# KOTHARI INTERNATIONAL SCHOOL, NOIDA
## ANNUAL EXAMINATION, SESSION: 2024-25
## GRADE: 11 SUBJECT: PHYSICS (042)
## SET B

**DATE & DAY: FEBRUARY 14, 2025 - FRIDAY**
**MAXIMUM MARKS: 70** **TIME ALLOTTED: 3 HOURS**
**NAME: _____** **ROLL NO: _____**

***GENERAL INSTRUCTIONS:***

***(1)*** *There are 33 questions in all. All questions are compulsory*
***(2)*** *This question paper has five sections: Section A, Section B, Section C, Section D and Section E.*
***(3)*** *All the sections are compulsory.*
***(4)*** ***Section A*** *contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each,* ***Section B*** *contains five questions of two marks each,* ***Section C*** *contains seven questions of three marks each,* ***Section D*** *contains two case study based questions of 4 marks each and* ***Section E*** *contains three long answer questions of five marks each.*
***(5)*** *There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C and one question in each CBQ in Section D and all the three questions in Section E. You have to attempt only one of the choices in such questions.*
***(6)*** *Use of calculators is not allowed.*

## SECTION – A

Q1. The component of a vector **r** along X-axis will have maximum value if **(1)**
(a) **r** is along positive Y-axis
(b) **r** is along positive X-axis
(c) **r** makes an angle of 45° with the X-axis
(d) **r** is along negative Y-axis

Q2. A bullet of mass m moving with a speed V strikes a wooden block of mass M & gets embedded into the block. The final speed is **(1)**

(a) $\sqrt{\frac{M}{M+m}}V$ (b) $\sqrt{\frac{m}{M+m}}V$

(c) $\frac{m}{M+m}V$ (d) $\frac{V}{2}$

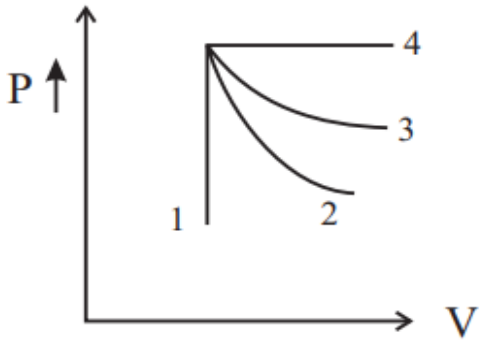
Q3. Two bodies with kinetic energies in the ratio 4 : 1 are moving with equal momentum. The ratio of their masses is **(1)**

(a) 4 : 1
(b) 1 : 1
(c) 1 : 2
(d) 1 : 4

Q4. An athlete finishes a round of circular track of radius R in 40 sec. What is his displacement at the end of 2 min 20 sec? **(1)**

(a) 2R
(b) 2πR
(c) 7πR
(d) Zero

Q5. An ideal gas undergoes four different processes from the same initial state as shown in the figure. Four processes are adiabatic, isothermal, isobaric & isochoric. Out of 1, 2, 3 & 4 which one is adiabatic **(1)**



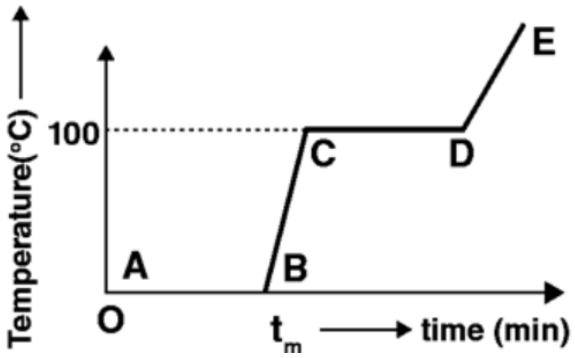

(a) 4
(b) 3
(c) 2
(d) 1

Q6. What is the angle between two vectors $\vec{A}$ & $\vec{B}$ when **(1)**

$$\left|\vec{A}+\vec{B}\right| = \left|\vec{A}-\vec{B}\right|$$

(a) θ = 90°
(b) θ = 0°
(c) θ = 120°
(d) θ = 180°

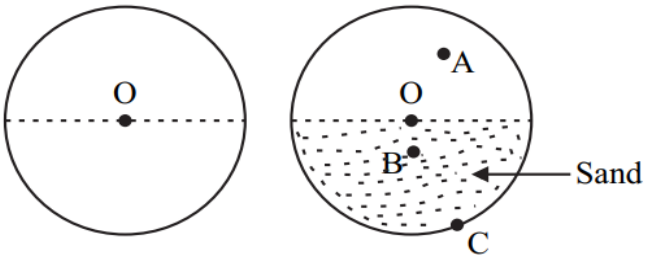
Q7. Refer to the plot of temperature versus time showing the changes in the state of ice on heating (not to scale). **(1)**




Which of the following is correct: ?
(a) The region AB represents ice & water in thermal equilibrium
(b) At B water starts boiling
(c) At C all the water gets converted into steam
(d) CD represents water & steam in equilibrium at melting point.

