KOTHARI INTERNATIONAL SCHOOL, NOIDA
ANNUAL EXAMINATION, SESSION: 2023-24
GRADE: 11 SUBJECT: PHYSICS (042)
SET A

DATE & DAY: FEBRUARY 12, 2024 - MONDAY
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 static force of friction **(1)**
(a) remains the same with increase in the applied force.
(b) decrease with the increase in the applied force.
(c) increase with increase in the applied force.
(d) increase with the decrease in the applied force.

Q2. The dot product of vectors $\vec{A}$ = **i** + 2**j** - **k** and $\vec{B}$ = - **i** + **j**- 2**k** is: **(1)**

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

Q3. Two bodies with kinetic energies in the ratio 4 : 1 are moving with equal linear momentum. **(1)**
The ratio of their masses is
(a) 4 : 1
(b) 1 : 1
(c) 1 : 2
(d) 1 : 4

Q4. A man fires a bullet of mass 200 g at a speed of 5 m/s. The gun is of one kg mass. by what velocity the gun rebounds backwards **(1)**

(a) 0.1 m/s
(b) 10 m/s
(c) 1 m/s
(d) 0.01 m/s

Q5. The angular displacement of a particle following circular path is given by $\theta(t) = 25t^3 + 3t + 7$, then angular velocity at t = 2 s is **(1)**

(a) 303 rad/s
(b) 400 rad/s
(c) 100 rad/s
(d) zero

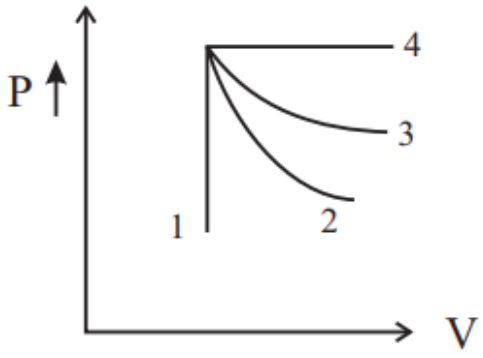
Q6. Angular momentum of the particle rotating with a central force is constant due to **(1)**

(a) Constant force
(b) Constant linear momentum
(c) Constant torque
(d) Zero torque

Q7. The Escape velocity from the Earth for a body of 20 g is 11.2 km/s. What will be its value for a body of 100 g? **(1)**

(a) 1.12 km/s
(b) 112 km/s
(c) 11.2 km/s
(d) 0.112 km/s.

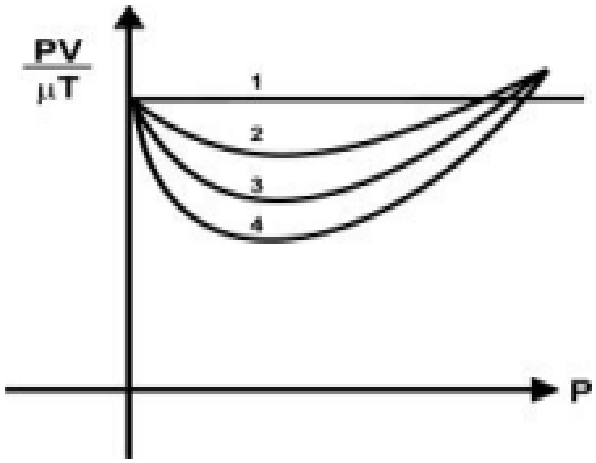
Q8. An ideal gas undergoes four different process from the same initial state as shown in the figure. Four process are adiabatic, isothermal, isobaric & isochoric. Out of 1, 2, 3 & 4 which one is adiabatic **(1)**



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

Q9. If common salt is dissolved in water, then the surface tension of saltwater is **(1)**
(a) increased
(b) decreased
(c) not changed
(d) first increased then decrease

Q10. 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

Q11. The time-period of a simple pendulum is 2 s. When its length is increased by 4 times, then its time period becomes **(1)**
(a) 16 s (b) 12 s (c) 8 s (d) 4 s

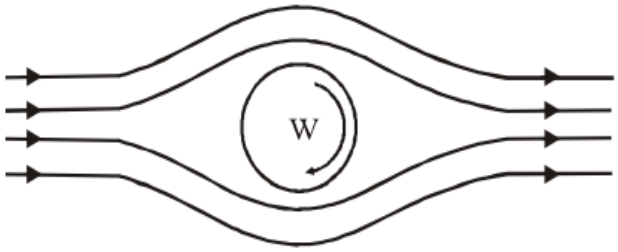
Q12. Standing wave are produced due to superposition of two identical progressive waves traveling in – **(1)**
(a) Same direction
(b) opposite direction
(c) perpendicular direction
(d) at an angle between their directions of propagation.

