

KVPY Interview Important Questions Physics Part 1

1. What is Newton's first law of motion?

Sol. Newton's law from an 1803 translation from Latin as Newton wrote "Every body preserves in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed thereon".

2. What is the need of first law of motion when Second law of motion is present? Isn't inertia implicit in the second law?

Sol. First law defines the frame of reference while second law measures the force and in second law motion nothing is mentioned related to the frame of reference i.e. to apply second law of motion, first law must be known.

3. Prove $0.9999\dots$ (recurring number) is equal to 1.

$$\text{Sol. } 9 \left[\frac{1}{10} + \frac{1}{10^2} + \frac{1}{10^3} + \dots \right] = \frac{9\left(\frac{1}{10}\right)}{1 - \frac{1}{10}} = \frac{9\left(\frac{1}{10}\right)}{\frac{9}{10}}$$

4. How do you find out if three given points are in a straight line?

Sol. Area of triangle from these three lines must be zero

5. Derive expression for gravitational force at a point inside the Earth

Sol. $r \leq R$

Assume an elementary concentric shell of mass dm . Due to this shell

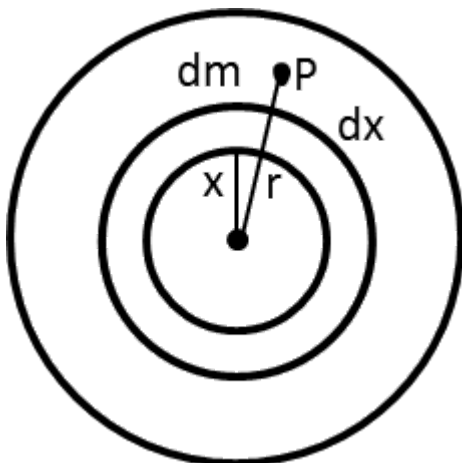


Image of Shell of Mass

The field at the point ($r < R$) will be:

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For $r < R$, there will be no gravitational field due to shell of radius greater than r , so gravitational field at the point will be present only due to shells having radius less than r .

$$E = \int_0^r \frac{Gdm}{r^2} = \int_0^r \frac{G4\pi x^2 dx}{r^2} = \frac{Gmr}{R^3}$$

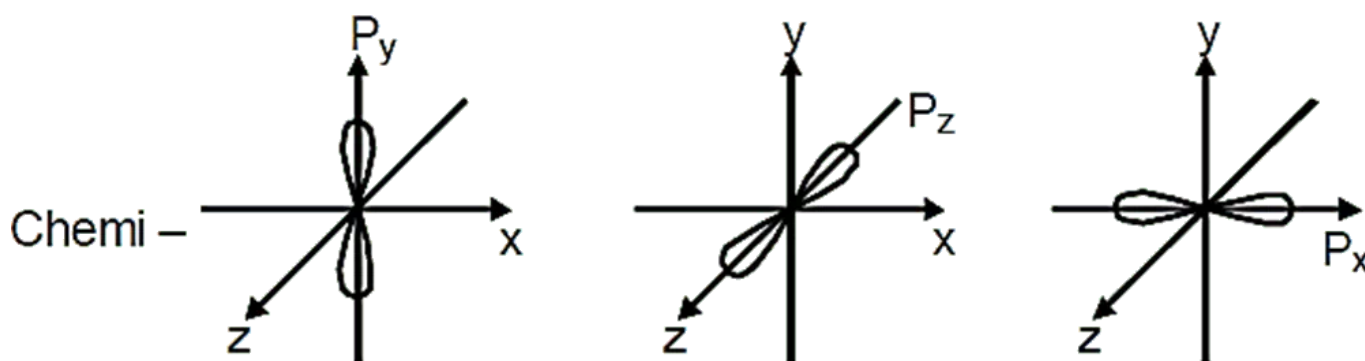
Note: The gravitational field inside and outside the Earth is always in radial direction.

Q: 6. Why does Gauss' Law consider charges only inside the imaginary closed surface, and not the ones outside?

Sol. Solid angle subtended by a point outside the Gaussian surface is zero

Q: 7. Draw the shape of p_x and p_z orbital with proper sign of orbital wave function

Sol.



