PHYS-2020: General Physics II
Problem Set 1, Spring 2025

There are two sections to this Problem Set, the first section of problems are located on the textbook publisher's *WebAssign* web site:

https://webassign.com

These problems will be graded and must be completed by 6:00 p.m. on Friday, February 7, 2025. **Start working on these problems immediately once they are posted on *WebAssign*. Don't wait until the last day to start them. One never knows when the network will go down, and you will not be able to use this as an excuse for not doing your *WebAssign* problems.** As a matter of fact, there will be no allowed excuses for not doing your *WebAssign* homework.

Once you click on the *WebAssign* web site above, click on the "Enter Class Key" button on the upper right of this web page. The class key for this course is:

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A Quick Start Guide for using this web site can be found on the course web page. Should you need additional assistance with *WebAssign*, you can contact Technical Support information at:

https://webassign.com/support/student-support/

via the web or

1-800-354-9706

by telephone.

The following problems will not be graded, but should be done as a study guide for Exam 1. The solutions are posted on the course web page. **Try to work these problems out by yourself before looking at the solutions I have supplied for you.**

1. Two small identical conducting spheres are placed with their centers 0.30 m apart. One is given a charge of 12×10^{-9} C, the other a charge of -18×10^{-9} C. (a) Find the electrostatic force exerted on one sphere by the other. (b) The spheres are connected by a conducting wire. Find the electrostatic force between the two after equilibrium is reached, where both spheres have the same charge.

2. Charge $q_1 = 6.00\ \mu\text{C}$ sits at 0.00 cm, charge $q_2 = 1.50\ \mu\text{C}$ sits at 3.00 cm, and charge $q_3 = -2.00\ \mu\text{C}$ sits at 5.00 cm. (a) Determine the electric field strength at a point 1.00 cm to the left of the middle charge. (b) If charge q_3 is placed at this point, what are the magnitude and direction of the force on it?

3. (a) Sketch the electric field pattern around two positive point charges of magnitude $1\ \mu\text{C}$ placed close together. (b) Sketch the electric field pattern around two negative point charges of $-2\ \mu\text{C}$ placed close together. (c) Sketch the pattern around two point charges of $+1\ \mu\text{C}$ and $-2\ \mu\text{C}$ placed close together.

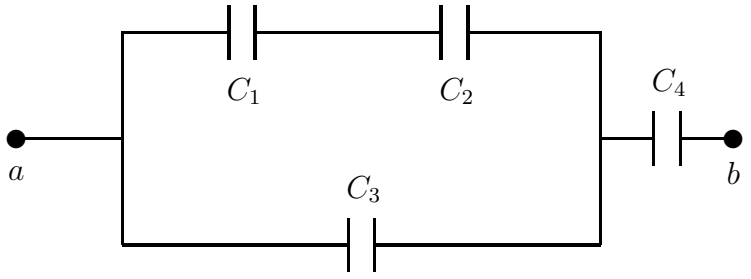
4. A point charge q is located at the center of a spherical shell of radius a that has a charge $-q$ uniformly distributed on its surface. Find the electric field (a) for all points outside the spherical shell and (b) for a point inside the shell a distance r from the center.

5. On planet Tehar, the free-fall acceleration is the same as that on Earth, but there is also a strong downward electric field that is uniform close to the planet's surface. A 2.00 kg ball having a charge of $5.00\ \mu\text{C}$ is thrown upward at a speed of 20.1 m/s. It hits the ground after an interval of 4.10 s. What is the potential difference between the starting point and the top point of the trajectory?

6. Three charges are at the vertices of an isosceles triangle. With $q = 7.00$ nC, the two charges at the base of the triangle are separated by 2.00 cm and each have a charge of $-q$. The charge q at the top of the triangle is 4.00 cm from each of the charges at the base. Calculate the electric potential halfway between the charges on the base of the triangle.

7. A 1-megabit computer memory chip contains many 60.0×10^{-15} F capacitors. Each capacitor has a plate area of $21.0 \times 10^{-12}\ \text{m}^2$. Determine the plate separation of such a capacitor. (Assume a parallel-plate configuration.) The diameter of atom is on the order of 10^{-10} m = 1 Å. Express the plate separation in angstroms.

8. Four capacitors are connected as shown below, where $C_1 = 15.0\ \mu\text{F}$, $C_2 = 3.00\ \mu\text{F}$, $C_3 = 6.00\ \mu\text{F}$, and $C_4 = 20.0\ \mu\text{F}$. (a) Find the equivalent capacitance between points a and b. (b) Calculate the charge on each capacitor if a 15.0-V battery is connected across points a and b.



9. A small sphere that carries a charge q is whirled in a circle at the end of an insulating string. The angular frequency of rotation is ω. What average current does this rotating charge represent?

10. Calculate the diameter of a 2.0-cm length of tungsten filament in a small light bulb if its resistance is 0.050 Ω.

11. At 20°C, the carbon resistor in an electric circuit connected to a 5.0-V battery has a resistance of 2.0×10^2 Ω. What is the current in the circuit when the temperature of the carbon rises to 80°C?

12. The heating element of a coffee-maker operates at 120 V and carries a current of 2.00 A. Assuming the water absorbs all of the energy converted by the resistor, calculate how long it takes to heat 0.500 kg of water from room temperature (23.0°C) to the boiling point.