

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

DATE & DAY: FEBRUARY 14, 2025 - FRIDAY

MAXIMUM MARKS: 70

NAME: _____

TIME ALLOTTED: 3 HOURS

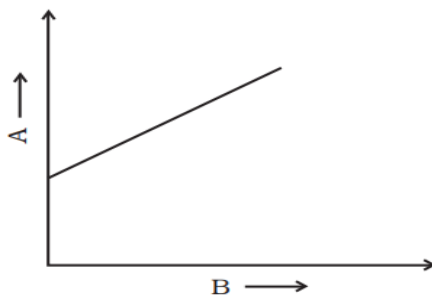
ROLL NO: _____

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 variation of quantity A with quantity B, plotted in given figure describes the motion of a particle in a straight line. (1)



- (a) Quantity B may represent time.
- (b) Quantity A is velocity if motion is uniform.
- (c) Quantity A is displacement if motion is uniform.
- (d) Quantity A is velocity if motion is uniformly accelerated.

Q2. 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) $2\pi R$
 (c) $7\pi R$
 (d) Zero

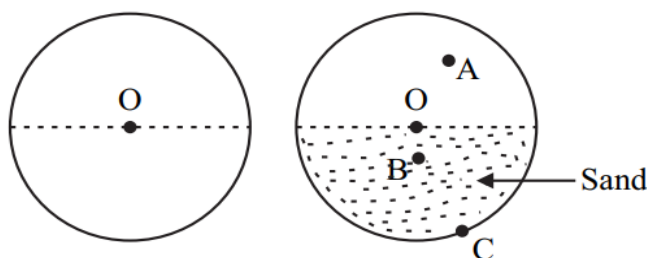
Q3. A cricket ball of mass 150 g has an initial velocity $\mathbf{u} = (3\mathbf{i} + 4\mathbf{j}) \text{ ms}^{-1}$ and a final velocity $\mathbf{v} = -(3\mathbf{i} + 4\mathbf{j}) \text{ ms}^{-1}$ after being hit. The change in momentum is (in kg m s^{-1}) (1)

(a) zero
 (b) $-(0.45\mathbf{i} + 0.6\mathbf{j})$
 (c) $-(0.9\mathbf{i} + 1.2\mathbf{j})$
 (d) $-5(\mathbf{i} + \mathbf{j})$.

Q4. If the kinetic energy of the body becomes four times of its initial value, then new momentum will (1)

(a) became twice its initial value
 (b) became four times
 (c) became thrice its initial value
 (d) remains same

Q5. The centre of mass of a hollow sphere is at its centre. Centre of mass of the hollow sphere when filled half with sand: (1)

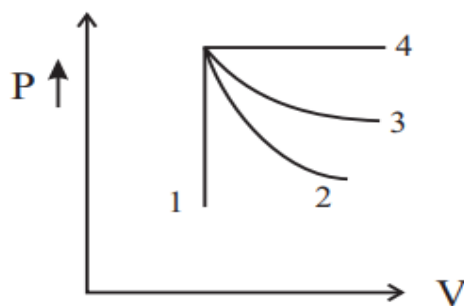


- (a) shifts to A
 (b) shifts to B
 (c) shifts to C
 (d) remains at O (centre of sphere)

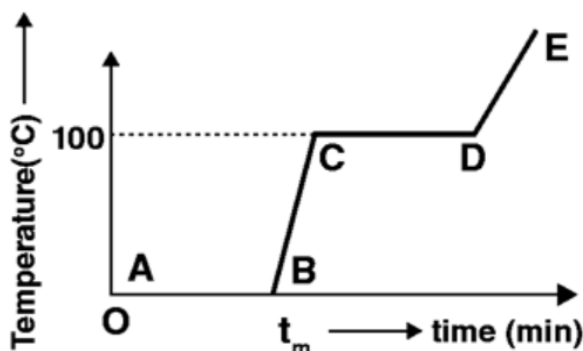
Q6. If three vectors \mathbf{a} , \mathbf{b} , \mathbf{c} are represented by three sides of a triangle taken in the same order, then which of the following is correct? (1)

(a) $\vec{a} + \vec{b} = \vec{c}$
 (b) $\vec{a} + \vec{c} = \vec{b}$
 (c) $\vec{a} + \vec{b} + \vec{c} = \vec{0}$
 (d) The given three vectors are not related.

- Q7. 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)

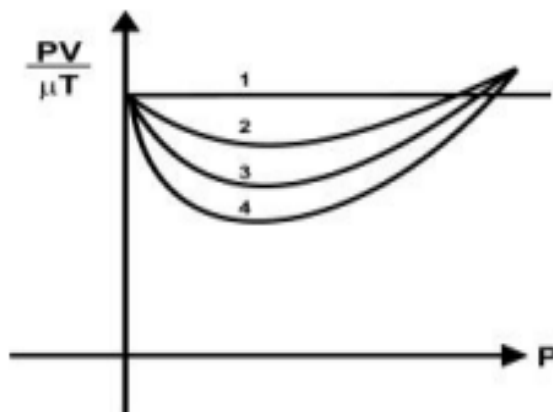


- (a) 4 (b) 3 (c) 2 (d) 1
- Q8. The escape speed of the planet is v . If the radius of the planet contracts to $1/4$ th of present value, without any change in mass, the escape speed would become (1)
- (a) halved
(b) doubled
(c) quadrupled
(d) one fourth
- Q9. Refer to the plot of temperature versus time showing the changes in the state of ice on heating (not to scale). Which of the following is correct: ? (1)



- (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.
- Q10. 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) $4 \times 10^{-2} \text{ m}$
(b) $4 \times 10^{-1} \text{ m}$
(c) $4 \times 10 \text{ m}$
(d) $4 \times 10^0 \text{ m}$

- Q11. $PV/\mu T$ 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

- Q12. 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

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.

