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Provincial Department of Education - NWP

01 S I

Second Term Test - Grade 12 - 2018

Index No.: ....

Physics I

Two 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.**

$(g = 10 \text{ NKg}^{-1})$

1. Which of the followings has no dimensions?
(1) displacement (2) velocity (3) angular displacement
(4) angular velocity (5) angular acceleration

2. Which of the followings can be the resultant of two forces 8 N and 6 N?
(1) 20 N (2) 15 N (3) 11 N (4) 1 N (5) 0 N

3. The weight of a body in air is 100 N. How much will it weigh in water, if it displaces 400 cm^3 of water? (density of water is 1000 kg m^{-3})
(1) 100 N (2) 98 N (3) 96 N 4)94 N (5) none of these

4. Which of the following is **not** associated with a sound wave?
(1) Amplitude (2) period (3) polarization (4) velocity (5) wavelength

5. When sound waves travel from air to water which of the following remains constant?
(1) velocity (2) frequency (3) wavelength (4) amplitude (5) all the above

6. Given that *v* is the speed, *r* is radius and *g* is acceleration due to gravity. Which of the following is dimensionless?
(1) $\frac{v^2}{gr^2}$ (2) $\frac{r^2}{gv^2}$ (3) $\frac{v}{gr}$ (4) $\frac{v^2}{gr}$ (5) $\frac{v^2}{g^2r^2}$

7. By which of the following make the period of oscillation of a simple pendulum decrease slightly.
(1) Increase the mass of the pendulum bob.
(2) Increase the volume of the pendulum bob.
(3) decrease the displacement of the pendulum bob.
(4) decrease the length of the pendulum string.
(5) decrease the pressure on the pendulum bob.

8. 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

9. In a damped wave
(1) speed is decreasing with the propagation.
(2) wave length is decreasing with the propagation.
(3) frequency is decreasing with the propagation.
(4) amplitude is decreasing with the propagation.
(5) angular frequency is decreasing with the propagation.

10. 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.

11. Sunil and Ramesh push a 1200 kg block horizontally in the same direction. Sunil pushes with a force of 500 N and Ramesh pushes with a force of 300 N. If a frictional force provides 200 N of resistance, what is the acceleration of the block?
(1) 1.3 m s^{-2} (2) 1.0 m s^{-2} (3) 0.05 m s^{-2} (4) 0.75 m s^{-2} (5) 0.5 m s^{-2}

12. Consider the following statements.
(A) In a flow of fluid, the pressure is less if the flow speed of fluid is less.
(B) Bernoulli's equation is another form of conservation of energy.
(C) The speed rise at a constriction of a steady flow of liquid through a uniform tube can be explained using Bernoulli's equation

of the above statements.

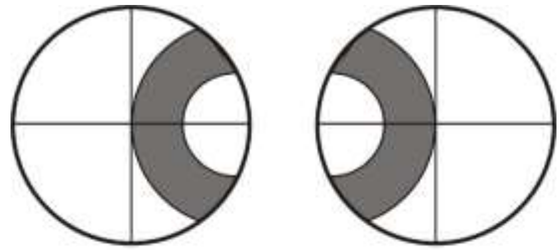
(1) Only (A) is true. (2) Only (B) is true. (3) Only (B) and (C) are true.
(4) Only (A) and (B) are true. (5) All (A), (B) and(C) are true.

13. 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.

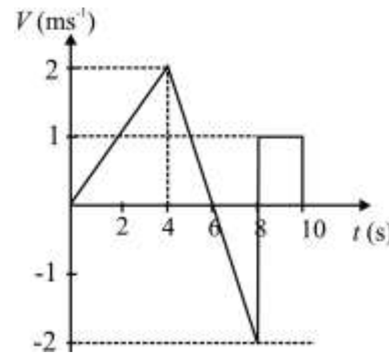
14. Outer diameter of a usual rubber tube in the laboratory is measured with a travelling microscope. Reading corresponding to figure (*a*) is 16.213 cm.


(*a*) (*b*)

(A) 15.275 cm.
(B) 10 .658 cm
(C) 17. 193 cm
Which of the above could be the reading corresponding to the figure (*b*)

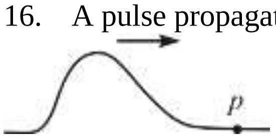
(1) only (A)   (2) only (C)   (3) only (B) and (C)
(4) only (A) and (C)   (5) non of (A), (B) and (C)

15. The velocity time graph of a body moving in a straight line is given in the figure. The displacement of the body in 10 s is. .

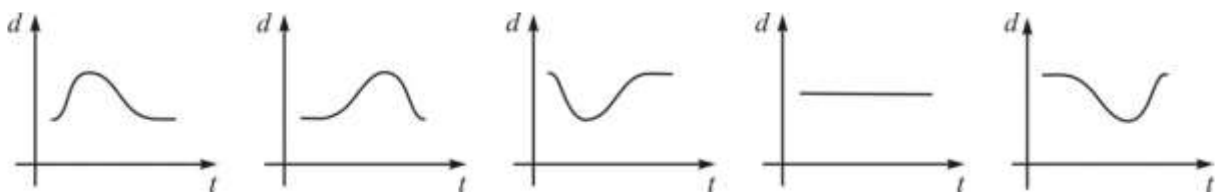


(1) 4 m   (2) 6 m   (3) 8 m
(4) 10 m   (5) 12 m

16. A pulse propagates with a uniform speed along a stretched string as shown in the figure.



Which of the following best represents the displacement (*d*) of the point *p* of the string with time

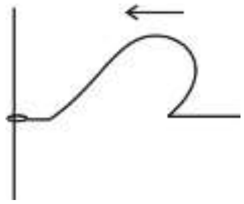


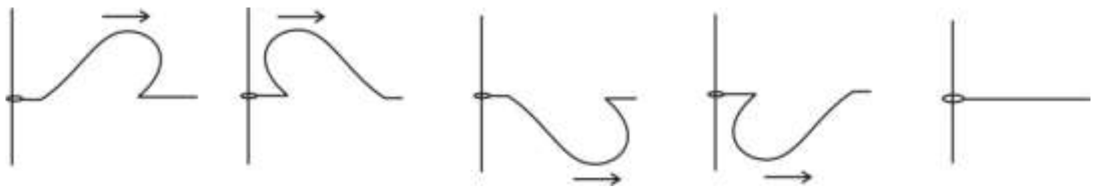
(1)   (2)   (3)   (4)   (5)

17. Two wires, made of same material, one thick and the other thin are connected to form one composite wire. The composite wire is subjected to the same tension throughout. A wave travels along one wire and passes the point where the two wires are connected.
Which of the following changes at that point?
(1) Frequency only.   (2) Propagation speed only.
(3) Wavelength only.   (4) Both propagation speed and wavelength.
(5) Both frequency and Propagation speed.

18. The velocity of sound in air is affected by change in the
(A) moisture content of air   (B) temperature of air   (C) composition of air
Of the above statements,
(1) only (A) is correct   (2) only (B) is correct
(3) only (A) and (B) are correct   (4) only (A) and (C) are correct
(5) all (A), (B) and (C) are correct

19. A transverse pulse is traveling on a stretched string as shown in the figure. The left end of the string is tied to a light ring that could slides on a frictionless rod perpendicular to the string. The reflected pulse is best represented by



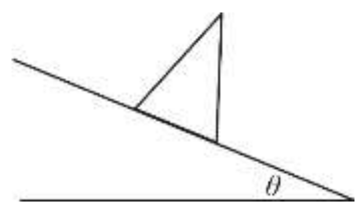


(1) (2) (3) (4) (5)

20. Which one of the following summarizes the changes occur when visible light passes from air into glass?

	Frequency	**speed**	**wavelength**
(1)	no change	no change	no change
(2)	changes	changes	no change
(3)	changes	changes	changes
(4)	changes	no change	no change
(5)	no change	changes	changes

21. The figure shows a uniform solid cone of height h and r radius at the bottom. If it doesn't slip before topple, The maximum angle of the plane that can keep the cone without topple is (center of gravity of the solid cone is $\frac{h}{4}$ above the bottom)



(1) $\tan^{-1}\left(\frac{h}{r}\right)$ (2) $\tan^{-1}\left(\frac{h}{3r}\right)$ (3) $\tan^{-1}\left(\frac{4r}{h}\right)$ (4) $\tan^{-1}\left(\frac{r}{h}\right)$ (5) $\tan^{-1}\left(\frac{h}{4r}\right)$

22. Equal masses of two liquids of relative density 3 and 2 are mixed together. If there is no volume increment or decrement, the relative density of the mixture will be

(1) 5 (2) 4.8 (3) 3.2 (4) 2.5 (5) 2.4

23. The tangent to the displacement - time graph of a particle moving with a constant acceleration makes an angle of 45° with the time axis at a certain instant. After one second it makes an angle of 60°. if axis are marked in SI units, the acceleration of the particle is

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

24. A sound wave of frequency 400 Hz is propagating along a railway track with a speed of 6000 m s^{-1}. The phase difference between two points which are 7.5 m apart on the track will be

(1) zero. (2) $\pi/4$ rad (3) $\pi/2$ rad (4) π rad (5) given data is not sufficient.

