FINAL JEE–MAIN EXAMINATION – FEBRUARY, 2021

(Held On Friday 26th February, 2021) TIME : 3 : 00 PM to 6 : 00 PM

PHYSICS

TEST PAPER WITH ANSWER & SOLUTIONS

SECTION-A

1. If 'C' and 'V' represent capacity and voltage respectively then what are the dimensions of λ, where $\frac{C}{V} = \lambda$?

(1) $[M^{-2}L^{-3}I^{2}T^{6}]$ (2) $[M^{-3}L^{-4}I^{3}T^{7}]$

(3) $[M^{-1}L^{-3}I^{-2}T^{-7}]$ (4) $[M^{-2}L^{-4}I^{3}T^{7}]$

Official Ans. by NTA (4)

Sol. $\lambda = \frac{C}{V} = \frac{Q/V}{V} = \frac{Q}{V^2}$

$V = \frac{\text{work}}{Q}$

$\lambda = \frac{Q^3}{(\text{work})^2} = \frac{(It)^3}{(F.s)^2}$

$= \frac{[I^3T^3]}{[ML^2T^{-2}]^2} = [M^{-2}L^{-4}I^3T^7]$

2. The length of metallic wire is ℓ_1 when tension in it is T_1. It is ℓ_2 when the tension is T_2. The original length of the wire will be -

(1) $\frac{\ell_1 + \ell_2}{2}$ (2) $\frac{T_2\ell_1 + T_1\ell_2}{T_1 + T_2}$

(3) $\frac{T_2\ell_1 - T_1\ell_2}{T_2 - T_1}$ (4) $\frac{T_1\ell_1 - T_2\ell_2}{T_2 - T_1}$

Official Ans. by NTA (3)

Sol. Assuming Hooke's law to be valid.

$T \propto (\Delta\ell)$

$T = k(\Delta\ell)$

Let, ℓ_0 = natural length (original length)

$\Rightarrow T = k(\ell - \ell_0)$

so, $T_1 = k(\ell_1 - \ell_0)$ & $T_2 = k(\ell_2 - \ell_0)$

$\Rightarrow \frac{T_1}{T_2} = \frac{\ell_1 - \ell_0}{\ell_2 - \ell_0}$

$\Rightarrow \ell_0 = \frac{T_2\ell_1 - T_1\ell_2}{T_2 - T_1}$

3. An aeroplane, with its wings spread 10 m, is flying at a speed of 180 km/h in a horizontal direction. The total intensity of earth's field at that part is 2.5×10^{-4} Wb/m^2 and the angle of dip is 60°. The emf induced between the tips of the plane wings will be :-

(1) 108.25 mV (2) 54.125 mV

(3) 88.37 mV (4) 62.50 mV

Official Ans. by NTA (1)

Sol. $\in = [\vec{B}\vec{V}\vec{L}] = BVL\sin\theta$

$= (2.5 \times 10^{-4}T)\left(180 \times \frac{5}{18} m/s\right)(10m)\sin60°$

$= 108.25 \times 10^{-3}V$

4. A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. When fork A is filed, the beat frequency decreases to 2 beats/s. What is the frequency of fork A ?

(1) 342 Hz (2) 345 Hz

(3) 335 Hz (4) 338 Hz

Official Ans. by NTA (3)

Sol. Initially beat frequency = 5 Hz

so, $\rho_A = 340 \pm 5 = 345$ Hz, or 335 Hz

after filing frequency increases slightly

so, new value of frequency of A > ρ_A

Now, beat frequency = 2Hz

$\Rightarrow$ new $\rho_A = 340 \pm 2 = 342$ Hz, or 338 Hz

hence, original frequency of A is $\rho_A = 335$ Hz

5. A particle executes S.H.M., the graph of velocity as a function of displacement is :-

(1) A circle (2) A parabola

(3) An ellipse (4) A helix

Official Ans. by NTA (3)

Sol. $v^2 = \omega^2(A^2 - x^2)$

$\frac{v^2}{\omega^2} + x^2 = A^2$

$\frac{v^2}{(\omega A)^2} + \frac{x^2}{A^2} = 1$

This is an equation of an ellipse.