Final- Exam
Class XI
Physics

Time: 3hrs **mm: 70**

General Instructions:

1. All questions are compulsory. There are 27 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains five questions of one mark each, Section B contains seven questions of two marks each, Section C contains twelve questions of three marks each, and Section D contains three questions of five marks each.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark, two questions of two marks, four questions of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.

Section A

1. The density of mercury is 13.6 g cm^{-3} in CGS system. Find its value in SI units. 1

OR

The diameter and height of a cylinder are measured by a meter scale to be 12.6 ± 0.1 cm and 34.2 ± 0.1 cm, respectively. What will be the value of its volume in appropriate significant figures? 1

2. 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? 1
3. If the angular momentum of a planet of mass m, moving around the Sun in a circular orbit is L, about the center of the Sun, find its areal velocity? 1
4. Define the power of a lens. Write its S.I. unit. 1

OR

When light travels from an optically denser medium to a rarer medium, why does the critical angle of incidence depend on the colour of light? 1

5. Write the displacement equation representing the following conditions obtained in a simple harmonic motion: Amplitude = 0.01 m, Frequency = 600 Hz, Initial phase = $\frac{\pi}{6}$. 1

Section B

6. A particle executes simple harmonic motion with an amplitude of 5 cm. When the particle is at 4 cm from the mean position, the magnitude of its velocity in SI units is equal to that of its acceleration. Then, find its periodic time in seconds? 2

OR

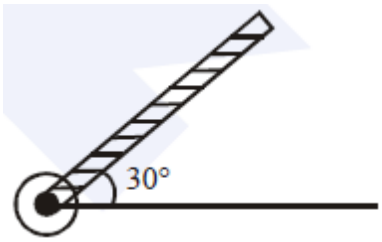
Explain Doppler effect in sound. Hence write the expression for the apparent frequency when the source moves away from the stationary observer. 2

7. Find the dimensions of a/b in the equation: F=a$\sqrt{x} + bt^2$ where F is force, x is distance and t is time. 2

OR

Derive an expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light). 2

8. A small telescope has an objective lens of focal length 150 cm and eyepiece of focal length 5 cm. What is the magnifying power of the telescope for viewing distant objects in normal adjustment?
If this telescope is used to view a 100 m tall tower 3 km away, what is the height of the image of the tower formed by the objective lens? 2
9. A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45° at the roof point. If the suspended mass is at equilibrium, find the magnitude of the force applied is (g = 10 ms $^{-2}$) 2
10. A force acts on a 2 kg object so that its position is given as a function of time as x = 3t^2 + 5. What is the work done by this force in first 5 seconds ? 2
11. A rod of length 50cm is pivoted at one end. It is raised such that if makes an angle of 30° from the horizontal as shown and released from rest. Find Its angular speed when it passes through the horizontal (in rad s^{-1}) (g = 10ms^{-2}) 2



12. Derive an expression for the elastic potential energy stored in a stretched wire under stress. 2

Section C

13. A body covers 12 m in 2nd second and 20 m in 4th second. How much distance will it cover in 4 seconds after the 5th second? 3
14. The position co-ordinates of a particle moving in a 3-D coordinate system is given by x = a cosωt, y = a sinωt and z = aωt. Find the speed of the particle? 3

OR

In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed 'v' more than that of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then find the magnitude of 'v'? 3
15. What do you understand by friction? Discuss about static friction and kinetic friction. Show how the force of friction f varies with the applied force F. 3

OR

Define angle of repose. Deduce its relation with coefficient of static friction. 3

16. Draw the graph of equation Fs =-kx, where Fs is the spring force and x is the displacement of block from equilibrium position. Using the graph, show that maximum work done by the spring at x_m is Ws = $-\frac{1}{2}\ kx^2$ k=spring constant). 3
17. (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
    (i) about its diameter
    (ii) about a tangent in its plane, and
    (iii) about a tangent perpendicular to its plane. 3
18. What do you mean by gravitational potential energy of a body? Derive an expression for the gravitational potential energy of a body of mass m located at distance r from the centre of the earth. 3
19. The energy required to take a satellite to a height 'h' above Earth surface (radius of Earth = 6.4×10^3 km) is E_1 and kinetic energy required for the satellite to be in a circular orbit at this height is E_2. Find the value of h for which E_1 and E_2 are equal? 3
20. Derive an expression for the excess pressure inside a liquid drop. 3

    OR

    What is capillarity? Derive an expression for the height to which the liquid rises in a capillary tube of radius r?
21. (a)On what factors does the amount of heat flowing a substance depend ? Obtain the expression for the heat conducted.
    (b) Define coefficient of thermal conductivity. Write its SI unit. 3

    OR

    State Newton's law of cooling. Deduce the relations : $\log_e(T-T_0)=-kt+c$ and where the symbols have their usual meanings. Represent Newton's law of cooling graphically by using each of the above equations. 3
22. 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 monoatomic gas? 3
23. Write Newton's formula for the speed of sound in air. What was wrong with this formula? What correction was made by Laplace in this formula? 3
24. The eye can be regarded as a single refracting surface. The radius of curvature of this surface is equal to that of cornea (7.8 mm). This surface separates two media of refractive indices 1 and 1.34. Calculate the distance from the refracting surface at which a parallel beam of light will come to focus. 3

Section D

25. (a)What is a projectile? A projectile is fired with a velocity u making an angle θ with the horizontal. Show that its trajectory is a parabola.
    (b) Derive expressions for its: (i) time of flight, (ii) maximum height, and (iii) horizontal range. 5

    OR

    A body is projected at an angle θ with the horizontal.
    (a) Determine the condition for maximum horizontal range.

(b) Prove that horizontal range of a projectile is same when fixed at an angle θ and (90°-θ) with the horizontal.

(c) Show that the horizontal range is same whether θ is the angle of projection with the horizontal or with the vertical.

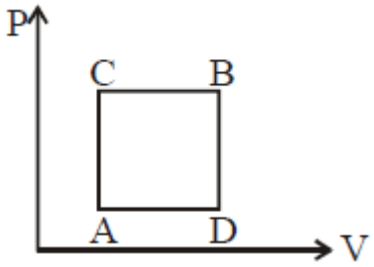
(d) Calculate the velocity of the projectile at any instant t.

(e) A projectile is fixed with velocity u making an angle θ with the horizontal from the surface of the earth. Prove that the projectile will hit the surface of the earth with the same velocity at the same angle. 5

26. 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

(a)A gas can be taken from A to B via two different processes ACB and ADB.



When path ACB is used 60 J of heat flows into the system and 30 J of work is done by the system. If path ADB is used work done by the system is 10 J. Find the heat Flow into the system in path ADB ?

(b) Derive expression for the work done during an adiabatic process? (3+2)

27. (a)A point-object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 ($n_2 > n_1$). Draw the ray diagram and deduce the relation between the distance of the object (u), distance of the image (v) and the radius of curvature (R) for refraction to take place at the convex spherical surface from rarer to denser medium.

(b) Use the above relation to obtain the condition on the position of the object and the radius of curvature in terms of n_1 and n_2 when the real image is formed. 5

OR

(a)Draw a labelled ray diagram showing the formation of image by a compound microscope in normal adjustment. Derive the expression for its magnifying power.

(b) You are given two converging lenses of focal lengths 1·25 cm and 5 cm to design a compound microscope. If it is desired to have a magnification of 30, find out the separation between the objective and the eyepiece. 5

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