National University

of Computer & Emerging Sciences

Assignment 5

Fall 2023

NS 1001 Applied physics

The due date is ……..

Q.1. Determine the amplitude of the resultant wave when two sinusoidal waves having the same frequency and traveling in the same direction are combined, if their amplitudes are 3.20 cm and 4.19 cm and they differ in phase by π/2 rad.

Q.2. The equation of a transverse wave traveling in a string is given by y = (0.15 m) sin [(0.79 rad/m)x - (13 rad/s)t].

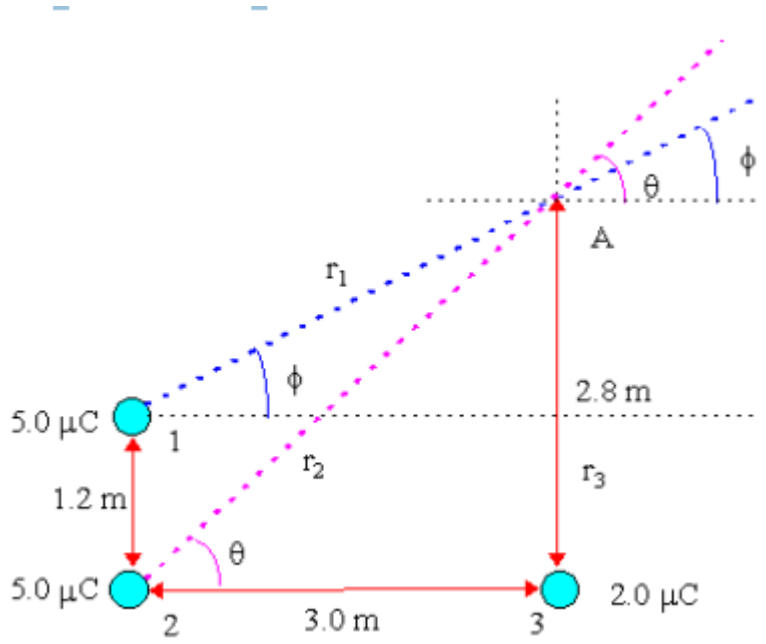
(a) What is the displacement at x = 2.3 m, t = 0.16 s?

(b) Write down the equation of a wave that, when added to the given one, would produce standing waves on the string.

(c) What is the displacement of resultant standing wave at x = 2.3 m, t = 0.16 s?

Q.3. A string vibrates according to the equation y = (0.520 cm) sin [(1.14 rad/cm)x] cos [(137 rad/s)t]. (a) What are the amplitude and speed of the component waves whose superposition can give rise to this vibration? (b) Find the distance between nodes. (c) What is the velocity of a particle of the string at the position x = 1.47 cm at time t = 1.36 s?

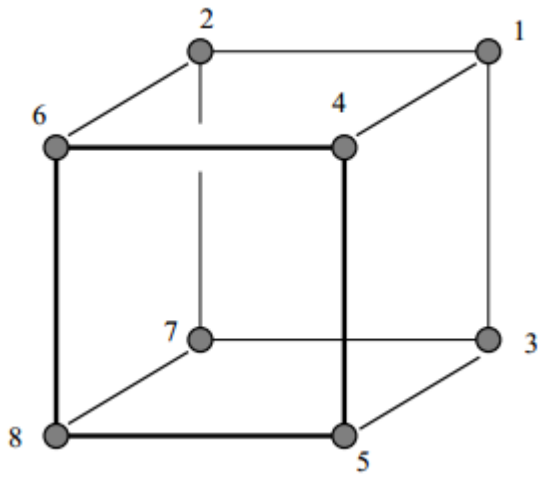
Q.4. Find the net electric field at point A in the diagram below?



