INDIAN SCHOOL SOHAR
TERM II EXAMINATION (2023-24)
PHYSICS THEORY (042)

Total No of Printed Pages: 6

CLASS: XI **Maximum Marks: 70**
DATE: 18/02/2024 **Time Allowed: 3 hours**

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.
7. You may use the following values of physical constants where ever necessary

$G = 6.7 \times 10^{-11}\ Nm^2/kg^2$, Mass of earth = 6×10^{24} kg, Radius of earth = 6.4×10^6 m
Solar Mass = 2×10^{30} Kg, Orbital radius of moon = 3.84×10^5 km, $c = 3 \times 10^8$ m/s

SECTION A

1 The dimension of light year is........... 1

(a) T (b) LT^{-1} (c) L (d) T^{-1}

2 When the distance travelled by a body is proportional to the time taken. Its speed: 1

(a) remains unchanged (b) becomes zero (c) increases (d) decreased

3 A vector is not changed if: 1

(a) it is rotated through an arbitrary angle (b) it is multiplied by an arbitrary scalar
(c) it is cross multiplied by a unit vector (d) it is displaced parallel to itself.

4 A bullet of mass m moving with a speed v strikes a wooden block of mass M and gets embedded into the block. The final speed is: 1

(a) $\frac{m}{m+M}v$ (b) $\frac{m}{2m+M}v$ (c) $\frac{m}{m+2M}v$ (d) $\frac{2m}{m+M}v$

5 A particle is projected at an angle of 60 degree to the horizontal with a kinetic energy E. The K.E at the highest point is: 1

(a) E/2 (b) E/4 (c) E/3 (d) 2E

6 A comet's maximum and minimum distances from the sun are 8×10^{12} m and 1.6×10^{12} m respectively. If its velocity is 60 m/s when it is closest to the sun, what is its velocity in m/s when it is farthest away? 1

(a) 12 (b) 60 (c) 112 (d) 6

7 Before breaking, a wire can undergo a maximum weight of 20 kg. Now, if the wire is cut into four equal parts. How much maximum weight can each wire undergo? 1

(a) 20 kg (b) 5 kg (c) 4 kg (d) None of these

8 A bimetallic strip is made of aluminium and steel ($\alpha_{Al} > \alpha_{Steel}$) on heating, the strip will: 1

(a) remain straight (b) get twisted
(c) bend with aluminium on concave side (d) bend with steel on concave side

9 The molar specific heat capacity of an ideal gas at constant volume is (3/2)R. The molar specific heat capacities, at constant pressure, is: 1

(a) (1/2)R (b) (5/2)R (c) (7/2)R (d) (9/2)R

10 SHM is performed by a particle on a 24cm long line. Its K.E. and P.E. will be equal when it's at the distance from the mean position: 1

(a) 3.145 cm (b) 6.134 cm (c) 7.456 cm (d) 8.485 cm

11 The period of a simple pendulum is doubled, when:

(a) its length is doubled

(b) the mass of the bob is doubled 1

(c) its length is made four times

(d) the mass of the bob and the length of the pendulum are doubled

12 A 200 Hz wave travels along a string towards its fixed end. When this wave returns after reflection, a node is formed 15 cm away from the fixed end. The incident and reflected wave speeds are: 1

(a) 30 m/s (b) 60 m/s (c) 90 m/s (d) 120 m/s

For Questions 13 to 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) Both Assertion and Reason are true and Reason is correct explanation of Assertion.

b) Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.

c) Assertion is true but Reason is false.

d) Both Assertion and Reason are false

13 **Assertion (A):** A body's specific heat is always greater than its thermal capacity.

Reason (R): Thermal capacity is the amount of energy required to raise the temperature of a unit mass of the body by one degree. 1

14 **Assertion (A):** Specific heat capacity and molar heat capacity both have the same units. 1

Reason (R): Specific heat capacity and molar heat capacity both depend on mass**.**

15 **Assertion (A):** In SHM, kinetic energy is zero when potential energy is maximum.

Reason (R): In SHM, the kinetic and potential energies become equal when the displacement is [1/√2] times the amplitude. 1

16 **Assertion (A):** The basic of Laplace correction was that, exchange of heat between the region of compression and rarefaction in air is not possible. 1

Reason (R): Air is a bad conductor of heat and velocity of sound in air is large**.**

SECTION B

17 It is easier to pull a roller than to push it. Why? (Explain using vector diagram) 2

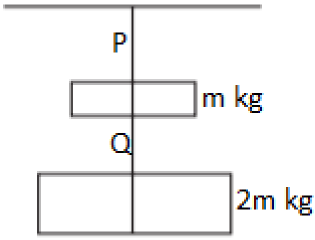
18 Using the expression for power and K.E. of rotational motion, derive the relation τ = Iα.

