



# B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS  
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL



## ANNUAL EXAMINATION (2025-26)

### PHYSICS (042) (SET-II)

**Class: XI**  
**Date: 12.02.26**  
**Admission no:**

**Time: 3hrs**  
**Max Marks: 70**  
**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 four 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, one question in each CBQ in Section D and all 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

1. Which of the following is a correct pair of fundamental quantities?  
(a) Length and Mass (b) Force and Time (c) Pressure and Temperature (d) Work and Energy
2. A body is thrown vertically upward. The velocity at the highest point is:  
(a) Maximum (b) Zero (c) Equal to initial velocity (d) None of these
3. In projectile motion, which quantity remains constant throughout the flight?  
(a) Vertical velocity (b) Acceleration (c) Horizontal velocity (d) Height

- |  |
|--|
| 4. The speed of a projectile at its maximum height is half of its initial speed. The angle of projection is; |
| (a) $60^\circ$ (b) $15^\circ$ (c) $30^\circ$ (d) $45^\circ$  |

- |   |
|---|
| 5. Two masses $m$ and $4m$ are moving with equal kinetic energies. The ratio of the magnitude of their linear momenta is; |
| (a) 1:3 (b) 1:4 (c) 1:2 (d) 1:6   |

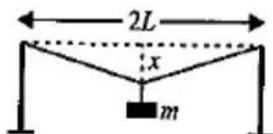
6. The rotational inertia of a rigid body is referred to as its \_\_\_\_\_.

- (a) Moment of energy (b) Moment of force  
(c) Moment of inertia (d) Moment of acceleration

7. A body of M.I.  $3 \text{ kg m}^2$  rotating with an angular velocity of  $2 \text{ rad/s}$  has the same K.E. as a mass of  $12 \text{ kg}$  moving with a velocity of:

- (a)  $1 \text{ m/s}$  (b)  $2 \text{ m/s}$  (c)  $4 \text{ m/s}$  (d)  $8 \text{ m/s}$

8. A mild steel wire of length  $2L$  and cross sectional area  $A$  is stretched, well within the elastic limit, horizontally between two pillars as shown in the figure. A mass  $m$  is suspended from the midpoint of the wire. Strain in the wire is-



- (a)  $(x^2) / (2L^2)$  (b)  $(x^2) / L$  (c)  $(x^2) / 3L$  (d)  $x / 2L$

9. After terminal velocity is reached, the acceleration of a body falling through a fluid is  
(a) equal to  $g$  (b) zero (c) less than  $g$  (d) greater than  $g$

10. The SI unit of specific heat capacity is

- (a)  $\text{J kg}^{-1}\text{K}^{-1}$  (b)  $\text{J kg}^{-1}\text{K}^{-2}$  (c)  $\text{J kg}^{-2}\text{K}^{-1}$  (d)  $\text{J}^{-1}\text{kgK}^{-1}$

11. First law of thermodynamics is based on?

- a) Conservation of energy (b) Conservation of mass  
c) Conservation of momentum (d) Conservation of work

12. Consider a gas contained in a rigid container of volume  $20\text{m}^3$ . What will be the change in internal energy if  $50\text{J}$  of heat is provided to it? Assume the gas exerts a pressure of  $1\text{atm}$  on the walls.

- a)  $50\text{J}$  (b)  $0$  (c)  $70\text{J}$  (d)  $20\text{J}$

**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 Assertion is false but Reason is true.**

13. **Assertion:** Displacement of a body may be zero when distance travelled by it is not zero.

**Reason:** The displacement is the longest distance between initial and final position.

14. **Assertion:** If the net external force on a body is zero, then its acceleration will be zero.

**Reason:** Acceleration does not depend upon the force.

15. **Assertion:** Gravitational potential of earth at every place on it is negative.

**Reason:** Everybody on earth is bound by the attraction of earth.

**16. Assertion:** Identical springs of steel and copper are equally stretched. More work will be done on the steel spring.

**Reason:** Steel is more elastic than copper.

### SECTION-B

17. Derive second equation of motion graphically. 2

Or

The ceiling of a long hall is 25 m high. What is the maximum horizontal distance that a ball thrown with a speed of  $40 \text{ m s}^{-1}$  can go without hitting the ceiling of the hall?

