



Second Term Test - Grade 12 - 2020

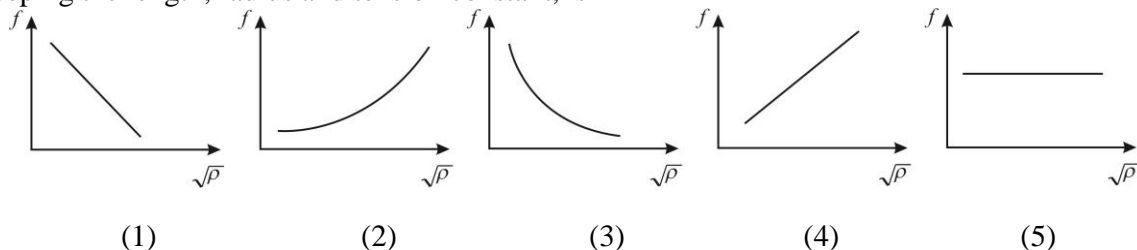
Index No.

Physics I

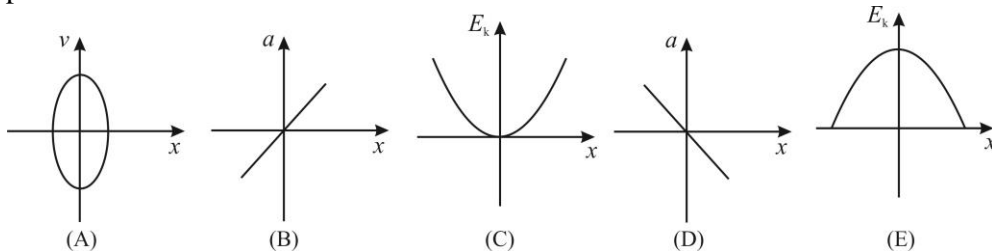
2 hours

- ❖ This paper consists of 50 questions and Answer all the questions.
- ❖ Use of calculator is not allowed.
- ❖ Write your index number in the space provided in the answer sheet.
- ❖ In each of the questions 1 to 50 pick one of the alternatives from (1),(2),(3),(4),(5) which is correct or most appropriate and mark your response on the answer sheet with a cross (x) in the answer sheet.

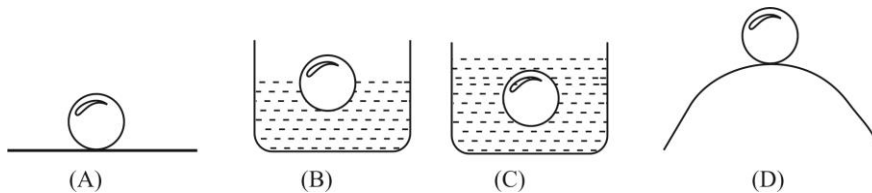
- In the relation $F = \frac{kmv^2}{r}$ F represents force, m represents mass and v represents velocity, the dimensions of k is
 (1) LT^{-1} (2) ML^2T^{-2} (3) ML^2T^{-4} (4) L^2T^{-4} (5) no dimensions.
- An object of mass m starts from rest and travels for a given time under the action of a constant force. The speed which it acquires is
 (1) proportional to m . (2) Proportional to $\frac{1}{m}$ (3) proportional to \sqrt{m}
 (4) Proportional to $\frac{1}{\sqrt{m}}$ (5) independent of m
- Speed of the transverse wave of frequency 60 Hz travelling along a stretched string is 90 m s^{-1} . The phase difference of two particles which are 75 cm apart will be
 (1) 2π (2) $\frac{3\pi}{2}$ (3) π (4) $\frac{2\pi}{3}$ (5) $\frac{\pi}{2}$
- During a short interval of time the speed v in m s^{-1} of an automobile is given by $v = at^2 + bt^3$, where the time t is in seconds. The units of a and b are respectively:
 (1) m s^{-3} ; m s^4 (2) m s^{-3} ; m s^{-4} (3) m s^{-4} ; m s^{-3} (4) m s^3 ; m s^4 (5) m s^{-4} ; m s^{-3}
- The correct graph between the fundamental frequency f and square root of density $\sqrt{\rho}$ of a wire, keeping the length, radius and tension constant, is



6. Which of the following waves cannot be polarized?
 (A) Transverse waves on a Slinky (B) Light rays
 (C) Transverse waves on water surface. (D) Sound propagating through water
 (1) Only (A) (2) Only (B) (3) Only (C) (4) Only (D) (5) Only (C) and (D)
7. Which of the following has the shortest wave length?
 (1) visible light (2) radio waves (3) x- rays (4) microwaves (5) ultraviolet
8. A circular container of diameter 40 cm is filled with water. By tapping the edge, a circular wave front is formed on water. Its speed of propagation is 25 cm s^{-1} . Which of the following correctly state the radius and the direction of propagation of the wave front after 1 s?
 (1) 25 cm, towards the center (2) 5cm, towards the center (3) 15cm, away from the center
 (4) 5cm, away from the center (5) 15 cm, towards the center
9. What is the speed of transverse waves propagating along a brass wire with a radius of 0.500 mm stretched with a tension of 200 N? The density of brass is $7.70 \times 10^3 \text{ kg m}^{-3}$.
 (1) 0.152 m s^{-1} (2) 43 m s^{-1} (3) 270 m s^{-1} (4) 400 m s^{-1} (5) 182 m s^{-1}
10. Some of the graphs in Figure refer to simple harmonic motion, where v is the velocity, a is the acceleration, E_k is the kinetic energy and x is the displacement from the mean (zero) position. Which graphs are correct?

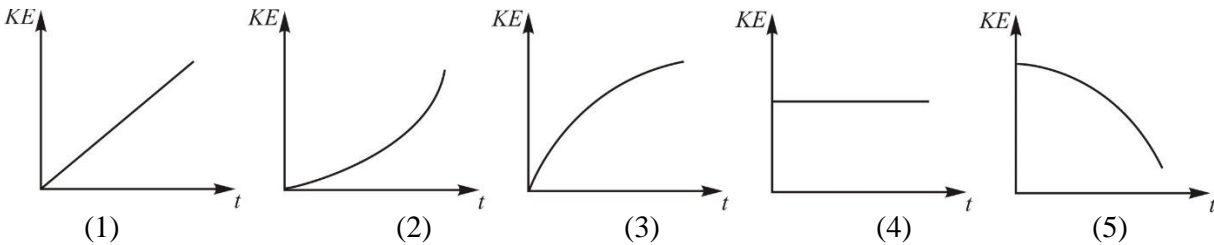


- (1) only (B) and (E) (2) only (D) and (C) (3) only (A), (D) and (E)
 (4) only (A), (C) and (D) (5) only (A), (B) and (E)
11. If equal masses of two liquids of densities d_1 and d_2 are mixed together, the density of the mixture is,
 (1) $\frac{d_1 d_2}{d_1 + d_2}$ (2) $\frac{d_1 + d_2}{2}$ (3) $\frac{d_1 d_2}{2(d_1 + d_2)}$ (4) $\frac{d_1 - d_2}{d_1 + d_2}$ (5) $\frac{2d_1 d_2}{d_1 + d_2}$
12. Three different spheres are shown in the following figure. All of them are in equilibrium. In (B), it floats and in (C) it is fully immersed in two different liquids. Surfaces of (A) and (D) are rigid. If a small displacement is given in suitable manner which of them are in neutral equilibrium?



- (1) only (B) (2) only (C) (3) only (D) (4) only (A) and (C) (5) only (A) and (B)

13. An object starts from rest and moves with a constant acceleration. Which of the following graphs best represents the variation of its kinetic energy KE with time t ?

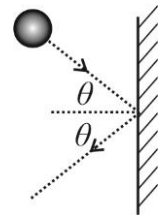


14. Water is flowing through a tube of non-uniform cross-section. If the radii of the tube at the entrance and the exit are in the ratio 3 : 2, then the ratio of the velocities of flow of water at the entrance and the exit is,

(1) 4 : 9 (2) 9 : 4 (3) 3 : 2 (4) 8 : 27 (5) 27 : 8

15. A particle of mass m travelling with a velocity u collide θ inclined to a wall and rebound with same speed. If the motion take place on a vertical plane and the collision lasts for δt time, the horizontal average force (direction and magnitude) on the wall is,

(1) $\rightarrow \frac{mu \cos \theta}{\delta t}$ (2) $\rightarrow \frac{2mu \cos \theta}{\delta t}$ (3) $\leftarrow \frac{mu \cos \theta}{\delta t}$
 (4) $\leftarrow \frac{2mu \cos \theta}{\delta t}$ (5) $\downarrow \frac{2mu \cos \theta}{\delta t}$



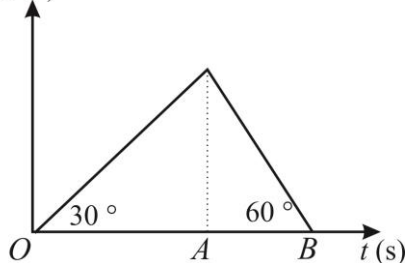
16. Consider the following statements made on pressure

(A) Pressure is a vector.
 (B) It acts always perpendicular to the surface.
 (C) Pressure on the bottom of a water tank is independent of surface area of the bottom.
 Of the above statements,

(1) Only (C) is true. (2) Only (B) is true. (3) Only (A) and (B) are true.
 (4) Only (B) and (C) are true. (5) All (A), (B) and (C) are true.

17. The velocity-time graph of an object moving on a straight line is given in the following figure. Its displacement during OA and AB intervals are S_1 and S_2 respectively. Then the ratio $\frac{S_1}{S_2}$ is


$v \text{ (m s}^{-1}\text{)}$



(1) $\frac{1}{3}$ (2) $\frac{1}{2}$ (3) 1
 (4) 2 (5) 3

18. Harry Potter is sitting 2.0 meters from the center of a merry-go-round when Draco Malfoy casts a spell that glues Harry in place and then makes the merry-go-round start spinning on its axis. Harry has a mass of 50.0 kg and can withstand $5g$ of acceleration before getting unconscious. What is the magnitude of Harry's angular momentum when he get unconscious?

(1) $200 \text{ kg m}^2 \text{ s}^{-1}$ (2) $330 \text{ kg m}^2 \text{ s}^{-1}$ (3) $660 \text{ kg m}^2 \text{ s}^{-1}$
 (4) $1000 \text{ kg m}^2 \text{ s}^{-1}$ (5) $1200 \text{ kg m}^2 \text{ s}^{-1}$

19.  The figure shows a wave on a water surface at time $t = 0$. There is a small object floating on the surface. The path of its motion during a single period T is best represented by



(1)



(2)



(3)



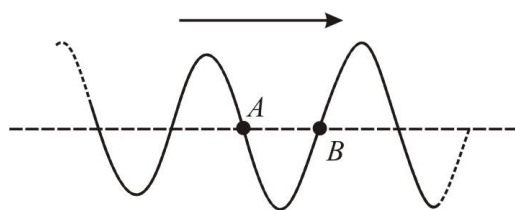
(4)



(5)

20. When a sound wave of frequency 300 Hz passes through a medium, the maximum displacement of a particle of the medium is 0.1 cm. The maximum velocity of particle is equal to
 (1) $6\pi \text{ cm s}^{-1}$ (2) $30\pi \text{ cm s}^{-1}$ (3) $60\pi \text{ cm s}^{-1}$ (4) 60 cm s^{-1} (5) 30 cm s^{-1}

21. Figure shows the instantaneous position of a transverse wave travelling to the right on a water surface. A and B are two small floating objects. As the wave travels away from this position to the right



- (1) both A and B begin to move to the right.
 (2) both A and B begin to move to the left.
 (3) both A and B begin to move downwards.
 (4) A begins to move upwards and B begins to move downwards.
 (5) A begins to move downwards and B begins to move upwards

22. A particle is executing S.H.M. What fraction of its energy is kinetic when the displacement is half the amplitude?

(1) $\frac{1}{2}$

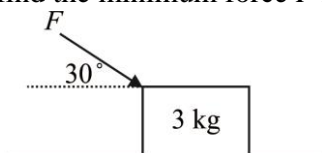
(2) $\frac{1}{3}$

(3) $\frac{2}{3}$

(4) $\frac{3}{4}$

(5) $\frac{1}{4}$

23. An object on a rough surface is given a force F as shown in the figure. If the coefficient of friction is 0.2 find the minimum force F required to push the object on the floor. (take $\sqrt{3} = 1.7$)



- (1) 2 N (2) 4 N (3) 6 N (4) 8 N (5) 10 N

24. A U-tube is partially filled with water. Oil, which does not mix with water, is next poured into one side until water rises on the other side by 25 cm with respect to initial level of water. If the relative density of oil is 0.8, the oil level will stand higher than the water level by

(1) 5 cm

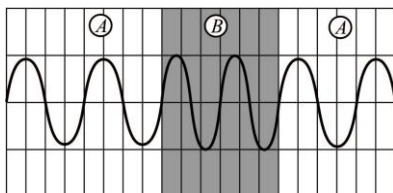
(2) 10 cm

(3) 15 cm

(4) 20 cm

(5) 25 cm

25. The figure shows how a wave passes through a medium B . The refractive index of the medium B with respect to A is



(1) 0.75

(2) 1.25

(3) 1.33

(4) 1.55

(5) 1.75

26. An open resonance tube and one end closed tube resonate in the same frequency at first overtone. The ratio of their length is

(1) 1 : 2

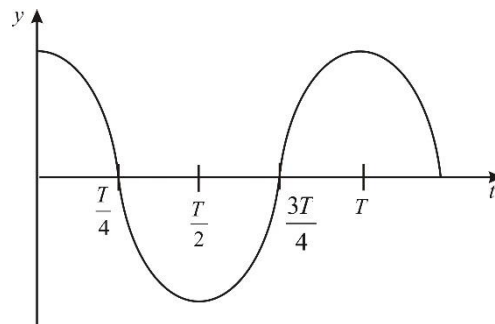
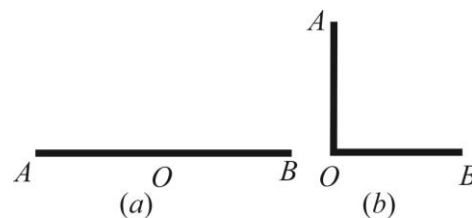
(2) 2 : 1