Q8. The maximum velocity for particle in SHM is 0.16 m/s and maximum acceleration is 0.64 $m/s^2$. The amplitude is **(1)**
(a) $4 \times 10^{-2}$m
(b) $4 \times 10^{-1}$m
(c) $4 \times 10$ m
(d) $4 \times 10^{0}$ m

Q9. The centre of mass of a hallow sphere is at its centre. Centre of mass of the hollow sphere when filled half with sand: **(1)**



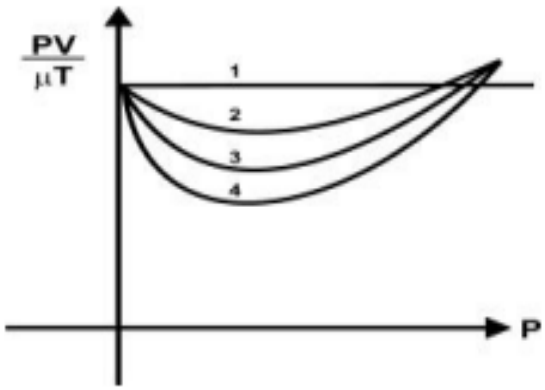

(a) shifts to A
(b) shifts to B
(c) shifts to C
(d) remains at O (centre of sphere)

Q10. A stationary wave is set up in a resonance air column of a glass tube partially filled with water by holding a tuning fork near the open end, the open end of the tube is **(1)**
(a) always a node
(b) always an antinode
(c) sometimes a node and sometimes an antinode
(d) neither a node nor an antinode

Q11. A satellite A of mass m is at a distance of r from the centre of the earth. Another satellite B of mass 2m is at distance of 2r from the earth's centre. Their time periods are in the ratio of **(1)**

(a) 1 : $2\sqrt{2}$
(b) 1 : 16
(c) 1 : 32
(d) 1 : 2

Q12. PV /μT versus P graphs for 4 gases are given below. Which curve/line represent an Ideal gas? **(1)**




(a) gas 1 (b) gas 2 (c) gas 3 (d) gas 4

**For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.**

**(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.**
**(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.**
**(c) If Assertion is true but Reason is false.**
**(d) If both Assertion and Reason are false.**

Q13. **Assertion (A):** When a 30 dyne force is inclined to y-axis at an angle 60°, the vertical and horizontal components of the force are 15 dyne and 15 $\sqrt{3}$ dyne respectively. **(1)**
**Reason(R):** When a vector A is inclined to y-axis at an angle $\theta$, the vertical and horizontal components of the vector are A cos $\theta$ and A sin $\theta$ respectively

Q14. **Assertion (A):** Air quickly leaking out of balloon becomes coolers. **(1)**
**Reason(R):** The leaking air undergoes isothermal expansion.

Q15. **Assertion (A):** Use of ball bearings between two moving parts of a machine is a common practice. **(1)**
**Reason(R):** Ball bearings reduce vibrations and provide good stability.

Q16. **Assertion (A):** The blood pressure in human is greater at the feet than at brain. **(1)**
**Reason(R):** Pressure of liquid at any point is proportional to height, density of liquid and acceleration due to gravity.

## SECTION – B

Q17. Find the work done if a particle moves from position $\vec{r_1} = (3\hat{i} + 2\hat{j} - 6\hat{k})$ to a position $\vec{r_2} = (14\hat{i} + 13\hat{j} - 9\hat{k})$ under the effect of force $\vec{F} = (4\hat{i} + \hat{j} + 3\hat{k})N$. **(2)**

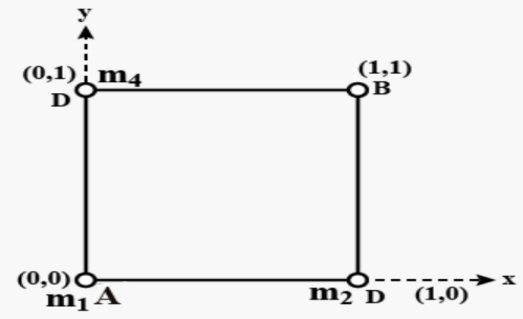
Q18. (a) Out of formulae (i) $y = a \sin 2\pi t/T$ and (ii) $y = a \sin vt$ for the displacement y of a particle undergoing a certain periodic motion, rule out the wrong formula on dimensional grounds (where a = maximum displacement of the particle, v= speed of the particle, T = time period of motion). **(2)**
(b) The surface tension of water is 72 dyne/cm. What would be its value in SI units?