18. State and explain law of momentum. 2

19. State and prove work-energy theorem for constant force. 2

20. Derive an expression of work done in an isothermal process. 2

21. Define simple harmonic motion. Write its mathematical expression. 2

### SECTION-C

22. What are the limitations of dimensional analysis? Give two examples where it fails. 3

23. A car moves with uniform acceleration of  $2 \text{ m/s}^2$ . If its initial velocity is  $5 \text{ m/s}$ , find the distance covered in 10 seconds. 3

24. A train runs along an unbanked circular bend of radius 30 m at a speed of  $54 \text{ km/hr}$ . The mass of the train is 106 kg. What provides the necessary centripetal force required for this purpose, the engine or the rails? What is the angle of banking required to prevent the rail from wearing out? 3

25. A pump on the ground floor of a building can pump up water to fill a tank of volume in 15 min. If the tank is 40 m above the ground, and the efficiency of the pump is 30%, how much electric power is consumed by the pump? 3

26. Define moment of inertia of a body. Give its units and dimensions. State the factors on which the moment of inertia of a body depends. 3

27. Four identical hollow cylindrical columns of mild steel support a big structure of mass 50,000 kg. The inner and outer radii of each column are 30 cm and 60 cm respectively. Assuming the load distribution to be uniform, calculate the compressional strain of each column. 3

OR

(a) The blood pressure in humans is greater at the feet than at the brain.

(b) Even though the atmosphere is more than 100 km high, the atmospheric pressure drops to nearly half its value at a height of about 6 km.

28. Write Newton's formula for the speed of sound in air. What was wrong with this formula? What correction was made by Laplace in this formula? 3

### SECTION-D (Case Study Based Questions)

29. **Average Speed and Average Velocity:**

When an object is in motion, its position changes with time. So, the quantity that describes how fast is the position changing w.r.t. time and in what direction is given by average velocity. It is defined as the change in position or displacement ( $\Delta x$ ) divided by the time interval ( $\Delta t$ ) in which that displacement occurs. However, the quantity used to describe the rate of motion over the actual path, is average speed. It defined as the total distance travelled by the object divided by the total time taken.

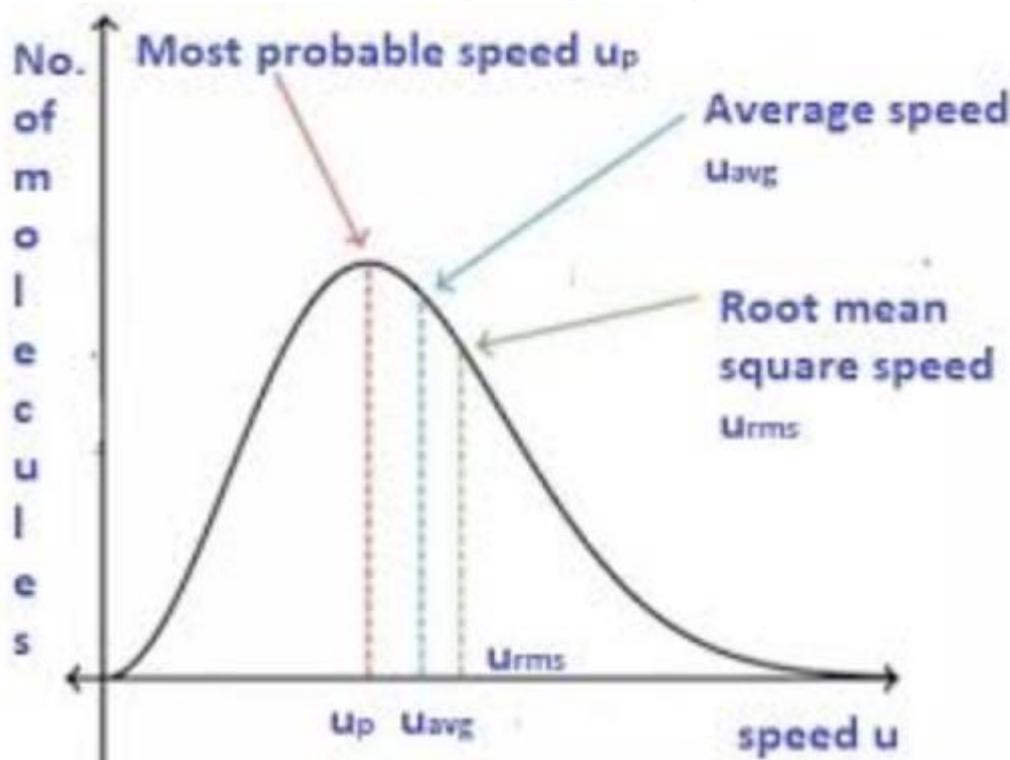
- (i) A 250 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 750 m is: 1  
 (a) 56 s (b) 68 s (c) 80 s (d) 92 s
- (ii) A truck requires 3 hr to complete a journey of 150 km. What is average speed? 1  
 (a) 50 km/h (b) 25 km/h (c) 15 km/h (d) 10 km/h
- (iii) Average speed of a car between points A and B is 20 m/s, between B and C is 15 m/s and between C and D is 10 m/s. What is the average speed between A and D, if the time taken in the mentioned sections is 20s, 10s and 5s, respectively? 1  
 (a) 17.14 m/s (b) 15 m/s (c) 10 m/s (d) 45 m/s