(3) 2 : 3

(4) 4 : 3

(5) 3 : 2

27. Consider the following statements made about a standing wave in a medium.
 (A) The displacement of the particles at the antinode is greater than the displacement at any other point.
 (B) The velocity of the particles at the antinode is greater than the velocity at any other point.
 (C) At any instant all the particles between any two consecutive nodes move in the same direction.
 Of the above statements,
 (1) only (A) is true. (2) only (A) and (B) are true. (3) only (B) and (C) are true.
 (4) only (A) and (C) are true. (5) all (A), (B) and (C) are true.
28. The height y and the horizontal distance x of a projectile on a certain planet is given by $y = 8t - 5t^2$ and $x = 6t$ meters when t is in seconds. The velocity of projection is
 (1) 6 m s^{-1} (2) 8 m s^{-1} (3) 7 m s^{-1} (4) 10 m s^{-1} (5) given data is not enough
29. A string of length $2l$, obeying Hooke's law, is stretched so that its extension is l . The speed of transverse waves in the string is v . If the string is further stretched so that the extension becomes $4l$, the speed of transverse waves in the string will be (assume that the cross sectional area remain unchanged)
 (1) $2\sqrt{2}v$ (2) $2v$ (3) $\frac{v}{\sqrt{2}}$ (4) $\sqrt{2}v$ (5) $\frac{v}{2}$
30. The temperature at which the speed of sound in air becomes double its value at 27°C is
 (1) 654°C (2) 1200°C (3) -123°C (4) 327°C (5) 927°C
31. A rope is used to lower a block of mass M vertically, through a distance d at a constant downward acceleration of $\frac{g}{4}$. Then the work done **by the cord on the block** is
 (1) Mgd (2) $\frac{Mgd}{4}$ (3) $-\frac{Mgd}{4}$ (4) $\frac{3Mgd}{4}$ (5) $-\frac{3Mgd}{4}$
32. The density of aluminum is $2.7 \times 10^3 \text{ kg m}^{-3}$. The speed of longitudinal waves in an aluminum rod is measured to be $5.1 \times 10^3 \text{ m s}^{-1}$. What is the value of Young's modulus for aluminum?
 (1) $7.0 \times 10^{10} \text{ N m}^{-2}$ (2) $7.0 \times 10^7 \text{ N m}^{-2}$ (3) $2.2 \times 10^{11} \text{ N m}^{-2}$
 (4) $2.2 \times 10^9 \text{ N m}^{-2}$ (5) $1.4 \times 10^7 \text{ N m}^{-2}$
33. AOB shown in the figure (a) is a uniform rod of length $2l$. O is the center of gravity of the rod. Now it is bent from O as shown in the figure (b). If O is considered as the origin of co-ordinate axes, the new co-ordinates of the center of gravity of the bent rod in figure (b) is
 (1) $0, 0$ (2) $2l, 2l$ (3) $1.5l, 1.5l$ (4) l, l (5) $0.5l, 0.5l$
34. The displacement-time graph of a particle executing simple harmonic motion is shown in the figure. Which of the following statement(s) is/are true?
 (a) The acceleration is maximum at $t = T$.
 (b) force on the particle is zero at $t = \frac{3T}{4}$
 (c) The potential energy equals the total energy at $t = \frac{T}{2}$
 (1) only (a) is true (2) only (c) is true (3) only (a) and (b) are true
 (4) only (a) and (c) are true (5) all (a), (b) and (c) are true

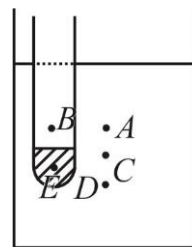


35. A uniform wooden plank of mass 200 kg and length 5 m is floating on still water with a man of 50 kg at one end of it. The man walks to the other end of the plank and stops. The distance moved by the man relative to water is

(1) 2.5 m (2) 4 m (3) 5 m (4) 7.5 m (5) zero

36. Weighted test tube floats on a container of water as shown in the figure. If the weight of the container is negligible, the center of gravity of the system can be at,

(1) A (2) B (3) C (4) D (5) D



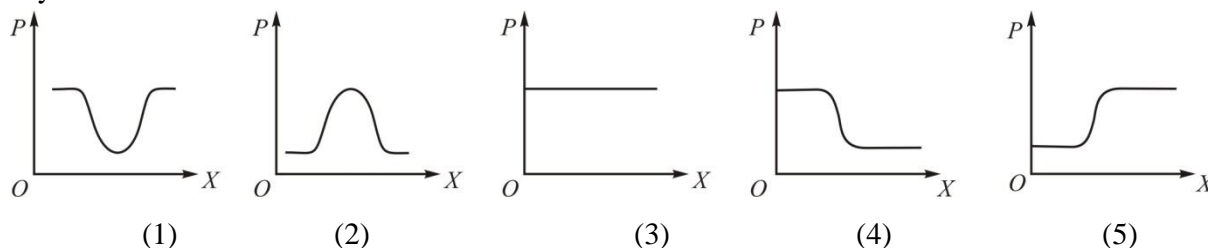
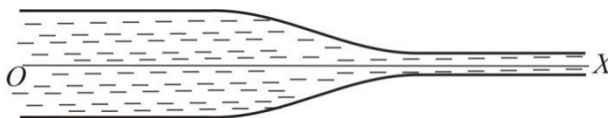
37. A wave on ripple tank enters from deep region to shallow region, then

(A) Its wave length is decreased.
(B) Its frequency is increased.
(C) its velocity is decreased.

Of the above statements

(1) Only (A) is true. (2) Only (B) is true. (3) Only (C) is true.
(4) Only (A) and (B) are true. (5) Only (A) and (C) are true.

38. A non viscous and incompressible fluid flows through a tube in which the cross-section is varying as shown in the figure. The variation of pressure P along the axis, OX , is best represented by



39. Two sound waves, each of amplitude A and frequency f , superimpose at a point a phase difference $\pi/2$. The amplitude and the frequency of the resultant wave are, respectively,

(1) $\frac{A}{\sqrt{2}}, \frac{f}{\sqrt{2}}$ (2) $\sqrt{2}A, f$ (3) $\sqrt{2}A, \frac{f}{\sqrt{2}}$ (4) $\sqrt{2}A, \frac{f}{2}$ (5) $\frac{A}{\sqrt{2}}, f$

40. A car is negotiating a circular turn of radius r on a level road. The distance between the left and the right wheel is $2a$. The height of the centre of gravity of the car above the road is h . The maximum speed of the car to avoid overturning is

(1) $\sqrt{\frac{gr^2a}{h}}$ (2) $\sqrt{\frac{ghr}{a}}$ (3) $\sqrt{\frac{gha}{r}}$ (4) $\sqrt{\frac{gra}{h}}$ (5) $\sqrt{\frac{gra^2}{h}}$

41. A body of mass 3 kg, moving with a speed of 4 m s^{-1} , collides head-on with a stationary body of mass 2 kg. Their relative velocity of separation after the collision is 2 m s^{-1} . Then

(A) The impulse of the collision is 7.2 N s
(B) The loss of kinetic energy due to collision is 7.2 J
(C) collision must be elastic.

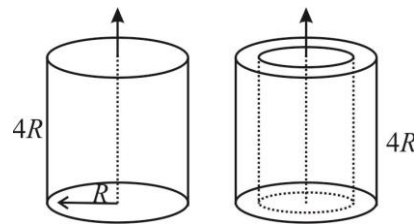
Of these statements

(1) Only (A) is true. (2) Only (B) is true. (3) Only (A) and (B) are true.
(4) Only (A) and (C) are true. (5) all (A), (B) and (C) are true.

42. A particle at rest starts moving in a straight line with a uniform acceleration. The ratio of the distances covered during the fourth and the third second is

(1) $\frac{4}{3}$ (2) $\frac{7}{5}$ (3) $\frac{9}{7}$ (4) 2 (5) $\frac{11}{7}$

43. Moment of inertia of a uniform solid cylinder of radius R and height $4R$ is I . Then, solid cylinder of radius $\frac{R}{2}$ is removed from this symmetrically so that it results a container of wall thickness $\frac{R}{2}$ as shown in the figure. The moment of inertia of the container is



(1) $\frac{1}{16}I$ (2) $\frac{15}{16}I$ (3) $\frac{9}{16}I$ (4) $\frac{121}{128}I$ (5) $\frac{249}{256}I$

44. The period of a particle in simple harmonic motion is 8 s. At $t = 0$ it is at the mean position. Consider the following statements.

(A) The particle will travel equal distances during the first 4 s and the next 4 s.
 (B) The particle will travel equal distances during the first 2 s and the next 2 s.
 (C) The particle will travel equal distances during the first second and the next second.

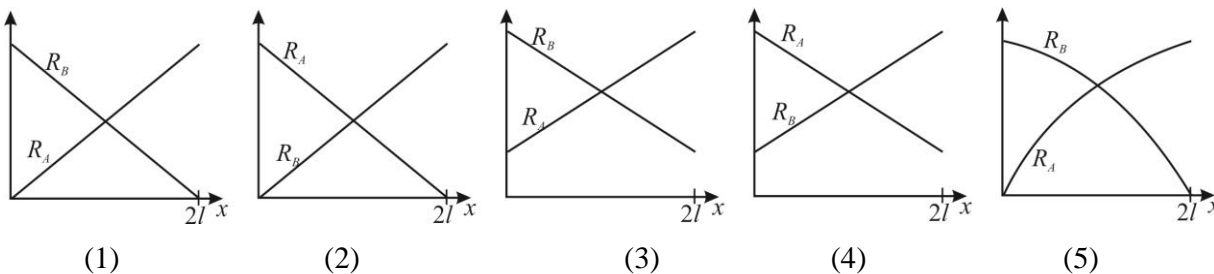
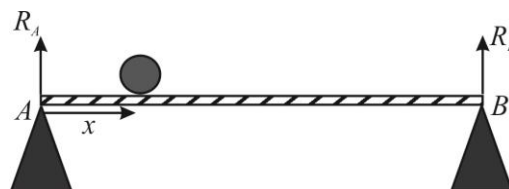
of these statements

(1) Only (A) is true. (2) Only (C) is true. (3) Only (A) and (C) are true.
 (4) Only (A) and (B) are true. (5) all (A), (B) and (C) are true.

45. 26 tuning forks are arranged in order of increasing frequency. Any two successive forks produce 4 beats s^{-1} when sounded together. If the frequency of last fork is three times the initial, the frequency of the first fork is,

(1) 25 Hz (2) 50 Hz (3) 75 Hz (4) 100 Hz (5) 150 Hz

46. A uniform heavy horizontal rod of length $2l$ is at equilibrium on two supports as shown in the figure. A sphere is then slowly rolling from A to B. If x is the distance measured from A to the sphere, the variation of reactions at two supports R_A and is best represented by



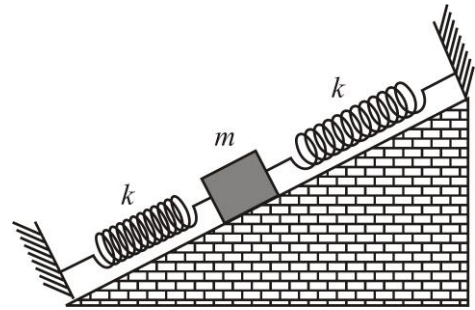
47. A ball projected 45 above the horizontal on a horizontal ground, just clears a wall at 2 m from the projection. The ball falls on the ground 4 m from the wall. The height of the wall can be,

(1) 2 m (2) 3 m (3) 4 m (4) $\frac{4}{3}$ m (5) $\frac{3}{4}$ m

48. A hydrometer has a uniform stem calibrated uniformly downwards from 0, 1, 2, ... up to 10. When floating in pure water it reads 0 and in a liquid of relative density 1.5 it reads 10. The relative density of a liquid in which it reads 5 is
 (1) 1.1 (2) 1.15 (3) 1.2 (4) 1.25 (5) 1.3

49. On a smooth inclined plane of inclination θ , a body of mass m is attached between two identical, light springs. The other ends of the springs are fixed to firm supports. If the force constant of each spring is k , the time period of oscillation of the body is

- (1) $2\pi\sqrt{(2m/k)}$ (2) $2\pi\sqrt{\frac{m}{2k}}$
 (3) $2\pi\sqrt{(mg/2k)}$ (4) $2\pi\sqrt{\frac{mg \sin \theta}{2k}}$
 (5) $2\pi\sqrt{\frac{mg}{2k}}$



50. The speeds of an object in simple harmonic motion when the displacements from the center are x_1 and x_2 are v_1 and v_2 respectively. The period of oscillation of the object will be,

- (1) $2\pi\sqrt{\frac{x_1^2 + x_2^2}{v_1^2 + v_2^2}}$ (2) $2\pi\sqrt{\frac{v_1^2 + v_2^2}{x_1^2 + x_2^2}}$ (3) $2\pi\sqrt{\frac{v_2^2 - v_1^2}{x_2^2 - x_1^2}}$ (4) $2\pi\sqrt{\frac{x_1^2 - x_2^2}{v_2^2 - v_1^2}}$ (5) $2\pi\sqrt{\frac{x_1^2 - x_2^2}{v_2^2 + v_1^2}}$

Index No.

3 hours

- ### Part - A (Structured Essay)

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- A -

D -

B -

E -

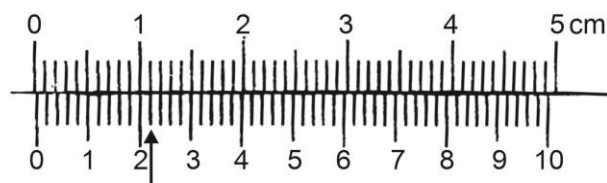
C -

- a) How would you check whether there is a zero error in the Vernier caliper?

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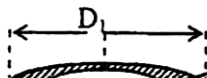
- b) 1) What is the least count of the above Vernier caliper in cm ?

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- 2) What is the magnitude of the zero error in cm ?

.....

- c)



Write down the suitable parts of the Vernier caliper for the measurements of D_1 , D_2 , D_3 , h_1 and h_2 .

D_1

D_2

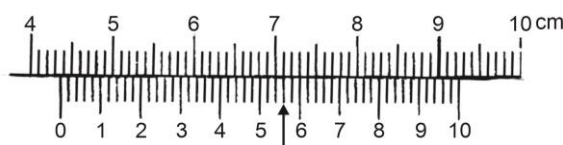
D_3

h_1

h_2

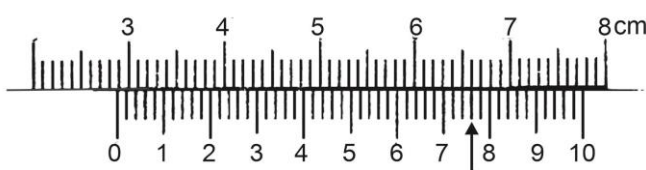
- d) The figures below show the positions of the main and the vernier scales when taking the measurements of D_1 and D_2

- 1)



What is the magnitude of D_1 ?

- 2)



What is the magnitude of D_2 ?.....

- e) 1) If the above solid object is drawn according to a scale, which measurement has the minimum fractional error?

.....

- 2) Give the reason for your answer.

.....

.....

- f) Write down an expression for the volume V of the material of the object using the given symbols.

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- g) Explain why the internal diameter (about 3cm) of a rubber tube cannot be measured using a Vernier caliper.

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02. You are asked to determine the mass (M) of a uniform glass cube of side 3 cm by performing the experiment which uses the principle of moments. You are provided with only the following items to carry out the experiment.

- A weight of mass $m (= 100\text{g})$
- A meter ruler
- A knife edge and a suitable wooden block
- Pieces of thread

- i) State the principle of moments.

