**Roll No. _____** **Code : 112012-042**

Please check that this question paper contains **30** questions and **7** printed pages.

# CLASS-XI
# PHYSICS

**Time Allowed : 3 Hrs.** **Maximum Marks : 70**

***General Instructions :***

*(i) All questions are compulsory.*

*(ii) There are 30 questions in total. Questions 1 to 5 are multiple choice questions and carry one mark each, questions no. 6 to 8 are very short answer questions and carry 1 mark each, questions 9 to 18 are short answer questions and cdarry 2 marks each, questions 19 to 27 are short answer questions and carry 3 marks each and questions 28 to 30 are long answer questions and carry 5 marks each.*

*(iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all three questions of 5 marks questions each. You have to attempt only one of the given choices in such questions.*

*(iv) Use of calculators is not permitted. Log tables will be provided if needed.*

*(v) 15 minutes time has been allotted to read this question paper. During this time, the student will read the question paper only. He/she will not write any answer on the answer script during this period.*

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1. An impulsive force of 100 N acts on a body for a small time interval of ($\Delta t$) seconds. The change, in linear momentum of the body would be :

   (a) (100 $\Delta t$) N/s (b) (100 $\Delta t$) N – s

   (c) (100 / $\Delta t$) N/s (d) (100 / $\Delta t$) N – s

2. If a force, $\vec{F}$ [= $(-2\hat{i} + 3\hat{j} + \hat{k})$], causes a displacement $\vec{D}$ [= $(\hat{i} + 2\hat{j} - 4\hat{k})$], of an object, the work done on the object, is :

   (a) 12 units (b) 6 units

   (c) 4 units (d) zero

3. When a mass ($^{m}/_{2}$) of sand is poured uniformly on a rotating disc of mass $m$, the angular velocity of the disc, would :

(a) decrease (b) increase

(c) remain unchanged (d) get exactly doubled

4. A given system undergoes a change in which the work done by the system equals the decrease in its internal energy. The system must have undergone an :

(a) isothermal change (b) adiabatic change

(c) isobaric change (d) isochoric change

5. A vibrating simple pendulum, of period T, is placed in a lift which is accelerating downwards with an acceleration equal to ($^{g}/_{100}$). The time period of the pendulum, would :

(a) increase (b) decrease

(c) become 0.99 T (d) become 0.9 T

6. The velocity of a particle, at a time $t$, is given by $V = a + bt + \frac{c}{d+t}$. What are the dimensions of the ratio a/c ?

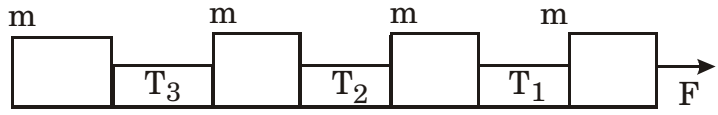
7. What happens to the state of motion of a body when the concurrent forces, acting on it, are in equilibrium ? Show, on a diagram, a system of concurrent forces in equilibrium.

8. State two conditions under which the behaviour of real gases approximates that of an ideal gas.

9. Distinguish between 'accuracy' and 'precision' of a measurement.

10. A body moving on a circular path, of radius $r$, has moved through three quarters of its circular path. What are the values of the displacement and the distance travelled by the body at this instant ?

11. Four block, of same mass $m$ each, connected by cords, are pulled by a force F on a smooth horizontal surface as shown in the figure. Determine the tensions $T_1$, $T_2$, $T_3$ in the cords.




12. Obtain the relation for the potential energy of a stretched spring of spring constant $k$.

13. An amount of energy, 484 J, is spent in increasing the angular speed of a flywheel from 60 rpm to 360 rpm. Calculate the moment of inertia of the flywheel.

14. (a) Differentiate between gravitational potential and gravitational potential energy.

(b) At what height above the earth's surface, the value of $g$ would be (nearly) the same as in a mine at a depth of $r$ km ?

***OR***

(a) Define binding energy of a satellite.

(b) Assuming the earth to be a sphere of radius R, find the altitude at which the value of acceleration due to gravity becomes $\left(\frac{1}{n^2}\right)$ of its value at the surface of the earth.

15. Two wires are drawn from the same metal. The length of the first wire is $(^1/_p)$ times that of the second wire and its diameter is $n$ times that of the second wire. If equal loads are applied on both wires, find the ratio of the increase in their lengths.

16. The volume of a gas is reduced by compressing it under adiabatic conditions. If the work done on the gas is 200 J, find the change in the internal energy of the gas and also the amount of heat absorbed by the gas.

17. A tuning fork, of frequency 220 Hz, produces sound waves of wavelength 1.5 m in air at NTP. Calculate the increase in the wavelength of these waves, when the temperature of air becomes 27°C.

18. (a) State two characteristics of a simple harmonic motion.

(b) Two exactly identical pendulums are executing (approximate) SHMs with amplitudes a and na respectively. Calculate the ratio of their energies of oscillation.

19. (a) The velocity – time graphs of two objects A and B make angles of 30° and 60° with the time axis. Find the ratio of their accelerations.