25. Wavelengths of two notes in air are $\frac{80}{195}$ m and $\frac{80}{193}$ m. Each note produces 5 beats/s with a third note of a fixed frequency. The speed of sound in air is

(1) 338 m s^{-1} (2) 350 m s^{-1} (3) 378 m s^{-1} (4) 380 m s^{-1} (5) 400 m s^{-1}

26. A vector of magnitude *a* is rotated through an angle θ. What is the magnitude of change in vector?

(1) $2a\sin\theta$ (2) $a\sin\theta$ (3) $2a\cos\theta$ (4) $2a\cos\left(\theta/2\right)$ (5) $2a\sin\left(\theta/2\right)$

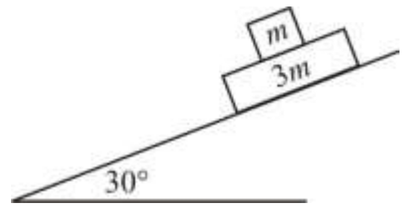
27. A body takes *n* times as much time to slide down a 45° rough an inclined plane as it takes to slide down an identical smooth 45° incline. The coefficient of friction is

(1) $\sqrt{1-\frac{1}{n^2}}$ (2) $\frac{1}{n^2-1}$ (3) $\frac{1}{n^2}-1$ (4) $\frac{1}{\sqrt{1-n^2}}$ (5) $1-\frac{1}{n^2}$

28. A cylindrical vessel has a radius *r*. The height to which the vessel should be filled with a homogenous liquid to make the force with which the liquid presses on the side of the vessel equal to the force exerted by the liquid on the bottom of the vessel is

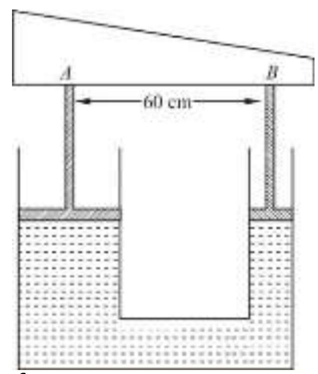
(1) *r* (2) 2 *r* (3) $\frac{3}{2}r$ (4) $\frac{1}{2}r$ (5) 3 *r*

29. Two smooth blocks of mass *m* and 3*m* shown in the figure are released from rest on a smooth inclined plane as shown in the figure. Respective Accelerations of *m* and 3*m* are



(1) 1 m s^{-2} , 3 m s^{-2} (2) 5 m s^{-2}, 3 m s^{-2}
(3) 10 m s^{-2}, 5 m s^{-2} (4) 5 m s^{-2}, 5 m s^{-2}
(5) 3 m s^{-2}, 3 m s^{-2}

30. A non-uniform rod is at equilibrium on a hydraulic jack as shown in the figure. If the cross sectional area of the large piston is five times as the small piston, the distance to the center of gravity of the rod from *A* is



(1) 6 cm (2) 12 cm (3) $\frac{12}{5}$ cm (4) 10 cm (5) 15 cm

31. Consider the following statements.

(A) The motion of an object is always towards the direction of the resultant force acting on it.
(B) Accelerating object can never have a zero velocity.
(C) Action and reaction discussed in the Newton's third law can never be on the same body.

Which of the above is\are wrong?

(1) Only A (2) Only C (3) Only A and B (4) Only A and C (5) all

32. Two particles attached to the end of a string are rotating in a conical pendulum. As shown in the figure. Suddenly one particle is detached. Then

(A) Angular velocity of the other particle is doubled.
(B) Momentum of the remaining particle doubled
(C) Tension of the string is decreased.

Which of the above is **incorrect?**

(1) Only (A) (2) Only (B) (3) Only (C)
(4) Only (A) and (B) (5) all (A), (B) and (C)

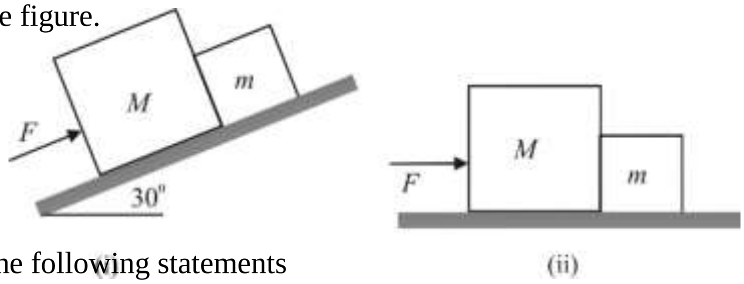
33. The pressure of water in a water pipe when tap is open and closed are 3 x 10^5 N m^{-2} and 3.5 x 10^5 N m^{-2} respectively. With open tap, the velocity of water flowing is,

(1) 10 m s^{-1} (2) 5 m s^{-1} (3) 15 m s^{-1} (4) 20 m s^{-1} (5) 25 m s^{-1}

34. A certain force applied to mass m_1 gives it an acceleration of 10 m s^{-2}. The same force applied to mass m_2 gives it an acceleration of 15 m s^{-2} . If the two masses are joined together and the same force is applied to the combination, the acceleration will be,

(1) 3 m s^{-2} (2) 6 m s^{-2} (3) 9 m s^{-2} (4) 12 m s^{-2} (5) 15 m s^{-2}

35. Two blocks in contact are pushed on a smooth inclined plane and a horizontal plane with a force F as shown in the figure.



Consider the following statements

(A) Acceleration is higher in (i)

(B) Reaction between two blocks is higher in (i)

(C) If the direction of the force is altered and applied on m reaction between two blocks is higher in (ii)

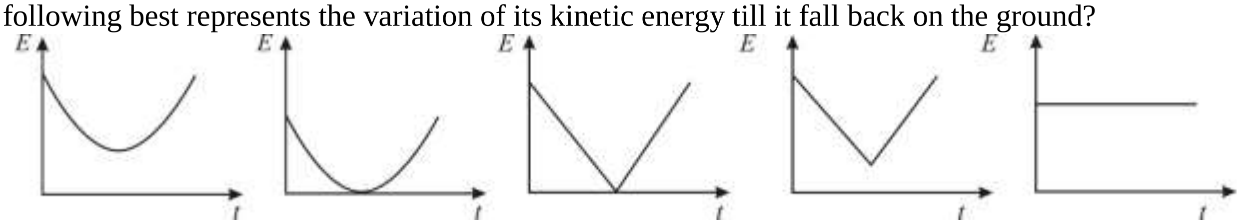
Of the above statements

(1) Only (A) is correct. (2) Only (B) and (C) are correct.

(3) Only (A) and (C) are correct. (4) all (A), (B) and (C) are correct.

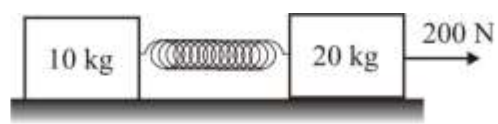
(5) all (A), (B) and (C) are incorrect.

36. A ball is thrown up so that it moves up while rotating. If the air resistance is negligible which of the following best represents the variation of its kinetic energy till it fall back on the ground?