.....

.....

.....

- ii) What is the purpose of balancing the meter ruler on the knife edge without masses?

.....

.....

- iii) Draw a diagram of the arranged experimental set up on the space given below for the balanced situation just before you take a reading. Label the items. Take the balanced lengths from the knife edge to M and m as ℓ_1 and ℓ_2 respectively.

- iv) Write down the relation among ℓ_1, ℓ_2, m and M when the system is balanced.

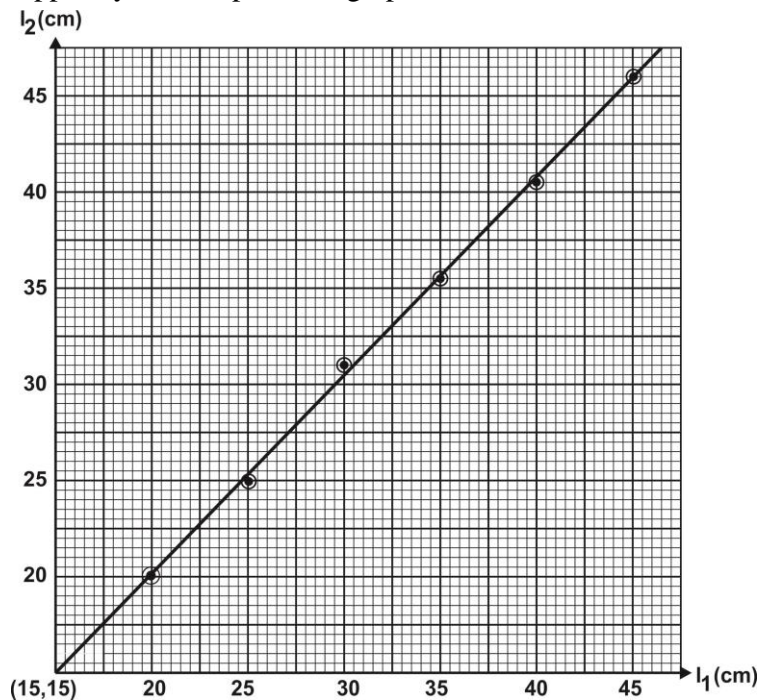
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- v) What is the reason of not taking readings for small values of ℓ_1 and ℓ_2 ?

.....

.....

- vi) Suppose you have plotted a graph as shown below to find the mass M



- a) By selecting the two most suitable points on the graph, calculate the gradient of the graph. The two points selected should be clearly marked on the graph using arrows.

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- vii) Calculate the mass M of the glass cube.

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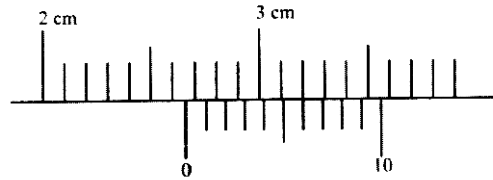
- viii) A meter ruler with the centre of gravity at 52 cm mark is balanced on a knife edge using the weight (m) and the glass cube (M) to find the mass m_0 of the meter ruler.

- a) Draw a suitable diagram of an experimental set up that could be used for this situation in the space given below. Take the balanced lengths from the knife edge to the masses M and m as y and x respectively.

- b) Write down an expression using the given symbols when the system is balanced.

.....

- ix) The figure below shows the positions of the main scale and the Vernier scale when taking the side length of the glass cube using a Vernier caliper.



- a) What is the side length of the glass cube in *cm*?

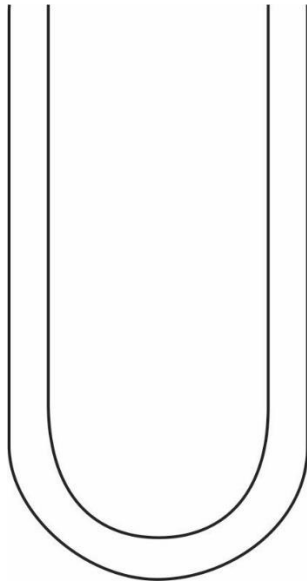
.....

- b) Substitute the values obtained to find the density of the glass cube in $kg\ m^{-3}$

.....

.....

03.



You are provided with a *U* tube, water and coconut oil to determine the relative density of coconut oil. The figure shows the U tube attached to the stand.

- i) Mark the liquid levels in the given figure when they are at equilibrium. Label liquids and the common interface.
- ii) If you are provided with two millimeter scales, show how you place it to measure the heights of liquid columns in the above figure.
- iii) What are the readings you take to measure the height of a liquid column?

.....

.....

- iv) a) Density of water and coconut oil are ρ_w and ρ_l respectively. Derive the relationship between heights of liquid columns. Take height of water column as h_w and that of coconut oil column as h_l . (If you use any other symbol other than g it must be introduced properly.)

.....

- b) Rearrange the above relation to plot a graph.

.....

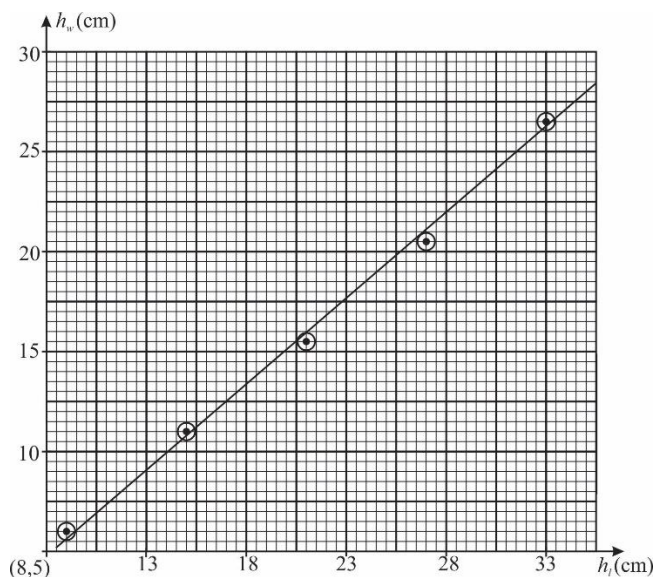
- v) a) When you fill the U tube **at the beginning**, which liquid do you insert first? Liquid with higher density or with low density.

.....

- b) If you are given small amounts of unknown immiscible liquids to compare densities, how do you identify the liquid that should be inserted first to the U – tube. Assume you have permission to use usual laboratory apparatus but no any measuring instruments.)

.....

- vi) The graph obtained in this experiment is shown below.



- a) Write down the coordinates of two points of the graph that you can use to determine the gradient of the graph.

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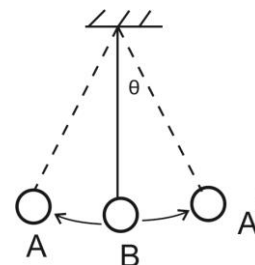
- b) Determine the gradient of the graph.

.....

- c) Calculate the relative density of coconut oil.

.....

04. A student plans to find the acceleration due to gravity in the laboratory using a simple pendulum.



- i) What are the other measuring instruments you need to perform this experiment?
.....
.....
- ii) a) Write down an expression for the period of oscillations (T) of the simple pendulum in terms of the length (L) of the pendulum and the acceleration due to gravity (g).
.....
.....
b) Rearrange the above expression in the most suitable manner in order to obtain a value for g by plotting a graph.
.....
.....
- iii) a) When taking readings for (T) a reference pin is used. To which point on the path of the pendulum should the reference pin be directed? ^A or B &
.....
.....
b) What is the reason of selecting the above point?
.....
.....
- iv) a) In this experiment, small oscillations are given for the pendulum? Give the reason.
.....
.....
b) Give a suitable value for the angle of oscillation.
.....
.....
- v) a) Instead of measuring the time for one oscillation, the student measured the time for 25 oscillations. Give the reason for this.
.....
.....
b) In the laboratory experiment to find the value of g , using the simple pendulum you are provided with a stop watch which can measure the time with an accuracy of 0.5s. If the estimated value of the period T is 2 s , determine the minimum number of oscillations you should take to reduce the percentage error of T down to 1%.
.....
.....
.....

vi) a) How would you start the counting of oscillations?

.....

.....

.....

.....

b) What type of error can be reduced from the above step?

.....

vii) a) The period of oscillation obtained when the string used for this experiment is light is T_1 and it is T_2 when the string is not light. Are these two values same. ?

.....

b) Explain your answer.

.....

.....

(viii) a) The student used a uniform metal sphere of radius R as the pendulum bob. The length of the string he used to suspend the pendulum bob is L and acceleration due to gravity is g . Write down an expression for the period of oscillation T in terms of L, g, R

.....

.....

b) After plotting the T^2 versus L graph he found that the gradient was $4 \text{ s}^2 \text{ m}^{-1}$ and the intercept was 0.025 s^2

i) Determine g .

.....

.....

.....

ii) Determine the radius R of the sphere.

.....

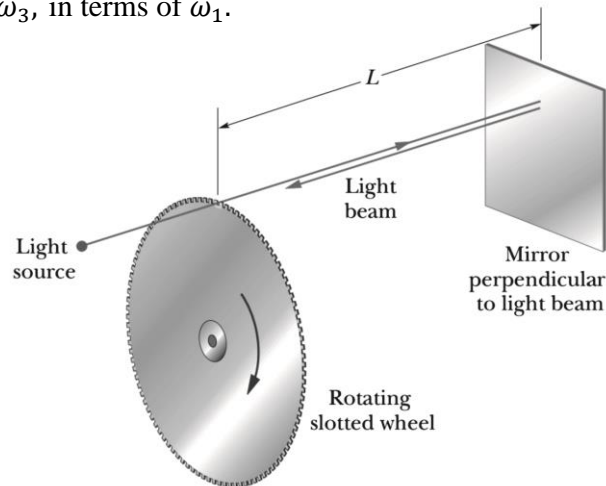
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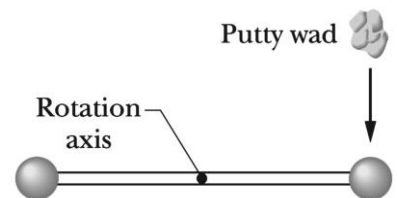
SecondTerm Test - 2020
Physics Part II - Grade 12
Part B (Essay)

• **Answer four questions only.**

05. a) A cyclist moves along a horizontal circular track of circumference 88 m with a constant speed. He takes 10 s to complete one round.
- Find the angular velocity ω for the motion.
 - Find the tangential speed V .
 - If the circumference of a circle ($C = 2\pi r$), find radius of it.
 - Calculate the centripetal acceleration a_r .
 - Calculate the centripetal force, F if the mass of the rider and the bicycle is 70 kg .
- b) Figure shows an early method of measuring the speed of light that makes use of a rotating slotted wheel. A beam of light passes through one of the slots at the outside edge of the wheel, travels to a distant mirror, and returns to the wheel just in time to pass through the next slot in the wheel. One such slotted wheel has 428 slots around its edge. Measurements taken when the mirror is $L = 500\text{ m}$ from the wheel indicate a speed of light of $2.996 \times 10^8\text{ ms}^{-1}$.
- Write down an expression for the angular velocity (ω_1) of the wheel substituting the values.
 - When $L = 750\text{ m}$, the angular velocity of the wheel is ω_2 . Express ω_2 in terms of ω_1 .
 - If the above beam of light travelled to the mirror returns to the wheel just in time to pass through the alternate slots in the wheel when $L = 750\text{ m}$, Express the new angular velocity of the wheel ω_3 , in terms of ω_1 .



06. a)
 - What are the dimensions of angular momentum?
 - State the principle of conservation of angular momentum.
 - Two 2 kg balls are attached to the ends of a thin rod of length 1 m and negligible mass. The rod is free to rotate in a vertical plane without friction about a horizontal axis through its center. Calculate the moment of inertia of the system.



- iv) With the rod initially horizontal, a $50g$ wad of wet putty drops vertically on to one of the balls, hitting it with a speed of 9 ms^{-1} and then sticking to it.

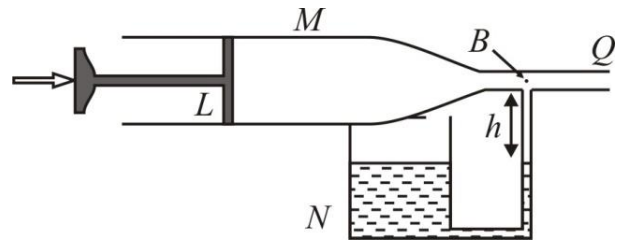
Show that the increase in moment of inertia of the system after sticking the wad of putty is about $\frac{1}{80}$.

- v) What is the initial angular velocity (ω_0) of the system just after the putty wad hits?
vi) Find the initial kinetic energy of the system.
vii) Through what angle will the system rotate before it momentarily stops?
viii) The rod with a wad of putty of mass more than $50g$ stuck to one of the balls attached to the ends of the rod continuously rotates to one direction.

Draw a $\omega - t$ graph (angular velocity – time) for the rotation.

07. i) Write down the Bernoulli's principle as a mathematical expression. Identify each term of this relation
ii) Show that the relation is dimensionally correct and each term has the dimensions of energy per unit volume.
iii) State the conditions under which this relation is valid.

- iv) Figure shows a household liquid sprayer. N is the tank where the liquid is kept. L is the hand operated piston. M is the pump through which the air can be pushed forward. The cross sectional area of M is A and that of the outlet tube Q is a . Assume that air behaves according to all the conditions that you have mentioned under (iii).



Consider a situation where L is pushed forward with a uniform speed v .

- a) Obtain an expression for the speed of air in the outlet tube Q .
b) Get an expression for the pressure difference between air in the pump and point B which is in the outlet tube. Consider the density of air as d .
c) Get an expression for the minimum speed of the piston to lift the liquid up to B . Assume that the pressure in the barrel M is same as the atmospheric pressure. Consider the density of liquid as ρ .
d) Now consider an occasion where the speed of piston L is increased to V . The power of pushing the piston is P . Get an expression for the rate of volume of liquid flowing through the outlet tube Q . (Assume that the density of air is negligible compared with the density of the liquid.)

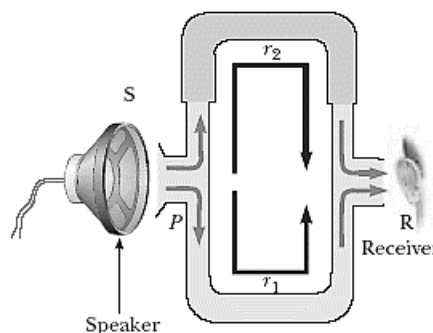
08. Any type of wave is basically generates to spread out the energy throughout the universe. Wave carries the characteristic identity of the source, the frequency along with it. Wave can undergo reflection, refraction, interference, diffraction and polarization. Then it becomes easy to spread the energy in every nook and corner of the universe.

Electromagnetic waves do not require a physical medium to propagate. It uses the electric and magnetic properties of the space.

All mechanical waves require some source of disturbance, a medium that can be disturbed, and some physical mechanism through which elements of the medium can influence each other.

