

Various Questions and Problems from Unit 5 | Physics

1. State Coulomb's law. Explain what each symbol in it stands for, and use it to find the force between a 0.002-C charge and a 0.006-C charge that are 10 meters apart.
2. List the similarities and differences between Coulomb's law and Newton's law of gravitation.
3. Calculate the electrical force between two electrons that are located on opposite sides of an ionized hydrogen atom. Use the following values for the distance and charge size.

$$\text{distance} = 5.3 \times 10^{-11} \text{ m}$$

$$\text{electron charge} = -1.6 \times 10^{-19} \text{ C}$$

4. What is the difference between an insulator and a conductor? Which would you guess copper is? Wood? Distilled water?
5. Why should you not stand or sit in water when using electrical appliances? Why is it not a good idea to talk to your friend on the phone while sitting in a bath?
6. What are three ways an object can become charged? How does each work? Give examples.
7. How is an electric field similar to a gravitational field? If you put a charged object in an electric field, what will happen to it? In which direction will it move?
8. What are electric field lines? What do they show? How can they show the strength of an electric field?
9. How is electric potential energy similar to gravitational potential energy? How is it different? Where will an electron bound in an atom have the largest electrical potential energy?
10. How is electrical potential different from electrical potential energy? What is its unit?
11. In Figure 33.17 on page 528, why does the hair on the woman's head stand out? Even though she is charged to a very high voltage, she is unharmed. Explain.
12. What is the definition of electric current? How does it apply to a wire? How fast are electrons normally moving? On the average, estimate how far they progress in 1 second. Explain why there is a difference between their actual speed and their net speed.
13. What is electrical resistance? What characteristics of a wire determine its resistance? How does resistance normally vary with temperature?
14. On an average day, estimate how much sustained voltage would you have to experience to feel a shock. What are some good safety measures when working around power tools and electrical appliances?
15. What is the difference between direct current and alternating current? When we plug a light bulb into a wall outlet, where do the electrons come from?
16. Suppose energy costs \$0.09 per kilowatt-hour. How much would it cost to keep a 40-watt porch light on all night every night for one month? (The average month is 30 days, and the average night is 10 hours.)
17. What is a series circuit? How do voltages, currents, and resistances add in a series circuit? Give an example.

18. What is a parallel circuit? How do voltages, currents, and resistances add in a parallel circuit? Give an example.
19. Draw a schematic diagram of two 3-ohm resistors in series with a 9-V battery and two 6-ohm resistors in series with the battery and in parallel with each other. What is the overall resistance of the resistors? What is the current through and voltage across each resistor?
20. Draw a schematic diagram of a 4-ohm resistor in series with an 18-V battery and also with a 4-ohm resistor connected in parallel with a second 4-ohm resistor. What is the equivalent resistance? What is the current through and voltage across each?
21. What is overloading? What is a short circuit? How do fuses work, and how do they protect us from overloading or short-circuiting a circuit?
22. 100,000 electrons are removed from a neutral plastic ball. What is its charge?
23. 100 electrons are added to a neutral plastic ball. What is its charge?
24. What is the magnitude of the force on an electron in an electric field of 400 N/C?
25. 48 J of work are done to push 0.1 C of charge from point A to point B in an electric field. What is the voltage difference between points A and B?
26. How much voltage is required to make 4 amperes flow through a 12-ohm resistor?
27. A battery does 18 J of work on 10 coulombs of charge. What voltage does the battery supply?

28. What is the current in a 60-W bulb connected to a 120-V source?
29. What is the power dissipated by a toaster that has a resistance of 40 ohms and is plugged into a 120-V outlet?
30. A certain bulb with a resistance of 240 ohms is labeled 60 W. For what voltage circuit was this bulb designed?
31. How many 6-ohm resistors must be connected in parallel to create an equivalent resistance of 1 ohm?
32. What is the equivalent resistance of a 30-ohm and a 20-ohm resistor connected in parallel?
33. Two identical resistors in parallel have an equivalent resistance of 7 ohms. If the same resistors were instead connected in series, what would be the equivalent resistance?
34. A 30-V potential difference is applied across a series combination of an 8.0-ohm resistor and a 3.0-ohm resistor. What is the current in the 8.0-ohm resistor?
35. A 60-V potential difference is applied across a parallel combination of a 10-ohm and a 20-ohm resistor. What is the current in the 10-ohm resistor?
36. A 20.0-V potential difference is applied across a parallel combination of a 60.0-ohm and a 10.0-ohm resistor. What is the current in the 10.0-ohm resistor?
37. A 2.0-ohm resistor is connected in series with a 20.0-V battery and a three-branch parallel network with branches whose resistances are 6.0 ohms each. Ignoring the battery's internal resistance, what is the current in the battery?
38. A 50.0-V battery is connected across a 10.0-ohm resistor and produces a current of 4.5 A. What is the internal resistance of the battery?