Name: _____
Hour: ____ Date: _____

Physics: *Electromagnetism HW*

Set 1: Coulomb's Law

1. A balloon rubbed against denim gains a charge of –1.1 μC. What is the magnitude of the electric force between the balloon and the denim when the two are separated by 1.35 cm?

2. Two electrostatic point charges of +72.0 μC and +57.0 μC repel each other with a force of 115 N. Find the distance between the two charges.

3. Two identical conducting spheres are placed with their centers 0.40 m apart. One is given a charge of +15.0 nC and the other is given a charge of –25.0 nC.

   a. Find the electric force exerted on one sphere by the other.

   b. The spheres are then connected by a conducting wire. After equilibrium is reached, find the electric force between the two spheres.

Set 2: Capacitance

4. A 5.00 μF capacitor is connected to a 15.0 V battery.

   a. What is the charge on each plate of the capacitor?

   b. If this capacitor is connected to a 6.00 V battery, how much electrical potential energy is stored?

ANSWERS: 1. 60. N 2. 0.567 m 3a. 2.1×10^{-5} N (attractive) 3b. 1.4×10^{-6} N (repulsive) 4a. 7.50×10^{-5} C 4b. 9.00×10^{-5} J

5. A capacitor acquires a charge of 6.50 μC on each plate when charged by a potential difference of 1.07 V.

a. Find its capacitance.

b. How much electrical potential energy is stored when this capacitor is connected to a 9.00 V battery?

6. A capacitor has a capacitance of 3.00 pF.

a. What potential difference would be required to store 37.5 pC?

b. How much charge is stored when the potential difference is 4.65 V?

7. A capacitor has a capacitance of 2.17 nF. If a 1.50 V battery is connected to this capacitor, how much electrical potential energy would it store?

8. An air-dielectric parallel-plate capacitor has an area of 3.0 cm^2, and the plates are separated by 1.5 mm.

a. What is the capacitance?

b. How much charge does this capacitor store when connected to a 3.0 V battery?

9. A 19.4 pF capacitor has a plate area of 5.5 cm^2 and a plate separation of 0.82 mm. Determine the dielectric constant for this capacitor.

.

ANSWERS:

5a. 6.07×10^{-6} F	6a. 12.5 V	7. 2.44×10^{-9} J	8b. 5.4×10^{-12} C
5b. 2.46×10^{-4} J	6b. 1.40×10^{-11} C	8a. 1.8×10^{-12} F	9. 3.3

Set 3: Current

10. The compressor on a refrigerator pulls 28.0 A when it starts up. If the start-up time is 0.44 s. how much charge passes a cross-sectional area of the circuit in this time?

11. If the current in a wire of a stereo speaker is 8.25 mA, how long would it take for 1.53 C of charge to pass through a cross-sectional area of this wire?

12. On a particular radar screen, the beam current is 54.0 μA. How long does it take for 8.50×10^{14} electrons to strike the screen? Recall that each electron has a charge of magnitude 1.60×10^{-19} C.

13. If a metal wire carries a current of 128 mA, how many electrons pass through a given cross-sectional area of the wire in 46.2 s?

14. A total charge of 17.9 mC passes through a cross-sectional area of a copper wire in 2.39 s.

    a. What is the current in the wire?

    b. How many electrons pass through the cross-sectional area in one minute?

    c. If the number of charges that pass through the cross-sectional area during the given time interval doubles, what is the resulting current?

ANSWERS:
10. 12 C
11. 185 s
12. 2.52 s
13. 3.70×10^{19} e^-
14a. 7.49×10^{-3} A
14b. 2.81×10^{18} e^-
14c. 0.0150 A

Set 4: Resistance

15. The current in a toaster oven is 3.88 A. If the resistance of the oven's circuitry is 30.4 Ω, what is the potential difference across the oven?

16. A blender with a resistance of 73 Ω is connected across a potential difference of 120 V. What is the current?

17. Find the current in skillet of resistance 44 Ω when it is connected across a potential difference of 120 V.

18. A 2.25 V battery is connected to a 3.1 Ω resistor. What is the current in the resistor?

19. A television draws 2.10 A of current when connected across 115 V. What is the effective resistance of the TV?

20. The current in a resistor is 0.72 A when it is connected to a potential difference of 121 V. What is the current in this same resistor if the operating potential difference is 146 V?

Set 5: Electric Power

21. A portable space heater is operated by applying a potential difference of 116 V across a wire of resistance 37.4 Ω. Find the current in the wire and the power rating of the heater.

22. What would the current in the heater in Q21 be if the resistance was reduced to 0.250 Ω?

ANSWERS:

15. 118 V
16. 1.6 A
17. 2.7 A
18. 0.73 A
19. 54.8 Ω
20. 0.87 A
21. 3.10 A, 360. W
22. 464 A

23. The electric potential difference across a resting neuron in the human body is about 70 mV, and the current in it is approximately 200 μA. Determine the power consumed by the neuron.