Interference of waves can be explained using the superposition principle. Interference of sound waves is illustrated in Figure. Sound from a loudspeaker S is sent into a tube at point P, where there is a T-shaped junction. Half of the sound energy travels in one direction, and half travels in the opposite direction.

The distance along any path from speaker to receiver is called the path length r . The lower path length r_1 is fixed, but the upper path length r_2 can be varied by sliding the U-shaped tube, which is similar to that on a slide trombone.

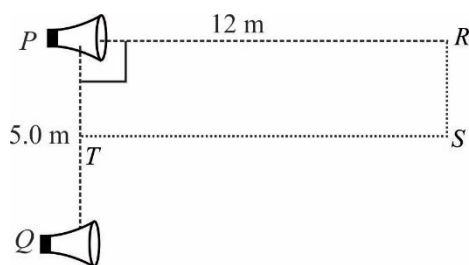


When the difference in the path lengths $\Delta r = |r_1 - r_2|$ is either zero or some integer multiple of the wavelength λ (that is, $\Delta r = n\lambda$, where $n = 0, 1, 2, 3, \dots$) two waves are in-phase. Two waves which are in-phase interfere constructively and a loud sound will be resulted. If the path length r_2 is adjusted such that the path difference $\Delta r = n\lambda/2$, (for n odd), the two waves are exactly opposite phase at the receiver and hence cancel each other. In this case of destructive interference, no sound is detected at the receiver.

In order to observe the interference, two sources must be monochromatic and coherent. If not, waves from the same source can be lead to the detector through two paths as shown here.

Nice and colourful pattern appear through oil layer present on water is due to interference of light. Colours you see on the CD are also due to interference of light.

- What is the primary purpose of generating a wave?
- What are the main characteristics of waves?
- Which of the above characteristics is related only to transverse waves?
- What is being used by electromagnetic waves to propagate?
- Name three requirements to be satisfied for a mechanical wave to arise and propagate.
- Give three features that are common in mechanical transverse waves and mechanical longitudinal waves. (Except above characteristics)
- In order to observe interference, what characteristics are expected in two sources?
- Write down the principle of super position.
- What are coherent sources?



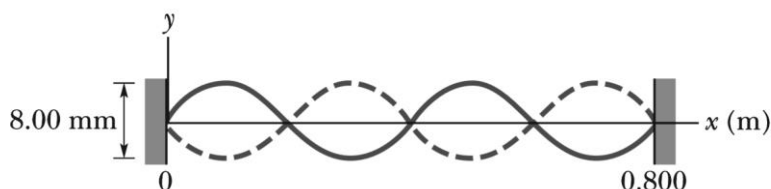
- (x) P and Q shown in the figure are two sound sources connected to the same audio device that produce sound with characteristics specified in (vii) above. They are 5 m apart and T is the center of PQ . Sound frequency is 680 Hz and the speed of sound in air is 340 m s^{-1} .
- If ST is the perpendicular bisector of PQ , give a reasonable argument to say that a loud sound can be heard anywhere on ST .
 - Given that PR and PQ are perpendicular to each other. $PR = 12 \text{ m}$, what type of interference take place at R . Prove your answer.
 - If a sensitive sound detector is brought from S to R , how many low sound positions (destructive interference positions) can be found.
- (xi) Give two day to day observations which occur due to interference of light.
- (xii) Usually we listen to music using two speakers connected to the same audio set. But we have never experience the interference of sound. What are the possible reasons for this?

09

Answer either part (A) or Part (B) only.

09. A) a) Show that the pressure at a point in a liquid is given by $= h\rho g$, where h is the depth to the point and ρ is the density of the liquid.
- b) i) State the Archimedes' principle.
 ii) Verify the above principle using a solid cylinder of height h and area of cross section A , fully immersed in a liquid of density ρ .
 iii) Describe an experiment which can be done in the laboratory to verify the Archimedes' principle.
- c) Two metals of densities 6000 kgm^{-3} and 4000 kgm^{-3} are mixed by taking same mass of them to make an alloy. The metallic volume of a tower made using the above alloy is 0.02 m^3 . To test whether there are air bubbles enclosed inside the tower, it is totally immersed in water and in a liquid of density ρ . The apparent weights shown are 210 N and 180 N respectively.
- Find the density of the alloy.
 - What is the mass of the tower?
 - Are there air bubbles enclosed inside the tower?
 If your answer is "Yes", find the volume of the air bubbles.
 - Calculate the value of ρ .
 - The above tower is constructed as a closed cylindrical object with a cavity. It floats in the liquid of density ρ such that $\frac{10}{13}$ of the whole volume of the object is submerged in liquid. What is the volume of the cylindrical object?

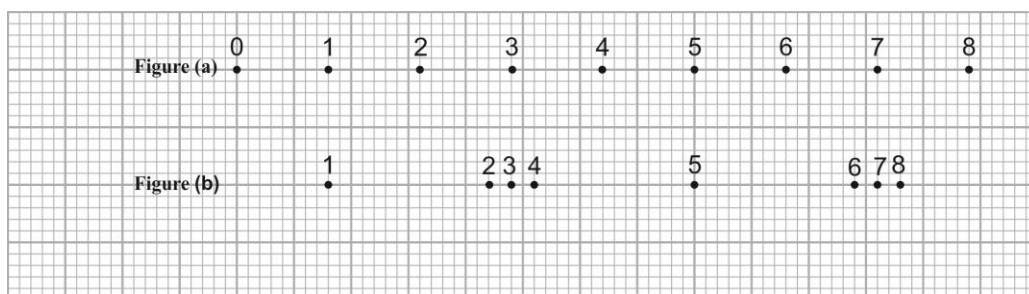
- B) a) i) Write down an expression for the velocity of transverse waves (V) in a stretched string in terms of tension (T) and mass per unit length (m).
 ii) Show that the above equation is dimensionally correct.
- b) i) Explain briefly how a transverse stationary wave is setup in a stretched string.
 ii) Explain the difference between the stationary wave and a progressive wave based on the energy transmission, phase of the particles and amplitude of the particles.
- c) Figure shows resonant oscillation of a string of mass $m = 2.50\text{ g}$ and length $L = 0.80\text{ m}$ and that is under tension $T = 320\text{ N}$.



- i) What is the harmonic number corresponding to the above transverse standing wave pattern?
 ii) What is the distance between two adjacent nodes?
 iii) What is the velocity of the transverse wave?
 iv) What is the frequency of the progressive transverse wave?
 v) What is the amplitude of an antinode?
 vi) What is the frequency of the string elements oscillating vertically in simple harmonic motion?
 vii) Write down an expression in the form of $a = -\omega^2 y$ for the oscillations of the moving string elements.

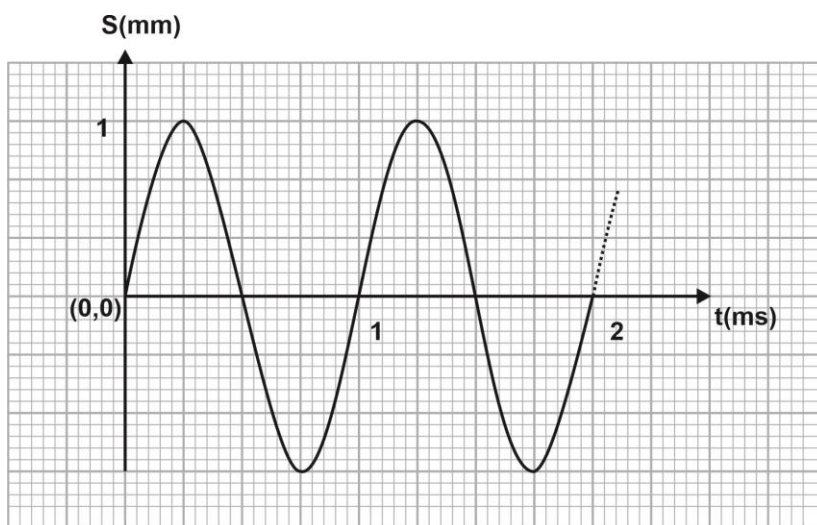
• **Answer either part (A) or Part (B) only.**

10. A) i) Explain the difference between transverse waves and longitudinal waves using the vibrational direction of the particles of the medium.



The figure (a) shows the actual positions of the nine air particles separated by the same distance. Figure (b) shows their positions when a sound wave propagates through the medium.

- ii) What are the particles in a compression?
 iii) Write down a particle in a rarefaction.
 iv) Find the wavelength of the sound wave if the separation between 3rd and 7th particles is 34 cm



Graph C

Graph (c) shows the displacement (s) - time (t) graph of an air particle situated on the line of propagation of the wave. The time- axis is calibrated in millisecond (ms) and the displacement axis is calibrated in millimeter (mm)

- v) What is the time period (T) of the particle?
 - vi) What is the frequency (f) of the particle?
 - vii) What is the frequency (f) of the sound wave?
 - viii) Find the sound velocity (v)
 - ix) Obtain the maximum displacement (A) of the particle using the graph(C)
 - x) Find the maximum velocity (V_{MAX}) of the particle.
 - xi) Find the maximum kinetic energy of the particle executing simple harmonic motion. (mass of the air particle $5 \times 10^{-23} g$)
 - xii) Find the maximum potential energy of the particle executing simple harmonic motion.
 - xiii) Show the variation of kinetic energy and potential energy with the displacement using a graph.
 - xiv) Which frequencies give the beat frequency of $6 Hz$ with the above sound wave?
- B) a) An air column inside a tube open at both ends vibrates at its fundamental mode. Show the variation of relative displacement of the particles and pressure with the distance from one end of the tube along it. Mark displacement nodes and antinodes, pressure nodes and antinodes on your graphs.
- b) i) The velocity of sound in a gas is given by $V = \sqrt{\frac{\gamma p}{\rho}}$.
Introduce the symbols of the equation.
- ii) Obtain the equation that shows the variation of sound velocity with the temperature assuming the gas behaves ideally.
 - iii) Describe briefly, the dependence of sound velocity on the temperature, pressure, density and humidity of the gas.
- c) i) At $27^\circ C$, two tubes closed at one end, of lengths $\ell_1 = 34.5 cm$ and $\ell_2 = 69.5 cm$ resonate at their fundamental modes with the tuning forks of frequencies $250 Hz$ and $125 Hz$ respectively. If both tubes have same diameter, find the end corrections of the two tubes and velocity of sound in air at $27^\circ C$.
- ii) Calculate the velocity of sound in air at $47^\circ C$.
 - iii) Find the average molecular mass of the gas at $27^\circ C$.
 $\gamma = 1.4, R = 8.3 J mol^{-1} K^{-1}$

Second Term Test - 2020

Physics - 1

1) 4	11) 5	21) 4	31) 2	41) 14
2) 5	12) 4	22) 4	32) 2	42) 4
3) 5	13) 1	23) 4	33) 1	43) 4
4) 2	14) 5	24) 5	34) 5	44) 2
5) 3	15) 1	25) 4	35) 3	45) 5
6) 5	16) 3	26) 2	36) 2	46) 2
7) 2	17) 3	27) 5	37) 5	47) 2
8) 3	18) 3	28) 2	38) 1	48) 2
9) 3	19) 4	29) 1	39) 5	49) 4
10) 2	20) 2	30) 3	40) 3	50) 2

Physics - 11

Structured Essay - A.

① $W_1 = Vdg$ — (01)

② $U = Vd_w g$ — (02) — (01)

③ $W_1 - W_2 = Vd_w g'$ — (1)

$W_1 = Vdg$ — (2)

② $\frac{W_1}{W_1 - W_2} = \frac{d}{d_w}$ — (01)

4) The sphere should not contact with the wall and the bottom of the liquid vessel. — (02)

5) The fractional error of reading W_1 is lower due to mass/weight of large sphere. — (02)

* The fractional error of value $(W_1 - W_2)$ is lower due to increasing of upthrust because of high volume. — (02)

6) a) $U = 200 \times 10^{-6} \times 10^3 \times 10$ — (01)
 $= 2N$ — (01) + (01) (unit - 01, value - 01)

b) $8.01 - 5.99 = 2.02 N = W_1 - W_2$ — (01)

The readings of the spring balance are obtained by rounding off to the nearest least count — (02)

c) $\frac{8.01}{2.02} = (3.96 - 3.97)$ — (01)
 — (01)

② (a) Thermometer, balance (Electronic / Three beam / Four beam) ———— (02)

(b) To reduce the error due to transfer of heat with the environment / heat compensation with environment ———— (02)

(c) (i) ice ^{Pieces} parts — (01)

(ii) crushed ice : not dry — (01)

large ice pieces : can not control final temperature. — (01)

(d) To remove the water layer on the surface of ice pieces. — (02)

(e) obtain low value for the latent heat capacity of fusion in ice.

$$(f) 10 \times 10^{-3} L + 10 \times 10^{-3} \times 4.2 \times 10^3 (27-0) = 42 (37-27) + 100 \times 10^{-3} \times 4.2 \times 10^3 (37-27) \text{ — (05)}$$

$$10^{-2} L + 1134 = 420 + 4200$$

$$L = \frac{3486}{10^{-2}}$$

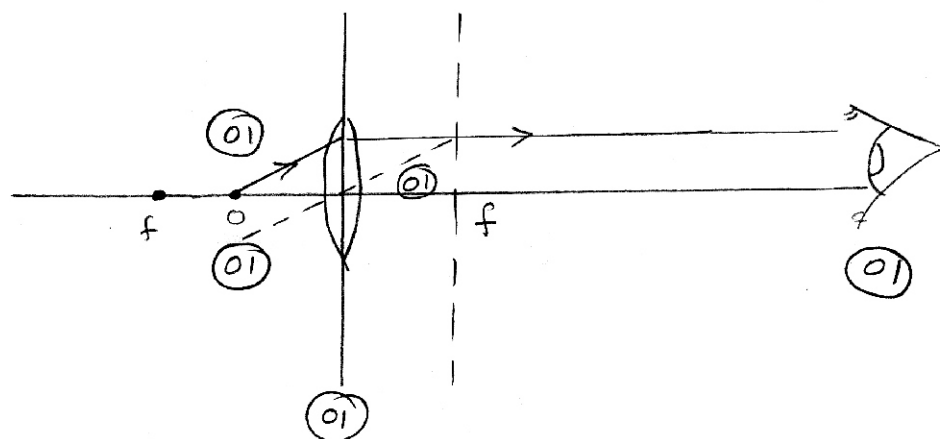
$$L = 348600$$

$$L = 3.486 \times 10^5 \text{ J kg}^{-1} \text{ — (02)}$$

(g) A lower value will obtain than before. — (02)

20

(03)



