No. of pages - 24

(M)

COMMON ANNUAL SCHOOL EXAMINATION (2023-24)
CLASS : XI
SUBJECT: PHYSICS (042)

11151

समय : 3 घंटे | **अधिकतम अंक - 70**

Time Allowed : 3 hours | **Maximum Marks : 70**

सामान्य निर्देश:

निम्नलिखित निर्देशों को सावधानीपूर्वक पढ़िए और उनका सख्ती से पालन कीजिए :

1. इस प्रश्न पत्र में कुल 33 प्रश्न हैं। सभी प्रश्न अनिवार्य हैं।
2. प्रश्न प्रश्न पत्र में पांच खंड हैं। क, ख, ग, घं एवं ङ।
3. खंड-क में प्रश्न संख्या 1 से 12 तक बहुविकल्पीय प्रश्न (MCQ) प्रकार के और प्रश्न ख्या 13 से 16 तक अभिकथन-कारण प्रश्न के एक-एक अंक के प्रश्न हैं। खंड-ख मं प्रश्न संख्या 17 से 21 तक अत लघु उत्तरीय (VSA)प्रकार के पाँच प्रश्न हैं, प्रत्येक दो-दो अंक के हैं। खंड-ग में प्रश्न संख्या 22 से 28 तक लघु उत्तरीय (SA) प्रकार क तीन-तीन अंक के सात प्रश्न हैं; खंड-घ में प्रश्न संख्या 29 स 30 तक कस आधारित चार-चार अंकों के दो प्रश्न हैं, खंड-ङ में प्रश्न संख्या 31 से 33 तक दीर्घ उत्तरीय (LA) प्रकार के पाँच-पाँच अंकों के तीन प्रश्न हैं।
4. प्रश्न पत्र में समग्र विकल्प नहीं दिया गया है। यद्यपि खंड-ख के एक प्रश्न में, खंड-ग में एक प्रश्न में, खंड-घ के दो प्रश्नों में एवं खंड-ङ के तीन प्रश्नों में आंतरिक विकल्प का प्रावधान दिया गया है।
5. कैलकूलेटर/इलेक्ट्रॉनिक गैजेट्स का उपयोग वर्जित है।

GENERAL INSTRUCTIONS:

Read the following questions very carefully and strictly follow them :

1. *This question paper contains 33 questions. All questions are compulsory.*
2. *This question paper is divided into 5 sections - A, B, C, D and E.*
3. *In Section A – Question numbers 1 to 12 are Multiple Choice (MCQ) type questions and question no. 13 to 16 are Assertion (A) – Reason (R) type questions carrying 1 mark each. In Section B - questions no. 17 to 21 are Very Short Answer (VSA) type questions, carrying 2 marks each. In Section C - questions no. 22 to 28 are Short Answer (SA) type questions, carrying 3 mark each. In Section D – question no. 29 to 33 are case-based questions, carrying 4 marks each. In Section E – question no. 31 to 33 are Long Answer (A) type questions, carrying 5 marks each.*
4. *There is no over all choice. However, an internal choice has been proved in 1 question in Section B, 1 questions in Section C, 2 question in Section D and 3 questions in Section E.*
5. *Use of calculator/electronic gadgets is NOT allowed.*

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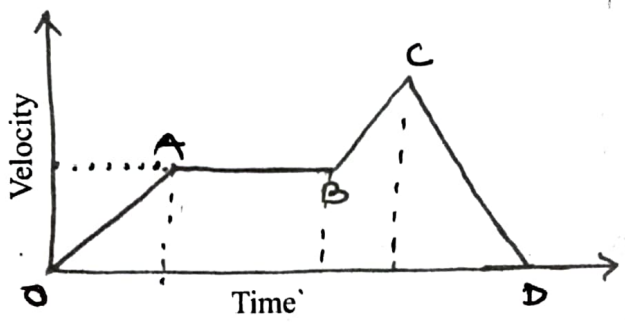
SECTION-A

1. In the Vander Walls equation $\left(P+\frac{a}{V^2}\right)(V-b)=RT$; P is pressure, V is volume, R is universal gas constant and T is temperature. The dimensional formula for the constant 'b' is: 1

(a) $ML^{-1}T^{-2}$ (b) ML^2T^{-2}

(c) L^3 (d) L^6

2. Velocity-time graph of an object is shown below : 1



For which of the region in the graph, the object is moving with zero acceleration?