(1) (2) (3) (4) (5)

37. Two masses of 10 kg and 20 kg are connected by a massless spring as shown in the figure. When a force 200 N acts on the 20 kg, the acceleration of 10 kg is found to be 12 m s^{-2}. the acceleration of 20 kg at that moment is

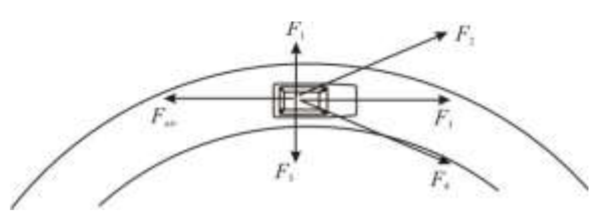


(1) 4 m s^{-2} (2) 6 m s^{-2} (3) 9 m s^{-2} (4) 10 m s^{-2} (5) 12 m s^{-2}

38. A vehicle of mass m is driven from rest, by an engine with constant power P along a straight road. The velocity of the vehicle after time t. (neglect the resistive forces)

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

39. A car travels with a constant speed on a circular road on level ground. In the diagram given, F_{air} is the force of air resistance on the car. Which of the arrow best represent resultant of **other horizontal forces** on the car's tires?

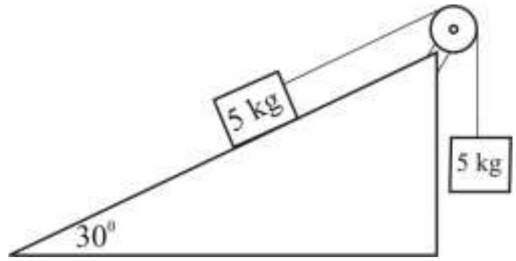


(1) F_1 (2) F_2 (3) F_3 (4) F_4 (5) F_5

40. A body kept on a smooth wedge of inclination 1:x will remain stationary relative to the wedge if the wedge is given an acceleration equal to

(1) $\frac{g}{\sqrt{x^2-1}}$ (2) $\frac{gx}{\sqrt{x^2-1}}$ (3) gx (4) g (5) $g\sqrt{x^2-1}$

41. Two masses, each of 5 kg are connected by a massless, inextensible string passing over a smooth pulley as shown in the figure. When masses are released from rest, the tension of the string and the common acceleration of the system are,



(1) 37.5 N ; 5 m s^{-2} (2) 37.5 N ; 2.5 m s^{-2}
(3) 35 N ; 2.5 m s^{-2} (4) 35 N ; 5 m s^{-2}
(5) 25 N ; 2.5 m s^{-2}

42. A pan containing a layer of uniform thickness of ice is placed on a circular turntable with its centre coinciding with the centre of the turntable. The turntable is now rotated at a constant angular velocity about a vertical axis passing through its centre and the driving torque is withdrawn. There is no friction between the table and the pivot. The pan rotates with the table. As the ice melts

(1) The angular velocity of the system decreases
(2) The angular velocity of the system increases
(3) The angular velocity of the system remains unchanged.
(4) The angular velocity of the system first decreases, but come back to the initial when all ice melt.
(5) the moment of inertia of the system remain unchanged.

43. A vertical U-tube contains mercury in both its arms, A glycerin (density 1.3 g cm^{-3}) column of length 10 cm is introduced into one of the arms. Oil of density 0.8 g cm^{-3} is poured into the other arm until the upper surfaces of oil and glycerin are at the same level. The length of the oil column is nearly (density of mercury = 13-.6 g cm^{-3})
(1) 8.5cm (2) 9.6 cm (3) 10.7 cm (4) 11.8 cm (5) 12.5 cm

44. A projectile is launched across flat ground at an angle θ to the horizontal and travels in the absence of air resistance. It rises to a maximum height H and lands a horizontal distance R away. What is the ratio H/R?

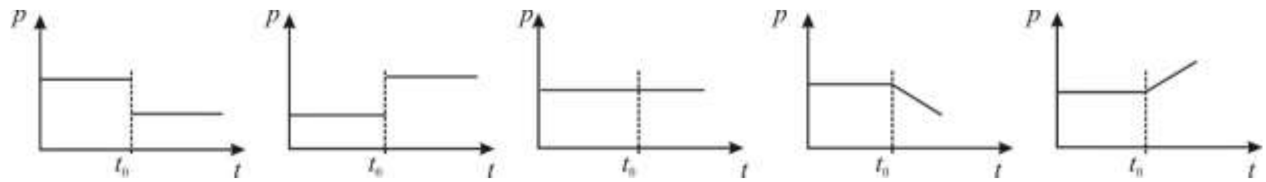
(1) $\tan\theta$ (2) $2\tan\theta$ (3) $\frac{2}{\tan\theta}$ (4) $\frac{\tan\theta}{2}$ (5) $\frac{\tan\theta}{4}$

45. The ratio of time taken by a solid sphere and that taken by a disk of the same mass and radius to roll down a inclined plane form rest from the same height is,
(1) 14 : 15 (2) $\sqrt{14}:\sqrt{15}$ (3) 15 : 14 (4) $\sqrt{15}:\sqrt{14}$ (5) non of these

46. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is

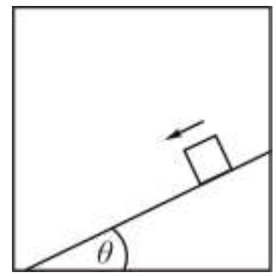
(1) $\frac{ML\omega^2}{2}$ (2) $ML\omega^2$ (3) $\frac{ML\omega^2}{4}$ (4) $2ML\omega^2$ (5) $\frac{3ML\omega^2}{2}$

47. A trolley loaded with a log is moving horizontal track with a uniform velocity. At $t = t_0$ the log fall off the trolley. Which of the following graph best represents the variation of momentum p of the trolley with time



(1) (2) (3) (4) (5)

48. There is a smooth inclined plane in an elevator. An object is released from rest on the top of this inclined plane, when the elevator is at rest, takes t_1 time to reach the bottom. It takes t_2 time for the same motion when the elevator is moving up with an acceleration of a. Then the ratio $\frac{t_1}{t_2}$ is.

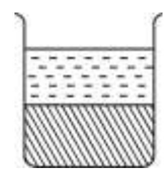


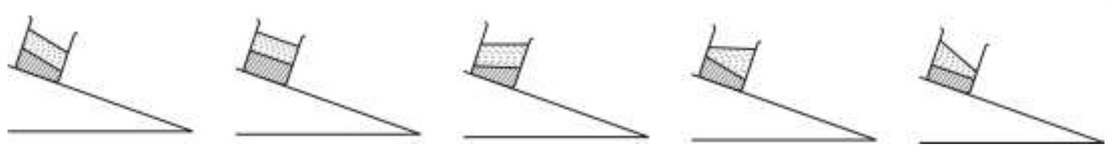
(1) 1 (2) $1+\frac{g}{a}$ (3) $\sqrt{1+\frac{g}{a}}$ (4) $1+\frac{a}{g}$ (5) $\sqrt{1+\frac{a}{g}}$

49. If it jumps in correct angle a grasshopper can jump a maximum distance of 0.8 m. If it continues to jump in this manner, spending negligible time on the ground, then the speed with which it moves forward is

(1) $2\sqrt{2}$ m s^{-1} (2) $\sqrt{2}$ m s^{-1} (3) $\frac{1}{\sqrt{2}}$ m s^{-1} (4) 2 m s^{-1} (5) $\frac{1}{2\sqrt{2}}$ m s^{-1}

50. Two immiscible liquids are in a beaker as shown in the figure. This beaker is released from rest on a smooth inclined plane. Which of the following best represents the correct nature of liquid surfaces when the beaker is sliding down along the plane?





(1) (2) (3) (4) (5)

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Provincial Department of Education - NWP

01 | S | II

Second Term Test - Grade 12 - 2018

Index No.: ....

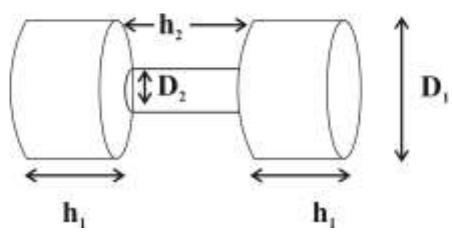
Physics II

Three hours

- This paper consists of two parts A and B allowed time for both parts is 3 (three) hours.
- Answer all the questions of **part A** on this paper itself. You must use the given space to answer. No lengthy answers are expected.
- **Part B** consists of 6 questions. Answer only four of them. After the exam, attach part A and part B and hand over to the staff.