OR

A passenger is sitting in a cabin of a train that is going at a constant speed on a smooth track. What is the velocity of the compartment’s centre of mass if the person starts running in it? 2

19 The radius of the circular orbits of two satellites, A and B of the earth, are 4R and R, respectively. If the speed of satellite A is 3v. What is the speed of satellite B? 2

20 Two wires P and Q of the same diameter are loaded as shown in the figure. The length of wire P is L meter and its Young’s modulus is Y N/m^2 while the length of wire Q is twice that of P and its material has Young’s modulus half that of P. Compute the ratio of their elongation. 2



21 Which of the following examples represents periodic motion?

(A) A swimmer completing one (return) trip from one bank of a river to another and back.

(B) A freely suspended bar magnet displaced from its North-South direction and released. 2

(C) A hydrogen molecule rotating about its centre of mass.

(D) An arrow released from a bow.

SECTION C

22 For an object projected upward with a velocity v_0, which comes back to the same point after some time, draw:

(A) Acceleration-time graph 3

(B) Position-time graph

(C) Velocity-time graph

23 A body is projected at an angle θ with the horizontal. Derive an expression for its horizontal range. Show that there are two angles θ_1 and θ_2 projections for the same horizontal range, such that $\theta_1 + \theta_2 = 90°$. 3

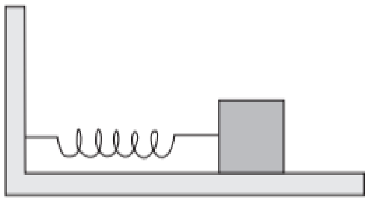
24 A metre stick is balanced at the centre. When two 5 g coins are placed one on top of the other at the 12.0 cm mark, the metre stick is found to be balanced at 45.0 cm. What is the weight of the metre stick? 3

25 a) What is Poisson's ratio?

b) Write the range of values of Poisson's ratio for steel. 3

c) Derive the expression for the elastic potential energy in a stretched wire.

26 A spring having a spring constant 1500 Nm^{-1} is mounted on a horizontal table as shown. A mass of 5.0 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 0.2cm and released. Determine: 3



(A) The frequency of oscillations.

(B) The maximum acceleration of the mass,

(C) The maximum speed of the mass.

27 A wave travelling along a string is described by, $y(x, t) = 0.005 \sin(80.0x - 3.0t)$, 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? 3

$\sin(1.699 \text{rad}) = \sin(97^\circ) = 0.9925$

OR

Show with diagrams, that when a string is fixed at its two ends vibrates in 1 loop, 2 loops, 3 loops and 4 loops, the frequencies are in the ratio 1: 2: 3: 4.

28 Derive the expression for the speed of efflux (Torricelli's law). 3

SECTION D

29 Measurement is one subject which matter in Physics and Chemistry due to the fact that each problem calls for the information of size, so that it will degree the quantities. Measuring an amount does now no longer continually provide a superbly correct answer. Only ideal measuring gadgets can offer a superbly correct answer. Practically size results in elements of a solution known as dependable digits and unsure digits. The reliability of a size is indicated via way of means of the variety of digits used to symbolize it. To specific it extra correctly we specific it with digits which are recognized with certainty. These are known as significant figures. They incorporate all of the positive digits plus one dubious digit in a variety.

(i) A car runs 1200 m in 22.5 sec. The average speed of a car in appropriate significant figures.

(a) 53.3 m/s (b) 53.33 m/s (c) 53.333 m/s (d) None of these

(ii) The radius of a uniform wire r = 0.024 cm. Take π = 3.142, then area of cross-section up to appropriate significant figures. 4

(a) 0.001808 cm^2 (b) 0.0018086 cm^2 (c) 0.0018 cm^2 (d) 18.08 cm^2

(iii) The volume of sphere is 2.42 cm^3. The volume of 12 spheres taking into account the significant figures.

(a) 29.0 cm^3 (b) 29.04 cm^3 (c) 29.1 cm^3 (d) 29 cm^3

(iv) The length of a rectangular block is 2.5 m, breadth is 1.75 m. The area of surface of block taking into account of the significant figures.

(a) 4.38 cm^2 (b) 4.3 cm^2 (c) 4.4 cm^2 (d) 4.375 cm^2

OR

(iv) The number of significant figures in 0.06900 is...........