(a) OA (b) AB

(c) BC (d) CD

3. If a cycle wheel of radius 5 m complete two revolution in 4 seconds, the angular speed of the wheel is : 1

(a) π rad/s (b) 2π rad/s

(c) $\frac{5\pi}{4}$ rad/s (d) $\frac{5\pi}{2}$ rad/s

4. The Newton's law of motion, which is also known as law of inertia, is : 1

(a) I-law (b) II-law

(c) III-law (d) both II-law and III-law

5. A body of mass 'm' tied to the one end of a string and rotating in a vertical circle. The difference in tensions in string at the highest and lowest points is : 1

(a) 0 (b) mg

(c) 3mg (d) 6mg

6. The equation of a plane-progressive wave is given by $y = 5\sin\left(2\pi t - \frac{2\pi}{200}x\right)$, where y and x are in cm and 't' is in sec. The wavelength of the wave is : 1

(a) 100 cm (b) $\frac{2\pi}{200}$cm

(c) 200 cm (d) 2π cm

7. A body of mass 2 kg initially at rest moves under the action of an applied horizontal force of 7N on a table. The work done by the applied force in displacing the body of 125 m is : 1

(a) 625 J (b) 250 J

(c) zero (d) 875 J

8. The moment of inertia of a circular disc of mass 'M' and radius R, about an axis passing through its centre and perpendicular to its plane is : 1

(a) MR^2 (b) $\frac{1}{2}(MR^2)$

(c) $2MR^2$ (d) $\frac{3}{2}(MR^2)$

9. The angular momentum of a body changes from L to 4L in 3 seconds, the torque acting on the body is : 1

(a) $\frac{L}{3}$ Nm (b) $\frac{L}{4}$ Nm

(c) L Nm (d) $\frac{5L}{3}$ Nm

10. Which type of coefficient of elasticity is involved in compressing a gas? 1

(a) Bulk modulus (b) Young modulus

(c) Shear modulus (d) All three moduli of elasticity

11. An electric heater supplies heat to a system at a rate of 100 W. If system performs work at a rate of 75 joules per second, the rate at which internal energy of the system is increasing, is : 1

(a) 175 W (b) 25 W

(c) 0.75 W (d) 1.33 W

12. The r.m.s. speed of an ideal gas is given by: 1

(a) $\sqrt{\frac{2k_BT}{m}}$ (b) $\sqrt{\frac{8k_BT}{m}}$

(c) $\sqrt{\frac{8k_BT}{\pi m}}$ (d) $\sqrt{\frac{3k_BT}{m}}$

Note : In question number 13 to 16, two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the code (A), (B), (C) and (D) as given below:

(a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true and (R) is the not correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is also false.

13. Assertion (A) : Total ~~disease~~ Linear momentum of a system in an elastic collision is always conserved.

Reason (R) : The third law of motion is always true during the collision. 1

14. Assertion (A) : If the ice on the polar caps of the earth melts, the duration of the day will increase.

Reason (R) : The angular momentum of the body is independent of its moment of inertia. 1

15. Assertion (A) : The maximum height of mountain on the earth depends upon shear modulus of rocks.

Reason (R) : The shear modulus of a material is also known as modulus of rigidity. 1

16. Assertion (A) : The function $y(t) = A\sin^2 wt$ represents a simple harmonic motion (SHM).

Reason (R) : The displacement of a particle is SHM is, directly proportional to square of its acceleration. 1

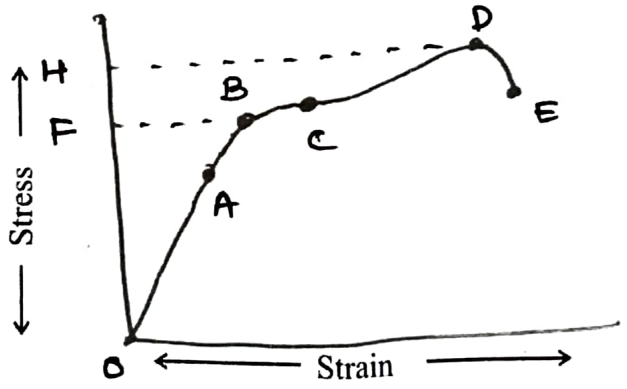
SECTION-B

17. Each side of a cube is measured to be 2.501 cm. Calculate total surface area of the cube to appropriate significant figures. 2

