General Instructions:

a) All questions are compulsory.

b) There are 26 questions in total. Questions 1 to 5 carry one mark each, questions 6 to 10 carry two marks each, question 11 to 22 carry three marks each, question 13 is a value-based question and question 24 to 26 carry five marks each.

c) There is no overall choice. However, internal choice has been provided in one question of two marks, one question of three marks, and all questions of five marks each. You have to attempt only one of the given choices in such questions.

d) Use of calculator is not permitted.

Section-A

Q-1 A girl is swing in the sitting position. How will the time period of the swing change if she stands up?

Q-2 Two sound sources produce 12 beats in 4 seconds, by how much do their frequencies differ?

Q-3 State the Zeroth law of thermodynamics using a labeled diagram.

Q-4 Prove that vectors \( \vec{A} = \hat{i} + 2\hat{j} + 3\hat{k} \) and \( \vec{B} = 2\hat{i} - \hat{j} \) are perpendicular to each other.

Q-5 How does the Kinetic energy of an object change, if its momentum is doubled?

Section-B

Q-6 What are the Transverse and Longitudinal waves? Give two examples for each.

Q-7 State condition for Simple harmonic Motion and Calculate the effective length of Second's Pendulum.

Q-8 State theorem of perpendicular axes for moment of inertia of rigid body using diagram.

Q-9 What should be minimum length of open Organ pipe for producing a fundamental Tone of 110 Hertz? [Given that speed of sound is 330 m/sec]

Q-10 How large a force is needed on a small piston of area 2 cm\(^2\) to support a 1000 Newton weight resting on a piston of area 20 cm\(^2\)?

OR

The surface tension of a soap solution is 0.03 N/m. How much work is done to produce a soap bubble of radius 0.05 meter?

Section-C

Q-11 Using principle of superposition, Mathematically prove that whenever two plane progressive waves superimposing each other then affected particle of medium vibrates simple harmonically.
Q-12 Obtain first equation of motion for a rigid body performing rotational motion with constant Angular acceleration. If a grind stone has a constant angular acceleration of 4 rad/sec starting from rest. Calculate the Angular velocity of the grindstone 2.5 second later?

Q-13 Two vectors P and Q are inclined to each other at an angle θ, using triangle law of vector addition, find the magnitude and direction of their resultant.

Q-14 State and prove that Bernoulli’s theorem for the steady flow of liquid using a labeled diagram.

Q-15 State law of conservation of momentum. A 30 Kg shell is flying at 48 m/sec. when explodes its one part of 18 Kg stops. While the remaining part flies on. Calculate the velocity of the second part?

Q-16 State Archemede’s principle and prove it mathematically using a labeled diagram.

Q-17 State Law of conservation of energy. The bob of a Pendulum is released from horizontal position A as shown in diagram. If the length of the pendulum is 1.5 meter, what is the speed with which the bob arrives at the lowermost point B, given that it dissipates 5 % of its initial energy against air resistance?

Q-18 Define centripetal acceleration. Derive an expression for centripetal acceleration of a particle moving with uniform speed ‘v’ along a circular path of radius ‘r’ mention its S.I. unit and dimensional formula.

Q-19 A thermo dynamical system undergoes a cyclic process as shown in P- V diagram.
[a] Name the process along AB, BC & CA.

[b] Calculate work-done along AB, BC & CA.

[c] Estimate Total work-done during cyclic process.

Q-20 What do you mean by Radius of Gyration of a Rigid body rotating about an axis. Obtain expression for it, on what factors does it depends?

Q-21 In a heat engine, the temperature of the source and sink are 500 K and 375 K. If engine consumes $25 \times 10^5$ joule per cycle. Calculate

[a] the efficiency of heat engine.

[b] Work – done per cycle.

[c] Heat rejected to the sink.

Q-22 A Projectile is fired with a velocity ‘u’ making an angle $\theta$ with the horizontal. Derive expression for

[a] The Flight Time

[b] Maximum height and

[c] Horizontal Range

OR

What do you mean by Doppler’s Effect and obtain relation for Apparent frequency when sound source is moving away from a stationary listener.

Section-D

Q-23 Once an NCC camp was organized near Jammu. The cadets were being trained for march-past. All of a sudden the cadets came near a bridge. On seeing this, their In-charge immediately stopped them from marching on the bridge. On seeing this, the In-charge explained them the reason for doing so.

[1] What are the values being displayed by the In-charge?


[3] Name the Phenomenon and list at least one example for such type of phenomenon from daily life experience.

Q-24 (a) define stationary wave and show that even and odd both type of harmonics are set up in a stretched string.

(b) How far does the sound travel in air when a tuning fork of frequency 256 Hz makes 64 vibrations? (Given that velocity of sound in air = 320 m/sec).

OR
(a) Derive Expression for Kinetic energy, Potential energy and total mechanical energy of a body executing Simple Harmonic Motion.
(b) A particle executing S.H.M. of Amplitude ‘A’ at what distance from mean position is the energy half Kinetic and half potential?

Q-25 (a) Define two specific heats of a gas, using P-V-diagram, derive a relation between specific heats of a gas.

[b] An electric heater supplies heat to a system at a rate of 100 watt. If system perform work at a rate of 75 Joules per second, at what rate is the internal energy increasing?

OR

[a] Define coefficient of linear Expansion and coefficient of superficial Expansion. Also obtain relation between these two coefficients.

[b] Normal Temperature of human body is 98.4 °F, Find the temperature on Cellicus and Kelvin scale of Temperature?

Q-26 (a) Define Young’s Modulus of Elasticity, Obtain expression for it using labeled diagram and mention its S.I. unit and dimensional formula.

[b] The edge of an aluminum cube is 10 cm long. One face of the cube is firmly fixed to a vertical wall. A mass of 100 Kg is then attached to the opposite face of the cube. What is the vertical deflection of this face? [Given that Modulus of rigidity of Aluminum is 23x10⁹ N/m²]

OR

[a] Define Terminal velocity of a spherical body in a viscos medium and derive expression for it using a labeled diagram.

[b] A square metal plate of 10 cm side moves parallel to another plate with a velocity of 10 cm/sec, both plates immersed in water. If the viscos force is 200 dyne and coefficient of viscosity of water is 0.01 poise. What is their distance apart?