KENDRIYA VIDYALAYA SANGATHAN LUCKNOW REGION

SESSION ENDING EXAMINATION (2023-24)

CLASS - XI

SUBJECT: PHYSICS

TIME: 3 Hrs **Max.Marks : 70**

Instructions:

i) The Question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
ii) Section A has sixteen questions 12 MCQ and 4 Assertion-Reason questions of 1 mark each.
iii) Section B contains five questions of two marks each.
iv) Section C contains seven questions of three marks each.
v) Section D contains two case study-based questions of 4 marks each.
vi) Section E contains three long questions of five marks each.
vii) There is no overall choice. However, an internal choice has been provided in 1 question in section B, 1 question in section C, 1 question in each case Based question in section D and in all 3 questions of section E. You have to attempt only one of the choices in such questions.

SECTION-A

1. The dimensions of Planck's constant equals to that of
   (a) Energy (b) Momentum
   (c) Angular momentum (d) Power

2. Which one of the following is unit less and dimensionless quantity?
   (a) Angle (b) Solid angle
   (c) Strain (d) Modulus of elasticity

3. A force of 49 N is just able to move a block of mass 10 kg on a rough horizontal surface. The coefficient of friction is
   (a) 0 (b) 0.5
   (c) 0.7 (d) 1

4. During the perfectly elastic collision, which of the following is conserved?
   (a) Linear momentum of the each body is conserved.
   (b) Kinetic energy of the each body is conserved.
   (c) Linear momentum of the system is conserved.
   (d) None of the above.

5. Rotational analogue of mass in rotational motion is -
   (a) Weight (b) Moment of inertia
   (c) Torque (d) Angular momentum

6. Orbital velocity of a satellite of earth does not depend upon -
   (a) mass of the earth (b) mass of the satellite
   (c) radius of the earth (d) acceleration due to gravity

7. Which of the following represents volumetric strain?

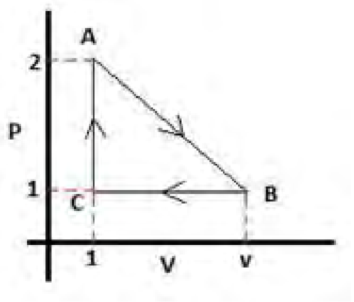
(a) V/(ΔV)	(b) (ΔV)/V
(c) P / V	(d) -P / (ΔV/V)

8. Surface energy is -
   (a) kinetic energy of the surface molecules
   (b) the force per unit length acting on surface particles
   (c) the energy of the molecules inside the liquid
   (d) the extra energy that the molecules at the surface have relative to molecules inside the liquid

9. A cube with a side length of 1m is heated uniformly a degree Celsius above the room temperature and all the sides are free to expand. What will be the increase in the volume of the cube? Consider the coefficient of thermal expansion as unity.

(a) Zero	(b) 1 m^3
(c) 2 m^3	(d) 3 m^3

10. In the process A to B to C, 20J of heat is supplied from A to B. 20.5J of heat has been removed from B to C and 2J of heat has been added from C to A. Calculate the value of 'v' from the given conditions in the diagram. The values of pressure and volume given in the graph are in S.I. units.



(a) $4m^3$	(b) $1.5m^3$
(c) $3m^3$	(d) $8m^3$

11. The area under the isotherm(P-V indicator diagram) represents the magnitude of the
    (a) net energy of the system
    (b) net work done on the system or by the system
    (c) net change in the temperature of the system
    (d) none of the mentioned

12. The monoatomic gas molecules have only three degrees of freedom because of
    (a) translatory motion
    (b) rotatory motion
    (c) both translatory and rotatory motion
    (d) translatory, rotatory and vibratory motion

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to questions 13 to 16 from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true and R is NOT the correct explanation of A

(c) A is true and R is false

(d) A is false and R is also false

13. **Assertion**: Horizontal range is same for angle of projection θ and $(90 - \theta)$.
Reason: Horizontal range is independent of angle of projection.

14. **Assertion:** In one dimensional elastic collision between two bodies, the relative speed of the bodies after collision is equal to the relative speed before the collision.
Reason: In an elastic collision, the linear momentum and kinetic energy of the system is conserved.

15. **Assertion**: The earth revolves around the sun in an elliptical orbit.
Reason: The earth revolves around the sun due to gravitational force between them.

16. **Assertion**: In adiabatic compression, the internal energy and temperature of the ideal gas get decreased.
Reason: The adiabatic compression is a slow process.

SECTION-B

17. E, m, L and G denote energy, mass, angular momentum, and gravitational constant respectively. Determine the dimensions of EL^2/m^5G^2.

18. A car is moving along a straight highway with speed 126 km h^{-1} is brought to a stop within a distance of 200 m. Calculate the retardation of the car (assumed uniform).

OR

Derive second equation of motion using v- t graph for uniformly accelerated motion.

19. Write the expressions for the 'g' at height 'h' and depth'd' from the surface of earth. Explain, why is the value of 'g' decreases with height and depth from the surface of the earth?

20. Define the term bulk modulus of elasticity, Give its SI unit. Write the relation between bulk modulus and compressibility.

21. Write the Newton's formula for the speed of sound in ideal gas. Explain the Laplace correction and write the modified formula for the speed of sound.

SECTION-C

22. (a) Give two examples of conservative forces. (b) State and prove work energy theorem.