(b) A point moves in the $xy$ plane according to the law $x = 4 \sin 6t$ and $y = 4 (1 - \cos 6t)$. Find the velocity components of the particle and hence the distance traversed by the particle in 5 s. [$x$ and $y$ are in meters].

20. A cyclist has to bend a little inwards from his vertical position while taking a turn on a curved path.

(a) Draw a diagram showing the different forces acting on the cyclist

(b) Calculate his angle of bending, θ, with the vertical

(c) Show that, the possibility of overturning decreases when the 'turn' is not a sharp turn.

21. A bullet of mass 0.01 kg, is fired horizontally into a 4 kg wooden block at rest on a horizontal surface. The coefficient of kinetic friction between the block and the surface is 0.25. The bullet gets embedded in the block and the combination moves 20 m before coming to rest. With what speed did the bullet strike the block ?

22. Show that in a head on elastic collision, between two balls of equal masses moving along a straight line, the balls simply exchange their velocities.

23. A solid cylinder of mass M and radius R rolls down an inclined plane, inclined at an angle θ to the horizontal. Obtain an expression for its linear acceleration, down the plane, in terms of '$g$' and θ.[Given that the moment of inertia of a cylinder, about its own axis of symmetry equals $\frac{1}{2}$ $MR^2$]

24. (a) State Kepler's laws of planetary motion.

(b) Obtain a formula for the orbital radius, $R_G$, of a geostationary satellite in terms of 'T' – the time duration of the earth's day.

***OR***

(a) Derive an expression the 'escape velocity' of an object.

(b) By what factor does this escape velocity differ from the orbital velocity of a (near by) satellite ?

25. A drop of water of radius 1 mm is split into 1000 small droplets of equal size. Find the energy spent if surface tension for water is 0.072 N/*m*.

26. (a) Draw the P-V curves for an

(i) isochoric process (ii) isobaric process

(b) One mole of an ideal gas undergoes an isothermal change from an initial state ($P_1$, V, T) to a final state ($P_2$, $V_2$, T). Obtain an expression for the work done during the process.

**Alternative question for Q. No. 26 (a)**
**for visually challenged students**

(a) Which thermodynamic variable remains constant during an

(i) isochoric process (ii) isobaric process

27. (a) Using the kinetic theory expression for pressure, show that the average translational kinetic energy per gram molecule equals $(^3/_2)$ RT.

(b) At what temperature would the rms velocity of gas become n times its value at 0°C, pressure remaining constant.

28. (a) Establish the relation $x(t) = x(0)t + v(0)t + \frac{1}{2}at^2$, where the symbols have their standard meanings.

(b) Points P, Q and R are in a vertical line such that PQ = QR. A ball at P is allowed to fall freely. What is the ratio of the times of its descent through PQ and QR ?

***OR***

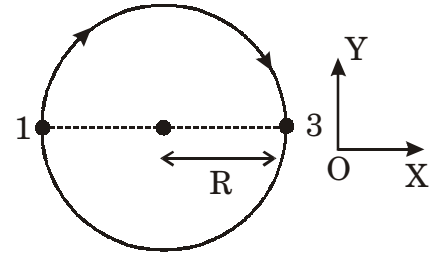
(a) Stating the relevant law, outline the sequence of steps followed in subtracting a vector B from a vector A.

(b) (i) Define the term 'relative velocity'.

(ii) Two objects are projected from the same point with initial speeds $u_1$ and $u_2$ at angles $\theta_1$ and $\theta_2$ to the horizontal. Their times of

projection are so adjusted as to make them reach the highest point of their paths at the same instant. What is the relative velocity of the second object, with respect to the first one, at this instant ?

(iii) A particle is moving in a circular path of radius R with a constant angular velocity w. What is the change in the velocity of this particle as it goes from position 1 to position 3 ?




**Alternative Question for b (iii) for visually challenged persons**

For a particle, moving in a circle of radius R, with a constant angular velocity, how does its

(i) speed

(ii) velocity

Change for two points located at the two ends of a diameter of the circle ?

29. State Bernoullis theorem. Stating the assumption used, show that the total energy possessed by a flowing ideal liquid is conserved.

***OR***

(a) What do we understand by a perfect black body ? How is a perfect black body (nearly) realized in actual practice ?

(b) Show, on a graph, the nature of distribution of energy among the different wavelengths emitted by a black body, for two different temperatures.

(c) State Wien's displacement law. On the basis of this law, discuss why a 'white hot' piece of iron is hotter than a 'red hot' piece of iron.

**Alternative question for part (b) for visually challenged persons**

What can we say about the nature of distribution of energy, among the different wavelengths emitted by a black body, for two different temperatures ?

30. What kind of a superposition of waves can result in the production of 'standing waves' ? What do we understand by the 'normal modes' of oscillation of these waves ?

Obtain the normal modes of oscillation of an air column with

(i) one end closed and the other open (closed pipe)

and (ii) both ends open (open pipe)

***OR***

Show that the time period of a oscillation of a liquid column in a U tube is independent of the mass of the liquid column, the density of the liquid and the cross section area of the U tube but depends only upon the length of the liquid column and on the value of the acceleration due to gravity.