BK BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL

ANNUAL EXAMINATION (2024-25)

SUBJECT- PHYSICS (042)

Class: XI
Date: /02/2025

Duration: **3 Hrs**
Max. Marks: **70**

General Instructions:

(1) *There are 33 questions in all. All questions are compulsory.*
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.
(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.

SECTION-A **(16 X 1=16 Marks)**

1. Dimensional formula of viscosity:
   (a) $[M^0L^2T^{-2}]$ (b) $[ML^{-1}T^{-1}]$ (c) $[ML^2T^{-2}]$ (d) $[ML^2T^2]$

2. What is the shape of displacement – time graph of a body, moving in positive direction with increasing velocity?
   (a) Straight line making an angle with time axis having positive velocity.
   (b) Straight line parallel to time axis.
   (c) Slope of the graph will keep on increasing.
   (d) Slope of the graph will keep on decreasing.
3. The slope of the tangent drawn on velocity-time graph at any instant is equal to the instantaneous
   (a) acceleration (b) force (c) velocity (d) momentum
4. At the highest point on the trajectory of a projectile, its:
   (a) potential energy is minimum (b) kinetic energy is maximum
   (c) total energy is maximum (d) kinetic energy is minimum.
5. A 4 kg and a 1 kg masses are moving with equal momentum, the ratio of their kinetic energy is:
   (a)2:1 (b) 1:2 (c) 1:4 (d) 4:1
6. A body in rotational motion possesses rotational kinetic energy given by:
   (a) $KE= 1/2\ \omega I^2$ (b) $KE= 1/2\ I\omega^2$ (c)$KE= 2\ \omega I^2$ (d)$KE= I\omega$
7. Moment of inertia depends on:
   (a) Shape and size of the body (b) Mass
   (c)Position of the axis of rotation (d) All of these
8. In magnitude hydraulic stress is equal to:
   (a) hydraulic force (b) hydraulic pressure (c) restoring force (d) hydraulic strain
9. For which of the following liquids, the liquid meniscus in the capillary tube is, convex?

(a) Water (b) Mercury (c) Both (a) & (b) (d) None of these

10. The transfer of heat between two adjacent parts of body due to their temperature difference is called as:
(a) Radiation (b) Convection (c) Conduction (d) None

11. When steam is converted into water, internal energy of the system:
(a) increases (b) decreases (c) remains constant (d) becomes zero

12. The efficiency of a Carnot engine working between 227°C and 27°C is:
(a) 100% (b) 50% (c) 20% (d) 40%

For Questions 13 and 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

13. **Assertion:** The maximum horizontal range of projectile is proportional to square of velocity.
Reason: The maximum horizontal range of projectile is equal to maximum height attained by projectile.

14. **Assertion:** If the net external force on a body is zero, then its acceleration will be zero.
Reason: Acceleration is directly proportional to the force.

15. **Assertion:** Specific heat of a body is always greater than its thermal capacity.
Reason: Thermal capacity is the required for raising temperature of unit mass of the body through unit degree.

16. **Assertion:** The gravitational attraction of moon is much less than that of earth.
Reason: Moon is a natural satellite of the earth.

SECTION-B (5 X 2=10 Marks)

17. State and explain Newton's third law of motion. 2

18. Derive second equation of motion graphically. 2

Or

A car moving along a straight highway with speed of 126 km h^{-1} is brought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform), and how long does it take for the car to stop?

19. State and prove work-energy theorem for variable force. 2

20. Derive an expression of work done in an isothermal process. 2

21. What are stationary waves? What is the necessary condition for the formation of stationary waves? 2

SECTION-C (7 X 3=21 Marks)

22. Mention three pairs that have the same dimensional formula. 3

23. What is centripetal acceleration? Find its magnitude and direction in case of uniform circular motion. 3

24. What do you mean by static and kinetic friction? Explain how a ball bearing placed between moving parts of a machine reduces friction? 3

25. Define inelastic collision. Show that there is always a loss of energy in inelastic collision. 3

26. Define moment of inertia of a body. Give its units and dimensions. State the factors on which the moment of inertia of a body depends. 3

27. What is the density of ocean water at a depth, where the pressure is 80.0 atm, given that its density at the surface is 1.03 X 10^3 kgm^{-3}? Compressibility of water= 45.8 X 10^{-11} Pa^{-1}.
Given 1 atm= 1.013 X 10^5 Pa. 3

Or

Apply Bernoulli's principle to determine the speed of efflux from the side of a container both when its top is closed and open. Hence derive Torricelli's law.