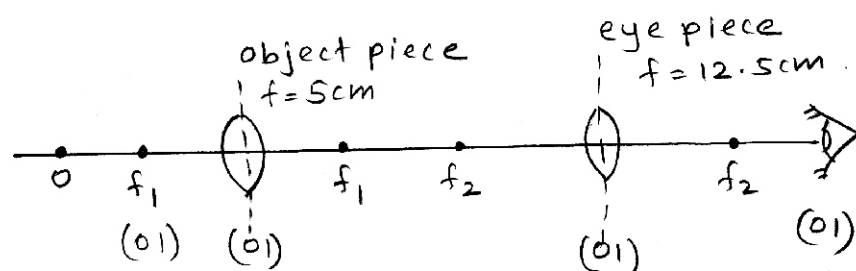
(ii) For any type of of correct ray (marks given in above figure)

(iv) Virtual (01)

(v) magnification = $\left(\frac{D}{f} + 1\right)$ — (02)

(vi) magnification = $\left(\frac{D}{f} + 1\right) = \frac{25}{5} + 1 = 6$ — (02)

(vii)



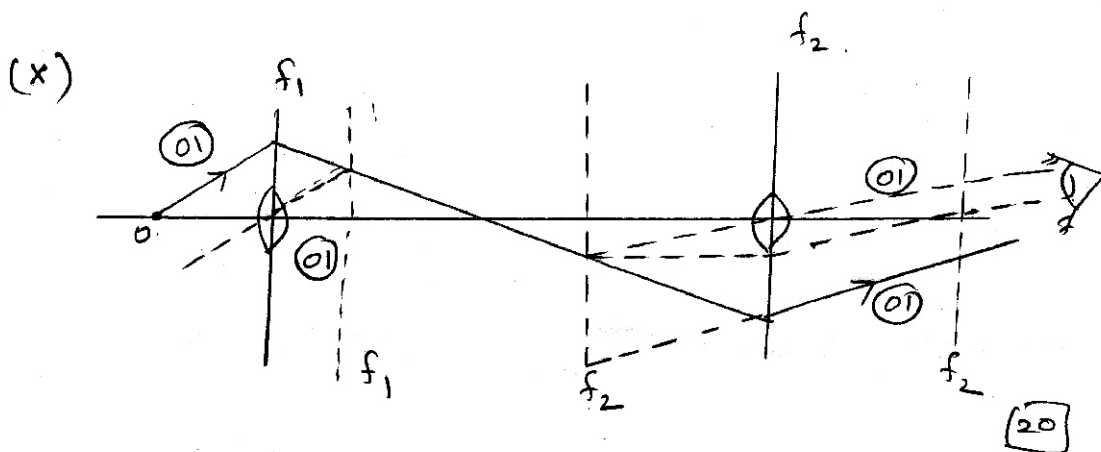
(viii)

(ix) magnification = magnification of object piece \times magnification of eye piece.

$$= m_1 \times m_2$$

$$m_2 = \left(\frac{D}{f_2} + 1\right) = \frac{25}{12.5} + 1 = 3$$

$$\therefore \text{magnification} = 5 \times 3 = 15 \text{ — (02)}$$



④ (i) Ammeter reading $= \frac{E - V_p}{r}$ — (02)

(ii) $I = \frac{E - V_p}{r}$
 $1 = \frac{3 - V_p}{r} \Rightarrow V_p = 2V$ — (02)

(iii) a) $I_A = \frac{2E}{R_0 + 2r}$ — (02)

b) $I_A = \frac{3E}{R_0 + 3r}$ — (02)

c) $I_A = \frac{5E}{R_0 + 5r}$ — (02)

d) $I_A = \frac{3E}{2R_0 + 3r}$ — (02)

(iv) a) $I_A = 2A$ — (01)

b) $I_A = 2.25A$ — (01)

c) $I_A = 2.5A$ — (01)

d) $I_A = 1.8A$ — (01)

(v) Volt meter measures real voltage difference
 ✓ through P because volt meter fixed
 parallel to p always. — (02)

(vi) $V = I_A (R_0 + R_A)$ — (02)

20

Essay - B.

⑤ (a) (i) $F_D = C_D V^2$ — (01)
 $50 = C_D V^2$ — (01)
 $C_D = 0.5 \text{ N s}^2 \text{ m}^{-2}$ — (02) (value → 01)
 (unit → 01)

(ii) $F_D = 0.5 \times 20^2 = 200 \text{ N}$ // — (01)
 Substitution — (01)

(b) (i) $P = FV$ — (01)
 $28.5 \times 10^3 = F \times 30$ — (01)
 $F = 950 \text{ N}$ // — (01)

(ii) $F_D = 0.5 \times 30^2$ — (01)
 $= 450 \text{ N}$ — (01)

$F = F_r + F_D$ — (01)

$950 = 450 + F_r$ — (01)

$F_r = 500 \text{ N}$ // — (01)

(iii) $F_r = C_r mg$ ($\cos \theta = 1$) — (01) or for taking $\cos \theta = 1$

$500 = C_r \times 5000$ — (01)

$C_r = 0.1$ // — (01)

(iv) speed V , $F_D = 0.5V^2$ — (01)

Force $= 0.5V^2 + 500$ — (01)

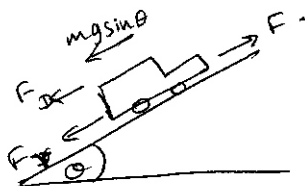
$P = FV$

$52 \times 10^3 = (0.5V^2 + 500)V$ — (01)

$52 \times 10^3 = 0.5V^3 + 500V$

$V^3 + 1000V = 104 \times 10^3 = 0$ // — (01)

c)



$F_D = 0.2 \times 30^2 = 180 \text{ N}$ — (01)

$F_r = C_r mg \cos \theta$
 $= 0.15 \times 4000 \times 0.8$ — (01)
 $= 480 \text{ N}$ — (01)

$$mg \sin \theta = 2000 \text{ N} \quad \text{--- (01)}$$

$$F = 2000 + 480 + 180 \quad \text{--- (01)}$$

$$F = F_D + F_r + mg \sin \theta$$

$$P = FV$$

$$= 2660 \times 30 \quad \text{--- (01)}$$

$$= 79800 \text{ W} \quad \text{--- (01)}$$

$$= 79.8 \text{ kW} \quad \text{--- (01)}$$

d) F_D changes due to shape --- (01)

tractive force changes due to that. --- (01)
 Therefore the power of engine changes, Then the fuel level that supply also changes.

⑥ (a) Longitudinal waves, Transverse waves — (02)

(b) Longitudinal waves — The oscillations are parallel to the direction in which the wave travels. — (01)

Transverse waves — The oscillations are perpendicular to the direction in which the wave travels. — (01)

(c) 1. The shape of wave does not travel.
2. energy does not propagate.
3. The amplitudes of elements in medium changes according to position — (03)

(d) The longitudinal progressive waves of air occur in air of the tube reflects and superpositioned — (02)

(e) $v \propto \sqrt{T}$

$$350 \propto \sqrt{273 + 37}$$

$$v \propto \sqrt{273 + 87}$$

$$\frac{v}{350} = \sqrt{\frac{360}{361}} = 1.08$$

$$v = 1.08 \times 350$$

$$v = 378 \text{ m/s} \quad \text{— (03)}$$

(f)



$$f = \frac{v}{2L} = \frac{340}{2 \times 40 \times 10^{-2}} = 425 \text{ Hz} \quad \text{— (02)}$$

(g) Child runs towards tube,

$$f' = f \cdot \left(\frac{v + v_o}{v} \right) = 425 \left(\frac{340 + 10}{340} \right)$$

$$= 437.5 \text{ Hz} \quad \text{--- (02)}$$

When The child passes the tube

$$f'' = f \cdot \left(\frac{v - v_o}{v} \right)$$

$$= 425 \left(\frac{340 - 10}{340} \right)$$

$$= 412.5 \text{ Hz} \quad \text{--- (02)}$$

The difference of frequency =

$$= 437.5 - 412.5$$

$$= 25 \text{ Hz} \quad \text{--- (02)}$$

- (h) 1. Police radars which use to determine the velocity of motor vehicles.
 2. To determine the heart beat of a child in the womb.
 3. To determine the velocity of a ship.

For any two answers --- (02)

(i) Pitch, loudness, quality of sound

(j) $\frac{B}{I_0} = \log_{10} \left(\frac{I}{I_0} \right)$

$$\frac{50}{10} = \log_{10} \left(\frac{I}{I_0} \right)$$

$$5 = \log_{10} \left(\frac{I}{1 \times 10^{-12}} \right)$$

$$10^{5.0000} \times 1 \times 10^{-12} = I$$

$$1 \times 10^7 \text{ Wm}^2 = I \quad \text{--- (03)}$$

30

- (7) (a) Hook's law: within elastic limit, the stress developed in a body is proportional to the strain produced in it. — (02)

$$y = \frac{F/A}{e/l} = \frac{Fl}{Ae} \quad \text{— (02)}$$

F = force, l = length of wire

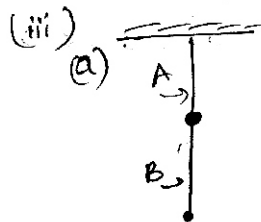
A = area of wire e = extension. — (02)

- (b) (i) x = Proportional limit.

y = breaking point — (02)

(ii) $y_A = \frac{2.5 \times 10^8}{1.0 \times 10^{-3}} = 2.5 \times 10^{11} \text{ Nm}^{-2}$ — (02)

$y_B = \frac{2 \times 10^8}{2 \times 10^{-3}} = 1 \times 10^{11} \text{ Nm}^{-2}$ — (02)



maximum weight hang by A,
 $2.6 \times 10^3 = \frac{m_1 g}{A}$

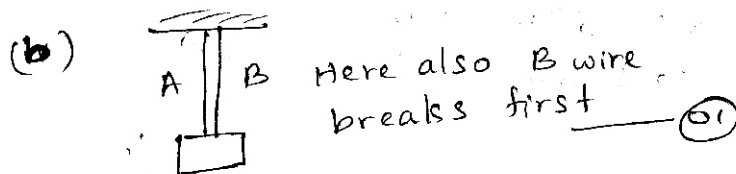
$m_1 g = 2.6 \times 10^8 A$ — (02)

maximum weight hang by B,

$2.1 \times 10^8 = \frac{m_2 g}{A}$

$m_2 g = 2.1 \times 10^8 A$ — (02)

when the weight increases B wire breaks first — (01)



Here also B wire breaks first — (01)

(iv) (a) Assume that when loaded stress of ^{wire} A is F_A and wire B is F_B :

$$F_A = 2.5 \times 10^{11} \frac{e}{l} \text{ --- (01)} \quad F_B = 1.0 \times 10^{11} \times \frac{2}{l} \text{ --- (01)}$$

$$\therefore F_A = 2.5 F_B \text{ --- (01)}$$

$$F_A \leq 2.6 \times 10^8 \text{ Nm}^{-2} \text{ and } F_B \leq 2.1 \times 10^8 \text{ Nm}^{-2}$$

To keep unbreakable the combined wire should satisfy the value $F_B = 2.1 \times 10^8 \text{ Nm}^{-2}$ --- (03)

$$\therefore F_A = 2.5 \times 2.1 \times 10^8 \\ = 5.25 \times 10^8 \text{ Nm}^{-2} \text{ --- (01)}$$

The maximum load suspended by combined

$$\text{wire } W = F_A \times 3 \times 10^{-6} + F_B \times 3 \times 10^{-6} \text{ --- (01)}$$

$$= 3 \times 10^{-6} (5.25 \times 10^8 + 2.1 \times 10^8)$$

$$= 22.05 \times 10^2$$

$$= 2205 \text{ N --- (01)}$$

$$= 220.5 \text{ kg}$$

(b) Extension of combined wire

$$F_A = 2.5 \times 10^{11} \times \frac{e}{l} \text{ --- (01)}$$

$$\frac{5.25 \times 10^8 \times 2}{10^{11}} = e \text{ --- (01)}$$

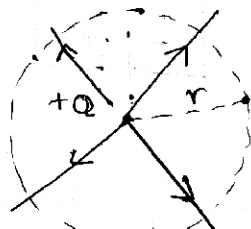
$$10.5 \times 10^{-3} \text{ m} = e$$

$$10.5 \text{ mm} = e \text{ --- (01)}$$

30

⑧ for writing gauss law. — (02).

(ii)



$$\phi = EA$$

$$\phi = \frac{Q}{\epsilon_0}$$

$$EA = \frac{Q}{\epsilon_0} \Rightarrow E \times 4\pi r^2 = \frac{Q}{\epsilon_0}$$

(iii) It is the charge to increase voltage by a unit. $E = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2}$ — (03)

(iv) $\phi = EA$

$$\phi = \frac{Q}{\epsilon_0} \Rightarrow EA = \frac{Q}{\epsilon_0}$$

$$\frac{V}{d} A = \frac{Q}{\epsilon_0} \Rightarrow \frac{A\epsilon_0}{d} = \frac{Q}{V}$$

$$C = \frac{\epsilon_0 A}{d} \quad \text{--- (02)}$$

(v) $C = \frac{A\epsilon_0}{d}$

$$C = \frac{8 \times 10^{-2} \times 5}{5 \times 10^{-3}} = 8 \times 10^{-9} \\ = 8 \times 10^{-9} \text{ F} \quad \text{--- (02)}$$

(vi) $C_1 = \frac{k\epsilon_0 A}{d}$

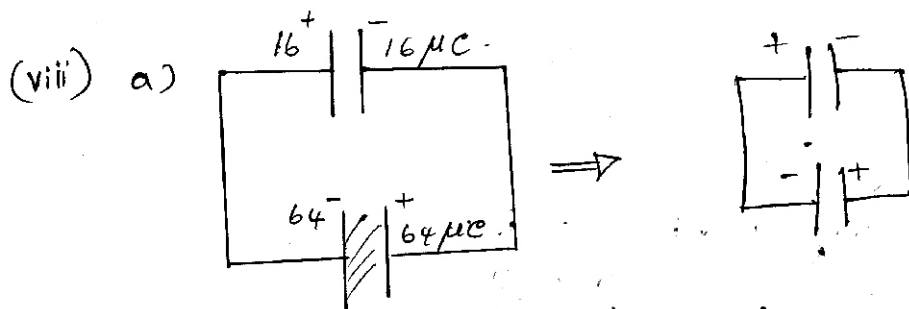
$$C_1 = 4.0 \times 8.0 \times 10^{-9}$$

$$C_1 = 32 \times 10^{-9} \text{ F} \quad \text{--- (02)}$$

(vii) (a) $Q_1 = C_1 V$
 $Q_1 = 8.0 \times 10^{-9} \times 2 \times 10^3 = 16 \times 10^{-6} = 16 \times 10^{-6} \text{ C} = 16 \mu\text{C}$ — (02)

$$Q_2 = C_2 V = 32 \times 10^{-9} \times 2 \times 10^3 \quad \text{--- (02)} \\ = 64 \times 10^{-6} \text{ C} = 64 \mu\text{C}$$