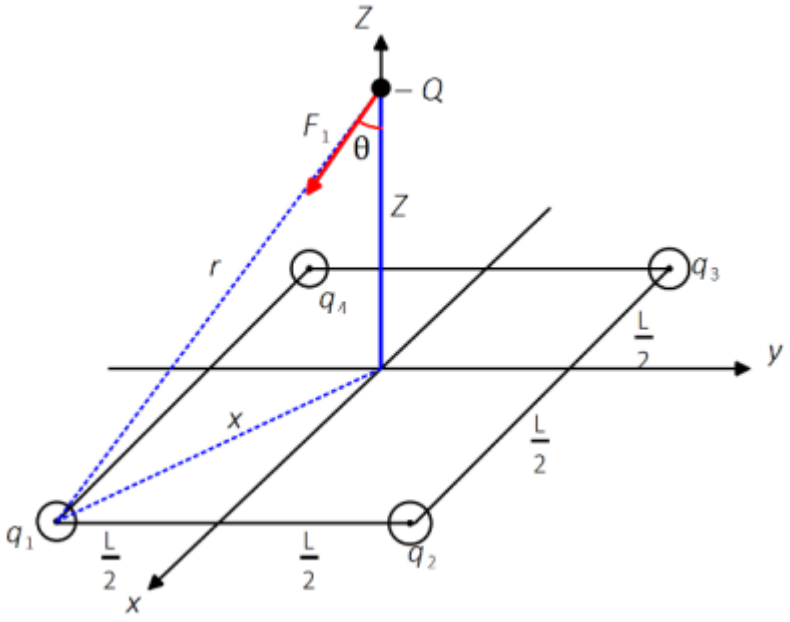
Q.5. Two free point charges +q & +4q are a distance L apart. A third charge is placed so that entire system is in equilibrium. Find sign, magnitude and location of the third charge.

Q.6. Four charges are located at the vertices of a square of side 2a. Point p lies at a distance x from the center of the square on a line parallel to the side of the square as shown in Fig. For x >> a, show that electric field at P is approximately given as, $E = 3(2qa^2)/2\pi\varepsilon_o x^4$

Q.7. A cube of edge a carries a point charge q at each corner. Show that resultant electric force on charge q_1 is given by $F = 0.262q^2/\varepsilon_o a^2$.



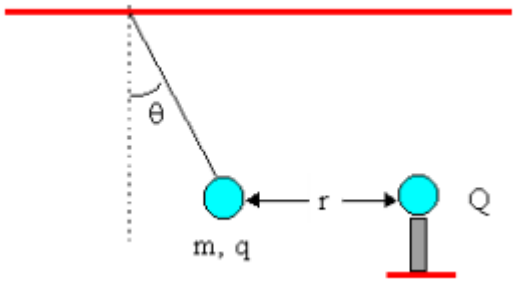
Q.8. Four identical particles, each having charge +q, are fixed at the corners of a square of side L. A fifth point charge −Q (at P point) lies a distance z along the line perpendicular to the plane of the square and passing through the center of the square. Determine the force exerted by the other four charges on −Q.



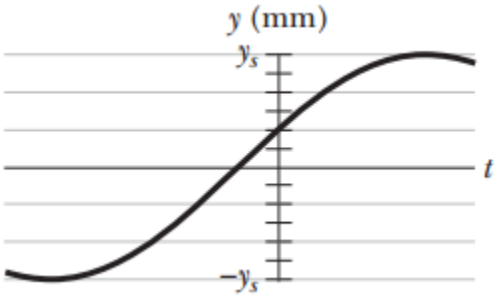
Q.9. A charged ball of mass m = 0.265 kg and unknown charge q is hanging by a

light thread from a ceiling. A fixed charge Q = +5.00 μC on an insulated stand is brought close to the unknown charge. As a result, the unknown charge hangs at an angle θ = 38.0° to the vertical as shown in the diagram below. The distance between the two charges is r = 22.0 cm.

(a) What is the sign of the unknown charge? Explain how you know this. (b) What is the magnitude of the unknown charge?



Q.10. Figure shows the displacement *y* versus time *t* of the point on a string at *x* = 0, as a wave passes through that point. The scale of the *y* axis is set by y_s = 6.0 mm. The wave is given by $y(x, t) = y_m \sin(kx - \omega t + \phi)$. What is the ϕ?



Q.11. Two waves are described by

$$Y_1 = 0.3 \sin(5\pi x - 200\pi t)$$

$$Y_2 = 0.3 \sin(5\pi x - 200\pi t)$$

Where, y_1, y_2, and x are in meters and t is in second. When these two waves are combined, a traveling is produced. What are the (a) amplitude, (b) wave speed and (c) wavelength of the traveling wave?