28. 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

SECTION-D **(2 X 4= 8 Marks)**

Case Study Based Questions

29. **Average Speed and Average Velocity:**

When an object is in motion, its position changes with time. So, the quantity that describes how fast is the position changing w.r.t. time and in what direction is given by average velocity. It is defined as the change in position or displacement (Δx) divided by the time interval (Δt) in which that displacement occurs. However, the quantity used to describe the rate of motion over the actual path, is average speed. It defined as the total distance travelled by the object divided by the total time taken.

(i) A 250 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 750 m is: 1

(a) 56 s (b) 68 s (c) 80 s (d) 92 s

(ii) A truck requires 3 hr to complete a journey of 150 km. What is average speed? 1

(a) 50 km/h (b) 25 km/h (c) 15 km/h (d) 10 km/h

(iii) Average speed of a car between points A and B is 20 m/s, between B and C is 15 m/s and between C and D is 10 m/s. What is the average speed between A and D, if the time taken in the mentioned sections is 20s, 10s and 5s, respectively? 1

(a) 17.14 m/s (b) 15 m/s (c) 10 m/s (d) 45 m/s

Or

(iii) The speed varies from 0 to 30 m/s in 5 s. Find the average speed during the motion.

(a) 10 m/s (b) 20 m/s (c) 0 m/s (d) 15 m/s

(iv) A cyclist is moving on a circular track of radius 40 m, completes half a revolution in 40 s. Its average velocity (in m/s) is: 1

(a) zero (b) 2 (c) 4π (d) 8π

30. **Specific Heat Capacity**

Heat capacity of a substance is defined as

$$H = \frac{\Delta Q}{\Delta T} = ms\ ,$$

Where Δ*Q* is the amount of heat supplied to the substance to change its temperature from *T* to *T* + Δ*T*. Specific heat capacity is the amount of heat per unit mass absorbed or given off to change its temperature by one unit.

$$S = \frac{1}{m}\frac{\Delta Q}{\Delta T} = \frac{H}{m}$$

It depends on the nature of substance and its temperature.

(i) Which one of the following substances has highest specific heat capacity at room temperature and atmospheric pressure? 1

(a) Water (b) Ice (c) Aluminium (d) Mercury

(ii) Heat capacity of a substance is infinite. It means: 1

(a) Heat is given out (b) heat is taken in

(c) No change in temperature whether heat is taken in or given out (d) all of these.

(iii) Water is used as a coolant because 1

(a) It has lower density. (b) It has low specific heat.

(c) It has high specific heat. (d) It is easily available.

(iv) Calorie is defined as the amount of heat required to raise the temperature of 1 g of water by 1°C and it is defined under which of the following conditions? 1

(a) From 14.5°C to 15.5°C at 760 mm of Hg (b) From 98.5°C to 99.5°C at 760 mm of Hg

(c) From 13.5°C to 14.5°C at 76 mm of Hg (d) From 3.5°C to 4.5°C at 76 mm of Hg

Or

(iv) Find the thermal capacity of 40 g of aluminum. (s = 0.2 cal/g K)

(a) 168 J/°C (b) 672 J/°C (c) 840 J/°C (d) 33.6 J/°C

SECTION-E **(3X 5=15 Marks)**

31. What is meant by acceleration due to gravity? Obtain an expression for it in terms of mass of the earth and gravitational constant. Explain how the mass and the density of the earth can be obtained from the knowledge of G. 5

Or

What is escape speed? Obtain an expression for the escape speed on the surface of the earth. Why is it that there is no atmosphere on the moon? Explain.

32. (i) State and prove Bernoulli's Theorem with the help of suitable diagram.

(ii) The flow of blood in a large artery of an anesthetised dog is diverted through a Venturi meter. The wider part of the meter has a cross-sectional area equal to that of the artery, A = 8 mm^2. The narrower part has an area, a = 4 mm^2. The pressure drop in the artery is 24 Pa. What is the speed of the blood in the artery? 5

Or

(i) What are the modes of heat transfer? Explain each mode with the help of a suitable example.

(ii) The coefficient of volume expansion of glycerine is $49\times10^{-5}K^{-1}$. What is the fractional change in its density for a 30°C rise in temperature?

33. A wave travelling along a string is described by, y(x, t) = 0.005 sin (80.0 x – 3.0 t), in which the numerical constants are in SI units (0.005 m, 80.0 rad m^{-1}, and 3.0 rad s^{-1}).

Calculate (a) the amplitude, (b) the wavelength, and (c) the period and frequency of the wave.

Also, calculate the displacement y of the wave at a distance x = 30.0 cm and time t = 20 s? 5

Or

Explain the relation in phase between displacement, velocity and acceleration in S.H.M., graphically as well as theoretically.

----------ALL THE BEST ----------