FINAL JEE–MAIN EXAMINATION – FEBRUARY, 2021

(Held On Wednesday 24th February, 2021) TIME : 3 : 00 PM to 6 : 00 PM

PHYSICS

TEST PAPER WITH ANSWER & SOLUTIONS

SECTION-A

1. When a particle executes SHM, the nature of graphical representation of velocity as a function of displacement is :

(1) circular (2) elliptical

(3) parabolic (4) straight line

Official Ans. by NTA (2)

Sol. For a particle executing SHM,

$x = A\sin(\omega t + \phi)$

$v = \omega A\cos(\omega t + \phi)$

$\Rightarrow \frac{v^2}{\omega^2 A^2} + \frac{x^2}{A^2} = 1 \Rightarrow$ equation of ellipse between v and x

Hence option (2)

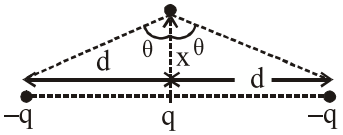
2. Two electrons each are fixed at a distance '2d'. A third charge proton placed at the midpoint is displaced slightly by a distance x (x << d) perpendicular to the line joining the two fixed charges. Proton will execute simple harmonic motion having angular frequency : (m = mass of charged particle)

(1) $\left(\frac{2q^2}{\pi\varepsilon_0 md^3}\right)^{\frac{1}{2}}$ (2) $\left(\frac{\pi\varepsilon_0 md^3}{2q^2}\right)^{\frac{1}{2}}$

(3) $\left(\frac{q^2}{2\pi\varepsilon_0 md^3}\right)^{\frac{1}{2}}$ (4) $\left(\frac{2\pi\varepsilon_0 md^3}{q^2}\right)^{\frac{1}{2}}$

Official Ans. by NTA (3)

Sol. From the given condition, we have



$F_{netq} = -\left[2F_{q/q}\cos\theta\right]$

$F_{netq} = -2.\frac{1}{4\pi\varepsilon_0}.\frac{q^2}{\left(\sqrt{d^2+x^2}\right)^2}.\frac{x}{\sqrt{d^2+x^2}}$

$= -\frac{q^2}{2\pi\varepsilon_0}\frac{x}{(d^2+x^2)^{3/2}}$

For x << d,

$F_{net\ q} = -\frac{q^2}{2\pi\varepsilon_0 d^3}x$

$\therefore\ a = -\frac{q^2}{2\pi\varepsilon_0.md^3}x$

Comparing with equation of SHM ($a = -\omega^2 x$)

$\therefore\ \omega = \sqrt{\frac{q^2}{2\pi\varepsilon_0 md^3}}$

Hence option (3) is correct

3. On the basis of kinetic theory of gases, the gas exerts pressure because its molecules :

(1) continuously lose their energy till it reaches wall.

(2) are attracted by the walls of container.

(3) continuously stick to the walls of container.

(4) suffer change in momentum when impinge on the walls of container.

Official Ans. by NTA (4)

Sol. From the assumption of KTG, the molecules of gas collide with the walls and suffers momentum change which results in force on the wall and hence pressure.

Hence option (4) is correct

4. A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains :

(1) increase in size but no change in orientation.

(2) have no relation with external magnetic field.

(3) decrease in size and changes orientation.

(4) may increase or decrease in size and change its orientation.

Official Ans. by NTA (4)

Sol. Soft ferromagnetic materials are materials which can be easily magnetised and demagnetised by external magnetic field. When external field is applied, the domains experiences a net torque hence change its orientation.

Hence option (4) is correct