

Physics 321
Homework 10

Due at midnight on the day of Hour 11.

- If we are dealing with forces like gravity and electrostatic forces, we can think of each particle as being the source of potential energy. The total potential energy is the sum of each potential energy.

1. Gravitational potential energy: $U = -\frac{GMm}{d}$ where d is the distance from the center of mass to the point where we wish to evaluate the potential energy.

2. Electrostatic potential energy: $U = \frac{kQq}{d}$.

- The force on an object in a potential energy field is $\vec{F} = -\nabla U$ where the object of interest is at coordinates (x,y,z) . The book also writes this as $\vec{F}_1 = -\nabla_1 U = -\frac{\partial U}{\partial x_1} \hat{x} - \frac{\partial U}{\partial y_1} \hat{y} - \frac{\partial U}{\partial z_1} \hat{z}$ where the object is at (x_1, y_1, z_1) .

- The homework demonstrates how to use Maple to solve these kinds of problems.

Problems:

1. Eight charges are located at coordinates $(\pm 1 \text{ m}, \pm 1 \text{ m}, \pm 1 \text{ m})$, thus forming a cube. The charges are all $+0.024 \text{ C}$. A test charge with $q=1.15 \mu\text{C}$ is placed at a location (x,y,z) .

A. Find the force on the test charge when it is located at $(2 \text{ m}, 3 \text{ m}, 4 \text{ m})$.

B. Find the total potential energy of the system of eight charges (without the test charge.)