(b) Total energy = $\frac{1}{2} Q_1 V + \frac{1}{2} Q_2 V$
 $= \frac{1}{2} V (Q_1 + Q_2)$
 $= \frac{1}{2} \times 2 \times 10^3 (16 + 64) = 80 \times 10^3$
 $= 8 \times 10^{-2} \text{ J} = 8 \times 10^4 \text{ MJ} \quad \text{--- (02)}$



charge store in combined capacitor = $64 + 16 = 80 \mu C$ — (02)

(b) This is equal to parallel two capacitors.

$$\text{Total capacitance} = (8 + 32) \times 10^{-9} \text{ F} \\ = 40 \times 10^{-9} \text{ F} \quad \text{--- (02)}$$

$$(c) C = \frac{Q}{V} \quad V = \frac{Q}{C} \quad V = \frac{48 \times 10^{-6}}{40 \times 10^{-9}} \\ V = \frac{6}{5} \times 10^3 \text{ V} \quad \text{--- (02)}$$

$$Q_1 = C_1 V \\ = 8 \times 10^{-9} \times \frac{6}{5} \times 10^3 \\ = \frac{48}{5} \times 10^{-6} \\ = 9.6 \times 10^{-6} \text{ C} \quad \text{--- (02)}$$

$$Q_2 = C_2 V \\ = 32 \times 10^{-9} \times \frac{6}{5} \times 10^3 \\ = \frac{192}{5} \times 10^{-6} \\ Q_2 = 38.4 \times 10^{-6} \text{ C} \quad \text{--- (02)}$$

$$(d) E = \frac{1}{2} QV \\ = \frac{1}{2} \times 48 \times 10^{-6} \times \frac{6}{5} \times 10^3 \\ = \frac{144}{5} \times 10^{-3} \\ = 28.8 \times 10^{-3} \text{ J} \quad \text{--- (02)}$$

9A a) When current flowing through the cell, the voltage difference between the ends of the cell is lower than 6V. (due to internal resistance)

So that bulb does not light up with the expected luminosity

(b)(i) For red bulb,

$$P = VI$$

$$5 = 5I_1$$

$$I_1 = 1A$$

For yellow bulb,

$$V = IR$$

$$4 = I_2 \times 4$$

$$I_2 = 1A$$

$$(ii) V_{EF} = 4 \times 4 = 16V$$

For green bulb

$$P = VI$$

$$8 = 2V$$

$$V = 4V$$

$$\therefore V_{BC} = 4 \times 4 = 16V$$

(iii) The current passes through the cell = $I_1 + I_2 + I_3$

$$= 1 + 1 + 2$$

$$= 4A$$

$$V = E - Ir$$

$$V = 24 - 4 \times 0.5$$

$$= 22V$$

$$(iv) V_{HI} = 5 \times 4 = 20V$$

$V_{GH} = 2V, I_1 = 1A$ for $R_1, V = IR$

$$2 = 1R$$

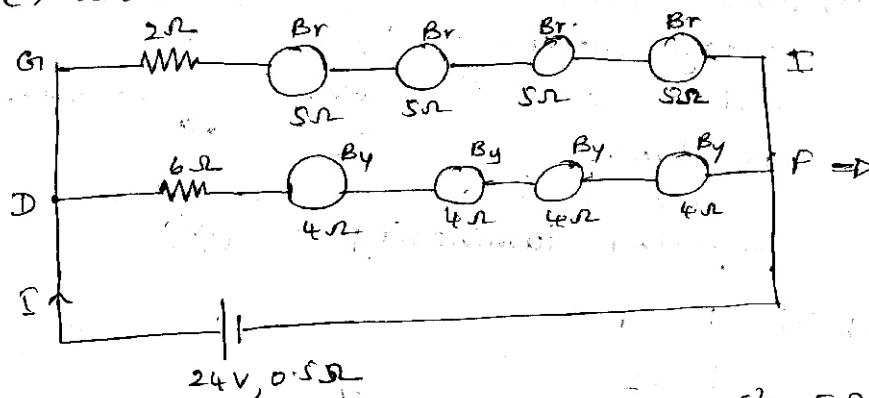
$$R_1 = 2\Omega$$

$V_{DE} = 6V, I_2 = 1A$ for $R_2, V = IR$

$$6 = 1 \times R$$

$$R_2 = 6\Omega$$

(c)(i) when bulb burn out,



For red bulb, $P = \frac{V^2}{R}$ — (01) $R = \frac{5^2}{5} = 5\Omega$ — (01)

$R_{GI} = 22\Omega$

$R_{DF} = 22\Omega$

For the circuit with the cell, $R_{total} = 11\Omega$

$E = I(R+r)$ — (01)

$24 = I \times 11.5$ — (01)

$I = 2.09A$ — (01)

(ii) The current through the bulb $= \frac{2.09}{2} = 1.045A$ — (01)

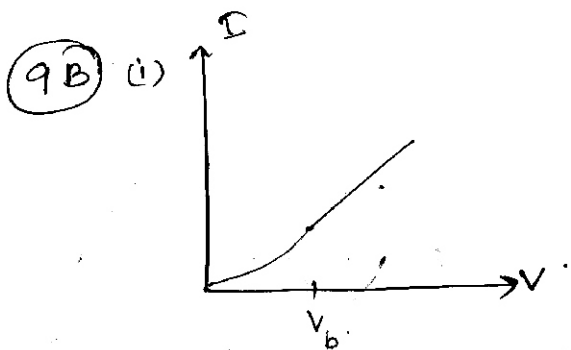
Quantitative current $= 1A$.

Increasing percentage $= \frac{0.045}{1} \times 100\%$

$= 4.5\%$ — (01)

\therefore bulbs are not burning

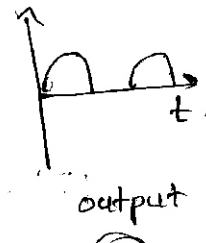
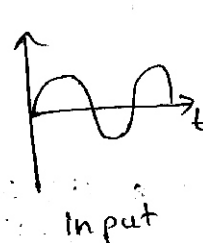
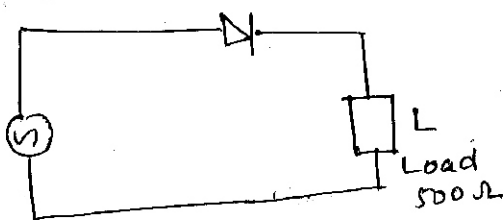
(01)



Potential barrier of a Si diode is 0.7V and for Ge, is 0.3V

By this difference ~~Si~~ Si and Ge diodes can be identify by I-V characteristics.

(ii)



(iii) If peak current is I ,
 $30 - 0.7 = I(50 + 500)$
 $I = \frac{29.3}{550}$ — (02)

(iv) a) $V_B = \frac{R_2}{R_1 + R_2} V_{CC}$
 $= \frac{2 \times 10^3}{12 \times 10^3} \times 12$
 $= 2V$ — (02)

(e) $V_C = V_{CC} - I_C R_C$
 $= 12 - 1.3 \times 10^{-3} \times 3 \times 10^3$
 $V_C = 12 - 3.9 = 8.1V$
 — (02)

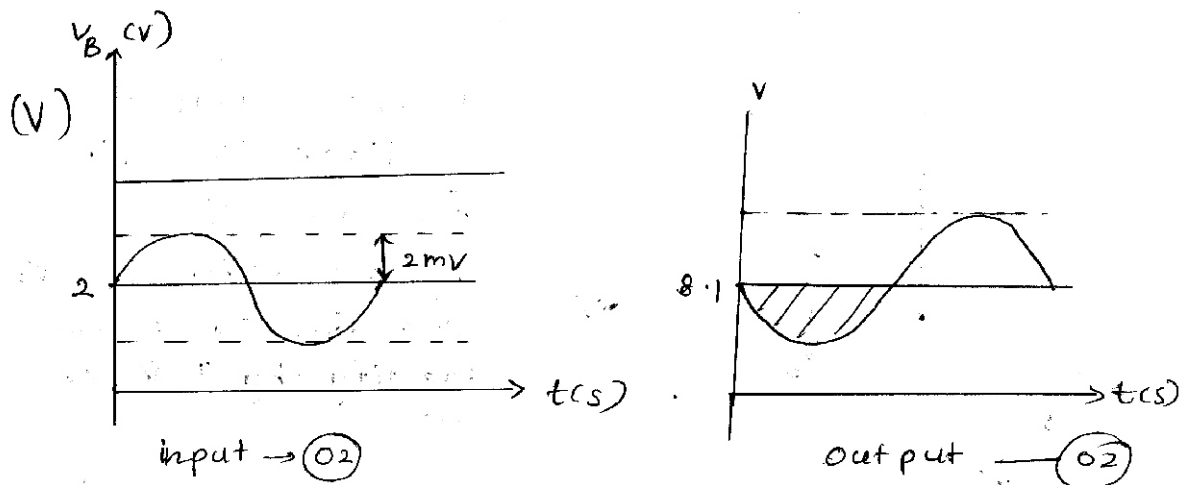
b) $V_E = 2 - 0.7 = 1.3V$ — (02) (f) $V_{CE} = V_C - V_E$
 $= 8.1 - 1.3$
 $= 6.8V$
 — (02)

c) $V_E = I_E R_E$
 $1.3 = I_E \times 1 \times 10^3$
 $I_E = 1.3 \times 10^{-3} = 1.3mA$ — (02)

d) $I_B \ll I_E$
 $I_C \approx I_E \therefore I_C = 1.3mA$ — (02)

(g) $A = \frac{V_{out}}{V_{in}}$

$V_{out} = A \cdot V_{in}$
 $= 100 \times 2$
 $= 200mV$
 $V_{out} = 200mV$
 — (02)



(10) A) a) (i) 30% — (01)

(ii) if mass of dry silica gel is x ,

$$\frac{13-x}{x} \times 100\% = 30\% \quad (02) \quad \text{(for moisture percentage equation - (01))}$$

$$13-x = 0.3x$$

$$x = 10g \quad (02)$$

for equating it
answer a) i)

b) i) $\frac{P}{P_0} \times 100\% = 80\% \quad (01) \text{ for equation}$

$\frac{P}{30} \times 100\% = 80\% \quad (01) \text{ for substitution}$

$P_1 = 24 \text{ gm}^{-3} \quad (02) \text{ (for answer and unit + one mark for each)}$

(ii) $R:H = 40\% \quad (01)$

$\frac{P}{30} \times 100\% = 40\% \quad (01)$

$P_2 = 12 \text{ gm}^{-3} \quad (01)$

mass of vapour that silica gel absorbed

$= 24 - 12 = 12g \quad (01)$

$(P_1 - P_2) \quad (01)$

$H = 40\%, \text{ EMC} = 25\% \quad (01)$

$\frac{12}{x} \times 100\% = 25\% \quad (01)$

$x = 48g \quad (01)$

c) mass of dry silica gel that entered is x ,
20%, wet mass (m')

$$\frac{m'}{x} \times 100\% = 15\% \quad \text{--- (01) (15% for graph)}$$

$$m' = 0.15x \quad \text{--- (01) equation.}$$

if 40%,

$$\text{if wet mass is } m'', \quad m'' = 0.25x \quad \text{--- (01)}$$

$$0.25x - 0.15x = \text{absorbed wet mass.} \quad \text{--- (01)}$$

$$0.1x = 12 \quad \text{--- (01)}$$

$$x = 120g$$

$$\text{The wet mass in entered sample} = \frac{120 \times 15}{100} \quad \text{--- (01)}$$

$$= 18g \quad \text{--- (01)}$$

$$\therefore \text{The mass of silica gel } \left. \begin{array}{l} \text{that entered} \end{array} \right\} = 138g \quad \text{--- (01)}$$

d) (i) * The moisture that enter to atmosphere by the wooden display

* The external atmospheric air, entered to chamber when opening it

(ii) R: H increases when moisture enter to atmosphere by the wooden display (for one reason) (02)

EMC increases when R: H increase, due to that absorbing amount of moisture increases (01)

\therefore Silica gel absorbs certain amount of increased moisture and controls increasing of R: H. (01)

10) B

(a) (i) The magnetic force acts perpendicular to motion of the particle. Particle move through the resultant of these components. So, It has a circular path.

(ii) $Bqv = \frac{mv^2}{r}$ (Need derivation) (02)

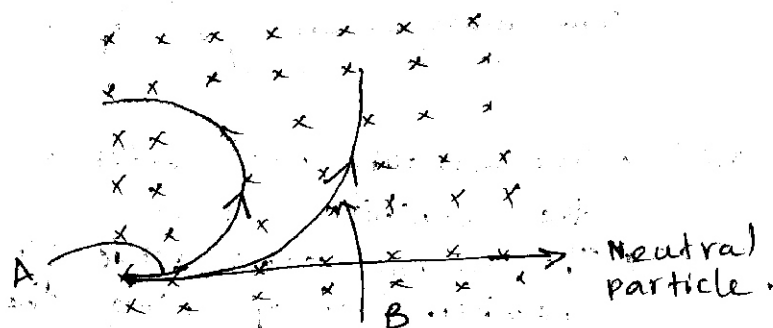
$r = \frac{mv}{Bq}$ (03)

(iii) $r = \frac{mv}{Bq}$

$r = \frac{1.8 \times 10^{-27} \times 6 \times 10^5}{1.2 \times 10^{-19} \times 0.018}$ (02)

$r = 0.5m$ (01)

Path of A (02)



(iv) $r_A = \frac{mv}{Bq}$

$r_B = \frac{5mv}{2qB}$


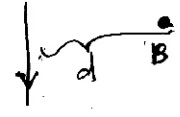
$r_B = \frac{5}{2} r_A$

$= \frac{5 \times 0.5}{2}$
 $= 1.25m$ (03)

The radius of B must be more than double of radius of A. For path of B (02)

(v) Path ——— (01)

b(i) $B = \frac{\mu I}{2\pi d}$ ——— (01)

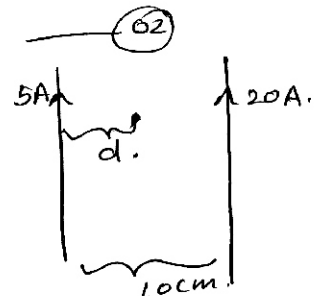
(ii)  or  and for correct rule ——— (03)

(iii) For first wire $B_1 =$ for second wire B_2

$$\frac{\mu I}{2\pi d} \otimes = \frac{\mu I}{2\pi d} \odot \text{ ——— (01)}$$

$$\frac{4\pi \times 10^{-7} \times 5}{2\pi d} = \frac{4\pi \times 10^{-7} \times 20}{2\pi (10-d)}$$

$$d = 2\text{cm} \text{ ——— (01)}$$



(iv) The magnitude of the magnetic field occur on second wire due to first wire

$$B = \frac{\mu I}{2\pi d} = \frac{4\pi \times 10^{-7} \times 5}{2\pi \times 10 \times 10^{-2}} = 1 \times 10^{-5} \text{ T} \text{ ——— (02)}$$

$$\begin{aligned} \text{Force } F &= BIL \\ &= 1 \times 10^{-5} \times 20 \times 1 \\ &= 2 \times 10^{-4} \text{ N} \text{ ——— (02)} \end{aligned}$$