23. State Parallelogram law of vectors addition and find the magnitude of the resultant of two vectors **A** and **B** in terms of their magnitudes and angle between them.

OR

A man can swim with a speed of 4.0 km/h in still water. How long does he take to cross a river 1.0 km wide if the river flows steadily at 3.0 km/h and he makes his strokes normal to the river current? How far down the river does he go when he reaches the other bank?

24. A car of mass 1000 kg travelling at 32 m/s dashes into the rear of a truck of mass 8000 kg moving in the same direction with a velocity of 4 m/s. After the collision, the car bounces backwards with a velocity of 8 m/s. What is the velocity of the truck after the impact?

25. (a) Define Centre of mass.

(b) Three point masses of 1 kg, 2 kg and 3 kg lie in X-Y plane at (1,2), (0,-1) and (2,-3) respectively. Calculate the co-ordinates(X_{cm}, Y_{cm}) of the centre of mass of the system.

26. (a) State Wein's displacement law.
(b) Explain the anomalous expansion of water from 0 ^{0}C to 4 ^{0}C and its importance for aquatic life.

27. (a) State the law of equipartition of energy
(b) Calculate the ratio of specific heats (γ) for a (a) Diatomic gas and (b) Poly atomic gas for rigid molecules.

28. (a) Calculate the length of a simple pendulum, which ticks seconds.
(b) Show the variation of kinetic energy, potential energy and total energy as a function of displacement of a particle in simple harmonic motion.

SECTION-D

29. We know that the motion of a rigid body, in general, is a combination of rotation and translation. If the body is fixed at a point or along a line, it has only rotational motion. let us take the example of opening or closing a door.

A door is a rigid body which can rotate about a fixed vertical axis passing through the hinges. What makes the door rotate? It is clear that unless a force is applied the door does not rotate. But any force does not do the job. A force applied to the hinge line cannot produce any rotation at all, whereas a force of given magnitude applied at right angles to the door at its outer edge is most effective in producing rotation. It is not the force alone, but how and where the force is applied is important in rotational motion.

Answer the following questions:

i) The rotational analogue of 'force' in rotational motion is
(a) Moment of force (b) Mass
(c) Gravitational force (d) Moment of inertia

ii) Torque is
(a) 2(**r** x **F**) (b) **r.F**
(c) **r** x **F** (d) 2(**r.F**)

iii) Why is the handle of a door fixed far away from the hinges?

iv) 120 N of force is required to open a nut using a spanner of length 10 cm. If another spanner of length 6 cm is used to open the same nut, amount of force to be applied is
(a) 100N (b) 200N
(c) 300N (d) 60N

OR

If applied torque on a system is zero, then for that system
(a) Moment of inertia is zero
(b) Angular momentum remains conserved
(c) angular acceleration is constant
(d) None of the above

30. When an object moves along a straight line with uniform acceleration, it is possible to relate its velocity, acceleration during motion and the displacement covered by it in a certain time interval by a set of equations known as the equations of motion. For convenience, a set of three such equations are given below: $v = u + at$. $s = ut + ½ at^2$, $2as = v^2 – u^2$ Where u is the initial velocity of the object which moves with uniform acceleration a for time t, v is the final velocity and s is the distance travelled by the object in time t.

i) Equation of motions are applicable to motion with
(a) uniform acceleration (c) non uniform acceleration
(b) constant velocity (d) none of these

ii) The displacement travelled by a body is directly proportional to the square of time taken ,its acceleration
(a) increases (b)decreases
(c) becomes zero (d)remains constant

iii) The brakes applied to a car produce an acceleration of 10 m/s^2 in the opposite direction to the motion. If the car takes 1 s to stop after the application of brakes, calculate the distance travelled during this time by car.

iv) An object is dropped from a tower falls with a constant acceleration of 10 m/s^2. Find its speed 10 s after it was dropped.

OR

A bullet hits a target with a velocity of 10 m/s and penetrates it up to a distance of 5 cm. Find the deceleration of the bullet in the target

SECTION-E

31. (i) Find the expression for the recoil velocity of a gun.
(ii) A person of mass 70 kg stands on a weighing scale in a lift which is moving
(a) upward with uniform acceleration of 5 $m\ s^{-2}$,
(b) downward with uniform speed 2 $m\ s^{-1}$
(c) downward with uniform acceleration of 10 $m\ s^{-2}$
Calculate the reading on the scale in each case? (take $g = 10\ m\ s^{-2}$)

OR

What is meant by banking of roads? Explain the need for it. Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at angle θ. The coefficient of friction between road and wheels is μ.

32. (i) State Pascal's law and explain the working of hydraulic lift.
(ii) Calculate the pressure on a swimmer 10 m below the surface of a lake.

OR

State and prove Bernoulli's theorem. Explain why to keep a piece of paper horizontal, we should blow over, not under it.

33. (a) Explain the meaning of the terms (i) Nodes and (ii) Anti nodes in respect of standing waves.
(b) Explain the formation of harmonics in a stretched string with the help of suitable diagrams and show that in case of a stretched string the first three harmonics are in the ratio 1:2:3.

OR

(a) Show the formation of standing waves :
(i) in a closed organ pipe and,
(ii) In an open organ pipe
(Draw only first three harmonics in each case)
(b) A pipe, 30.0 cm long, is open at both ends. Which harmonic mode of the pipe resonates a 1.1 kH_z source? Take the speed of sound in air as 330 $m\ s^{-1}$

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