CBSE Board
Class XI Physics
Sample Paper-5

Time: - 3 **Marks: - 70 Marks**

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.

$$e = 1.6\times10^{-19} C$$
$$c = 3\times10^{8} ms^{-1}$$
$$h = 6.6\times10^{-34} JS$$
$$\mu_o = 4\pi\times10^{-7} NA^{-2}$$
$$k_B = 1.38\times10^{23} JK^{-1}$$
$$N_A = 6.023\times10^{23} / mole$$
$$m_n = 1.6\times10^{-27} kg$$

1. Why is kilogram a fundamental unit? (1)

2. What is the ratio of the time taken by a body to go up and come down when thrown vertically upwards? (1)

3. When are two vectors equal? (1)

4. A fixed force acts on two bodies of different masses, initially at rest, what is the ratio of their speeds at the end of a certain time interval? (1)

5. Define impulse. (1)

6. What is a conservative force? (1)

7. Where is the centre of mass of a meter stick? (1)

8. Write 2 characteristics of a medium that determine the speed of sound waves through the medium. (1)

9. A quantity R is related to 4 observables a, b, c and d as follows $R = \frac{a^3 b^2}{\sqrt{cd}}$. The percentage errors of measurement in a, b, c and d are 1%, 3%, 4% and 2%, respectively. What is the percentage error in the quantity R? (2)

10. What is the angle of projection at which the h_{max} and range R are equal? (2)

OR

The position of a particle is given by $r(t) = 3.0t\hat{i} + 2.0t^2\hat{j}$, where t is in seconds. Find v(t) and a(t) for the particle. (2)

11. A cyclist stops in 10m. During this the force on the cycle due to the road is 200N and it directly opposes the motion. How much work does the cycle do on the road? (2)

12. What is the angle between the vectors $\hat{a} \times \hat{b}$ and $\hat{b} \times \hat{a}$? State the rule used to find the direction of cross product of vectors. (2)

13. Why is the force of attraction due to a hollow spherical shell of uniform density, on a point mass situated inside it zero. (2)

14. A spherical ball contracts in volume by 0.01% when subjected to a uniform pressure of 2 atmospheres. What is the bulk modulus of the material? (2)

15. State Newton's law of cooling. (2)

16. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the rms speed of a helium gas atom at – 20 °C? (atomic mass of Ar = 39.9 u, of He = 4.0 u). (2)

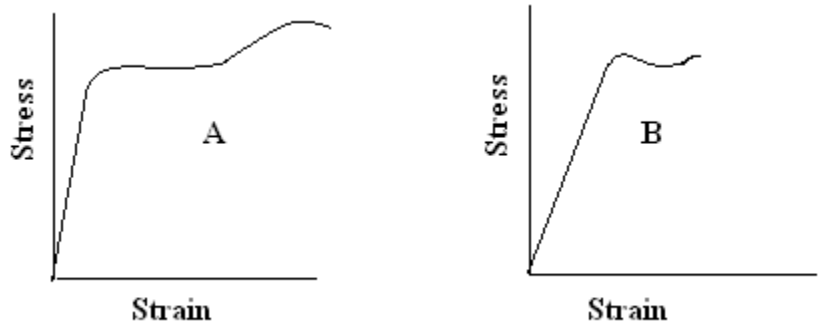
17. A projectile is projected with velocity u making an angle θ with the horizontal. Find
(a) Time of flight
(b) Horizontal range (3)

18. In a nuclear reactor a neutron of high speed is slowed down so that the probability of its causing fission increases. Show that a neutron can lose most of its kinetic energy in an elastic collision with light nuclei that has a mass only a few times the neutron mass. (3)

19. Define moment of inertia. What is the moment of inertia of a ring about a tangent to the circle of the ring? (3)

20. 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 4 R_E? What are the changes in its kinetic and potential energies? (3)

21. The stress-strain graphs for materials A and B are shown below:
(a) Which of the materials has greater Young's modulus?
(b) Which of the two is a stronger material? (3)



OR

State Pascal's law. What is the pressure on a swimmer 10m below the surface of a lake? (3)

22. State the law of equipartition of energy. Show that the ratio of specific heat at constant pressure to specific heat at constant volume is 7/5 for a rigid diatomic molecule. (3)

23. Two cars A and B are running at velocities of 60km/h and 45km/h on parallel roads. Find the relative velocity of car A is
(i) they are both traveling northwards, and
(ii) car A is traveling northwards and car B is traveling southwards. (3)

24. State and prove Work-energy theorem. (3)

25. Prove that the impulse received during an impact is equal to the total change in momentum produced during the impact. (3)

26. Padma's little sister was crying. Then she took a piece of camphor and put it in water. By seeing the camphor piece dancing on the surface of water, the little one stopped crying.
(a) What can you say about the qualities of Padma?
(b) hy do small pieces of camphor dance on the surface of water? (4)

27. When a cyclist moves along a circular track, what provides the centripetal force? Show that the maximum permissible speed of the cyclist is independent of the mass of the cycle.

A cyclist speeding at 18km/h on a level road takes a sharp circular turn of radius 3m without reducing his speed. The coefficient of static friction between the tyres and the road is 0.1. Will the cyclist slip while taking the turn? (5)

OR

(i) Prove that the isothermal elasticity of a gas is equal to its pressure.

(ii) Prove that the adiabatic elasticity of the gas = $\gamma \times P$, where P is pressure of the gas and $\gamma = C_p / C_v, C_p$ and C_v being the specific heats of the gas at constant pressure and constant volume respectively. (5)

28. State Hooke's law. Draw a stress-strain curve for a metal and mark the proportional limit, elastic limit and fraction point.

Define each of the terms: proportional limit, elastic limit and fraction point. (5)

OR

A body is projected with velocity u at angle Î¸ upward from horizontal. Prove that the trajectory is parabolic. Deduce expression for

(i) horizontal range, and

(ii) maximum height attained. (5)

29. Show that for a particle in linear SHM the average kinetic energy over a period of oscillation equals the average potential energy over the same period. (5)

OR

A train, standing in a station-yard, blows a whistle of frequency 400 Hz in still air. The wind starts blowing in the direction from the yard to the station with at a speed of 10 m s^{-1}. What are the frequency, wavelength, and speed of sound for an observer standing on the station's platform? Is the situation exactly identical to the case when the air is still and the observer runs towards the yard at a speed of 10 m s^{-1}? The speed of sound in still air can be taken as 340 m s^{-1}. (5)