(v) $F = Bqv \sin \theta$.
 $v = 0$ A force does not acts ——— (02)

30

Second Team Test - Grade 12 - 2020
Physics Answer Script - Part A

- | | |
|---------|---------|
| 1. (5) | 26. (4) |
| 2. (2) | 27. (5) |
| 3. (3) | 28. (4) |
| 4. (2) | 29. (1) |
| 5. (3) | 30. (5) |
| 6. (5) | 31. (5) |
| 7. (3) | 32. (1) |
| 8. (4) | 33. (5) |
| 9. (5) | 34. (5) |
| 10. (3) | 35. (2) |
| 11. (5) | 36. (3) |
| 12. (4) | 37. (5) |
| 13. (2) | 38. (4) |
| 14. (1) | 39. (2) |
| 15. (2) | 40. (4) |
| 16. (4) | 41. (3) |
| 17. (5) | 42. (2) |
| 18. (4) | 43. (4) |
| 19. (4) | 44. (4) |
| 20. (3) | 45. (2) |
| 21. (4) | 46. (4) |
| 22. (4) | 47. (4) |
| 23. (4) | 48. (3) |
| 24. (1) | 49. (2) |
| 25. (3) | 50. (4) |

Grade 12 - Physics

2nd term test. March (2020)

- (a) (i) A - Internal jaws D - Main scale
B - External jaws E - depth bar } — For all correct
C - Vernier Scale } — 02

(ii) (a) checking the zero error — (01)

(b) (i) $50V = 49 \text{ mm}$

$$1V = \frac{49}{50} \text{ mm}$$

$$\text{least count} = \left(1 - \frac{49}{50}\right) \text{ mm} = \frac{1}{50} \text{ mm}$$

$$= 0.002 \text{ cm} \text{ — (02)}$$

(2) $0.002 \times 11 = 0.022 \text{ cm} \text{ — (02)}$

- (c) D_1 - External jaws h_1 - External jaws }
 D_2 - Internal jaws h_2 - depth bar } — (02)
 D_3 - Internal jaws

(d) 1) $D_1 = 4.356 - 0.022 = 4.334 \text{ cm} \text{ — (03)}$

2) $D_2 = 2.876 - 0.022 = 2.854 \text{ cm} \text{ — (02)}$

(e) i) h_1 — (01)

2) fractional error (percentage error) is low, ∴
when the measurement is high. — (01)

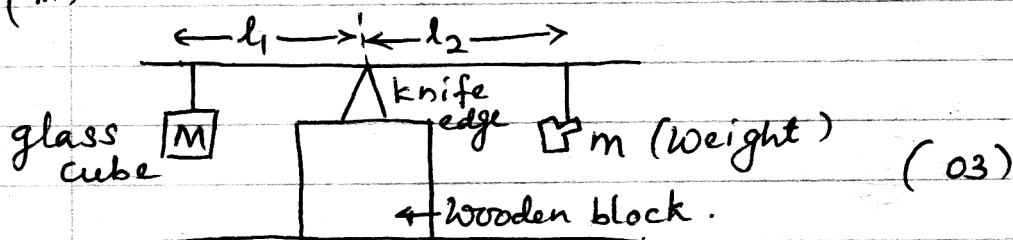
(f) $V = \pi \left(\frac{D_1}{2}\right)^2 h_1 - \pi \left(\frac{D_2}{2}\right)^2 h_2 - \pi \left(\frac{D_3}{2}\right)^2 (h_1 - h_2)$
 $= \frac{\pi}{4} [D_1^2 h_1 - D_2^2 h_2 - D_3^2 (h_1 - h_2)] \text{ — (02)}$

(g) shape of it is changed — (02)

(02) (i) principle of moments — (02)

(ii) To locate the centre of gravity of the metre ruler
or To avoid the moment of the meter ruler in the calculation — (02)

(iii)



(iv) $ML_1 = mL_2$ — (01)

(v) To reduce the fractional error (percentage error) of the length measurement — (01)

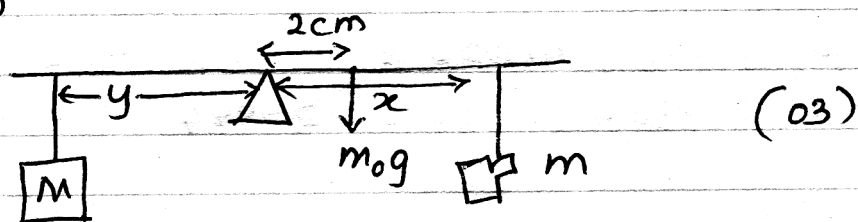
(vi) Marking two pts. on the graph — (01)

Gradient = $m = 1.04$ — (02)

(vii) $\frac{M}{m} = 1.04$

$M = 104 \text{ g}$ — (01)

(viii) (a)



(b) $My = 2m_0 + mx$ — (02)

(ix) a) 2.66 cm — (01)

(b) $d = \frac{m}{V} = \frac{104 \times 10^{-3}}{(2.66 \times 10^{-2})^3} \text{ kg m}^{-3}$ — (01)

- (03) (i) Drawing liquid columns such that the length of coconut oil column is longer than water column w.r.t. the common interface — (01)
labelling water, coconut oil and common interface — (01)
- (ii) Scales must be closed to arms. Scale marks must be on the side of arms. Scale marks must be evenly distributed. They must be extended well enough above the top of the liquid columns. — (02)
- (iii) Scale reading at the interface and at the top of liquid columns. — (02)
- (iv) (a) P_0 — atmospheric pressure — (01)
 $P_0 + h_w \rho_w g = P_0 + h_e \rho_e g$ — (02)
 $h_w \rho_w = h_e \rho_e$ — (01)
- (b) $h_w = \left(\frac{\rho_e}{\rho_w} \right) h_e$ — (02)
 $\uparrow \quad \quad \quad \uparrow$
 $y = m x$
- (v) (a) liquid with higher density — (01)
 b) Take a small amount from each liquid to a test tube. The liquid at the bottom has higher density. — (02)
- (vi) (a) Any pt. from (10, 6.5), (13.5, 9.5) or (17, 12.5)
 Any pt. from (31.5, 25), (28, 22) — (02)
 Two pts. must be within the range of data pts.
 They must be sufficiently apart from each other.
- (b) Gradient = $(y_2 - y_1) / x_2 - x_1$
 For the subⁿ of two pts. correctly to determine the gradient — (01)
- (c) gradient = relative density — (01)
 relative density = 0.86 (0.860 — 0.863)
 — (01)

(04) (i) Meter ruler, stop watch — (01)

(ii) (a) $T = 2\pi\sqrt{\frac{L}{g}}$ — (01)

$$(b) T^2 = \left(\frac{4\pi^2}{g}\right)L$$

$\uparrow \qquad \qquad \uparrow$
 $y = m x \quad \text{--- (01)}$

(iii) (a) B — (01); (b) — bob has the highest speed at B

(iv) (a) The above eqⁿ $T = 2\pi\sqrt{\frac{L}{g}}$ is valid only for — (01)
Small oscill^{ns} — (01)

(b) 5° or 6° — (01)

(v) (a) The fractional error or percentage error of time measurement is minimum in this case. — (01)

$$(b) \frac{0.5}{n \times 2} \times 100 = 1 \quad ; \quad n = 25 \quad \text{--- (02)}$$

(vi) (a) Start counting from '3' when the bob passes the locating pin and activate the stop watch when counting '0'. — (02)

(b) personal error — (01)

(vii) (a) No — (01)

(b) $T_2 < T_1$ and explanation — (01)

(viii) (a) $T = 2\pi\sqrt{\frac{L+R}{g}}$ — (01)

$$(b) T^2 = \left(\frac{4\pi^2}{g}\right)L + \frac{4\pi^2}{g}R$$
$$y = m x + c$$

$$(i) \frac{4\pi^2}{g} = 4 \quad ; \quad g = \pi^2 = 9.87 \text{ m s}^{-2} \quad \text{--- (01)}$$

$$(ii) \left(\frac{4\pi^2}{g}\right)R = 0.025 \quad \text{--- (01)}$$
$$4R = 0.025$$

$$R = \frac{0.025}{4} = 0.00625 \text{ m} \quad \text{--- (01)}$$

$$05 \text{ a (i) } \omega = \frac{2\pi}{10} = \frac{2}{10} \times \frac{22}{7} \quad \text{--- (01)}$$

$$= 0.628 \text{ rad s}^{-1} \quad \text{--- (02)}$$

$$(ii) \text{ speed } v = 88 \text{ m} \div 10 \text{ s} \quad \text{--- (01)}$$

$$= 8.8 \text{ m s}^{-1} \quad \text{--- (02)}$$

$$(iii) \quad r = \frac{C}{2\pi} = \left(\frac{88}{2}\right) \times \left(\frac{7}{22}\right) \quad \text{--- (01)}$$

$$r = 14 \text{ m} \quad \text{--- (01)}$$

$$(iv) \quad a_r = r\omega^2 = 14 \times \left(\frac{\pi}{5}\right)^2 = 14 \times \frac{\pi^2}{25} \quad \text{--- (02)}$$

$$= \frac{14 \times 10}{25} \quad \text{--- (01)}$$

$$= 5.6 \text{ m s}^{-2} \quad \text{--- (02)}$$

$$(v) \quad F = ma \quad \text{--- (01)}$$

$$= 70 \times 5.6 \quad \text{--- (01)}$$

$$= 392 \text{ N} \quad \text{--- (01)}$$

$$b(i) \text{ total distance travelled by the light} = 1000 \text{ m} \quad \text{--- (01)}$$

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$= \frac{1000 \text{ m}}{2.996 \times 10^8 \text{ m s}^{-1}} \quad \text{--- (02)}$$

$$\left. \begin{array}{l} \text{rotated angle in that} \\ \text{period} \end{array} \right\} = \frac{2\pi}{428} \text{ rad} \quad \text{--- (01)}$$

$$\text{angular velocity} = \frac{\theta}{t} = \left(\frac{2\pi}{428}\right) \div \left(\frac{1000}{2.996 \times 10^8}\right) \quad \text{--- (03)}$$

$$(ii) \text{ distance traveled} = 1.5 \times (\text{previous distance}) \quad \text{--- (01)}$$

$$\omega_2 = \omega_1 \div 1.5 = 0.666 \omega_1 \quad \text{--- (02)}$$

$$(iii) \quad \omega_3 = \frac{\omega_2}{2} = \frac{\omega_1}{1.5} \div 2 = \frac{\omega_1}{3} \quad \text{--- (02)}$$

$$= 0.333 \omega_1 \quad \text{--- (02)}$$

at (a) (i) ML^2T^{-1} — (02)

(ii) The principle of conservation of angular mom^m — (02)

(iii) moment of Inertia $I = 2 \cdot m r^2$ — (01)

$$I = 2 \cdot 2 \cdot \left(\frac{1}{2}\right)^2 = 1 \text{ kg m}^2 \quad \text{— (01)}$$

(iv) mass of the Puttywad = $\frac{50}{1000} \text{ kg} = \frac{1}{20} \text{ kg}$ — (01)

$$\begin{aligned} \text{Inertia of the Puttywad} &= m' r^2 = \frac{1}{20} \times \left(\frac{1}{2}\right)^2 \\ &= (1 \div 80) \text{ kg} \end{aligned} \quad \text{— (02)}$$

$$\text{Increase in } I = \frac{\Delta I}{I} = \frac{1 \div 80}{1} = \frac{1}{80} \quad \text{— (01)}$$

(v) linear momentum of Puttywad = $\frac{1}{20} \times 9$ — (01)

$$\text{moment of the linear momentum} = \frac{1}{20} \times 9 \times \frac{1}{2} \quad \text{— (01)}$$

applying the Conservation of angular momentum

$$I_0 \omega_0 = m v r \quad \text{— (01)}$$

$$\omega_0 = \frac{m v r}{I_0} = \frac{\left(\frac{1}{20}\right) \times 9 \times \left(\frac{1}{2}\right)}{\left(1 + \frac{1}{80}\right)} \quad \text{— (02)}$$

$$\text{Initial angular velocity} = \frac{2}{9} \text{ rad s}^{-1} = 0.222 \text{ rad s}^{-1} \quad \text{— (02)}$$

(vi) rotational kinetic energy = $\frac{1}{2} I \omega^2$ — (01)

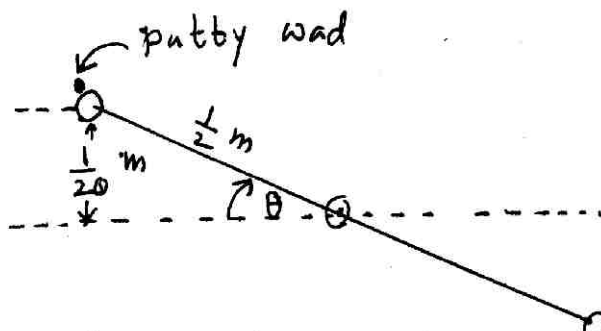
$$= \left(\frac{1}{2}\right) \left(\frac{81}{80}\right) \left(\frac{2}{9}\right)^2$$

$$= \frac{1}{40} \text{ J} = 0.025 \text{ J} \quad \text{— (02)}$$

(vii) $m g h = \frac{1}{2} I \omega^2$

$$h = \frac{\frac{1}{2} I \omega^2}{m g} = \frac{\frac{1}{40}}{\left(\frac{1}{20}\right) \times 10} = \frac{20}{40 \times 10} \quad \text{— (03)}$$

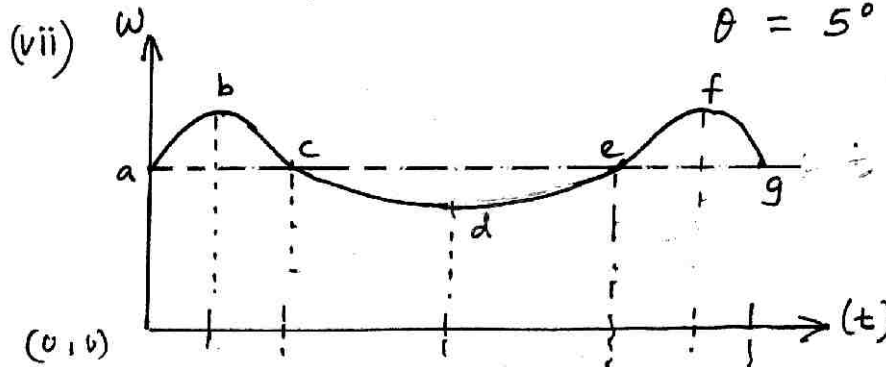
$$= \frac{1}{20} \text{ m} = 0.05 \text{ m} \quad \text{— (01)}$$



———— (01)

$$\sin \theta = \left(\frac{1}{20}\right) \div \left(\frac{1}{2}\right) = \frac{1}{10} = 0.10 \quad \text{———— (01)}$$

$$\theta = 5^\circ 44' \quad \text{———— (01)}$$



(03)

