Annual Examination (2019-20)

CLASS – XI PHYSICS (042)

Time allowed: 3 hours **Max. Marks: 70**

General Instructions:

(i) All questions are compulsory. There are **37** questions in all.

(ii) This question paper has four sections: Section A, Section B, Section C and Section D.

(iii) **Section A** contains **twenty** questions of one mark each, **Section B** contains **seven** questions of two marks each, **Section C** contains **seven** questions of three marks each and **Section D** contains **three** questions of five marks each.

(iv) There is no overall choice. However, an internal choice has been provided.

Section – A

Directions (Q1-Q10) select the most appropriate option from those given below each question (1×10)

1. Length of a simple pendulum is 25.0 cm and time of 40 oscillation is 50 sec. If resolution of stop watch is 1 sec then accuracy is g is (in %)

   (1) 2.4 (2) 3.4 (3) 4.4 (4) 5.4

2. If unit of length and time is doubled, the numerical value of 'g' (acceleration due to gravity) will be : 1

   (1) doubled (2) halved (3) four times (4) remain same

3. Two vectors $\vec{A}$ and $\vec{B}$ lie in a plane. Another vector $\vec{C}$ lies outside this plane. The resultant $\vec{A}+\vec{B}+\vec{C}$ of these three vectors 1

   (1) can be zero (2) cannot be zero

   (3) lies in the plane of $\vec{A}$ & $\vec{B}$ (4) lies in the plane of $\vec{A}$ & $\vec{A}+\vec{B}$

4. The linear momentum p of a body moving in one dimension varies with time according to the equation $p = a+bt^2$, where a and b are positive constants. The net force acting on the body is 1

   (1) Proportional to t^2 (2) A constant

   (3) Proportional to t (4) Inversely proportional to t

5. The tension in the spring is: 1

   (1) Zero (2) 2.5 N (3) 5 N (4) 10 N

6. A truck accelerates from speed v to 2v. work done in during this is 1

   (1) Three times as the work done in accelerating it from rest to v.

   (2) same as the work done in accelerating it form rest to v.

   (3) four times as the work done in accelerating it from rest to v.

   (4) less than the work done in accelerating it from rest to v.

7. A bomb travelling in a parabolic path under the effect of gravity, explodes in mid air. The centre of mass of fragments will: 1

   (1) Move vertically upwards and then downwards

(2) Move vertically downwards

(3) Move in irregular path

(4) Move in the parabolic path which the unexploded bomb would have travelled

8. The theorem of perpendicular axes is not applicable for determination of moment of inertia along the diameter, for which of the following body : 1

(1) sphere (2) disc (3) ring (4) blade

9. Which of the following is a necessary and sufficient condition for S.H.M. 1

(1) Constant period

(2) Constant acceleration

(3) Proportionality between acceleration and displacement from equilibrium position

(4) Proportionality between restoring force and displacement from equilibrium position

10. Equal masses of two liquids are filled in two similar calorimeters. The rate of cooling will 1

(1) Depend on the nature of the liquids (2) Depend on the specific heats of liquids

(3) Be same for both the liquids (4) Depend on the mass of the liquids

Fill in the blanks: (Q 11 to Q 15)

11. A body A is projected upwards with a velocity of 98 m/s . The second body B is projected upwards with the same initial velocity but after 4 sec. Both the bodies will meet after_____ sec. 1

OR

A bus is moving with a velocity 10 ms^{-1} on a straight road. A scooterist wishes to overtake the bus in 100s. If, the bus is at a distance of 1 km from the scooterist, with _____ velocity should the scooterist chase the bus?

12. A projectile is thrown with an initial velocity of ($a\hat{\imath} + b\hat{\jmath}$) m/sec. If range of projectile is maximum then a=___. 1

13. A bullet of mass m is being fired from a stationary gun of mass M. If the velocity of the bullet is v, the velocity of the gun is-_____. 1

14. The work done by the frictional force on a surface in drawing a circle of radius r on the surface by a pencil of negligible mass with a normal pressing force N (coefficient of friction μ_k) is _____. 1

15. A body of mass m is placed on the earth's surface. It is taken from the earth's surface to a height h = 3R . The change in gravitational potential energy of the body is _____. 1

16. What is the slope for an isothermal process? 1

17. 300 calories of heat is supplied to raise the temperature of 50 gm of air from 20°C to 30°C without any change in its volume. Find the change in internal energy per gram of air. 1

18. Find the water equivalent of a 400 g copper calorimeter (specific heat = 0.1 cal/gºC) 1

19. A 1 cm long string vibrates with fundamental frequency of 256 Hz. If the length is reduced to $\frac{1}{4}\ cm$ keeping the tension unaltered, find the new fundamental frequency? 1