Orbital with Proper Sign of Orbital Wave Function

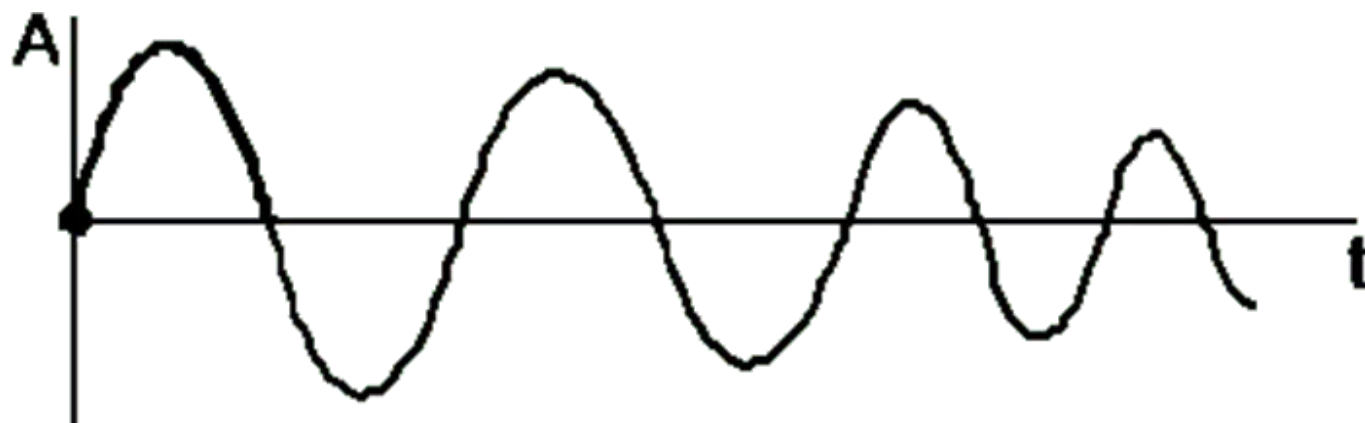
Q: 8. If simple pendulum is taken, plot amplitude-time function for the following:

(A) When placed in air

(B) When placed in such that half part in air and other half part in vacuum separated by emergency wall

Sol.

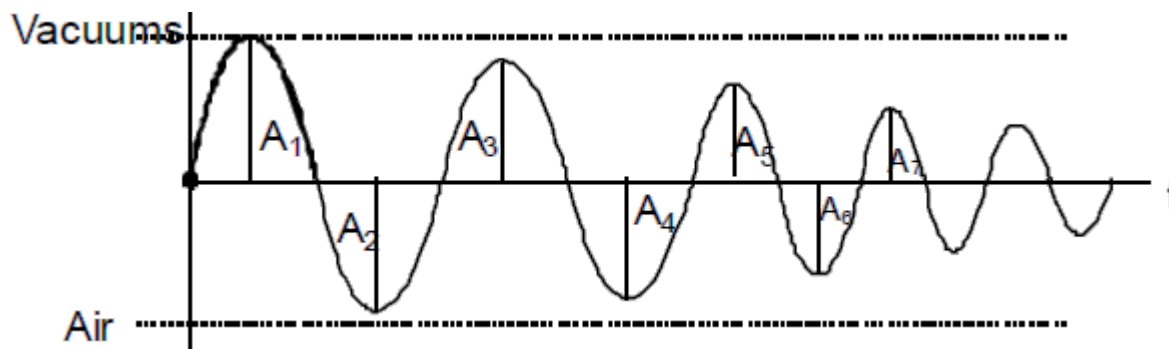
(A)



Pendulum when Placed in Air

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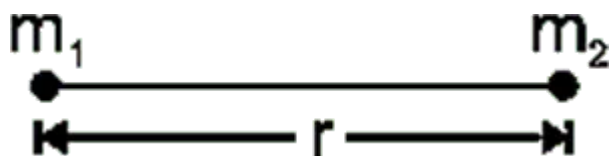
(B) $A_1 > A_2 > A_3 > A_4$



Pendulum for Half Part Air Other Half Vacuum

Q: 9. State Newton’s law of gravitation. Is it applicable inside the nucleus between two protons?

Sol. According to this law “Each particle attracts every other particle. The force of attraction between them is directly proportional to the product of their masses and inversely proportional to square of the distance between them”.



Newton's Law of Universal Gravitation

$$\left. \begin{array}{l} F \propto m_1 m_2 \\ F \propto 1/r^2 \end{array} \right\} F = G \frac{m_1 m_2}{r^2}$$

Where $G = 6.67 \times 10^{-11} \text{Nm}^2 \text{kg}^{-2}$ is the universal gravitational constant.

Q: 10. State sine equation of a string wave and explain all its terms

Sol. $y = A \sin (\omega t - kx)$

y → Displacement from mean position

A → Amplitude

ω → Angular frequency

K → Wave propagation const.

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