be. This recommendation is made because the resistance of a wire varies

(A) directly with length and inversely with cross-sectional area
(B) inversely with length and directly with cross-sectional area
(C) inversely with both length and cross-sectional area
(D) directly with both length and cross-sectional area

$$R = \frac{\rho L}{A}$$

25. A 0.500 meter length of wire with a cross-sectional area of 3.14×10^{-6} meters squared is found to have a resistance of 2.53×10^{-3} ohms. According to the resistivity chart, the wire could be made of

(A) copper (B) aluminum (C) nichrome (D) silver

$$\rho = \frac{RA}{L} = \frac{(2.53\times10^{-3}\Omega)(3.14\times10^{-6}m^2)}{0.500m} = 1.59\times10^{-8}\Omega\cdot m$$

26. What is the current in an electric circuit if 10. coulombs of charge are transferred through the circuit in 5.0 seconds?

(A) 15 A (B) 2.0 A (C) 0.50 A (D) 50. A

$$I = \frac{q}{t} = \frac{10.C}{5.0s}$$

27. Compared to insulators, metals are better conductors of electricity because metals contain more free

(A) electrons (B) protons (C) negative ions (D) positive ions

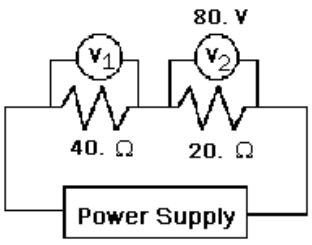
Electricity is moving charges – electrons are the ones that move

28. How much current flows through a 12 ohm flashlight bulb operating at 3.0 volts?

(A) 0.25 A (B) 3.0 A (C) 4.0 A (D) 0.75 A

$$I = \frac{V}{R} = \frac{3.0V}{12\Omega}$$

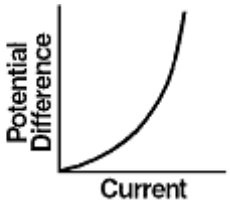
29. In the circuit shown below, voltmeter V_2 reads 80. volts. What is the reading of voltmeter V_1?

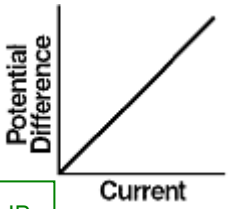


$$I_2 = \frac{V_2}{R_2} = \frac{80.V}{20.\Omega} = 4.0A$$
$$I_T = I_1 = I_2 = 4.0A$$
$$V_1 = I_1R_1 = (4.0A)(40.\Omega)$$

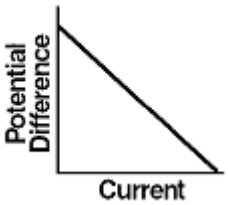
(A) 80. V (B) 40. V (C) 160 V (D) 20. V

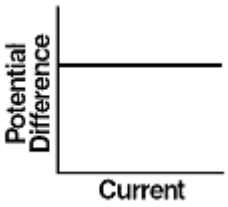
30. Which graph *best* represents the relationship between the potential difference across a conductor and the current through the conductor at constant temperature?

A) 

B) 

$V = IR$

C) 

D) 

31. One watt is equivalent to one

(A) N/m (B) J • s (C) J/s (D) N • s

$P = \frac{W}{t}$

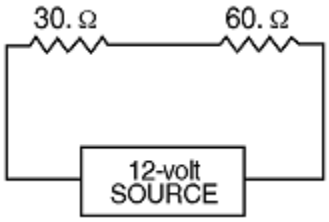
32. While operating at 120 volts, an electric toaster has a resistance of 15 ohms. What is the power used by the toaster?

(A) 120 W (B) 960 W (C) 8.0 W (D) 1,800 W

$P = \frac{V^2}{R} = \frac{(120V)^2}{15\Omega}$

33. A 30. ohm resistor and a 60. ohm resistor are connected in an electric circuit as shown below.

$I_t = I_1 = I_2$



Compared to the electric current through the 30. ohm resistor, the electric current through the 60. ohm resistor is

(A) the same (B) larger (C) smaller

34. If a 15 ohm resistor is connected in parallel with a 30. ohm resistor, what is the equivalent resistance?

(A) 45 Ω (B) 2.0 Ω (C) 15 Ω (D) 10. Ω

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{15\Omega} + \frac{1}{30.\Omega}$

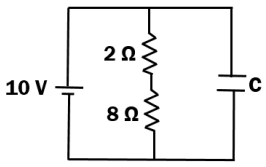
35. A physics student is given three 12 ohm resistors with instructions to create the circuit that would have the *lowest* possible resistance. The correct circuit would be a

(A) series circuit with an equivalent resistance of 36 Ω
(B) parallel circuit with an equivalent resistance of 4.0 Ω
(C) parallel circuit with an equivalent resistance of 36 Ω
(D) series circuit with an equivalent resistance of 4.0 Ω

Parallel is always better – more paths

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{12\Omega} + \frac{1}{12\Omega} + \frac{1}{12\Omega}$

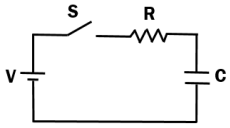
36. A resistor-capacitor circuit is connected as shown.