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):** For equilibrium of concurrent forces acting at a point, net force must be zero. **(1)**
Reason(R): For a point mass object to be in equilibrium, its linear acceleration must be zero.

Q14. **Assertion (A):** As wind flows left to right and a ball is spinned as shown, there will be a lift of the ball. **(1)**



Reason(R): Decreased velocity of air below the ball increases the pressure more than that above the ball.

Q15. **Assertion (A):** Two bodies of different masses dropped simultaneously from the top of tower hit the ground simultaneously. **(1)**
Reason(R): Time taken by a body to fall through certain height depend on the mass of body.

Q16. **Assertion (A):** When a bottle of cold carbonated drink is opened a slight fog forms around the opening. **(1)**
Reason(R): Adiabatic expansion of the gas causes lowering of temperature and condensation of water vapours.

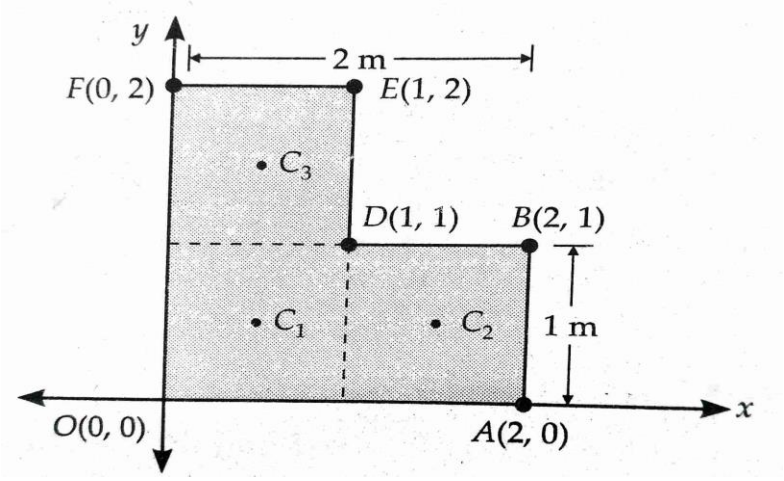
SECTION – B

Q17. A force is given by $F = at + bt^2$, where 't' is time, find the dimensions of a / b from the given equation. **(2)**

Q18. Find the torque of a force $7\mathbf{i} + 3\mathbf{j} - 5\mathbf{k}$ about the origin which acts on a particle whose position vector is $\mathbf{i} - \mathbf{j} + \mathbf{k}$. **(2)**

OR

Find center of mass of a uniform L-shaped lamina with dimensions as shown in figure below. The mass of lamina is 3 kg.



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

Q20. (i) A gas has two specific heats i.e., Cp and Cv , which one is greater and why? **(2)**
(ii) Write two limitations of the first law of thermodynamics.

Q21. A elastic spring is compressed by an amount 'x'. Show that its Potential energy is 1/2 kx^2 where 'k' is the spring constant. **(2)**

SECTION – C

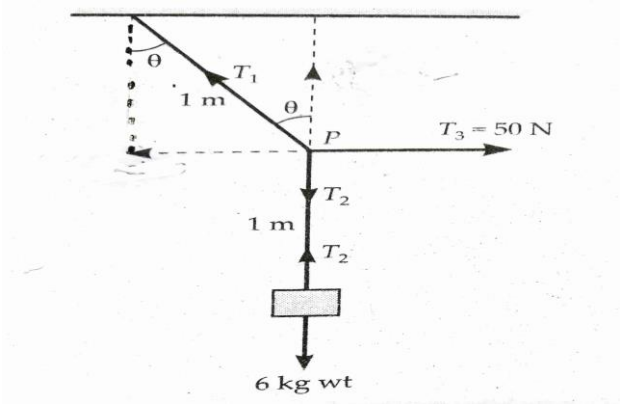
Q22. The time period of vibration of tuning fork depends on length 'l' of its prong, density 'd' and Young's modulus 'Y' of its material. Deduce an expression for the period of vibration on the basis of dimensions. **(3)**