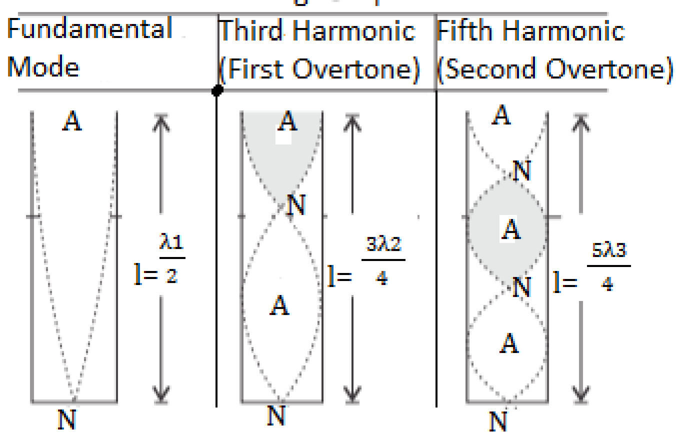
(a) 5 (b) 4 (c) 2 (d) 3

30 Organ pipes are the musical instruments which are used for producing musical sound by blowing air into the pipe. Longitudinal stationary waves are formed on account of superimposition of incident and reflected longitudinal waves. Equation of standing wave,

$$y = 2a\cos\frac{2\pi t}{\lambda}\sin\frac{2\pi x}{\lambda}$$

Frequency or vibration, $n = \frac{v}{\lambda}$

Closed Organ Pipe



(For open pipe : first overtone is second harmonic, second overtone is third harmonic and so on) 4 (i)A tube closed at one end and containing air is excited. It produces the fundamental note of frequency 512 Hz. If the same tube is open at both the ends the fundamental frequency that can be produced is

(a) 1024 Hz (b) 512 Hz (c) 256 Hz (d) 128 Hz

(ii) A closed pipe and an open pipe have their first overtones identical in frequency. Their lengths are in the ratio

(a) 1 : 2 (b) 2 : 3 (c) 3 : 4 (d) 4 : 5

(iii) The first overtone in a closed pipe has a frequency

(a) Same as the fundamental frequency of an open tube of same length

(b) Twice the fundamental frequency of an open tube of same length

(c) Same as that of the first overtone of an open tube of same length

(d) None of the above

OR

(iii) An empty vessel is partially filled with water, then the frequency of vibration of air column in the vessel

(a) Remains same (b) Decreases

(c) Increases (d) First increases then decreases

(iv) Two closed organ pipes have lengths of 0.80 m and 0.67 m. When they are sounded together, they produce 5 beats per second. The sound velocity will be:

(a) 100.12 m/s (b) 123.10 m/s (c) 125.625 m/s (d) 132.64 m/s

SECTION E

31 A bob of mass m is suspended by a light string of length L. It is imparted a horizontal velocity v_o at the lowest point A such that it completes a semi-circular trajectory in the vertical plane with the string becoming slack only on reaching the topmost point, C.

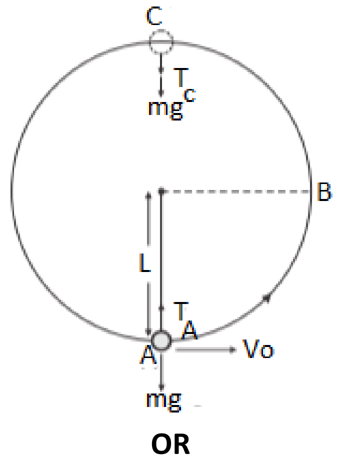
Obtain an expression for

(i) v_o

(ii) The speeds at points B and C

(iii) The ratio of the kinetic energies (K_B/K_C) at B and C.

(iv) Comment on the nature of the trajectory of the bob after it reaches the point C. 5



OR

A body of mass 5 kg moves along the x-axis with a velocity of 2 m/s. A second body of mass 10 kg moves along the y-axis with a velocity of $3 ms^{-1}$. They collide at the origin and stick together. Calculate: (A) The final velocity of the combined mass after collision. (B) The amount of heat liberated in the collision.

32 Define capillarity .Derive an expression for the capillary rise of water through a capillary tube.

OR

a) Water rises to a height of 10 cm in a certain capillary tube. If in the same tube, level of mercury is depressed by 3.42 cm, compare the surface tension of water and mercury. Specific gravity of mercury is 13.6, the angle of contact for water is zero degree and that for mercury is 135 degree. 5

b) Eight rain drops of radius 1mm each falling downwards with a terminal velocity of 5cm/s coalesce to form a bigger drop. Find the terminal velocity of the bigger drop

33 a) Explain in detail the energy of Simple Harmonic Motion and prove that the total energy at any instant is constant.

b) Also show the graphical representation of Kinetic energy, Potential energy and Total energy as a function of time and as a function of displacement.

OR 5

A block whose mass is 1 kg is fastened to a spring. The spring has a spring constant of 50 N m^{-1}. The block is pulled to a distance x = 10 cm from its equilibrium position at x = 0 on a frictionless surface from rest at t = 0. Calculate the kinetic, potential and total energies of the block when it is 5 cm away from the mean position.

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