Roll No. _____

Code : 11–201718PY–A

Please check that this question paper contains **26** questions and **7** printed pages.

CLASS–XI
SUBJECT–PHYSICS (THEORY)

Time allowed : 3 Hrs. **M.Marks : 70**

General Instructions :

1. *All questions are compulsory. There are 26 questions in all.*
2. *This question paper has five sections : Section A, Section B, Section C, Section D and Section E.*
3. *Section A contains five questions of one mark each. Section B contains five questions of two marks each. Section C contains twelve questions of three marks each. Section D contains one value based question of four marks and Section E contains three questions of five marks each.*
4. *There is no overall choice. However, internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.*
5. *Fifteen minutes time has been allotted to read this question paper. During this time, you will only read the question paper and will not write anything in the answer sheet.*

Section-A

1. Write the name of the SI unit of 'luminous intensity'.

2. A body is initially at rest. It undergoes one-dimensional motion with a constant acceleration. How does its displacement(s) depend on time (t) ?

3. Say 'yes' or 'no' :

   (i) Average speed of an object always equals the magnitude of its average velocity.

   (ii) Instantaneous speed of an object always equals the magnitude of its instantaneous velocity.

4. A box contains equal number of molecules of hydrogen and oxygen. If there is a fine hole in the box, which gas will leak out more rapidly ?

5. From the following three, name the factor/factors on which the average kinetic energy of a gas molecule depends :

   nature of gas, temperature, volume

Section-B

6. The escape velocity 'v' of a body depends upon (i) the acceleration due to gravity (g) of the planet and (ii) the radius (R) of the planet.

   Use the method of dimensions to obtain a relation between v, g and R.

7. Derive an expression for the variation of acceleration due to gravity with height 'h' from the surface of the earth.

8. (a) Write the mathematical form of the first law of thermodynamics.

   (b) Hence obtain its corresponoding forms for an

      (i) adiabatic process

      (ii) isothermal process

OR

   (a) State the zeroth law of thermodynamics.

(b) For two systems in thermal equilibrium, name the physical quantity that :

(i) has the same value for the two systems

(ii) does not get exchanged between the two systems.

9. The lower face of an aluminium cube, of side 10 cm, is riveted to the floor. A shearing force of 1000 N is applied on the upper face. Given that the shear modulus of aluminium is 25×10^9 N m^{-2}, find the displacement of the upper edge of the cube.

10. Which of the following examples represent (nearly) simple harmonic motion and which represent periodic, but not simple harmonic, motion?

(i) The rotation of earth about its axis.

(ii) Motion of an oscillating mercury column in a u-tube.

(iii) Motion of a ball bearing inside a smooth curved bowl, when released from a point slightly above the lower most point.

(iv) General vibrations of a polyatomic molecule about its equilibrium position.

Section-C

11. A ball, initially at rest, is released from the top of a tower of height 27 metres. It takes 'T' seconds to reach the ground. Find the height of the ball, above the ground, at $t = {}^{T}/_{3}$.

12. A projectile is thrown upward at an angle θ with the horizontal, with an initial velocity u. Obtain the equation of its trajectory and state its nature.

13. Draw the following graphs for the motion of a object (initially at rest) under 'free fall'. Neglect air resistance.

    (i) Variation of position with respect to time

    (ii) Variation of velocity with respect to time

    (iii) Variation of acceleration with respect to time.

14. Why does a cyclist lean inwards while negotiating a curve ? Explain with a diagram.

    Obtain an expression for the angle which a cyclist will have to make with the vertical (for 'safe' negotiation), while taking a circular turn.

OR

    Two masses M and m (M > m) are connected at the two ends of an inextensible string. The string passes over a smooth frictionless pulley. Obtain the acceleration of the masses and the tension in the string.

15. A helicopter, of mass 1000 kg, rises with a vertical acceleration of 15 ms^{-2}. The crew and the passengers weigh 300 kg. Give the magnitude and direction of :

    (i) force on the floor by the crew and passengers.

    (ii) action of the rotor of the helicopter on the surrounding air.

    (Take g $\cong$ 10 ms^{-2})

16. (a) State theorem of parallel axes for the moment of inertia of a body.

    (b) Determine the moment of inertia of a thin ring (of mass m and radius r) about a tangential axis in the plane of the ring.

17. A circular ring of radius 2 m weighs 100 kg. It rolls along a horizontal floor so that its centre of mass has a speed of 20 cm s^{-1}. How much work has to be done to stop it ?

18. Define the term : 'gravitational potential energy of a body'.

    Obtain an expression for it, for a body of mass 'm' lying at distance 'r' (r > R where R = radius of earth) from the centre of the earth.

19. Why do we say that there is always an excess pressure on the concave side of the meniscus of a liquid.

    Obtain the expression for the excess pressure inside a liquid drop.

20. With the help of a block diagram, write the working principle of a refrigerator and obtain the expression for its coefficient of performance.

21. A given vessel contains two non-reacting gases : neon (mono atomic) and oxygen (diatomic). The ratio of their partial pressures is 3 : 2. Estimate the ratio of (i) number of molecules and (ii) mass of neon and oxygen in the vessel.

    Atomic mass of Neon = 20.2 units molecular mass of O_2 = 32.0 units

22. State the effect of (i) change of pressure only (ii) change of density only and (iii) change of temperature only
    on the speed of sound. Justify your answers.

Section-D

23. Ravi was very interested in athletics, specially in Javelin throw. He used to watch it on television and imagined himself playing the same. His friends encouraged him to do practice in the fields instead of just dreaming. He started practising daily but his range of throwing didn't increase much. He then approached his PTI who patiently listened to his problem. He advised Ravi that he should aim to throw the javelin at an angle of 45° with the horizontal. Ravi did the same and his range of throw started improving day by day. He soon started participating in competitions.

    (i) State the values shown by Ravi and his PTI.

    (ii) Why did the PTI advise Ravi to throw the javelin at an angle of 45° with the horizontal direction ?

Section-E

24. (a) Prove that the magnitude of the ratio of the difference in speeds after collision, to the difference in speeds before collision, for a one-dimensional elastic collision, equal to one.

    (b) A particle of mass m is moving in a horizontal circle of radius r, under a centripetal force equal to $\left(\frac{-k}{r^2}\right)$, where k is a constant. Obain the expression for the total energy of the particle.

OR

    (a) One end of a block (of mass m), resting on a smooth horizontal surface, is attached to one end of an ideal spring. The other end of this spring is attached to a rigid wall.

Find an expression for the work done by the spring force if the block is moved from an initial displacement x_i to a final displacement x_f.

Hence show that this spring force is conservative in nature.

(b) The above block is extended from the 'equilibrium position' through a distance x_m and then released from rest. Find the maximum speed of the block.

25. Name and prove the principle which states :

"When a liquid is in a streamline flow through a pipe of non-uniform cross section, the sum of its kinetic energy, potential energy and pressure energy per unit volume remain constant".

Write any two of its applications.

OR

The oil rises in the wick through the narrow spaces between the threads of the wick. Name the phenomenon associated.

Derive an expression for the rise of liquid in a narrow tube and show that the height of the liquid column supported is inversely proportional to the density of liquid and radius of the tube.

26. Explain Doppler effect in sound. Obtain an expression for apparent frequency of sound when source and observer are :

(a) both approaching each other

(b) both moving away from each other

OR

State the condition for the formation of stationary waves.

Obtain an expression for the stationary waves formed by two sinusoidal waves travelling along the same path in opposite directions. Obtain the positions of the nodes and the antinodes.

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