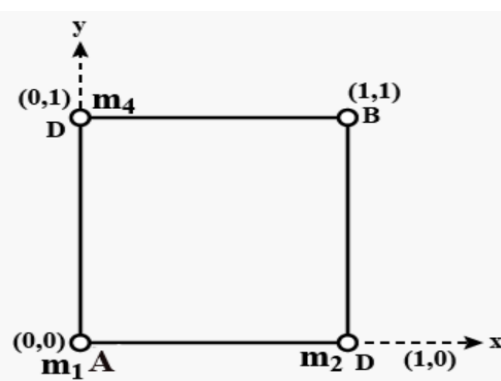
- Q13. **Assertion (A):** Use of ball bearings between two moving parts of a machine is a common practice. (1)
Reason(R): Ball bearings reduce vibrations and provide good stability.
- Q14. **Assertion (A):** The blood pressure in human is greater at the feet than at brain. (1)
Reason(R): Pressure of liquid at any point is proportional to height, density of liquid and acceleration due to gravity.
- Q15. **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 θ , the vertical and horizontal components of the vector are $A \cos \theta$ and $A \sin \theta$ respectively.
- Q16. **Assertion (A):** Air quickly leaking out of balloon becomes cooler. (1)
Reason(R): The leaking air undergoes isothermal expansion.

SECTION – B

- Q17. (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?
- Q18. Establish the relation between angular momentum 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?



- Q19. Show that average kinetic energy of a gas molecule is directly proportional to the absolute temperature of the gas. (2)
- Q20. (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?
- Q21. 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)

SECTION – C

- Q22. The velocity of sound waves 'v' through a medium may be assumed to depend on: (3)
- (a) the density of the medium 'd'
- (b) The modulus of elasticity 'E'
- Deduce by the method of dimensions the formula for the velocity of sound. Take dimensional constant $k = 1$.

- Q23. (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 $2.0 \times 10^{-4} \text{ Nm}$ 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?

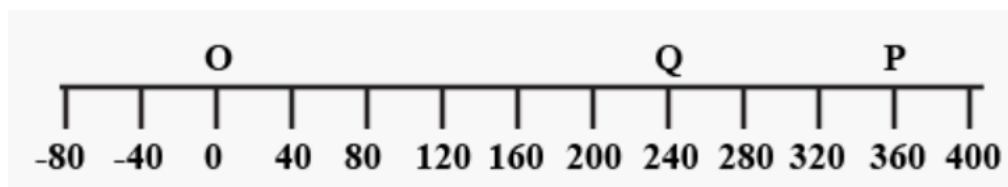
OR

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

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

Here symbols have usual meaning.

- Q24. Write the essential conditions for an isothermal process to take place. Derive an expression for work done during an isothermal process. (3)
- Q25. (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?



- Q26. Prove that in case of open organ pipe of length L , different frequencies of vibrating air column are in ratio 1:2:3:4..... (3)
- Q27. 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.
- Q28. 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)

SECTION – D

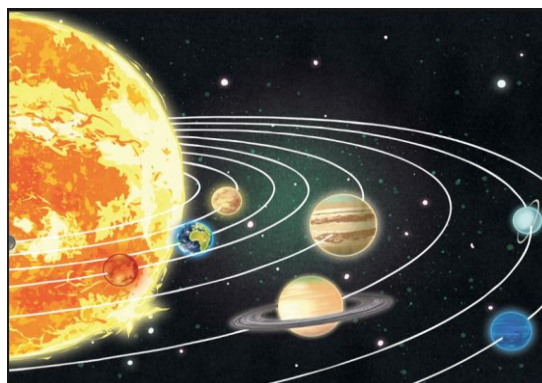
Case Study Based Questions

Q29.

Read the following paragraph and answer the questions that follow.
Gravitation in universe

(4)

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) 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.

(ii) 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

(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) 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)

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

OR

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

Q30.

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) Force responsible for the circular motion of the body is

- (a) Centripetal force
- (b) Centrifugal force
- (c) Gravitational force
- (d) Magnetic force

(ii) 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) $\sqrt{rg \tan \theta}$

(iii) Which statement is not correct about banking of roads?

- (a) Banking of roads reduces wear and tear on tyres of vehicles.
- (b) It provides 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 $g = 10 \text{ m/s}^2$)

- (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.

SECTION – E

Q31. 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 $t = 1 \text{ s}$.

OR

(a) State triangle 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 $\sqrt{3P^2 + Q^2}$

Q32. (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

$$y = 10 \sin(0.01\pi x - 2\pi t)$$

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

Q33. (i) State and prove Bernoulli's theorem. (5)
(ii) A liquid has a surface tension of 0.075 N/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?