Part A – Structured Essay

01). The figure shows a metal piece made of the same solid material. It consists of 3 coaxial cylindrical pieces. The diameters and heights of them are shown in the figure given below. The approximate values of the length measurements are given as $D_1 = 4\ cm$, $D_2 = 1cm$, $h_1 = 1\ cm$ and $h_2 = 2\ cm$



You are provided a vernier caliper to determine the volume of the metal piece.

a.) Show that the meter ruler is not convenient to use to obtain the above length measurements using a suitable calculation.

....

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b.) Which part of the vernier caliper would you use for the measurements of h_1 , h_2 , D_1 and D_2.

h_1 ....

h_2 ....

D_1 ....

D_2 ....

c.) i. How would you check the zero error of the vernier caliper.

....

....

....

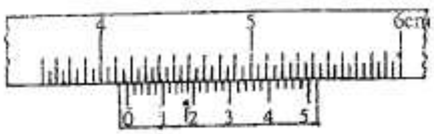
ii If the least count of the main scale of the caliper is $0.5\ mm$ and the instrument has 25 vernier divisions, show that the least count of the vernier caliper given is $0.02\ mm$.

....

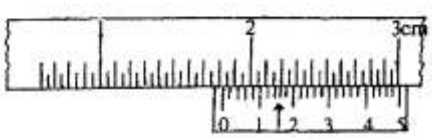
....

....

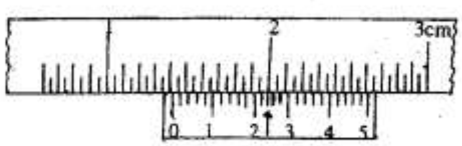
d.) The relative positions of main and vernier scales of the caliper used to measure D_1 , D_2 , h_1 and h_2 are shown below. Find the appropriate values for the given positions. The caliper used has no zero error.

i. 

D_1 = ...

ii. 

D_2 = ...

iii. 

h_1 = ...

iv. 

h_2 = ...

e.) Write down an expression for the volume of the metal piece in terms of the above symbols.

....

....

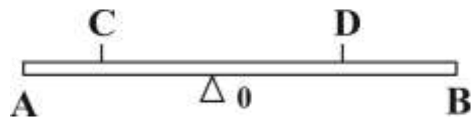
....

f.) Write down the two readings that you would take to find the volume of the metal piece if you use the water displacement method. (For this purpose measuring cylinder is provided for you.)

i ....

ii ....

02). The figure shows a meter ruler AB, horizontally balanced on a knife edge. The reading of the meter ruler at the point O, on the knife edge is $52cm$.

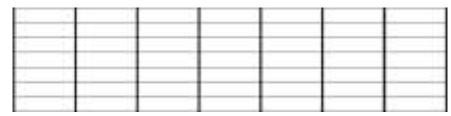


a.) i. In the figure given above, mark the forces acting on the ruler.

ii. What can you say about the nature of the meter ruler?

....

b.) When a weight of mass M and a stone of mass W are hung from the point C and D respectively keeping the knife edge at the same position O, the system rotates to the clockwise direction. To which direction should the stone be displaced in order to balance the ruler horizontally keeping the knife edge at O.



....

Explain your answer.

....

....

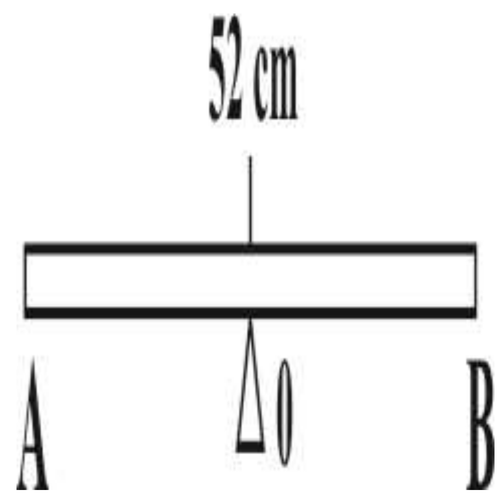
c.) To obtain the above balanced situation, the stone should be hung at the point D'. Then $OC = \ell_1$ and $OD' = \ell_2$. Write down an equation that can be used to calculate the mass of the stone.

....

....

d.) The table given below shows a different set of readings obtained for ℓ_1 and ℓ_2 after balancing the ruler in the above manner. Draw the required graph to determine W taking ℓ_1 as the independent variable.

$\ell_1\ (cm)$	$\ell_2\ (cm)$
20	16.0
30	24.0
40	32.0
50	40.0
60	48.0



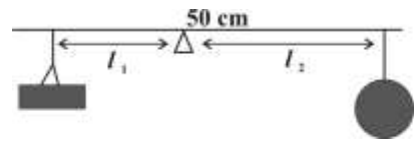
e.) Use the graph to determine W . Take $M = 100g$.

....

....

....

f.) A student obtained a different set of readings for ℓ_1 and ℓ_2 by keeping the knife edge at the mid point of the ruler (50cm). Write down the expression for the balanced situation of the meter ruler. Introduce the extra quantities you use in the equation.



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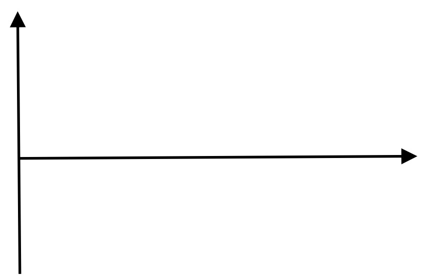
g.) Draw a rough sketch of the graph corresponding to the readings obtained in part (f)



h) How would you determine the mass of the meter ruler using the graph.

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03). i. As shown in the diagram of the hydrometer, AB is a tube of uniform cross – section, BC is a bulb of larger cross – section and CD is a heavy part with lead shot.

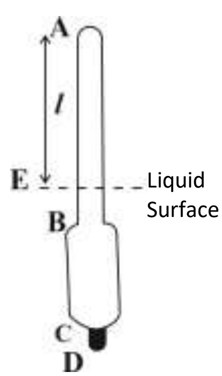


figure (1)

Mg - Weight of the hydrometer.

U - up thrust on the hydrometer

ρ - density of the liquid. ($\rho > \rho_w$ of water)

a - cross sectional area of tube AB

l - length of stem AB above the liquid surface of density ρ

V - total volume of the hydrometer

a.) Mark the weight Mg and upthrust U acting on the hydrometer on the given diagram.

b.) The hydrometer is floating on this liquid. Write down an equation for its equilibrium using above introduced symbols.

....

....

c.) Re- arrange the above relationship to plot a straight line graph separating the variables. (take ℓ as the dependent variable)

....

....

....

d.) You are provided with three liquids X, Y and Z whose densities are $1000\ kgm^{-3}$, $1200\ kgm^{-3}$ and $1400\ kgm^{-3}$. Mark the positions on the above diagram for these three liquids as X,Y and Z. Explain why you marked them as that.

....

....

....

e.) What is the reason for having a wide bulb BC in this instrument?

....

....

....

f.) What is the reason for adding a weight CD at the bottom of the bulb.?

....

....

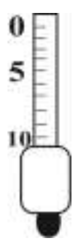
....

g.) By how, the sensitivity of the hydrometer is increased.

....

....

h.) As shown in the diagram, the stem of a hydrometer is divided in to 10 equal divisions. In pure water, this hydrometer reads 'O' value, in a liquid of relative density 1.5, it reads '10' What will be the relative density of the liquid for reading '5'.