18. A bomb of mass 10 kg, initially at rest explodes into two pieces of masses 6 kg and 4 kg. If the velocity of mass 6 kg is 2 m/s, find the velocity of mass 4 kg. 2

19. The acceleration due to gravity at the surface of earth is 'g'. Deduce an expression for its value at a depth 'd' below the surface of earth. 2

20. The graph given below shows variation in stress with strain of a metallic wire. Identify the points on the graph showing : (i) elastic limit (ii) ultimate strength. How would you distinguish between a ductile and a brittle material on the bases of this graph? 2



OR

A steel cable with a radius 'r' can supports a chair lift of maximum load W. What maximum load the chair left will support if the radius of cable is doubled? Explain.

21. State law of equipartition of energy of a dynamic system. Write the ratio of specific heats (Cp/Cv) of a (i) monoatomic gas (ii) ~~distance~~ diatomic gas. 2

SECTION-C

22. Derive an expression for elastic potential energy of a stretched spring. 3

23. A ball is thrown vertically upwards with a speed of 20 m/s from the top of a multistoreyed building. The height of the point from where the ball in thrown 25 m from the ground. (i) How high the ball will rise? (ii) How long will it be before the ball hits the ground? (Take $g = 10\ m/s^2$) 3

24. A car is moving along a circular horizontal track of radius 'r'. The coefficient of friction between car tyres and the road along the surface is 'μ'. Derive an expression for the maximum safe speed of the car on the track. 3

25. Define centre of mass of a system. Two bodies of masses 2kg and 4kg are placed at (2,3) and (−1, −3/2) respectively. Find the coordinates of centre of mass of the system. 3

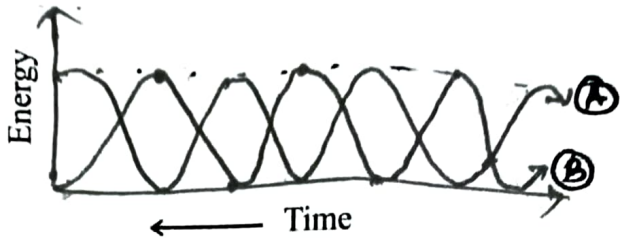
26. What is an isothermal process? Obtain an expression for the work done during an isothermal expansion. 3

27. What is meant by coefficient of cubical expansion? The coefficient of volume expansion of glycorine is $49 \times 10^{-5}\ °C^{-1}$. Calculate fractional change is its density for a 30°C rise in temperature. 3

OR

State Wein's displacement law. The surface temperature of the moon is 206 K. Estimate the wavelength at which it radiates maximum energy. Wein's constant= 2.884×10^{-3} mK.

28. (a) The graph given below, shows two curves A & B. Identify, which curve represents (i) K.E. (ii) P.E. of a particle executing simple harmonic motion at t = 0 it is passing through mean position.



(b) Draw a graph showing variation of total energy with time in part (a).

(c) In simple harmonic motion, at what point from the mean position, the speed of a body (1/4)th of its maximum speed?

SECTION-D

Note : Question number 29 and 30 are case study based questions. Read following paragraph and answer the question.

29. In mechanics, we encounter several types of forces some forces on an object arises due to contact with some other object : Solid or fluid. Such forces are called contact forces. An object can also experience a force at a distance without the need of any intervening medium. Such force are called non-contact forces.

Another common force is tension in a string. When some mass hangs from a fixed point by a string, the string is in the state of tension. An ideal string is massless and inextensible under the influence of tension.

(i) Which of the following is a non-contact force?

