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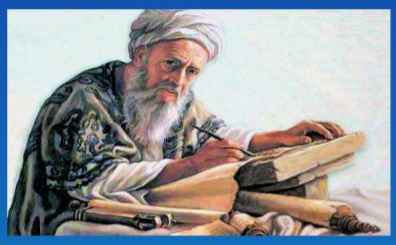
SEVEN MUSLIMS NOTES

PHYSICS 11



Al-Biruni (973–1048) calculated the Earth's radius and worked on the physics of planetary motion.

Best Regards to

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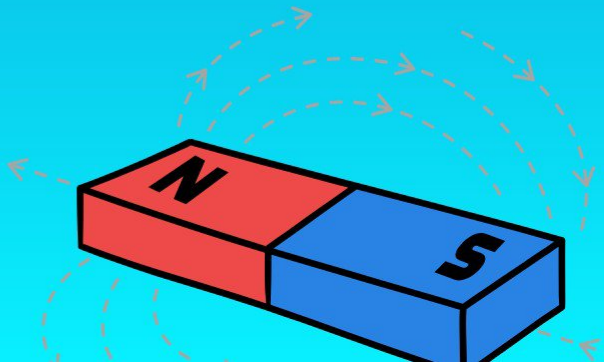

OSCILLATIONS

EXERCISE SHORT QUESTIONS

7.1. Name the two characteristics of Simple harmonic motion.

1. Acceleration of a body in SHM is directly proportional to displacement and is always directed towards mean position.
2. Total energy of a body executing SHM remains constant.

7.2. Does frequency depend upon amplitude for harmonic oscillators?

No, the frequency of harmonic oscillator does not depend upon amplitude.

For a mass spring system

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

Frequency depends upon mass of the object and spring constant of the spring.

For a simple pendulum

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

Frequency depends upon length and gravitational acceleration.

7.3. Can we realize an ideal simple pendulum?

No, we cannot realize an ideal simple pendulum because it requires an inextensible string, small heavy mass and frictionless support which are impossible to attain.

7.4. What is the total distance travelled by an object moving with SHM in a time equal to its time period if its amplitude is A?

The total distance travelled by an object moving with SHM in a time equal to its time period will be 4A.

$$\text{Distance} = A + A + A + A = 4A$$

7.5. What happens to the period of simple pendulum if its length is doubled? What happens if the suspended mass is doubled?

Time period of Simple Pendulum

$$T = 2\pi\sqrt{\frac{l}{g}}$$

If length is doubled

$$T' = 2\pi\sqrt{\frac{2l}{g}} = \sqrt{2}\left(2\pi\sqrt{\frac{g}{l}}\right) = \sqrt{2}T$$

Time period of simple pendulum is independent of mass.

7.6. Does the acceleration of a simple harmonic oscillator remain constant during its motion? Is the acceleration ever zero?

Acceleration of a simple harmonic oscillator

$$\alpha \propto -x$$

At mean position acceleration is zero and at extreme position it becomes maximum but not remain constant.

7.7. What is meant by phase angle? Does it define angle between maximum displacement and driving force?

"The angle that specifies the displacement as well as direction of motion of a particle executing SHM is called phase."

Phase does not define the angle between maximum displacement and driving force it gives the information about the state of motion of a vibrating particle.

7.8. Under what condition does the addition of two simple harmonies motions produce resultant, which is also simple harmonic Motion?

For this purpose

1. The two SHMs must be parallel
2. The two SHMs must be in phase
3. The two SHMs must have same frequency.

7.9. Show that in SHM, the acceleration is zero when the velocity is greatest and velocity is zero when the acceleration is greatest.

The acceleration and velocity of a body in SHM at any instant is given by

$$a = -\omega^2 x \qquad and\ v = \omega\sqrt{x_o^2 - x^2}$$

At mean position x=0

$$a = -\omega^2(0) = 0 \quad and \quad v = \omega\sqrt{x_o^2 - 0^2} = \omega x_o \neq 0$$

At extreme position x = x_o

$$a = -\omega^2 x_o \neq 0 \qquad and\ v = \omega\sqrt{x_o^2 - x_o^2} = 0$$

7.10. In relation to SHM, explain the equations:

i) $y = A\sin(\omega t + \phi)$ ii) $\alpha = -\omega^2 x$

Ans.

i) $y = A\sin(\omega t + \phi)$

y = instantaneous displacement

A = amplitude

ϕ = initial phase

ωt = angle subtended in time 't'

ii) $\alpha = -\omega^2 x$

where

a = acceleration of a particle executing SHM, ω = constant angular frequency and x = instantaneous displacement from the mean position.

7.11. Explain relation between total energy, potential energy and kinetic energy for a body executing SHM.

The energy of the body executing SHM is completely kinetic at mean position and potential at extreme positions but according to law of conservation of energy the total energy at every instant remains constant.

$$k.E = \frac{1}{2}kx_o^2\left(1 - \frac{x^2}{x_o^2}\right)$$

$$P.E = \frac{1}{2}kx^2$$

7.12. Describe two common phenomena in which resonance plays an important role.

The common phenomena in which resonance plays an important role are

1. Tuning of a particular radio station by adjusting the frequency of LC circuit in radio according to the frequency of transmission waves.
2. Heating or cooking of food in microwave oven when frequency of oscillating water or fat molecules becomes equal to the frequency of microwaves.

7.13. If a mass spring system is hung vertically and set into vibrations, why does the motion eventually stops?

It eventually stops due to friction and air resistance which causes dissipation of energy. The amplitude gradually decreases and motion eventually stops.