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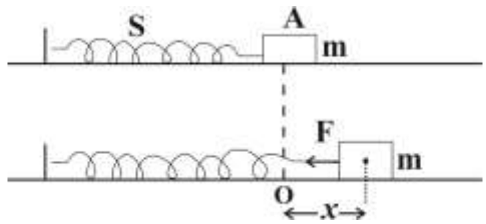
04). An object (A) of mass m lies on the frictionless horizontal surface. It is connected to one end of a spring of negligible mass whose other end is fixed to a table as shown in the following figure. If the object A is given a small displacement and released, the system executes simple hormonic motion. O is the center of the Oscillation that is the position of A when the spring is at its natural length or the spring is neither extended nor compressed.



a.) Write down the relation among the extension of the spring (x) , restoring force (F) and the force constant of spring (k)

....

b.) If the mass of A is m, then acceleration of A is given by $F = ma$. Using the above relation, show that above motion is simple harmonic and write down the equation for period of oscillation (T)

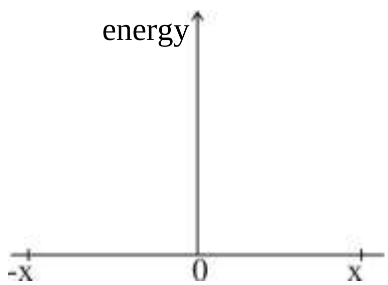
....

....

....

....

c.) The energy stored in the extended spring is potential energy. Draw the variation of potential energy, kinetic and total energy with displacement that is measured from center of oscillation.



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d.) When a small mass of $0.2\ kg$ is attached to the lower end of vertical helical spring, the extension is $15mm$. Now the mass executes a vertical oscillation with amplitude 10 mm.

i. Find period of oscillation.

....

....

....

ii. Find the maximum kinetic energy of the mass.

....

....

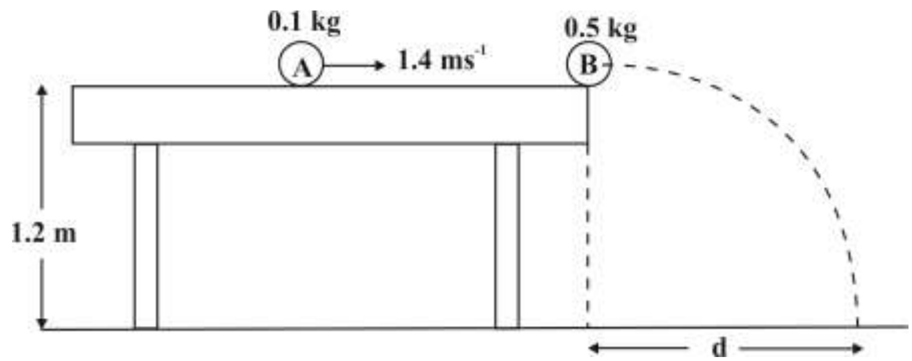
Second Term Test – 2018
Physics Part II - Grade 12
Part - B (Essay)

❖ **Answer four questions only.**

05). a) i. Define momentum and write down the unit and dimensions.

ii. State the principle of 'conservation of linear momentum'

b)



A ball A of mass $0.1\ kg$ is sliding at $1.4 ms^1$ on the horizontal table top of negligible friction as shown above. It makes a collision with ball B of mass $0.5\ kg$ at rest at the edge of the table. As a result of the collision, the ball A rebounds, and slides backwards at $0.7\ ms^{-1}$ immediately after the collision.

i. Calculate the speed of the ball B after the collision.

ii. Find the energy of the system before collision and after the collision.

iii. Is the collision perfectly elastic.

Considering the motion of the ball B after the collision as a projectile motion.

iv. Find the total time of flight of ball B.

v. Calculate the horizontal range (d)

vi. The ball B is replaced by ball C of mass $0.1\ kg$. Considering the collision of A and C is perfectly elastic, find the new speed of ball A to obtain the same horizontal range calculated in part (v) above.

06). A wave can be generated in any medium solids, liquids and gases by vibrating the particles of the medium. There are two types of wave motions. They are transverse and longitudinal.

a) Write down two requirements that a medium should have for the generation of a wave.

b) Distinguish between longitudinal and transverse wave motions clearly showing the direction of transmission of energy and the vibrations of particles.

c) The velocity of transverse waves along a stretched string depends on some physical quantities. Mention them and write down the equation for the wave velocity.

d) A steel wire of length 200cm and mass 40g is stretched between two clamps while being subjected to a tension 800N. Calculate the speed of transverse wave travelling along the wire.

e) The wave travelling with the above speed calculated in part (d) reflects to from a stationary wave with 8 anti-nodes. Calculate the vibrational frequency of the wire.

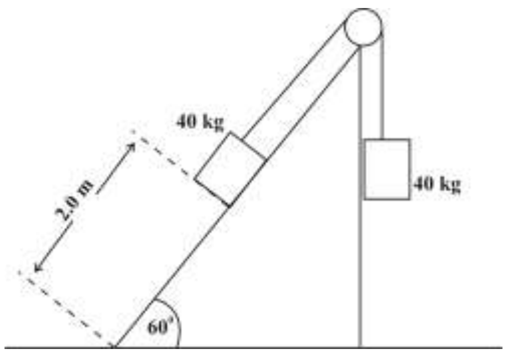
f) When a small mass is dropped to a pond of depth 6.4 m, a wave travels on water due to the vibrations of water particles on the surface.

i. Which type of wave is formed on water ?

ii. What is the speed of that wave ?

iii. Calculate the frequency of the wave if the distance between eleven adjacent maximum displacements of the particles is 8m.

07). Two 10 kg boxes are connected by a massless string that passes over a massless frictionless pulley as shown below.



The boxes remain at rest, with one on the right hanging vertically and the other on the left, 2m from the bottom of an inclined plane that makes an angle 60^0 with the horizontal. The coefficient of kinetic friction and static friction between the left hand box and the plane are 0.15 and 0.3 respectively. $(Sin\ 60^0 = 0.87\ , Cos\ 60 = 0.5)$

a) What is the tension T in the string.

b) Draw and label all the forces acting on each box, pulley and the inclined plane. (Draw a free body diagram.)

c) Determine the magnitude of frictional force acting on the box on the plane.

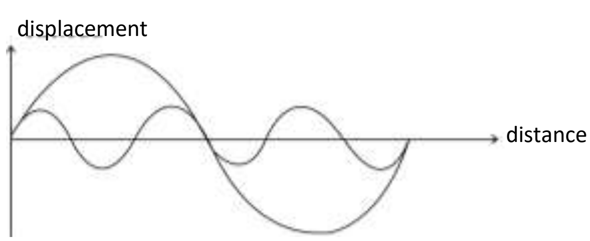
The string is then cut and left hand box slides down the inclined plane.

d) Determine the amount of mechanical energy that is converted in to thermal energy during the sliding down to the bottom.

e) Determine the kinetic energy of the left hand box when it reaches the bottom of the plane.

08). I) State the principle of superposition of waves.

II)



copy the above figure on your answer sheet and draw the superposed wave on the same figure.

III) Briefly explain 3 phenomena occuring due to the superposition of waves.

IV) Write down the frequencies of five tuning forks $512Hz, 480Hz, 384\ Hz, 288Hz$ and $256Hz$ in the descending order and draw a figure of the tuning fork to represent its frequency.

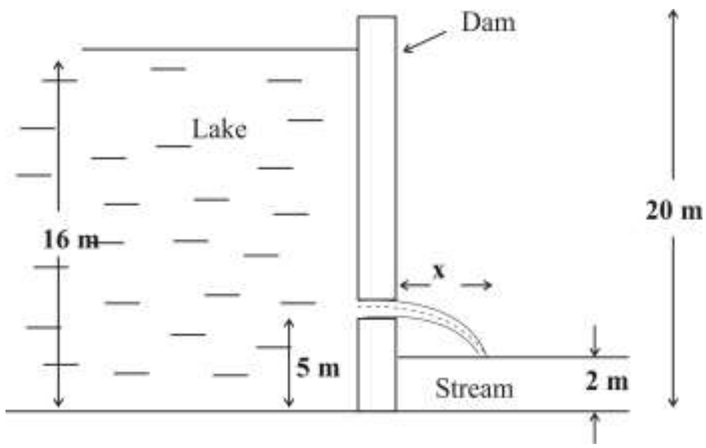
V) When a tuning fork of unknown frequency is sounded near a source of sound emitting sound waves of frequency $400Hz,$ beats can be heard with a frequency of $7\ Hz.$ When a small piece of wax is fixed to a prong of the tuning fork, the beat frequency decreases to $4\ Hz.$

a. Find the frequency of the tuning fork,

i. before loading ii. after loading.

