Topics: Everything! Part 1

Intro discussion: Do you prefer to do dishes or laundry?

1. Each of the three containers shown in the figure at right weighs the same amount and is filled with water to the same level. All three have the same surface area in contact with the table. Which are true?
   a. The pressure at the bottom of the container is the same for all three
   b. The force by water on the bottom of the container is the same for all three
   c. The force of the container on the table is the same for all three

2. A person who weighs 550 N empties her lungs as much as possible and is then completely immersed in water while suspended from a harness attached to a scale. When she is submerged the scale now reads 21.2 N. What is her density? The density of water is 1000 kg/m³.

3. In a section of horizontal pipe with a diameter of 3.00 cm the pressure is 100 kPa and water is flowing with a speed of 1.50 m/s. The pipe narrows to 2.00 cm. What is the pressure in the narrower region?

4. In the figure, all the charges are point charges and the charge in the middle is \( Q = -3.0 \text{ nC} \). For what charge \( q_1 \) will charge \( q_2 \) be in static equilibrium?

5. Three equal point charges of varying signs are placed on three of the corners of a square of side \( d \) as shown in the figure above. Which of the arrows shown represents the direction of the net electric field at the vacant corner of the square?

6. An initially-stationary electric dipole of dipole moment \( \mathbf{p} = (5.00 \times 10^{-10} \text{ C} \cdot \text{m}) \hat{i} \) placed in an electric field \( \mathbf{E} = (2.00 \times 10^6 \text{ N/C}) \hat{i} + (2.00 \times 10^6 \text{ N/C}) \hat{j} \). What is the magnitude of the maximum torque that the electric field exerts on the dipole?

7. Consider a spherical Gaussian surface of radius \( R \) centered at the origin. A charge \( Q \) is placed inside the Gaussian surface. To maximize the magnitude of the flux of the electric field through the Gaussian surface, where should the charge be located?

8. An infinitely long cylinder of radius \( R = 2.00 \text{ cm} \) carries a uniform volume charge density of 18.0 \( \mu \text{C/m}^3 \). Calculate the electric field at distance \( r = 1.00 \text{ cm} \) from the axis of the cylinder.

9. An uncharged conductor has a hollow cavity inside of it. Within this cavity there is a charge of +10 \( \mu \text{C} \) that does not touch the conductor. There are no other charges in the vicinity. Describe the charge on every surface of the system in equilibrium.