Or

- (iii) The speed varies from 0 to 30 m/s in 5 s. Find the average speed during the motion.  
 (a) 10 m/s (b) 20 m/s (c) 0 m/s (d) 15 m/s
- (iv) A cyclist is moving on a circular track of radius 40 m, completes half a revolution in 40 s. Its average velocity (in m/s) is: 1  
 (a) zero (b) 2 (c)  $4\pi$  (d)  $8\pi$

30. Read the case study given below and answer any four subparts:

Root mean square velocity (RMS value) is the square root of the mean of squares of the velocity of individual gas molecules and the Average velocity is the arithmetic mean of the velocities of different molecules of a gas at a given temperature.



- (i) Moon has no atmosphere because: - 1  
 (a) It is far away from the surface of the earth  
 (b) Its surface temperature is  $10^{\circ}\text{C}$   
 (c) The r.m.s. velocity of all the gas molecules is more than the escape velocity of the moon's surface  
 (d) The escape velocity of the moon's surface is more than the r.m.s velocity of all molecules
- (ii) For an ideal gas,  $C_p/C_v$  is: 1  
 (a)  $>1$  (b)  $<1$  (c)  $\leq 1$  (d) none of these

- (iii) The root mean square velocity of hydrogen is 5 times than that of nitrogen. If T is the temperature of the gas, then: 1  
 (a)  $T(\text{H}_2) = T(\text{N}_2)$  (b)  $T(\text{H}_2) < T(\text{N}_2)$  (c)  $T(\text{H}_2) > T(\text{N}_2)$  (d) none of these
- (iv) Suppose the temperature of the gas is tripled and  $\text{N}_2$  molecules dissociate into an atom. Then what will be the rms speed of atom: 1  
 (a)  $\sqrt{6} v_0$  (b)  $v_0$  (c)  $\sqrt{3} v_0$  (d) none of these

Or

- (iv) The velocities of the molecules are  $v, 2v, 3v, 4v$  &  $5v$ . The rms speed will be: 1  
 (a)  $11 v$  (b)  $v (11)^{1/2}$  (c)  $v$  (d)  $v (12)^{1/2}$

### SECTION-E

31. Derive the expression for escape velocity from Earth's surface. Then calculate the escape velocity for a body on Earth using the values: Radius of Earth  $R=6.4 \times 10^6$  m,  $g=9.8$  m/s<sup>2</sup>. (5)

Or

Find the expression of gravitational acceleration at the Earth's surface, hence find the expression for gravitational acceleration (i) above (ii) below the Earth's surface.

32. A wave travelling along a string is described by,  $y(x, t) = 0.005 \sin(80.0x - 3.0t)$ , in which the numerical constants are in SI units (0.005 m, 80.0 rad m<sup>-1</sup>, and 3.0 rad s<sup>-1</sup>). Calculate (a) the amplitude, (b) the wavelength, and (c) the period and frequency of the wave. Also, calculate the displacement  $y$  of the wave at a distance  $x = 30.0$  cm and time  $t = 20$ s. (5)

Or

Explain the relation in phase between displacement, velocity and acceleration in S.H.M., graphically as well as theoretically.

33. (i) Define surface tension, write its mathematical formula and SI unit. (5)  
 (ii) Find expression of height of liquid column in a capillary tube.

Or

(i) Develop a relation between the co-efficient of linear expansion, co-efficient superficial expansion and coefficient of cubical expansion of a solid?

(ii) Show that  $C_P - C_V = R$ . [Where  $C_P$  = specific heat at constant pressure;  $C_V$  = specific heat at constant volume and  $R$  = Universal Gas constant] for an ideal gas?

----- ALL THE BEST -----