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

09). A)



A $20m$ high dam is used to create a large lake. The lake is filled to a depth of 16m as shown above. (The density of water $1000\ kgm^{-3}$)

a) Calculate the pressure on base of the lake due to the height of water column.

b) Draw a graph to represent the variation of pressure with depth of the water column.

c) If the length of the dam is 100m, find the applied force on the dam by the water column.

A release valve is opened 5m above the base of the dam, and water emerges horizontally from the valve.

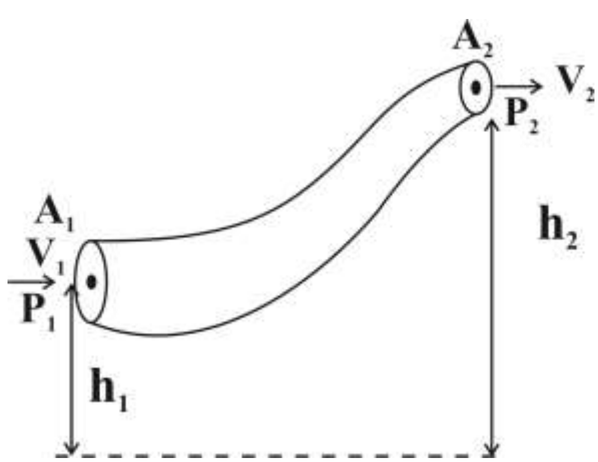
d) Use Bernoulli's equation to calculate the initial speed of water emerging from the valve. (Give the answer to the nearest whole number)

e) The stream below the surface of the dam is 2m deep. Calculate the horizontal distance (x) from the dam at which the water emerging from the valve strikes the surface of the stream. $(consider\ \sqrt{0.6} = 0.8)$

B) a) i. State the Bernoulli's principle. Show that the Bernoulli's equation is dimensionally correct.

ii. State the conditions under which the Bernoulli's equation is valid.

b)



The diagram shows a non-uniform tube. An incompressible liquid flows through it under conditions valid for Bernoulli's principle. The cross sectional areas at its two ends are A_1 and A_2 and the pressures are P_1 and P_2. The speeds of the liquid at A_1 and A_2 are V_1 and V_2 respectively.

i. Show that $V_2 = \frac{A_1 V_1}{A_2}$

ii. Show that the work done against pressure when taking a unit volume of the liquid through the tube is $P_1 - P_2$

C) The diagram shows a sprinkler used to water a nursery. It consists of a rubber tube of internal diameter 1.9 cm and sprinkler at the end B. In the sprinkler there are 24 holes each of diameter 0.13cm. The speed at which water flowing in the rubber tube is 0.91 ms^{-1} .

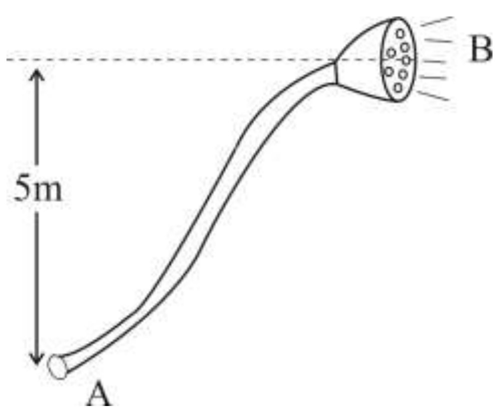
(density of water is $10^3 Kgm^{-3}$.)

i. Assume the speed of water flowing in the rubber tube is V_1, speed of water emerging from a hole on the sprinkler is V_2, the internal cross sectional area of the tube is A_1, area of a hole is A_2 and total number of holes in the sprinkler is n . Derive an expression for V_2 in terms of V_1, A_1, A_2 and n.

ii. Use the numerical values given above to calculate the speed V_2 of water emerging from the sprinkler.

iii. As shown in the diagram above, end A of the tube is on the ground. The end B with the sprinkler is at a height of 5m above the ground. The pressure of water entering to the tube at end A is $2x10^5 \ Nm^{-2}$. Find the pressure of water emerging from a hole of the sprinkler.

iv. Write down an expression for the additional power required for the functioning of the sprinkler. (Density of water is $10^3 \ kgm^{-3}$)



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

10). A) a) A wheel initially at rest is rotated an angle of 200rad by applying a torque of $100Nm$ for 10s.

i. Find the angular acceleration of the wheel.

ii. Find the moment of inertia of the wheel about axis of rotation.

iii. Find the angular speed of the wheel after $10 \ s$.

b) The radius of a circular saw blade that is used to sawing wood is 50 cm. This saw is rotated by using a motor with a constant rate of 120rpm. When the motor is switched off, the saw becomes stationary within 2 minutes under a constant angular deceleration. Calculate the following.

i. Angular deceleration of the saw.

ii. Number of revolutions rotated by the saw before coming to rest.

After 1 minute, when the motor is switched off,

iii. Find the velocity of the tip (tooth) of the saw

iv. Find the magnitude of the components of tangential acceleration and radial acceleration of the one tip (tooth) of the saw.

B) Waves are classified in two parts as progressive waves and stationary waves.

a) Explain briefly above two types of waves and write down two examples for each type.

b) i. Write down an expression for velocity of longitudinal waves in an ideal gas and introduce its terms.

ii. When a tuning fork of frequency 512Hz is sounded near the open end of a resonance tube with variable length, the shortest resonance length of the tube was 16.4 cm. When the length of the tube is gradually increased, the next resonance length obtained was 49.6 cm. The temperature of the laboratory is 27^0C.

1) Draw and Name the stationary wave patterns of the above two modes in the resonance tube.

2) Under experimental conditions, Find the wave length, end correction of the tube and velocity of sound waves in the air.

3) Find the velocity of sound waves at the standard temperature and pressure.

4) If the density of air at STP is $1.2kgm^{-3}$, find the ratio of its molar heat capacities.

(Consider the standard atmospheric pressure as $1.0\ x\ 10^5Nm^{-2}$)

Grade 12 - Physics 2018

Part I - Answers

(1)	3	(11)	5	(21)	3	(31)	3	(41)	2
(2)	3	(12)	4	(22)	5	(32)	4	(42)	1
(3)	3	(13)	5	(23)	3	(33)	1	(43)	2
(4)	3	(14)	4	(24)	4	(34)	2	(44)	5
(5)	2	(15)	2	(25)	5	(35)	5	(45)	2
(6)	4	(16)	2	(26)	5	(36)	1	(46)	1
(7)	4	(17)	4	(27)	5	(37)	1	(47)	3
(8)	1	(18)	5	(28)	1	(38)	1	(481	5
(9)	4	(19)	2	(29)	4	(39)	4	(49)	4
(10)	4	(20)	5	(30)	4	(40)	1	(50)	2

Part II - Structured Essay

(01) a) $D_1 = 4\text{ cm}$; percentage error $= \frac{0.1}{4} \times 100 = 2.5\% > 1\%$

$h_1 = D_2 = 1\text{ cm}$; percentage error $= \frac{0.1}{1} \times 100 = 10\% > 1\%$

$h_2 = 2\text{ cm}$; percentage error $= \frac{0.1}{2} \times 100 = 5\% > 1\%$

The percentage errors of the measurements h_1, h_2, D_1 and $D_2 > 1\%$. ∴ Meter ruler is not suitable to take the readings. — (01)

b) h_1 – external jaws
h_2 – internal jaws
D_1 – external jaws
D_2 – external jaws

} If all are correct — (01)

c) i) When the outside jaws are in contact, if the zero of the vernier scale is not in contact with the zero of the main scale, zero error is the difference in two zeros. — (01)

ii) 1 main scale division $= 0.5\ mm = 1\ M$

$25\ V = 24\ M$

$1\ V = \frac{24 \times 0.5}{25}\ mm$

least count $= 1M - 1V$

$= \left\{0.5 - \frac{24 \times 0.5}{25}\right\} mm$

$= \underline{0.02\ mm}$ — (01)

d) $D_1 = 4.168\ cm$ — (01)

$D_2 = 1.816\ cm$ — (01)

$h_1 = 1.424\ cm$ — (01)

$h_2 = 2.186\ cm$ — (01)

e) $2\left[\pi\left(\frac{D_1}{2}\right)^2 h_1\right] + \pi\left(\frac{D_2}{2}\right)^2 h_2$ — (01)