Q23. (i)Establish the relation between angular momentum and moment of inertia for a rigid body. **(3)**
(ii)Why is it more difficult to revolve a stone by tying it to a longer string than by tying it to a shorter string?

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

Q25. Draw stress-strain graph for a metallic solid and show **(3)**
(i) elastic limit
(ii) region of plasticity
(iii) point of ultimate tensile strength
(iv) fracture point on the graph

Q26. (i) The distance travelled by a moving body is directly proportional to time. Is any external force acting on it? **(3)**
(ii)A mass of 6 kg is suspended by a rope of length 2 m from a ceiling. A force of 50 N in the horizontal direction is applied at the midpoint of the rope as shown in figure. What is the angle the rope makes with the vertical in equilibrium?



OR

(i) What is the need of banking a circular road?
(ii) A cyclist speeding at 18 km/h on a level road takes a sharp circular turn of radius 3 m without reducing the speed and without bending towards the center of the circular path. The coefficient of static friction between the tyres and road is 0.1. Will the cyclist slip while taking a turn?

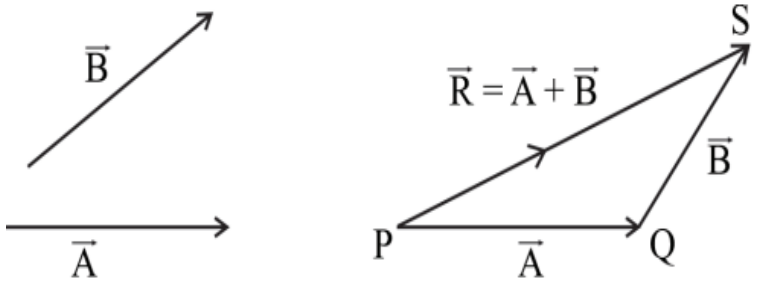
Q27. (i) Prove that in an elastic collision in one dimension, the relative velocity of approach before collision is equal to relative velocity of separation after collision. **(3)**
(ii) Two bodies stick together after collision. What type of collision is in between these two bodies? Justify your answer.

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.** **(4)**

A vector quantity is a quantity that has both magnitude & direction and obeys vector law of addition. Let **A** and **B** be two vectors in a plane, then their vector sum **A+B** is shown in adjoining figure.



The vector sum of two vector is also known as their resultant vector. In the procedure of vector addition shown, vectors are arranged head to tail method. Since the two vectors and their resultant form three sides of a triangle, this method is also known as triangle method of vector addition.

(i) What is the expression for magnitude of resultant of the two vectors **A** & **B** in terms of their magnitude and angle θ between them?

(a) $R = \sqrt{A^2 + B^2 + 2AB\sin\theta}$

(b) $R = \sqrt{A^2 + B^2 - 2AB\sin\theta}$

(c) $R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

(d) $R = \sqrt{A^2 + B^2 - 2AB\cos\theta}$

(ii) Under what condition the magnitude of sum of two vector is equal to sum of magnitudes of these vectors?
(a) When two vectors are in same direction.
(b) When two vectors are acting in opposite direction.
(c) When two vectors are perpendicular to each other.
(d) When two vectors are inclined in any direction, i.e. does not depend upon direction.

(iii) What is the angle between two vectors $\vec{A}$ & $\vec{B}$ when

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

(a) $\theta = 90°$
(b) $\theta = 0°$
(c) $\theta = 120°$
(d) $\theta = 180°$

OR

If three vectors **a**, **b**, **c** are represented by three sides of a triangle taken in the same order, then which of the following is correct?
(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.

