**Description / Instructions:** Covers 9th edition chapters 21-1 -- 21-6 and 22-1 -- 22-4.

**Question 1**

Figure 21-14 shows four situations in which charged particles are fixed in place on an axis. In which situations is there a point to the left of the particles where an electron will be in equilibrium?

- (a)
- (b)
- (c)
- (d)

**Question 2**

In Fig. 21-16, a central particle of charge \(-q\) is surrounded by two circular rings of charged particles. What are the magnitude and direction of the net electrostatic force on the central particle due to the other particles? (*Hint:* Consideration of symmetry can greatly reduce the amount of work required here.)
Question 3

In Fig. 21-20, a central particle of charge \(-2q\) is surrounded by a square array of charged particles, separated by either distance \(d\) or \(d/2\) along the perimeter of the square. What are the magnitude and direction of the net electrostatic force on the central particle due to the other particles? (Hint: Consideration of symmetry can greatly reduce the amount of work required here.)
Question 4

Figure 22-24 shows two charged particles fixed in place on an axis.

Where on the axis (other than at an infinite distance) is there a point at which their net electric field is zero: between the charges, to their left, or to their right?

- To the left of the charges.
- To the right of the charges.
- Between the charges.

Is there a point of zero net electric field anywhere off the axis (other than at an infinite distance)?
Question 5

In the figure three charged particles lie on an x axis. Particles 1 and 2 are fixed in place. Particle 3 is free to move, but the net electrostatic force on it from particles 1 and 2 happens to be zero. If $L_{23} = L_{12}$, what is the ratio $q_1/q_2$?

![Diagram of particles on an x axis]

*1

Significant digits not applicable; exact number, no tolerance

Question 6

In the figure four particles form a square with edge length $a = 3.91 \times 10^{-2}$ m. The charges are $q_1 = q_4 = 2.34 \times 10^{-15}$ C and $q_2 = q_3 = q$. What is $q$ (in Coulombs) if the net electrostatic force on particle 1 is zero?

![Diagram of square with particles]

Number

*1 Units

Significant digits are disabled; the tolerance is +/-2%
**Question 7**

A nonconducting spherical shell, with an inner radius of 6.0 cm and an outer radius of 9.3 cm, has charge spread nonuniformly through its volume between its inner and outer surfaces. The *volume charge density* $\rho$ is the charge per unit volume, with the unit coulomb per cubic meter. For this shell $\rho = b/r$, where $r$ is the distance in meters from the center of the shell and $b = 5.4 \, \mu\text{C}/\text{m}^2$. What is the net charge (in Coulombs) in the shell?

Number  
Units

*Significant digits are disabled; the tolerance is +/-2%*

**Question 8**

What is the magnitude (in C) of a point charge that would create an electric field of 1.13 N/C at points 1.30 m away?

Number  
Units

*Significant digits are disabled; the tolerance is +/-2%*

**Question 9**

In the figure the three particles are fixed in place and have charges $q_1 = q_2 = +2e$ and $q_3 = 3e$. Distance $a = 3.15 \, \mu\text{m}$. What is the magnitude of the net electric field at point $P$ due to the particles?

![Diagram of three particles](image)

Number  
Units

*Significant digits are disabled; the tolerance is +/-2%*

**Question 10**

In the figure particle 1 of charge $q_1 = 7.40 \, \text{pC}$ and particle 2 of charge $q_2 = -7.90 \, \text{pC}$ are fixed at
a distance \( d = 2.60 \text{ cm} \) apart. In unit-vector notation, what is the net electric field at points (a)\( A \), (b)\( B \), and (c)\( C \)?

(a) Number \( \begin{array}{c} \text{*1 i +} \\ \text{*2 j Units} \end{array} \)

(b) Number \( \begin{array}{c} \text{*3 i +} \\ \text{*4 j Units} \end{array} \)

(c) Number \( \begin{array}{c} \text{*5 i +} \\ \text{*6 j Units} \end{array} \)

*1 - significant digits are disabled; the tolerance is +/-2%
*2 - significant digits are disabled; the tolerance is +/-2%
*3 - significant digits are disabled; the tolerance is +/-2%
*4 - significant digits are disabled; the tolerance is +/-2%
*5 - significant digits are disabled; the tolerance is +/-2%
*6 - significant digits are disabled; the tolerance is +/-2%