



TOPPER SAMPLE PAPER 4 XI – PHYSICS

Time: Three Hours

Maximum Marks: 70

General Instructions

- (a) All questions are compulsory.
- (b) There are 30 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 18 carry two marks each, questions 19 to 27 carry three marks each and questions 28 to 30 carry five marks each.
- (c) 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.
- (d) Use of calculator is not permitted.
- (e) You may use the following physical constants wherever necessary.

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

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

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

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

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

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

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

1. Give the number of significant figures in 5.300×10^3 . (1)
2. The dimension $ML^{-1}T^{-2}$ corresponds to? (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.

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° 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

$$S(t) = 5t\hat{i} + 6t^2\hat{j} - 10\hat{k}$$

where t is in seconds. Find the velocity $v(t)$ and acceleration $a(t)$ of the particle at $t = 1$ s. (2)

17. Why is it easier to pull a lawn mower than to push it? (2)

18. Three particles of mass m are placed at the corners of an equilateral triangle. Find the position of centre of mass in terms of coordinates. (2)

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

20. State Bernoulli's theorem. Explain the lift on an airfoil using the theorem. (3)



21. 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)

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

23. 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°C ? Given $R = 8.32\text{J/mol/K}$. (3)

24. A particle executes SHM according to the equation (3)
 $x = A \cos \omega t$.

Draw graphs to represent the displacement, velocity and acceleration of the particle.

25. A sound wave traveling along a string is described by (3)
 $y = 5 \times 10^{-3} \sin(80x - 3t)$.

Calculate

- (i) the amplitude
- (ii) the wavelength
- (iii) frequency of the wave.

26. What is a conservative force? Prove that gravitational force is conservative and frictional force is non-conservative (3)

27. The bob A of a pendulum released from 30° 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)

28. 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?

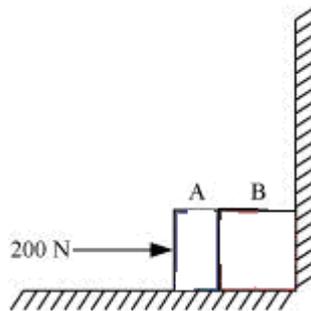
OR

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)



29. Two bodies A and B of masses 5 kg and 10 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 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)

30. What is a projectile? Derive the expressions for the time of flight, and maximum height for the projectile thrown upwards at an angle with the horizontal direction.

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 m s^{-1} can go without hitting the ceiling of the hall?

(5)