(iv) Two vectors, both equal in magnitude have their resultant equal in magnitude of either. Find the angle between these vectors.
(a) 30°
(b) 90°
(c) 60°
(d) 120°

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

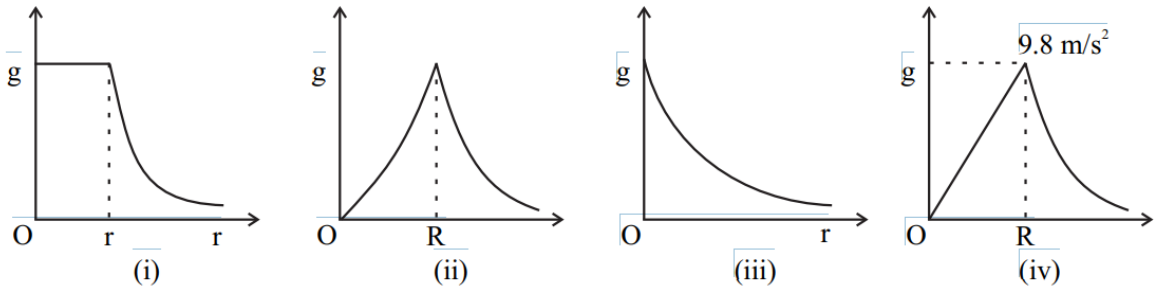
Acceleration due to gravity and its variation with altitude & depth

Relation between g and G is

$$g = \frac{GM_e}{R_e^2}$$

where Me = Mass of the earth and Re = Radius of the earth This relation gives acceleration due to gravity at the surface of the earth. The value g is independent of mass, size and shape of the body falling under gravity but g varies with altitude and depth & depends on shape of the earth and rotation of the earth.

(i) Which of the following graph shows the correct variation of acceleration due to gravity with distance from the centre of the earth?



(a) (i) (b) (ii) (c) (iii) (d) (iv)

(ii) At which place, the weight of the body is maximum
(a) at poles
(b) equator
(c) at the centre
(d) at 1 km above the surface of the earth

(iii) The change in the value of g at a height h above the surface of the earth is same distance at a depth h below the surface of the earth. When both d and h are much smaller that the radius of the earth, then choose the correct answer

(a) d = h / 2 (b) d = 3h / 2 (c) d = 2h (d) d = h

(iv) If the radius of two planets be R_1 and R_2 and their densities be ρ_1 and ρ_2, then ratio of acceleration due to gravity on the planets will be

(a) $R_1 \rho_1 : R_2 \rho_2$
(b) $R_1 \rho_2 : R_2 \rho_1$
(c) 1 : 1
(d) $R_2 : R_1$

OR

If the diameter of the earth becomes twice its present value but mass remaining the same, then the weight of the object would be
(a) W / 2 (b) W / 4 (c) unaffected (d) W /√2

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)Show that the horizontal range is same whether Θ is angle of projection with the horizontal or with the vertical.

(iii)What will be the effect on maximum height of a projectile when its angle of projection is changed from 30^o to 60^o, keeping the same initial velocity of projection?

OR

(a)Draw velocity-time graph of uniformly accelerated motion in one dimension. From the graph derive the following equations;

(i) $v = u + at$

(ii) $v^2 - u^2 = 2as$

(b)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.

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) For a particle executing SHM, find that at what displacement from the mean position is the energy half kinetic and half potential.

OR

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

(ii) A wave travelling along a string is given by $y = 0.005 \sin(80x - 3t)$, where the numerical values are in SI units. Symbols have their usual meaning.
Calculate: (a) Frequency of the wave (b) Velocity of the wave

Q33. (i)State and prove Bernoulli's theorem. Give its two applications. **(5)**

(ii)Water flows through the horizontal pipe whose internal diameter is 2.0 cm at a speed of 1.0 m/s. What should be the diameter of the nozzle, if the water is to emerge at a speed of 4.0 m/s?

OR

(i) What is the phenomenon of capillarity? Derive an expression for the rise of liquid in a capillary tube.
(ii) Calculate excess pressure in an air bubble of radius 6 mm. Surface tension of liquid is 0.58 N/m. What will be the excess pressure for a liquid drop for the same Surface tension?