(0,0)

90°

180°

270°

360°

(rotated angle, ^{not} need
to mark

(7)(i) Bernoulli's principle

$$P + \frac{1}{2} \rho v^2 + \rho gh = \text{constant} \quad \text{--- (03)}$$

P = pressure, $\frac{1}{2} \rho v^2$ = K.E. per unit volume, ρgh = PE per unit volume
--- (02)

(ii) Deterⁿ of dimensions of each term --- (03)

claim that the relation is dimensionally correct (d)

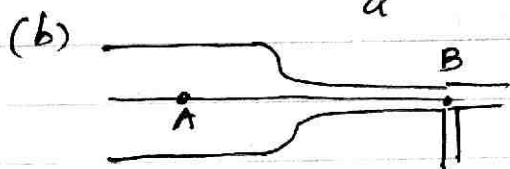
showing the each term has the dimⁿ of energy per unit vol. --- (02)

(iii) Incompressible, non viscous, streamlined flow. --- (03)

(iv) (a) By eqⁿ of continuity --- (02)

$$AV = aU$$

$$U = \frac{AV}{a} \quad \text{--- (01)}$$



considering a streamline through B --- (02)

$$P_A + \frac{1}{2} \rho v^2 = P_B + \frac{1}{2} \rho u^2 \quad \text{---}$$

$$P_A - P_B = \frac{1}{2} \rho v^2 \left(\frac{A^2 - a^2}{A^2} \right) \quad \text{--- (02)}$$

(c) If liquid rise to B

$$P_0 - P_B = h \rho g = P_A - P_B \quad \text{--- (02)}$$

$$\frac{1}{2} \rho v^2 \left(\frac{A^2 - a^2}{A^2} \right) = h \rho g \quad \text{--- (01)}$$

$$v = \sqrt{\frac{2 h \rho g A^2}{\rho (A^2 - a^2)}} \quad \text{--- (01)}$$

(d) If the speed of flow in narrow tube is U_0

$$AV = aU_0 \quad \text{--- (01)}$$

consider t time, V - rate of liquid spray

$$Pt = \frac{1}{2} V t \rho U_0^2 \quad \text{--- (03) (idea)}$$

$$V = \frac{2 P a^2}{\rho A^2 v^2} \quad \text{--- (01)}$$

(08)(i) To spread out the energy throughout the universe — (01)

(ii) Reflⁿ, refraction, interference, diffⁿ, polarⁿ — (02) or (01)

(iii) polarization — (01)

(iv) Electric and magnetic properties of the space — (01)

(v) Source of disturbance

Medium that can be disturbed

physical mechanism through which elements of the medium can influence each other — (03)

(vi) particles perform SHM

transfer energy

obey $v = f\lambda$

, need a medium

} (03)

(vii) Source must be monochromatic and coherent — (02)

(viii) principle of superposⁿ — (02)

(ix) coherent: phase diff^{ce} of two waves remain constant with time. — (02)

(x) (a) Distance to both speakers are equal from any point on ST. \therefore path difference is always zero. Then only constructive interference takes place — (03)

(b) $QR = \sqrt{5^2 + 12^2} = \sqrt{169} = 13 \text{ m}$ — (01)

path diff^{ce} = $13 - 12 = 1 \text{ m}$ — (01)

$p.d = 2 \times 0.5 = 2\lambda$ since path diff^{ce} can be written as $n\lambda$ where n is an integer, a constructive interf^{ce} takes place at R. — (01)

(c) There will be 2 low sound positions — (02)

Reason (not expected)

(xi) colour patterns on oil film on water } (02)
colour pattern on CD or DVD

(xii) They are not monochromatic (music comprise of different frequencies) — (03)

9(A)

(a) showing $P = h\rho g$ — (02)

(b)(i) Archimedes' principle — (02)

(ii) verifⁿ of the principle — (02)

(iii) Describing an expt to } — (02)
verify the principle

(c)

	A	B	
mass	m	m	(i) density of the alloy = $\frac{2m}{V_1 + V_2}$ — (01)
vol.	V_1	V_2	
	$V_1 = \frac{m}{6000}$	$V_2 = \frac{m}{4000}$	$= \frac{2m}{m/6000 + m/4000}$ — (02)
			$= 4800 \text{ kg m}^{-3}$ — (02)

(ii) metallic vol = 0.02 m^3 — (01)

mass of the tower = $0.02 \times 4800 = 96 \text{ kg}$ — (02)

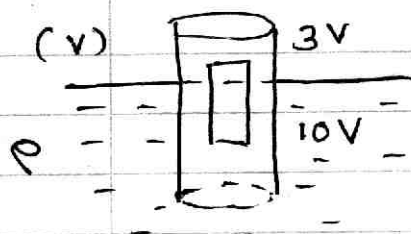
(iii) Upthrust in Water = $V_E \rho g = 960 - 210 = 750 \text{ N}$ — (02)

External vol. of the tower = $V_E = \frac{750}{10^3 \times 10} = 0.075 \text{ m}^3$ — (02)

Volume of the air bubbles = $0.075 - 0.02 = 0.055 \text{ m}^3$ — (02)

(iv) upthrust in the liquid $V_E \rho g = 960 - 180 = 780 \text{ N}$ — (02)

$\rho = \frac{780}{0.075 \times 10} = 1040 \text{ kg m}^{-3}$ — (02)



$960 = 10V \times 1040 \times 10$ — (02)

$V = \frac{960}{1040 \times 100} = 0.009 \text{ m}^3$ — (02)

volume of the cylindrical object = $0.009 \times 13 = 0.12 \text{ m}^3$ — (02)

9 B (i) $V = \sqrt{\frac{T}{m}}$ — (02)

(ii) L.H.S. = $[V] = L T^{-1}$ — (01)

R.H.S. = $\left[\sqrt{\frac{T}{m}} \right] = \frac{(M L T^{-2})^{1/2}}{(\frac{M}{L})^{1/2}} = (L^2 T^{-2})^{1/2}$
 $= L T^{-1}$ — (01)

(b) consider a string stretched between two fixed supports. When a wave is set up in the string by plucking it at one end the disturbance travels in both dir^{ns} while being reflected at each end. — (03)

For the three (3)
 (ii) differences between stationary & progressive waves (06)

c (i) 4th (fourth harmonic) — (02)

(ii) $\frac{0.8}{4} = 0.2 \text{ m} = 20 \text{ cm}$ — (02)

(iii) $V = \sqrt{\frac{T}{m}}$
 $= \left[\frac{320}{(\frac{2.5 \times 10^{-3}}{0.8})} \right]^{\frac{1}{2}} = \left[\frac{256 \times 10^2}{25} \right]^{\frac{1}{2}}$ — (02)
 $= 320 \text{ m s}^{-1}$ — (01)

(iv) $f = \frac{V}{\lambda}$ — (01)

$= \frac{320 \text{ m s}^{-1}}{0.4 \text{ m}} = 800 \text{ Hz}$ — (02)

(v) $A = 4 \text{ mm}$ (01) (vi) $f = 800 \text{ Hz}$ — (01)

(vii) $\omega = 2\pi f = 2\pi \cdot 800 = 1.6\pi \times 10^3$ — (02)
 $\omega^2 = (1.6)^2 \pi^2 = 2.56 \times 10^7$

$a = -(256 \times 10^5) \text{ Y}$ — (02)

No: For the

Date: ___/___/___

(i) difference bet. transverse and longitudinal waves — (02)

(ii) 2, 3, 4 or 6, 7, 8 — (02)

(iii) 1 or 5 — (01)

(iv) $\lambda = 34 \text{ cm} = 0.34 \text{ m}$ — (02)

(v) $T = 1 \text{ ms} = 1 \times 10^{-3} \text{ s}$ — (01)

(vi) $f = \frac{1}{T} = \frac{1}{10^{-3}} = 10^3 \text{ Hz}$ — (01)

(vii) 10^3 Hz — (01)

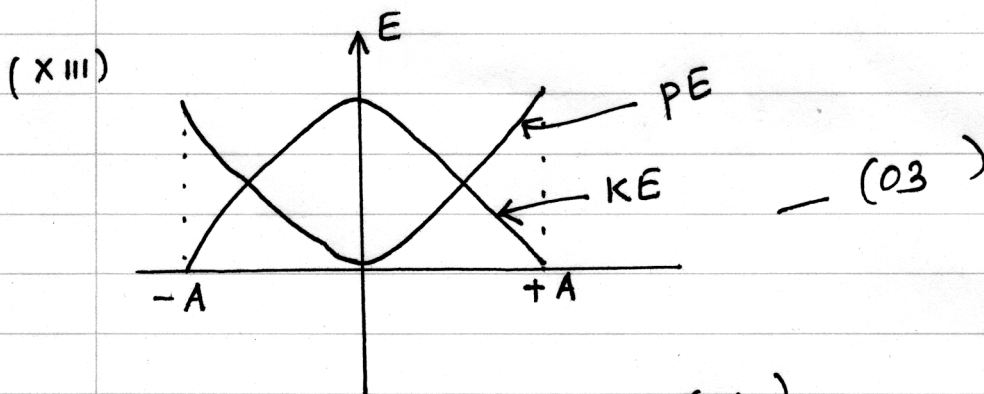
(viii) $v = f\lambda = 10^3 \times 34 \times 10^{-2} = 340 \text{ m s}^{-1}$ — (02)

(ix) $A = 1 \text{ mm} = 10^{-3} \text{ m}$ — (01)

(x) $V_{\max} = A\omega = A 2\pi f = 10^{-3} \times 2 \times \frac{22}{7} \times 10^3 = 6.28 \text{ m s}^{-1}$ — (01)

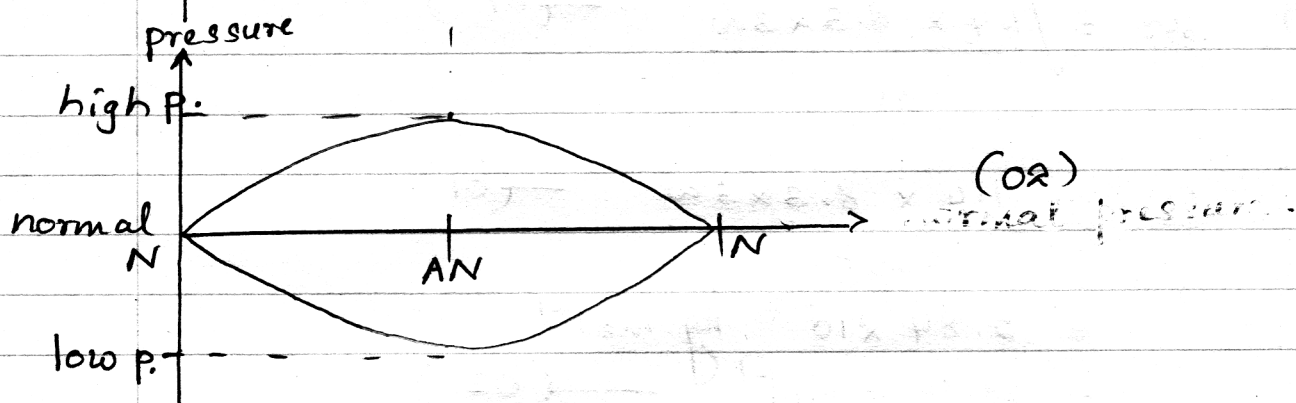
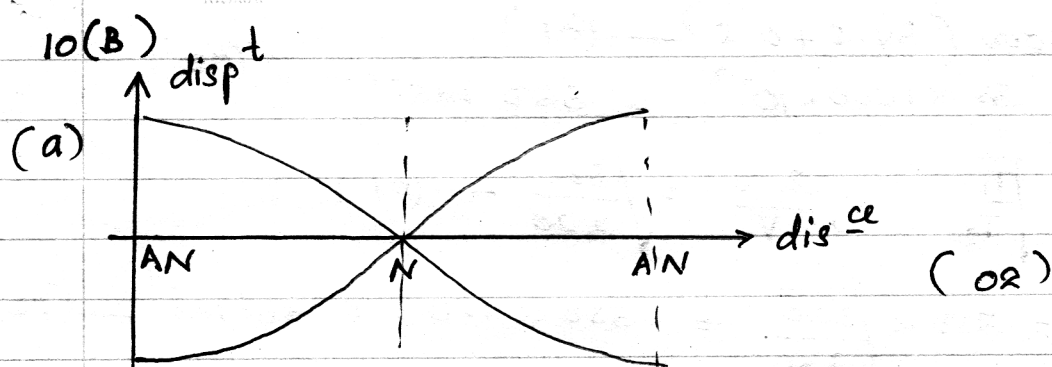
(xi) $KE_{\max} = \frac{1}{2} m V_{\max}^2 = \frac{1}{2} \times 5 \times 10^{-23} \times 10^{-3} \times (6.28)^2 = 98.6 \times 10^{-26} \text{ J}$ — (01)

(xii) Max. PE = $98.6 \times 10^{-26} \text{ J}$ or answer in (xi) — (02)



(xiv) $f_1 - f_2 = 6$ — (01)

1006 Hz or 994 Hz — (02)



b) i) $V = \sqrt{\frac{\gamma P}{d}}$ is V - vel. of sound in air
 γ - The ratio of the principle specific heats
 P - pressure of the gas
 d - density

ii) $PV = nRT$ — (01)

$P = \left(\frac{m}{M V}\right) RT$; $\frac{P}{d} = \frac{RT}{M}$; $V = \sqrt{\frac{\gamma RT}{M}}$ — (01)

iii) V increases with Temp. (T)
 V does not change with P and d .
 $V \uparrow$ with the humidity

For the expla²
 $0.2 \times 3 = 0.6$

(c) $\frac{\lambda}{4} = 34.5 + e$; $\lambda = 4(34.5 + e)$ — (01)
 $\frac{\lambda_1}{4} = 69.5 + e$; $\lambda_1 = 4(69.5 + e)$ — (01)

$V = 250 \times 4(34.5 + e)$ — (01)

$V = 125 \times 4(69.5 + e)$ — (01)

$e = 0.5 \text{ cm}$ — (02)

$$V = 1000 (34.5 + 0.5) \text{ --- (01) } \\ = 35 \times 1000 \times 10^{-2} = 350 \text{ ms}^{-1} \text{ --- (02) }$$

$$\text{ii) } \frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}} ; \frac{350}{V_2} = \sqrt{\frac{300}{320}} \text{ --- (01) }$$

$$V_2 = 350 \times \sqrt{\frac{320}{300}} = 350 \times 1.03 = 361 \text{ ms}^{-1} \text{ --- (02) }$$

$$\text{iii) } 350 = \sqrt{\frac{1.4 \times 8.3 \times 300}{M}} \text{ --- (01) }$$

$$M = \frac{1.4 \times 8.3 \times 300}{350^2} \text{ --- (01) }$$

$$= 2.84 \times 10^{-2} \text{ kg mol}^{-1}$$

$$= 28.4 \text{ g mol}^{-1} \text{ --- (02) }$$



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