(a) Gravitational force (b) Tension

(c) Normal reaction (d) Friction

(ii) Two bodies A and B masses 10 kg and 20 kg respectively kept on a smooth horizontal surface are tied to the ends of a light string. A horizontal force F = 600 N is applied to A. The tension in the string is :

(a) 400 N (b) 600 N

(c) 300 N (d) 200 N

(iii) A man of 70 kg stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s^2. What would be the reading on the scale?

(a) 70 kg (b) 105 kg 1050 N

(c) 35 kg (d) 700 kg

(iv) A pebble of mass 0.05 kg is thrown vertically upwards. The force acting on the pebble during its upwards motion would be :

(a) 0.05 N, downwards (b) 0.05 N, upwards

(c) 0.005 N, downwards (d) 0.005 N, upwards

• Correct answer: 0.5N downwards

OR

The net force acting on a stone of mass 0.1 kg just after it is dropped from a window of a train accelerating with 1 m/s^2, is :

(a) 1 N (b) 0.1 N

(c) $\sqrt{2}$ N (d) 2 N

30. While launching a satellite into its orbit, it is given certain minimum vertical velocity to achieve a suitable height and then it is given some horizontal velocity such that the satellite always remain in the state of free fall and keep revolving around earth into its orbit. If we can throw an object with some minimum velocity such that it never fall back on the surface of earth is known as escape velocity.

(i) Two satellites of masses 10 kg and 1000 kg are revolving around earth into a same orbit. The ratio of then orbital speeds would be :

(a) $1:\sqrt{100}$ (b) $\sqrt{100}:1$

(c) 1 : 1 (d) 1 : 10

(ii) The escape speed of body from the surface of earth is v_e and the orbital speed of a satellite revolving very close to the surface of earth is v_o. Then :

(a) $v_e = v_o$ (b) $v_e = \sqrt{2}v_o$

(c) $v_e = v_o/\sqrt{2}$ (d) $v_e = 2v_o$

(iii) An ant, an elephant and a cat are to be projected out of earth, gravitational field into the space. Which of the above will have greatest escape speed?

(a) ant (b) elephant

(c) cat (d) all three will have equal escape speed

(iv) The escape speed of a projectile on the surface of earth is v_e. A body is projected out with ~~think~~ twice this speed. The speed of the body far away from the earth would be – (ignore presence of sun and other planets)

(a) zero (b) $\frac{v_e}{\sqrt{2}}$

(c) $\sqrt{3}\, v_e$ (d) $\sqrt{2}\, v_e$

OR

The escape speed of a projectile on the surface of earth is v_e. The escape speed of this projectile on the surface of a planet whose mass is 8 times mass of earth and radius is 2 times radius of earth would be :

(a) v_e (b) $v_e/2$

(c) $2v_e$ (d) $4v_e$

SECTION-E

31. A projectile is projected upwards at an angle 'θ' with the horizontal. Show that its trajectory is parabolic. Obtain expressions for – (i) Time of flight (ii) Horizontal range.

OR

State the parallelogram law of vector addition and find the magnitude and direction of the resultant vector of two vectors $\vec{A}$ and $\vec{B}$ inclined at an angle θ with each other.

32. (a) Deduce an expression for excess pressure inside a liquid drop.

(b) What is the excess pressure inside a bubble of soap solution of radius 5.0 mm. The surface tension of soap solution is 2.5×10^{-2} Nm^{-1}.

OR

(a) State and prove Bernoulli's ~~promote~~. principle.

(b) Water flows through a horizontal pipe of variable cross sectional area at the rate of 50 cm^3/sec. Calculate the velocity of water in the pipe of cross section of 5 cm^2.

33. (a) Write equation for (i) displacement (ii) velocity and (iii) acceleration of a particle in simple harmonic motion. Hence discuss the phase relationship of displacement with velocity and acceleration.

(b) If the function $f(t) = \sin wt + \cos wt$ represented simple harmonic motion, calculate the amplitude of oscillation.

OR

(a) Define ~~mode~~ node and ~~antimode~~ antinode of stationary wave.

(b) Deduce an expression for displacement equation for stationary waves in an open pipe.

(c) A pipe 15.0 cm long open at both ends. Which harmonic mode of pipe is resonantly excited by a source of ~~1.0~~ 1.1 KHz? Speed of sound in air is 330 ms^{-1}.