CBSE Board
Class XI Physics
Sample Paper-8

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.

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

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1. Express one parsec in terms of light year. (1)

2. While swimming, why does a person push the water backwards? (1)

3. Define angle of repose. (1)

4. A man whose mass is 75 kg walks up 10 steps, each 20 cm high, in 5 s. Find the power he develops. Take g = 10 ms^{-2}. (1)

5. Will it be correct to write the unit of torque as Joule? (1)

6. Plot a graph between the height (h) of a liquid in a capillary tube and the radius (r) of the tube. (1)

7. What is the relation between α, β and γ; the coefficient of linear, superficial and cubical expansion respectively? (1)

8. Name the mode of transfer of energy in which there is no actual movement of matter along the direction of propagation. (1)

9. Force (F) and density (d) are related as

$$F = \frac{\alpha}{\beta + \sqrt{d}}$$

(i) then the dimensions of α are
(ii) then the dimensions of β are. (2)

10. Prove that the vectors $\hat{i} + 2\hat{j} + 3\hat{k}$ and $2\hat{i} - \hat{j}$ are perpendicular to each other. (2)

11. What is the ratio of maximum range and height for a projectile for an angle at which range is maximum? (2)

12. A body constrained to move along the z-axis of a coordinate system is subjected to a constant force given by $F = -\hat{i} + 2\hat{j} + 3\hat{k}$ N where $\hat{i}, \hat{j}$ and $\hat{k}$ are unit vectors along x, y and z-axis of the system respectively. What is the work done by this force in moving the body a distance of 4 m along the z-axis? (2)

13. The equation of a transverse wave on a string is $y = 4\sin 2\pi(\frac{t}{0.05} - \frac{x}{50})$ with length in cm and time in seconds. Calculate the wave velocity. (2)

14. Calculate the acceleration produce in the earth when a stone of mass 6kg falls on it Mass of earth (M) = 6 x 10^{24} kg, and the acceleration due to gravity (g) = 9.8 ms^{-2}. (2)

15.
(a) Write an adiabatic relation between pressure and volume.
(b) Write an adiabatic relation between:
(i) Volume and temperature
(ii) Pressure and temperature. (2)

16. State two characteristics for a gas to be ideal or perfect. (2)

OR

A hollow sphere with a small hole at its bottom is filled with water. It is hung by a long thread and made to oscillate as the water flows out. How is the period of oscillation affected and why? (2)

17. A motor boat, with its engine on in running river and blown over by a horizontal wind is observed to travel at 20 km/hour in a direction 53º east of north. The velocity of the boat with its engine on in still water and blown over by the horizontal wind is 4 km/hr eastward and the velocity of the boat with its engine on over the running river, in the absence of wind is a 8 km/hr, due south. Calculate

(a) the velocity of the boat in magnitude and direction over still water in the absence of wind.

(b) the velocity of the wind in magnitude and direction. (3)

18. Derive a relation for the distance covered in n^{th} second by a uniformly accelerated body. (3)

19. A man weighing 60 kg is standing in a lift. Find his weight as recorded by the weighing machine when the lift.

(a) moves upward with a uniform velocity of 5 ms^{-1},

(b) moves upward with an acceleration of 2 ms^{-1},

(c) moves downward with a uniform acceleration of 2 ms^{-1},

(d) falls freely under gravity. (3)

20. An electron and a proton are detected in a cosmic ray experiment, the first with kinetic energy 10 keV and the second with 100 keV. Which is faster, the electron or the proton? Obtain the ratio of their speeds.

Electron mass = 9.11×10^{-31} kg

Proton mass = 1.67×10^{-27} kg

1 eV = 1.60×10^{-19} J (3)

OR

A liquid is in streamlined flow through a tube of non- uniform cross-section. Prove that sum of its kinetic energy, pressure energy and potential energy per unit mass remains constant. (3)

21. A comet orbits the sun in a highly elliptical orbit. Does the comet have a constant, (i) linear speed, (ii) angular speed, (iii) angular momentum, (iv) kinetic energy, (v) potential energy, (vi) total energy throughout its orbit?

Neglect any mass loss of the comet when it comes very close to the sun. (3)

22. (i) Prove that the work done in stretching a wire = ½ x tension x extension.

(ii) Prove that the work done per unit volume in stretching a wire for every type of strain =½ × stress × strain. (3)

23. What does a heat engine do? Name two types of heat engines. Give one example of each. (3)

24. Two vessels of the same size are at the same temperature. One of them holds 1 kg of H_2 gas and the other holds 1 kg of N_2 gas.

(i) Which of the vessels contains more molecules?

(ii) Which of the vessels is under greater pressure and why?

(iii) In which vessel is the average molecular speed greater? How many times is it greater? (3)

25. 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)

26. (a) Savita was surprised to see oil spreading on to the surface of water and asked her mother to explain why oil spreads on to the surface of water. Her mother explained her daughter the reason behind it. By going through the explanation she thought of learning more about the other scientific phenomenon also. What qualities do you find in Savita?

(b) Oil spreads over the surface of water whereas water does not spread over the surface of oil. Why? (4)

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

OR

What is a projectile? Write the expressions for the time of flight, and maximum height for the projectile thrown upwards at an angle θ 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)

28. The displacement of a body is given to be proportional to the cube of time elapsed. What is the nature of the acceleration of the body? Justify your answer.

A car accelerates from rest at a constant rate of α for some time; after which it decelerates at constant rate of β to come to rest. If the total time elapsed is T second.

(a) Draw a velocity time graph for the motion.

(b) Calculate maximum velocity attained in terms of α, β and T. (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)

29. When a mass is suspended from two springs separately, the periods of vertical oscillations are T_1 and T_2. Find the period when the same mass is suspended from two springs connected in series and in parallel. (5)

OR

Derive an expression for maximum speed a vehicle should have, to take a turn on a banked road. Hence deduce expression for angle of baking at which there is minimum wear and tear to the tyres of the vehicle. (5)