20. If the velocity of a particle is given by v = $\sqrt{180 - 16x}$ m/s, then find its acceleration? 1

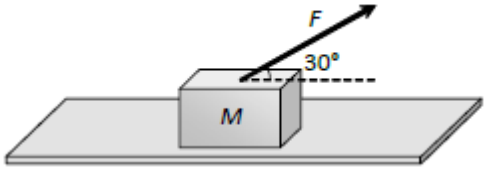
Section – B

21. A man can swim with a speed of 4 kmh^{-1} in still water. How long does he take to cross the river 1 km wide, if the river flows steadily at 3 kmh^{-1} and he makes his strokes normal to the river current? How far from the river does he go, when he reaches the other bank? 2

22. Define the term coefficient of limiting friction between the surfaces. A body of mass 10 kg is placed on an inclined surface of angle 30°. If the coefficient of limiting friction is $\frac{1}{\sqrt{3}}$, find the force required to just push the body up the inclined plane. The force is being applied parallel to the inclined surface. 2

OR

A block of mass M = 5 kg is resting on a rough horizontal surface for which the coefficient of friction is 0.2.When a force F = 40 N is applied, the acceleration of the block will be (g = 10 m/s^2) 2



23. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion? 2

24. If angular momentum is conserved in a system whose moment of inertia is decreased, will its rotational kinetic energy be conserved? 2

25. The radii of two planets are R and 2R respectively and their densities ρ and $\frac{\rho}{2}$ respectively. What is the ratio of acceleration due to gravity at their surfaces? 2

26. Draw a graph between the velocity of a small sphere dropped from rest into a viscous liquid and time. Also indicate the terminal velocity as v_t on the graph? 2

27. What happens to the change in internal energy of a gas during isothermal process? (b) State what happens to the heat change in an isothermal process. 2

Section – C

28. Discuss the formation of beats analytically and hence calculate the beat frequency. 3

29. State the law of equipartition of energy of a dynamic system and use it to find the values of internal energy and the ratio of the specific heats of a (i) monoatomic (ii) diatomic and (iii) triatomic gas molecules. 3

30. What is capillarity? Derive an expression for the height to which the liquid rises in a capillary tube of radius r. 3

OR

Prove that elastic energy density is equal to $\frac{1}{2}$ stress x strain. 3

31. Find the expression for the total energy of a satellite revolving around the surface of the earth. What is the significance of negative sign in the expression? 3

32. If the earth were to suddenly contract to half of its present radius (without any external torque on it), by what duration would the day be decreased? Assume earth to be a perfect solid sphere of moment of inertia $\frac{2}{5}MR^2$. 3

OR

(a) Derive an expression for the moment of inertia of a thin uniform circular ring about an axis passing through the centre and perpendicular to the plane of the ring.

(b) Hence determine the moment of inertia of a thin ring 3

(i) about its diameter

(ii) about a tangent in its plane, and

(iii) about a tangent perpendicular to its plane.

33. A body of mass m moving with speed v collides elastically head-on with another body of mass m initially at rest. Show that the moving body will come to a stop as a result of this collision. 3

34. Define the terms static friction, limiting friction and kinetic friction. Draw the graph between friction and applied force on any object and show static friction, limiting friction and kinetic friction in graph. Using graph show that static friction is a self-adjusting force. 3

Section – D

35. Derive the expressions for the kinetic and potential energies of a harmonic oscillator. Hence show that total energy is conserved in SHM. Draw graphs for (a) Energy vs. time and (b) energy vs. displacement. 5

OR

What is Doppler Effect in sound? Obtain an expression for the observed frequency of sound produced by a source when both observer and source are in motion and medium is at rest. 5

36. What is Carnot engine? Explain the construction and various operations for Carnot's heat engine working between two temperatures. Hence derive from it the efficiency of the engine. On what factors does it depend? 5

OR

Derive an expression for the pressure exerted by an ideal gas as under P =$\frac{1}{3}\rho v^2$, where ρ is density and v is the r.m.s velocity, on the basis of kinetic theory of gases**.** **5**

37. (a)Show that there are two values of time for which a projectile is at the same height. Also show that the sum of these two times is equal to the time of flight.
(b)Show that there are two angles of projection for which the horizontal range is the same. Also show that the sum of the maximum heights for these two angles is independent of the angle of projection. 5

OR

(a)Prove that the horizontal range is same when angle of projection is (i) greater than 45° by certain value and (ii) less than 45° by the same value.

(b) A stone is thrown horizontally with a speed $\sqrt{2gh}$ from the top of a wall of height h. It strikes the level ground through the foot of the wall at a distance x from the wall. What is the value of x? 5