# FAST National University of Computer and Emerging Sciences, Lahore

**Course:** EE–117: Applied Physics
**Session:** Fall 2019
**Section:** _____
**Due Date:** 4 November 2019 (In the class)

**Instrument:** Assignment–2
**Instructor:** Muhammad Shiraz Ahmad
**Total Points:** 100

**Name:** _____ **Roll No.:** _____

**Note: All problems must be attempted. At the slightest suspicion of cheating, your submission will be marked zero. Submit your assignments using A4 or similar sheets. After due date, 20% marks per day will be deducted.**

**Q. 1** (10 points) Sketch $y$ versus $t$ at $x = 0$ for a sinusoidal wave of the form $y = 0.150\cos(15.7 - 50.3t)$, where $x$ and $y$ are in meters and t is in seconds. (b) Determine the period of vibration.

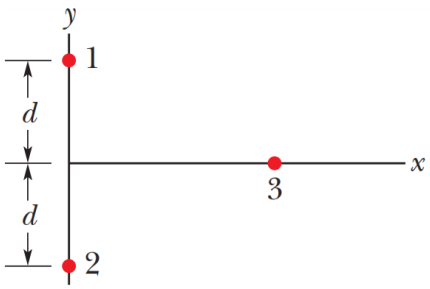
**Q. 2** (20 points) A sinusoidal wave traveling in the negative $x$ direction (to the left) has an amplitude of $20\,\text{cm}$, a wavelength of $35\,\text{cm}$, and a frequency of $12\,\text{Hz}$. The transverse position of an element of the medium at $t = 0$, $x = 0$ is $y = -3\,\text{cm}$, and the element has a positive velocity here. We wish to find an expression for the wave function describing this wave. (a) Sketch the wave at $t = 0$. (b) Find the angular wave number $k$ from the wavelength. (c) Find the period $T$ from the frequency. Find (d) the angular frequency v and (e) the wave speed $v$. (f) From the information about $t = 0$, find the phase constant $\phi$. (g) Write an expression for the wave function $y(x, t)$.

**Q. 3** (20 points) A transverse wave on a string is described by the wave function

$$y = 0.120\sin\left(\frac{\pi}{8}x + 4\pi t\right)$$

where $x$ and $y$ are in meters and $t$ is in seconds. Determine (a) the transverse speed and (b) the transverse acceleration at $t = 0.200\,\text{s}$ for an element of the string located at $x = 1.60\,\text{m}$. What are (c) the wavelength, (d) the period, and (e) the speed of propagation of this wave?

**Q. 4** (20 points) In the figure below, particles 1 and 2 of charge $q_1 = q_2 = +3.20 \times 10^{-19}$ C are on a y axis at distance $d = 17\,\text{cm}$ from the origin. Particle 3 of charge $q_3 = +6.40 \times 10^{-19}$ C is moved gradually along the x axis from $x = 0$ to $x = +5.0$ m. At what values of $x$ will the magnitude of the electrostatic force on the third particle from the other two particles be (a) minimum and (b) maximum? What are the (c) minimum and (d) maximum magnitudes?



**Q. 5** (20 points) The charges and coordinates of two charged particles held fixed in an xy plane are $q_1 = +3.0$ μC, $x_1 = 3.5$ cm, $y_1 = 0.50$ cm, and $q_2 = -4.0$ μC, $x_2 = -2$ cm, $y_2 = 1.5$ cm. Find the (a) magnitude and (b) direction of the electrostatic force on particle 2 due to particle 1. At what (c) x and (d) y coordinates should a third particle of charge $q_3 = +4.0$ μC be placed such that the net electrostatic force on particle 2 due to particles 1 and 3 is zero?

**Q. 6** (5 points) A charge $Q = +100 \times 1.6 \times 10^{-19}$ C is uniformly distributed over the surface of sphere, of radius $R = 10$ cm. A test charge $q = +1.6 \times 10^{-19}$ C is placed at the center the sphere; find force experienced by charge $q$ due to charge $Q$.

**Q. 7** (5 points) When we touch a doorknob (or something else made of metal), sometimes we get a shock; why is it so?