

SECTION 'B' (SHORT ANSWER QUESTIONS) (MARKS-40)

Note: Answer any **TEN** questions from this section. All questions carry equal marks.

Q.2(i) If $|\vec{A} + \vec{B}| = \sqrt{15}$ and $|\vec{A}| = 3$, $|\vec{B}| = 4$, find out $|\vec{A} - \vec{B}|$. **OR**

Two forces \vec{F}_1 and \vec{F}_2 are acting on a body, the angle between them is θ . Assuming that

\vec{F}_1 is acting along x-axis, prove that the magnitude of resultant force \vec{F} is equal to

$$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$$

(ii) An automatic gun fires 'n' bullets with a speed of 1800m/sec in 3seconds. The mass of each bullet is 25gm. If 450N force is required to hold the gun in position, find the number of bullets fired in each second. **OR**

A 50 g bullet is fired into a 10 kg block that is suspended by a long cord, so that it can swing as a pendulum. If the block is displaced so that its centre of gravity rises by 10 cm. What was the speed of bullet?

(iii) State and prove law of conservation of linear momentum? **OR**

Show that all the bodies sliding down a frictionless inclined plane must have the same acceleration.

(iv) Define angular velocity. Derive the relation $v = r\omega$ or $a = r\alpha$.

(v) A particle of mass 0.3kg moves in the xy-plane. At this instant, the coordinates of its position are (2,4)m and its velocity is $(3\hat{i} + 4\hat{j})$ m/sec. Determine the angular momentum of the particle relative to the origin. **OR**

Prove that the torque due to couple is equal to the product of magnitude of a force and perpendicular distance between the forces. **OR**

State and prove law of conservation of angular momentum for a system of particles.

(vi) The ratio of the acceleration due to gravity inside a deep mine and that on the surface of earth is 0.99. Find the depth of mine, assuming that the density of earth is uniform throughout and radius of earth is 6300 km. **OR**

Describe variation in 'g' with altitude or depth. **OR**

How can artificial gravity be created to overcome the problem due to weightlessness? If the two chambers of a spacecraft are connected by a tunnel of length 30m. Calculate the spin frequency to produce the artificial gravity in spacecraft.

- (vii) Derive work-energy equation.
- (viii) A horse pulls a cart with a force of 40N at an angle of 30° above the horizontal and moves along at a speed of 6m/sec
- (a) How much work it does in 8 minutes? (b) What is the power output of the horse?
- (ix) A standing wave is established in a 120cm long string fixed at both ends. The string vibrates in four segments when driven at 120 Hz.
- (a) Determine the wave length (b) What is the fundamental frequency? OR
- A sound wave propagating in air has a frequency of 4000 Hz. Calculate the percent fractional change in wavelength when the wave fronts initially in a region where $T = 27^\circ\text{C}$ enters a region where temperature decreases to 10°C .
- (x) What will be the effect on the time period of a body connected by a spring if the mass of body is doubled. OR
- Define loudness, intensity and intensity level of musical sound also state weber Fechner law and derive decibel scale for intensity level of musical sound.
- (xi) Determine the frequency of a monochromatic light used if 14^{th} bright ring has a radius of 1 mm when a plano-convex lens of radius of curvature 126 mm is used. OR
- What is interference of light? Give the difference between Fresnel and Fraunhofer diffraction. OR
- A parallel beam of X-rays is diffracted by rock salt crystal. The 1st order maximum being obtained when the glancing angle of incidence is 6 degree and 5 minutes. The distance between the atomic planes of the crystal is $2.81 \times 10^{-10}\text{m}$. Calculate the frequency of the radiation. ($c = 3 \times 10^8\text{ m/s}$)
- (xii) What are the conditions of interference of light? Differentiate between Fresnel and Fraunhofer diffraction. OR
- What is meant by plane polarization? How does this phenomenon explain that light waves are transverse in nature?
- (xiii) If a magnifying glass produces an image of magnification 6, what is the power of the lens? What is the best position of the object, if a watch maker holds the same lens close to his eye to see the damaged spring of a watch? OR
- Power of objective of an astronomical telescope is 1 dioptre and the length is 110 cm. Find out its angular magnification.
- (xiv) Prove that the reciprocal of the focal length of the combination of lenses is equal to the sum of the reciprocals of the focal lengths of two convex lenses which are placed in contact. OR
- Why do thick lenses have chromatic and spherical aberration? Suggest remedies for the rectification of these defects.

SECTION 'C' (DETAILED ANSWER QUESTIONS) (MARKS-28)

Note: Answer any TWO questions from this section. All questions carry equal marks.

- Q.3 (a) A bob of mass m is attached to one end of a flexible, inextensible string which hangs vertically from a rigid support. When it is displaced from its mean position, show that it executes S.H.M. Derive the expression for its frequency.

OR

What is Doppler effect? Explain this effect analytically when the source of sound moves away from a listener at rest. Write down the three applications of Doppler effect.

OR

Derive the expression for the frequency of stationary waves produced in a stretched string vibrating in

- (i) one loop (ii) two loops (iii) three loops.

State three laws of transverse vibration of a stretched string in a sonometer

- (b) Two bodies of masses M & m are connected to the ends of a string passing over a frictionless pulley such that the two bodies are moving vertically. Derive the expressions for

- (i) The acceleration of the bodies (ii) The tension in the string.

What will be acceleration of the system, if $M = 3m$?

- Q.4 (a) What is diffraction of light and what is diffraction grating? Derive an expression for the wave length and frequency of light by using diffraction grating.

OR

What is interference of light? Explain Thomas Young's experiment for the determination of wavelength of monochromatic light for bright fringes.

OR

Give the construction and working of the Michelson interferometer. How is it used to determine the wave length of a monochromatic light?

- (b) Draw a labeled diagram showing the passage of light ray through an astronomical telescope focussed for infinity. Describe its working and obtain an expression for its magnifying power.

OR

An object is placed within the focal length of a convex lens. Derive the formula for its magnifying power.

- Q.5 (a) Two forces \vec{F}_1 and \vec{F}_2 are acting at a point making angles θ_1 and θ_2 with the +ve x-axis respectively.

Derive the expression for the magnitude and direction of the resultant force.

- (b) What is projectile motion? A bullet of mass m is fired from a gun with velocity V_0 at an angle θ with respect to x-axis. Derive the formula for its total time of flight and horizontal range.