Q19. (a) Why a gas has two principal specific heat capacities? **(2)**
(b) Which one is greater?
(c) Of what significance is the difference between these two specific heat capacities and their ratio?

Q20. Establish the relation between rotational kinetic energy and moment of inertia for a rigid body. **(2)**

**OR**

Four particles of masses 1kg, 2kg, 3kg and 4kg are placed at the four vertices A, B, C and D of a square of side 1m. Find the position of centre of mass of the particle?




Q21. Show that average kinetic energy of a gas molecule is directly proportional to the absolute temperature of the gas. **(2)**

## SECTION – C

Q22. The viscous force 'F' acting on a small sphere falling through a medium depends on the **(3)**
(i) coefficient of viscosity ' η ' of the fluid
(ii) its velocity 'v' through fluid
(iii) radius 'r' of the sphere.
Using dimensional analysis derive the formula for the viscous force.

Q23. Write the essential conditions for an adiabatic process to take place. Derive an expression for work done during an adiabatic process. **(3)**

Q24. (i)Two solid spheres of the same mass are made of metals of different densities. Which of them has larger moment of inertia about its diameter? **(3)**
(ii)Two identical particles move towards each other with velocities 2v and v respectively. What is the velocity of the centre of mass?
(iii)A torque of 2.0 x $10^{-4}$ Nm is applied to produce an angular acceleration of 4 rad/$s^2$ in a rotating body. What is the moment of inertia of the body?

**OR**

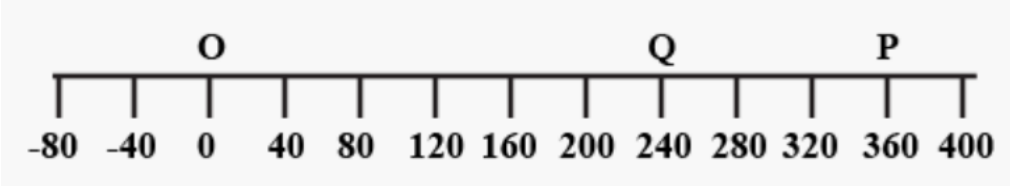
Derive the three equations of rotational motion under constant angular acceleration-

(i) $\omega = \omega_0 + at$ (ii) $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ (iii) $\omega^2 = \omega_0^2 + 2\alpha\theta$ .

Here symbols have usual meaning.

Q25. Prove that in case of closed organ pipe of length L, different frequencies of vibrating air column are in ratio 1:3:5:7…… **(3)**

Q26. (a)An aircraft executes a horizontal loop of radius 1 km with a steady speed of 900 km/h. Compute its centripetal acceleration. **(3)**
(b)A car is moving along a straight line OP in the figure. It moves from O to P in 18 s and returns from P and Q in 6 s. What are average velocity of the car in going from
(i) O to P
(ii) from O to P and back to Q?




Q27. Define terminal velocity. Obtain an expression for terminal velocity of a sphere falling through a viscous liquid. Use the formula to explain the observed rise of air bubbles in a liquid. **(3)**

Q28. A truck of mass 1000 kg accelerates uniformly from rest to a velocity of 15 $ms^{-1}$ in 5 seconds. Calculate **(3)**

(i) its acceleration,
(ii) its gain in kinetic energy
(iii) average power of the engine during this period, neglect friction.

## SECTION – D
## Case Study Based Questions

Q29. **Read the following paragraph and answer the questions that follow.** **(4)**

**Banking of roads**

The maximum permissible speed for a vehicle to negotiate a turn on a level circular road (without getting slip), depends upon the value of coefficient of friction between the tyres and road. But in practice, this limiting value of speed for sharp turn is quite low, especially in hilly areas where the turns are too sharp. In order to move the vehicle at a reasonable speed without getting skid/slip to go around the sharp turns, the outer edges are raised for the curved roads above the inner edge and this process is called as banking of roads.

(i) What is maximum safe speed of car negotiating a circular turn of radius r on a frictionless banked track with angle of banking θ?

(a) $\sqrt{r \tan \theta}$ (b) $\sqrt{rg \sin \theta}$

(c) $\sqrt{g \tan \theta}$ (d) $\sqrt{rg \tan \theta}$

(ii) Force responsible for the circular motion of the body is
(a) Centripetal force
(b) Centrifugal force
(c) Gravitational force
(d) Magnetic force

(iii)Which statement is not correct about banking of roads?
(a) Banking of roads reduces wear and tear on tyres of vehicles.
(b) It provide required centripetal force.
(c) It reduces the friction between road and the tyres.
(d) All are correct.