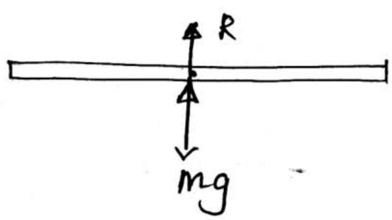
f)

I. The measuring cylinder is filled with some water and the reading is taken.

II. The metal piece is completely immersed in Water and the reading is taken.

— (01) For both

(2) a) (i)



— (01)

(ii) The meter ruler is <u>not uniform</u> — (01)

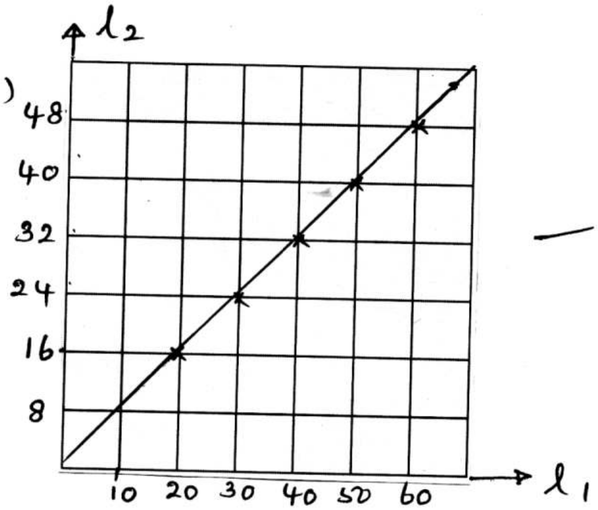
(b) To the left — (01)

Due to the clockwise moment > anticlockwise moment

(c) $Mg \cdot l_1 = Wg \cdot l_2$

$M l_1 = W l_2$ — (01)

(d)



— (01)

(e) $l_2 = \frac{M}{W} \cdot l_1$ gradient $= \frac{48-16}{60-20} = \frac{32}{40} = 0.8$

$W = \frac{100}{0.8} = 125\,g$ — (01)

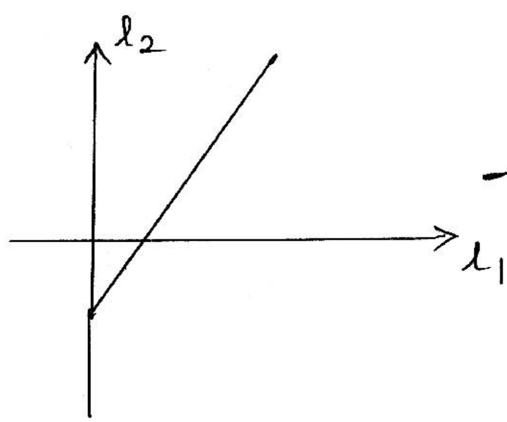
(f) $Mg \times l_1 = mg \times 2 + Wg \times l_2$

$M l_1 = W l_2 + 2m$ — (01)

extra quantity - mass of the meter ruler (m

— (01)

(g)

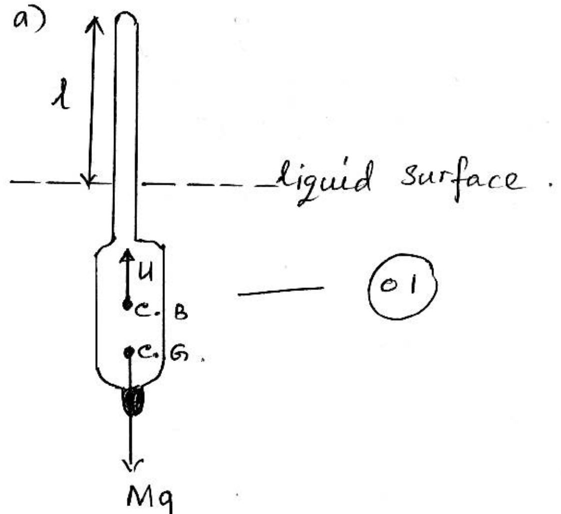


— (01)

(h) From the intercept — (01)

(3)

a)



— (01)

b) ↑U = Mg ↓

$(V - la)\rho g = Mg$

$(V - la)\rho = M$ — (01)

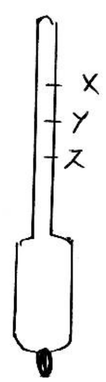
c) $V - la = \frac{M}{\rho}$

$la = V - \frac{M}{\rho}$

$l = \frac{V}{a} - \left(\frac{M}{a}\right)\frac{1}{\rho}$ — (01)

$y = c - m x$

d)



— (01)

e) The hydrometer can float without sinking in a liquid with a less density because large bulb provides a adequa-te upward force. — (01)

l increases when ρ is increased (01)

(f) To keep the centre of gravity below the centre of buoyancy. or — (01)
To keep the hydrometer upright

(g) Using a narrow tube for AB — (01)

(h) $(V-0)\rho_w g = Mg$ — ①

$(V-10a)\rho_w g = Mg$ — ②

$(V-5a)\rho_2 g = Mg$ — ③

} — (01)

$\frac{②}{①}$; $\left(\frac{V-10a}{V}\right)\frac{3}{2} = 1$

$V = 30a$

$\frac{③}{①}$; $\left(\frac{V-5a}{V}\right)\frac{\rho_2}{\rho_w} = 1$

$\frac{\rho_2}{\rho_w} = \frac{V}{V-5a} = \frac{30}{25} = \underline{\underline{1.2}}$ — (01)

(4) a) $F = -kx$ — (01)

b) $ma = -kx$

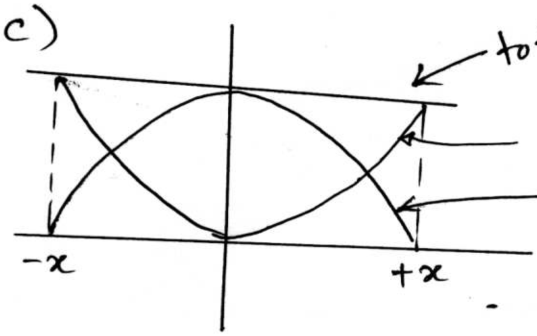
$a = -\frac{k}{m}.x$ — (01)

$a = -\omega^2 x$ where $\omega = \sqrt{\frac{k}{m}}$

The motion is simple harmonic.

$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$ — (01)

c)



— (03)

d) i) k = force constant of the spring $\Rightarrow k = \frac{mg}{x}$

$$k = \frac{0.2 \times 10}{0.015} = \underline{\underline{133.33 \ Nm^{-1}}}$$ — (01)

$$T = 2\pi\sqrt{\frac{m}{k}} = 2 \times \frac{22}{7}\sqrt{\frac{0.2 \times 0.015}{0.2 \times 10}}$$

$$T = \frac{44}{7}\sqrt{15 \times 10^{-4}} = \underline{\underline{0.24 \ s}}$$ — (01)

ii) Maximum KE $= \frac{1}{2} m V_m^2 = V_m = r\omega$

$$= \frac{1}{2} \times 0.2 \times 0.01^2 \times \frac{10}{0.015}$$ — (01)

$$= \frac{10^{-4}}{15 \times 10^{-3}} = \underline{\underline{6.7 \times 10^{-3} \ J}}$$ — (01)

(5) (a) (I) Definition, units, Dimensions (If ALL correct) - (01)

(II) For correct Principle - - - - - - (02).