After a long time, the current in the 2 Ω resistor is

(A) 0 (B) 10 A (C) 8 A (D) 2 A (E) 1 A

Questions 37 through 39 refer to the following diagram.



37. Immediately after the switch S is closed, what is the voltage across the resistor R?

(A) zero (B) V (C) R (D) C (E) V/R

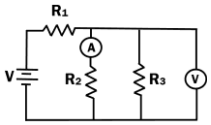
38. Immediately after the switch S is closed, what is the current in the circuit?

(A) zero (B) V (C) R (D) C (E) V/R

39. A very long time after the switch S has been closed, what is the current in the circuit?

(A) zero (B) V (C) R (D) C (E) V/R

Questions 40 through 42 refer to the following diagram. The resistors R_1, R_2, and R_3 each have a different value.



40. Through which resistor(s) will the total current in the circuit pass?

(A) R_1, R_2, R_3 (B) R_1 only (C) R_2 only (D) R_3 only (E) R_2 and R_3 only

41. Through which resistor(s) will the ammeter read the current?

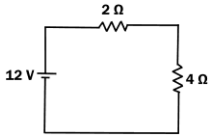
(A) R_1, R_2, R_3 (B) R_1 only (C) R_2 only (D) R_3 only (E) R_2 and R_3 only

42. Across which resistor(s) will the voltmeter correctly read the voltage?

(A) R_1, R_2, R_3 (B) R_1 only (C) R_2 only (D) R_3 only (E) R_2 and R_3 only

Questions 43 through 45 refer to the following diagram.

Two resistors of 2 ohms and 4 ohms are placed in series with a 12 volt battery.



43. Which of the following statements is true?

(A) The 2 Ω will get more current than the 4 Ω resistor since it has less resistance
(B) The 4 Ω will get more current than the 2 Ω resistor since it has less resistance
(C) The voltage drop across the 2 Ω and 4 Ω will be the same
(D) The voltage drop across the 2 Ω resistor will be more than that across the 4 Ω resistor
(E) The voltage drop across the 4 Ω resistor will be more than that across the 2 Ω resistor

44. The current in the 2 Ω resistor is

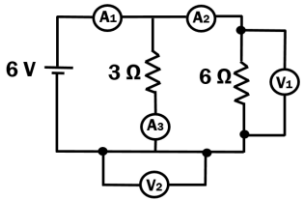
(A) 6 A (B) 4 A (C) 3 A (D) 2 A (E) 1 A

45. The voltage across the 4 Ω resistor is

(A) 3 V (B) 4 V (C) 6 V (D) 8 V (E) 12 V

Questions 46 through 48 refer to the following.

Two resistors of 3 Ω and 6 Ω are placed in parallel with a 6 V battery. Three ammeters and two voltmeters are placed in the circuit as shown.



46. Which of the following statements is true of the voltmeters?

(A) Voltmeter 1 and voltmeter 2 will read the same voltage.
(B) Voltmeter 1 will read 6 V
(C) Voltmeter 2 will read 6 V
(D) Voltmeter 2 will read the correct voltage across the 3 Ω resistor
(E) Both voltmeters will read the correct voltage across the 6 Ω resistor

47. Which ammeter will read the highest amount of current?

(A) Ammeter 1
(B) Ammeter 2
(C) Ammeter 3
(D) All three will read the same current
(E) All three will read zero current

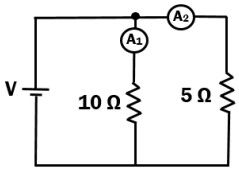
48. What is the correct reading on ammeter 2?

(A) 0 A (B) 1 A (C) 2 A (D) 3 A (E) 6 A

49. A 40 Ω resistor in a closed circuit has 20 volts across it. The current flowing through the resistor is

(A) 0.5 A (B) 2 A (C) 20 A (D) 80 A (E) 800 A

50. Two ammeters are placed in the circuit above with the two resistors shown. If A_1 is the reading on ammeter 1 and A_2 is the reading on ammeter 2, which of the following statements is true?



(A) $A_1 = A_2$ (B) $A_1 > A_2$ (C) $A_1 < A_2$ (D) $A_1 = 0$ (E) $A_2 = 0$

Answers:

14. P = 10. W
15. a. R = 1.91 Ω
b. I =0.79 A
16. W = 5300 J
17. a) R_{eq} series 24.0 Ω
R_{eq} parallel 2.2 Ω
b) I series 1.00 A
Parallel
I_1 = 6.0 A
I_2 = 3.0 A
I_3 = 2.00 A
18. R_{eq} = 14.7Ω
19. a) 15 Ω
b) 60. Ω

Answers:

20. D
21. C
22. B
23. B
24. A
25. D
26. B
27. A
28. A
29. C
30. B
31. C
32. B
33. A
34. D
35. B
36. E
37. B
38. E
39. A
40. B
41. C
42. E
43. E
44. D
45. D
46. B
47. A
48. B
49. A
50. C