24. How much does it cost to watch an entire NBA finals (22 h) on a 110 W LCD TV, if the cost of electrical energy is $0.085/kW-h?

25. An interactive video game is rated at about 19 W. If the potential difference is 120 V, what is the resistance of the circuitry?

26. A 1040 W microwave oven operates on a household circuit of 120 V. What is the resistance of the microwave?

27. A small electronic device is rated at 0.13 W when connected to 120 V. What is the resistance of this device?

Set 6: Resistors in Series

28. A 14.0 V battery is connected to three series resistors: 8.75 Ω, 17.3 Ω, and 23.6 Ω.

a. Determine the equivalent resistance. b. Determine the current in the circuit.

29. A 7.5 Ω resistor, a 9.25 Ω resistor, and a 10.6 Ω resistor are connected in series with a 9.0 V battery.

a. Determine the equivalent resistance. b. Determine the current in the circuit.

ANSWERS:
23. 1×10^{-5} W
24. $0.21
25. 760 Ω
26. 14 Ω
27. 1.1×10^{5} Ω
28a. 49.6 Ω
28b. 0.282 A
29a. 27.4 Ω
29b. 0.33 A

30. A 9.5 Ω resistor is connected in series with another resistor and a 16.2 V battery. The current in the circuit is 0.570 A. Determine the value of the unknown resistor.

31. A string of holiday lights is connected across 120 V.

    a. If the current is 2.22 A, what is the resistance of the string?

    b. If each bulb has a resistance of 1.35 Ω, how many bulbs are in each string of lights?

32. A series combination of two resistors, 10.4 Ω and 14.8 Ω, is connected to a 24.0 V battery.

    a. Calculate the equivalent resistance of the circuit and the current.

    b. What is the potential difference across each resistor?

33. Four resistors (3.0 Ω, 6.0 Ω, 9.0 Ω, and 12.0 Ω) are connected in series across a potential difference. The current in the circuit is observed to be 0.80 A. Find the voltage drop across each resistor.

Set 7: Resistors in Parallel

34. A 5.5 Ω resistor, an 8.7 Ω resistor, and a 16.1 Ω resistor are connected in parallel across a 12.0 V battery.

    a. Find the equivalent resistance.

    b. What is the current in each resistor?

ANSWERS:
30. 18.9 Ω
31a. 54 Ω
31b. 40 bulbs
32a. 25.2 Ω, 0.952 A
32b. 9.90 V, 14.1 V
33. 2.4 V, 4.8 V, 7.2 V, 9.6 V
34a. 2.8 Ω
34b. 2.2 A, 1.4 A, 0.745 A

35. An 18.0 Ω, 12.0 Ω, and 9.00 Ω resistor are connected in parallel across an emf source. A current of 3.00 A is measured to be flowing in the 9.00 Ω resistor.

a. Find the equivalent resistance.

b. What is the emf of the source?

c. Calculate the current in the other resistors.

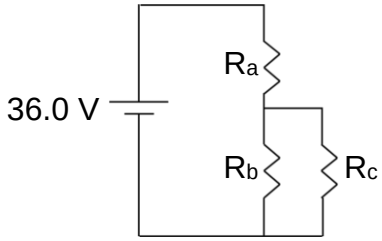
36. Four resistors (4.2 Ω, 5.8 Ω, 8.3 Ω, and 9.5 Ω) are connected in parallel across a 21 V battery. Calculate the value of the current in each resistor.

37. A length of wire is cut into three equal pieces. The three pieces are connected in parallel, with the resulting resistance being 6.00 Ω. What was the resistance of the original length of wire, before it was cut up?

Set 8: Equivalent Resistance

38. For each set of values, determine the equivalent resistance for the circuit shown in the figure.

a. R_a = 31.0 Ω R_b = 6.0 Ω R_c = 42.0 Ω



b. R_a = 19.0 Ω R_b = 49.0 Ω R_c = 28.0 Ω

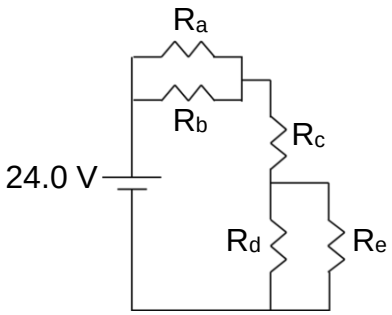
c. R_a = 17.2 Ω R_b = 18.1 Ω R_c = 11.6 Ω

