

**CBSE Board**  
**Class XI Physics**  
**Sample Paper-4**

**Time: - 3**

**Marks: - 70 Marks**

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**General Instructions**

- (a) All questions are compulsory.
- (b) There are 29 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 16 carry two marks each, questions 17 to 25 carry three marks each and questions 27 to 29 carry five marks each.
- (c) Question 26 is a value based question carrying four marks.
- (d) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choices in such questions.
- (e) Use of calculator is not permitted.
- (f) You may use the following physical constants wherever necessary.

$$e = 1.6 \times 10^{-19} C$$

$$c = 3 \times 10^8 ms^{-1}$$

$$h = 6.6 \times 10^{-34} JS$$

$$\mu_o = 4\pi \times 10^{-7} NA^{-2}$$

$$k_B = 1.38 \times 10^{23} JK^{-1}$$

$$N_A = 6.023 \times 10^{23} /mole$$

$$m_n = 1.6 \times 10^{-27} kg$$

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- 1. Give the number of significant figures in  $5.300 \times 10^3$ . (1)
- 2. The dimension  $ML^{-1}T^{-2}$  corresponds to which quantity? (1)
- 3. Why do we use a wrench of long arm to unscrew a nut tightly fitted to a bolt? (1)
- 4. Can kinetic energy be negative? What about potential energy? (1)
- 5. Does the spring constant of a spring depend on its length? (1)
- 6. Is the Young's modulus of rubber greater than that of steel? (1)
- 7. State the SI unit of angular velocity. (1)
- 8. Explain why a cricketer moves his hands back while holding a catch. (1)

9. Find the angle of projection for which horizontal range and maximum height are equal. (2)

**OR**

Is acceleration vector in uniform circular motion a constant vector? (2)

10. Differentiate between wave velocity and particle velocity for a mechanical wave in the medium. (2)

11. A light body and a heavy body have same momentum. Which one has greater kinetic energy? Support your answer with an explanation (2)

12. State the law of equipartition of energy. (2)

13. What is an adiabatic process? How is it different from an isothermal process? (2)

14. A ball of mass 5 kg strikes against a wall at an angle of  $45^\circ$  and is reflected at the same angle. Find the change in momentum. (2)

15. Check the dimensional consistency of the following equation  $\frac{1}{2}mv^2 = mgh$  where  $m$  is the mass of the body,  $v$  is its velocity,  $g$  is acceleration due to gravity and  $h$  is the height. (2)

16. The position of a particle is given by  $S(t) = 5t\hat{i} + 6t^2\hat{j} - 10t\hat{k}$  where  $t$  is in seconds. Find the velocity  $v(t)$  and acceleration  $a(t)$  of the particle at  $t = 1$  s. (2)

17. The kinetic energy of a satellite is  $E$ . Find the total energy of the satellite. (3)

18. Explain why

- (i) a body with large reflectivity is a poor emitter
- (ii) heating systems based on circulation of steam are more efficient in warming a building than those based on circulation of hot water. (3)

19. What is a Carnot's engine? What is its efficiency? (3)

**OR**

Two masses  $m_1$  and  $m_2$  are connected at the ends of a light inextensible string that passes over frictionless pulley. Find the acceleration, tension in the string and thrust on the pulley when the masses are released. (3)

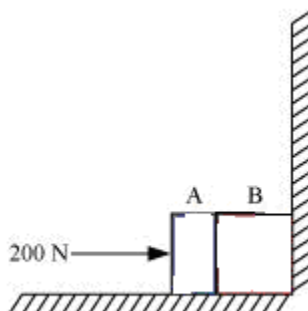
20. A cylinder of fixed capacity 44.8 litres contains helium gas at standard temperature and pressure. What is the amount of heat needed to raise the temperature of the gas in the cylinder by  $15.0^\circ\text{C}$ ? Given  $R = 8.32\text{J/mol/K}$ . (3)

21. A particle executes SHM according to the equation  $x = A \cos \omega t$ . Draw graphs to represent the displacement, velocity and acceleration of the particle. (3)
22. A sound wave travelling along a string is described by  $y = 5 \times 10^{-3} \sin(80x - 3t)$ . Calculate  
 (i) the amplitude  
 (ii) the wavelength  
 (iii) frequency of the wave. (3)
23. What is a conservative force? Prove that gravitational force is conservative and frictional force is non-conservative (3)
24. The bob A of a pendulum released from  $30^\circ$  to the vertical hits another bob B of the same mass at rest on a table as shown in Fig. 6.15. How high does the bob A rise after the collision? Neglect the size of the bobs and assume the collision to be elastic. (3)
25. A 400kg satellite is in a circular orbit of radius  $2R_E$  about the earth. How much energy is required to transfer it to an orbit of radius  $4R_E$ ? What are the changes in its kinetic and potential energies? (3)
26. Vineet saw his uncle planting seeds in the field. His uncle does not know methods of growing plants. Then he decided to make his uncle aware of this. He explained the importance of ploughing the land before planting the seeds. Uncle is convinced with his ideas. He planted accordingly. The plants grew successfully.  
 (a) What can you say about Vineet?  
 (b) What is the utility of ploughing a field? (4)
27. Draw the first three harmonics in an open organ pipe. Two piano strings A and B are playing slightly out of tune and produce beats of frequency 5Hz. The tension in string B is slightly increased and the beat frequency is found to decrease to 3Hz. What is the original frequency of B if the frequency of A is 500Hz? (5)

**OR**

Two identical springs each of force constant  $K$  are connected in (a) series (b) parallel, so that they support a mass  $m$ . Find the ratio of the time periods of the mass in the two systems. (5)

- 28.** Two bodies  $A$  and  $B$  of masses  $5\text{ kg}$  and  $10\text{ kg}$  in contact with each other rest on a table against a rigid wall as shown in the given figure. The coefficient of friction between the bodies and the table is  $0.15$ . A force of  $200\text{ N}$  is applied horizontally to  $A$ . What are (a) the reaction of the partition (b) the action-reaction forces between  $A$  and  $B$ ? (c) What happens when the wall is removed? (5)



**OR**

Give any three differences between progressive waves and stationary waves. A stationary wave is  $y = 12 \sin 300 t \cos 2x$ . What is the distance between two nearest nodes? (5)

- 29.** What is a projectile? Write the expressions for the time of flight, and maximum height for the projectile thrown upwards at an angle  $\theta$  with the horizontal direction. The ceiling of a long hall is  $25\text{ m}$  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? (5)

**OR**

What do you mean by the centripetal force? Derive an expression for it. (5)