(iv) What is maximum safe speed of car on a circular road of radius 3m? The coefficient of friction between the tyres and road is 0.1. (Take g = 10 $m/s^2$)
(a) 1.43 m/s
(b) 1.73 m/s
(c) 1.63 m/s
(d) 1.53 m/s

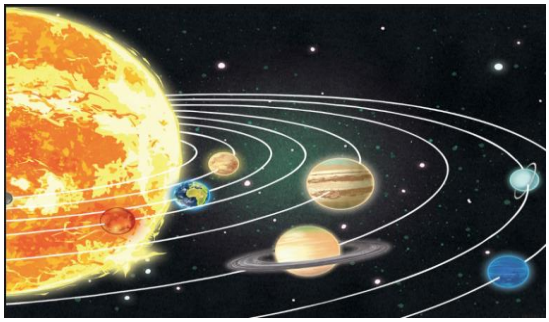
**OR**

A car sometime overturns while taking a turn. When it overturns, it is
(a) the inner wheel, which leaves the ground first.
(b) the outer wheel, which leaves the ground first.
(c) both the wheels leave the ground simultaneously.
(d) either wheel, which leaves the ground first.

Q30. **Read the following paragraph and answer the questions that follow.** **(4)**

**Gravitation in universe**

The milky way galaxy is a disk-shaped collection of dust, planets and billions of stars, including our sun and solar system. The force that binds it or any other galaxy together is the same force that holds the moon in orbit and us on earth is called as gravitational force. That force is also responsible for one of the nature's strongest objects, the black hole, a star that has completely collapsed onto itself. The gravitational force near a black hole is so strong that not even light can escape it.



**(i)** If suddenly the gravitational force of attraction between the earth and moon revolving around it becomes zero, then the moon will
(a) continue to move in its orbit with the same velocity
(b) move tangentially to the original orbit with the same velocity
(c) become stationary in its orbit
(d) move towards the earth

**(ii)** A man waves his arm, while walking. This is
(a) to keep constant velocity
(b) to ease the tension
(c) to increase the velocity
(d) to balance the effect of earth's gravity.

**(iii)**Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space around masses is now filled with a liquid of specific gravity 3. The gravitational force now be
(a) 3F
(b) F
(c) F/3
(d) F/9

**(iv)** A body of weight of 72N moves from the surface of earth at a height half the radius of earth, then the gravitational force exerted on it will be
(a) 36 N
(b) 32N
(c) 144N
(d) 50N

**OR**

Two stars of masses, $m_1$ and $m_2$ are parts of binary star system. The radii of their orbits are $r_1$ and $r_2$ respectively, measured from the centre of mass of the system. The magnitude of the gravitational force that $m_1$ exerts on $m_2$ is

(a) $\frac{m_1 m_2 G}{(r_1 + r_2)^2}$

(b) $\frac{m_1 G}{(r_1 + r_2)^2}$

(c) $\frac{m_2 G}{(r_1 + r_2)^2}$

(d) $\frac{G(m_1 + m_2)}{(r_1 + r_2)^2}$

## SECTION – E

Q31. (i) State and prove Bernoulli's theorem. **(5)**
(ii) A liquid has a surface tension of 0.075N/m. Calculate the excess pressure inside a spherical droplet of this liquid with a radius of 0.5 mm.

**OR**

(i) What is the phenomenon of capillarity? Derive an expression for the rise of liquid in a capillary tube.
(ii) Calculate the capillary rise of water in a glass tube of radius 0.5 mm where surface tension of water = 0.072 N/m, angle of contact = 0° and density of water = 1000 kg/m³.
(iii) Small drops of mercury are spherical and larger ones tend to flattened. Why?

Q32. A body is projected at an angle Θ with the horizontal. **(5)**

(i) Derive an expression for its time of flight and horizontal range. Determine the condition for maximum horizontal range.

(ii) The position of projectile is given by

$$\mathbf{r} = 3t\,\mathbf{i} + 2t^2\,\mathbf{j} + 5\,\mathbf{k}$$

where t is in seconds and r is in meter. Find the magnitude of velocity and acceleration of particle at t = 1 s.

**OR**

(a) State parallelogram law of vector addition. Give its analytical treatment to find magnitude and direction of resultant vector by using this law.

(b) At what angle do the two forces (P + Q) and (P – Q) act so that the resultant is $\sqrt{3P^2 + Q^2}$

Q33. (i) Derive the expressions for the kinetic and potential energies of a harmonic oscillator. Hence show that the total energy is conserved in SHM. Draw the variation of energy with displacement graphically. **(5)**

(ii) The equation of transverse wave travelling along x-axis is given by

$$y = 10\,\mathrm{Sin}\,(0.01\pi\,x - 2\pi\,t)$$

where y and x are expressed in cm and t in s. Find the frequency, wavelength and velocity the wave.

**OR**

(i) Discuss the Newton's formula for velocity of sound in air. What correction was applied to it by Laplace and why?

(ii) At what temperature will the speed of sound be double its value at 273 K?

(iii) If the density of oxygen is 16 times that of the hydrogen, what will be the corresponding ratio of their velocities of sound waves?