ANSWERS: 35a. 4.00 Ω 35b. 27.0 V 35c. 1.50 A, 2.25 A 36. 5.0 A, 3.6 A, 2.5 A, 2.2 A 37. 54.0 Ω 38a. 36.2 Ω 38b. 36.8 Ω 38c. 24.3 Ω

39. For each set of values, determine the equivalent resistance for the circuit shown in the figure.

a. $R_a = 30.0\ \Omega$ $R_b = 6.0\ \Omega$ $R_c = 50.0\ \Omega$ $R_d = 19.0\ \Omega$ $R_e = 32.0\ \Omega$

b. $R_a = 17.0\ \Omega$ $R_b = 48.0\ \Omega$ $R_c = 36.0\ \Omega$ $R_d = 68.0\ \Omega$ $R_e = 55.0\ \Omega$



Set 9: Complex Circuits

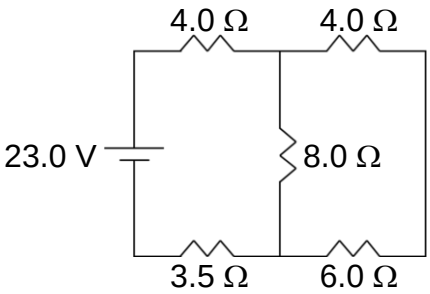
40. A string of holiday lights contains fifty bulbs wired in series. Each bulb has a resistance of 14.0 Ω. Find the equivalent resistance when three such strands are connected in parallel.

Refer to the figure shown to answer Q41-43.

41. Find the equivalent resistance.

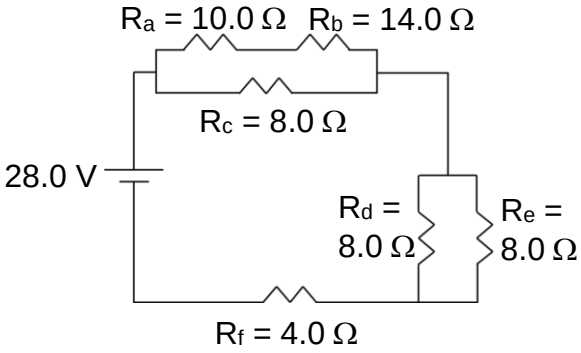
42. What is the current in the 3.5 Ω resistor?

43. What is the potential difference across the 3.5 Ω resistor?



44. Calculate the current in – <u>and</u> the potential difference across – each resistor shown in the diagram.

	ΔV	I	R
Batt.	28.0 V		
R_a			10.0 Ω
R_b			14.0 Ω
R_c			8.0 Ω
R_d			8.0 Ω
R_e			8.0 Ω
R_f			4.0 Ω



ANSWERS: 39a. 66.9 Ω 39b. 79.0 Ω 40. 233 Ω 41. 11.9 Ω 42. 1.93 A 43. 6.8 V

Set 10: Transformers

45. A step-down transformer in a residential area has 2575 turns in its primary. When the potential difference across the primary is 7730 V, the potential difference at the secondary is 120 V. How many turns are in the secondary?

46. A step-up transformer used in a car has a potential difference across the primary of 12 V and a potential difference across the secondary of 2.4×10^4 V. If there are 56 turns in the primary, what is the number of turns in the secondary?

47. A step-up transformer for long-range power transmission creates a potential difference of 255,000 V across the secondary. If the potential difference across the primary is 140 V and the number of turns in the secondary is 40,200, what is the number of turns in the primary?

48. A potential difference of 0.850 V is needed to provide a large current for arc welding. If the potential difference across the primary of a step-down transformer is 115 V, what is the ratio of the number of turns of wire on the primary to the number of turns on the secondary?

49. A step-down transformer at an electrical substation has 575 turns in its secondary and 1.40×10^4 turns in its primary. If the primary potential difference is 255,000 V, what is the secondary potential difference?

ANSWERS: 45. 40 turns 46. 1.1×10^5 turns 47. 22 turns 48. 135:1 49. 10,500 V

50. A step-up transformer in an electrical adapter has a primary voltage of 120 V and a primary current of 54 mA. If the secondary current is 0.72 A, find the secondary voltage.

51. The secondary current and voltage of a step-up transformer are given as 0.42 A and 12,000 V, respectively. If the primary voltage is 220 V, find the primary current.

52. The primary of a step-down transformer has a voltage of 8,200 V and 153 turns. The secondary has 42 turns, and carries a current of 4.8 A. Find the primary current.

53. The primary of a step-up transformer with 91 turns carries 7.31 A at 285 V. If the secondary current is 1.18 A, how many turns does the secondary have?

54. The secondary of a transformer has 308 turns. The primary has 37 turns, and carries 28 A at a voltage of 65 V. Find the secondary current.

ANSWERS: 50. 9.0 V 51. 23 A 52. 1.3 A 53. 564 turns 54. 3.4 A