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Instructions:

- Return the question paper with your answer sheet.
- Read each question completely before answering it. There are **2 questions and 2 pages.**
- **All the answers must be solved according to the sequence given in the question paper. Otherwise 5 marks will be deducted.**

Time: 60 minutes. **Max Marks:** 60 points

Question: 1(Wave Motion) [30]

a) Fig -1 is a composite of three snapshots, each of which is a wave traveling along particular string. The phases of the waves are given by (a) $2x - 4t$ (b) $4x - 8t$ (c) $8x - 16t$ Which wave corresponds to which phase in the figure? Detect and label it. [04]

Fig-1

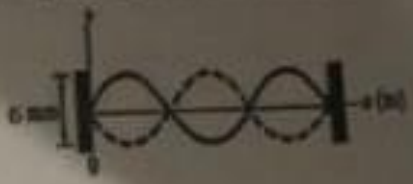

Fig-2

b) *Fig-2* shows a pattern of resonant oscillation of a string of mass m =3 g and length L =0.8 m and that is under tension T =300 N. What is the wavelength λ of the transverse waves producing the standing-wave pattern, and what is the harmonic number n? What is the frequency f of the transverse waves and of the oscillations of the moving string elements? What is the maximum magnitude of the transverse velocity v of the element oscillating at coordinate x =0.180 m ? [08]

c) When two waves interfere, can the amplitude of the resultant wave be greater than either of the two original waves? Under what conditions? [02]

d) If one end of a heavy rope is attached to one end of a light rope, the speed of a wave will change as the wave goes from the heavy rope to the light one. Will it increase or decrease? [02]

e) Two identical traveling waves, moving in the same direction, are out of phase by $\frac{\pi}{2}$ rad. What is the Amplitude of the resultant wave in terms of common amplitude y_m of the two combining waves? [06]

f) A sinusoidal wave is describe by the equation $y = (0.25m)\ \text{Sin}\ (0.3x - 40t)$, where x and y are in meters and t is in seconds. Determine for this wave the (a) wave length (b) frequency (c)wave speed. [08]

Question: 2(Electric Field) [30]

a) Three charges lie on a straight line, as shown in Fig-3. Find the resultant force exerted on -2μC charge. [04]

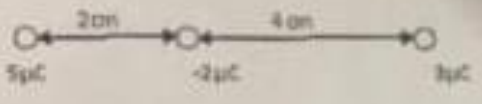

Fig-3

Fig-4

b) Consider the electric dipole shown in Fig-4. Show that the electric field at a distant point on the +x axis is $E_x = \frac{4\,k_e q a}{x^3}$. [06]

c) Why sparks are often seen or heard on a dry day when fabrics are removed from a clothes dryer in dim light? OR. Plot the graph between Electric field (E) and distance(r) for spherically symmetric distribution of charges. [02]

d) When defining the electric field, why is it necessary to specify that the magnitude of the test charge be very small? [02]

e) A spherical Gaussian surface surrounds a point charge q, describe what happens total flux through the surface if: (i) A charge is tripled? (ii) The radius of the surface is doubled? (iii) The surface is changed to a cube? [06]

f) What is the electric flux through a sphere that has a radius of 1.00 m and carries a charge of +1.00 μC at its center? [04]

Have a nice day ☺