(b) (I) before collision momentum } = After collision momentum

$m_A \overrightarrow{V_A} = m_A \overleftarrow{V_A} + m_B \overrightarrow{V_B}$

$0.1 \times 1.4 = \overleftarrow{(0.1 \times 0.7)} + 0.5 \times V_B$ - - - - (01)

$0.14 = -0.07 + 0.5 V_B$

$0.21 = 0.5 V_B$

$V_B = 0.42 \ ms^{-1}$ - - - - - - - - (01)

(II) Before collision, energy

$E_1 = \frac{1}{2} \times 0.1 \times (1.4)^2 = 0.098 \ J$ - - - - (01)

After collision, energy

$E_2 = \frac{1}{2} \times 0.5 \times (0.42)^2 + \frac{1}{2} \times 0.1 (0.7)^2$ - - - (01)

$E_2 = 0.0441 + 0.0245$

$E_2 = 0.0686 \ J$ - - - - - - - - (01)

∴ Collision is not perfectly elastic,

(III) To motion of ~~ball~~ sphere B,

↓ $S = ut + \frac{1}{2}at^2$ - - - - - - (01)

$1.2 = 0 + \frac{1}{2} \times 10 t^2$

$0.24 = t^2$

$t = \sqrt{0.24}$

$t = 0.48 \ s$ - - - - - - - - - (01)

To motion of sphere B,

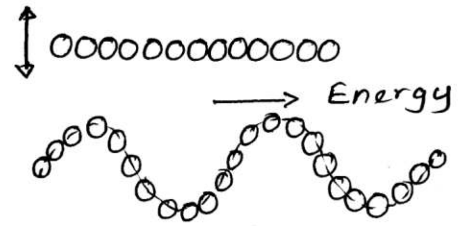
→ $S = ut$

$S = 0.42 \times 0.48$

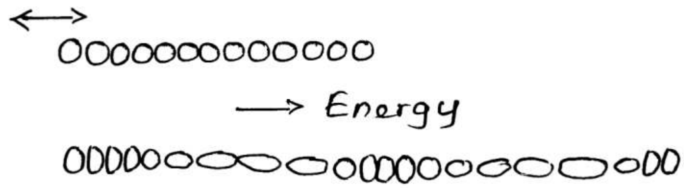
$S = 0.2016 \ m$ - - - - - - (01)

(b) a) 1. A bond between the particles of the medium — (01)

2. An elastic nature of the medium — (01)

b) 

— (01)



— (01)

c)

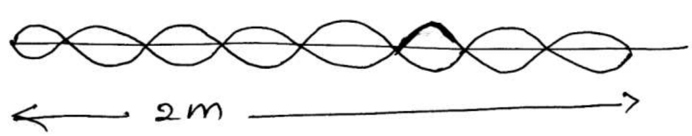
1. Tension in the string – T
2. length of the string – l
3. mass of the string – M

} — (01)

velocity of the wave, $V = \sqrt{\frac{Tl}{M}}$ — (01)

d) $V = \sqrt{\frac{T.l}{M}} = \sqrt{\frac{800 \times 200 \times 10^{-2}}{40 \times 10^{-3}}}$ — (01)

$V = \underline{\underline{200 \ ms^{-1}}}$ — (01)

e) 

$\lambda = 0.5$ m.

$V = \nu\lambda$ — (01)

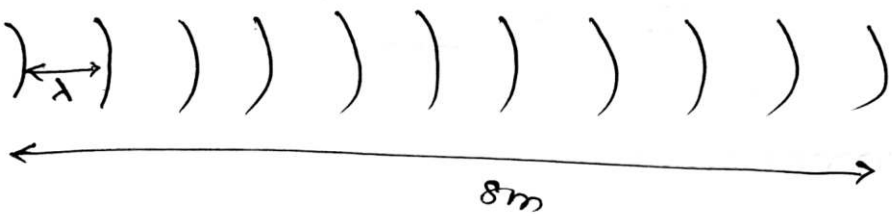
$\nu = \frac{V}{\lambda} = \frac{200}{0.5} = \underline{\underline{400 \ Hz}}$ — (01)

f) 1) A transverse wave — (01)

2) $V = \sqrt{gh}$ — (01)

$= \sqrt{10 \times 6.4} = \underline{\underline{8\ ms^{-1}}}$ — (01)

3)



$10\lambda = 8\ m$

$\lambda = 0.8\ m$ — (01)

$V = \nu\lambda$

$\nu = \frac{V}{\lambda} = \frac{8}{0.8} = \underline{\underline{10\ Hz}}$ — (01)

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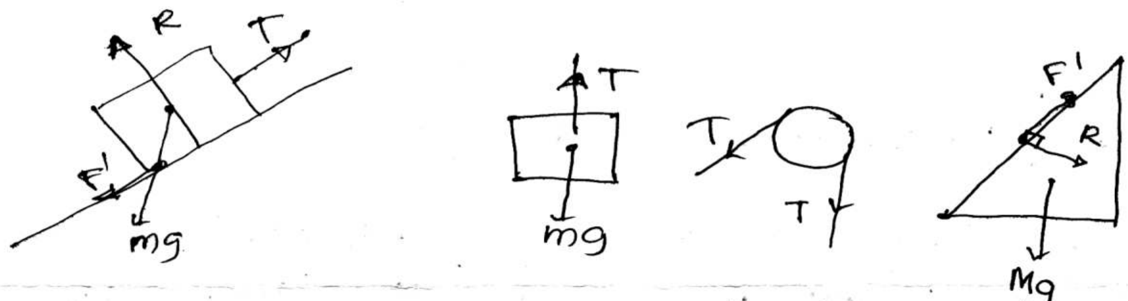
(7) (a) $T = mg$ ---------- (01)

$T = 100N$ ---------- (01)

(b)



(give 4 marks for all diagrams)

(c) To left mass,

$F = ma$

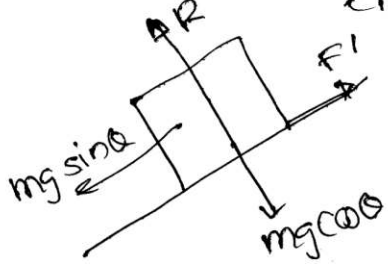
$T - F' - mg\sin\theta = 0$ ---- (1)

$F' = T - mg\sin\theta$

$F' = 100 - 10 \times 10 \times 0.87$ ---- (1)

$F' = \underline{13\ N}$ ---- (1)

(d) dissipated mechanical energy } = work done against friction. ---- (1)



$F' = \mu R$

$F' = \mu mg\cos\theta$

$= 0.15 \times 10 \times 10 \times 0.5$ —— (1)

$F' = 7.5\ N$

∴ work against friction = $F' \times S$

$= 7.5 \times 2$

$= 15J$ ---- (1)

Heat energy = work against friction.

$= 15J$ —— ---- (1)

(e) using Conservation of Energy,

potential Energy at higer position } = Kinetic energy at lower position + work against friction.

$mgh = K.E + 15$

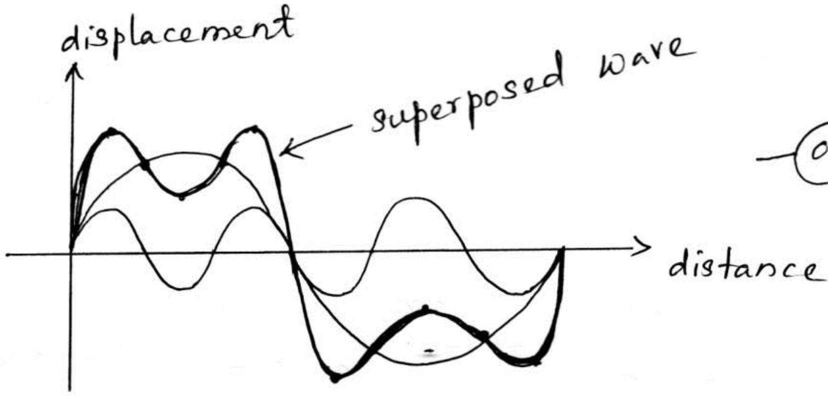
$10 \times 10 \times 2\sin 60^{\circ} = K.E + 15$ ---- (1)

$200 \times 0.87 = K.E + 15$

$K.E = 159\ J$ ---------- (1)

(08) I) The principle of superposition states that whenever two or more waves are travelling in the same region, the total displacement at any point is equal to the vector sum of their individual displacements at that point. — (02)

II)



— (01)

III) 1. Interference
2. Stationary waves
3. Beats
} (03)

Interference :
1. When two waves meet and overlap they interfere with each other, the resultant amplitude at a point being the sum of the amplitudes of the two waves at that point. — (02)

2. Stationary waves

A stationary wave results when two waves which are travelling in opposite directions, and which have the same speed and frequency and approximately equal amplitudes, are superposed. The profile of a stationary wave doesnot travel.

— (02)

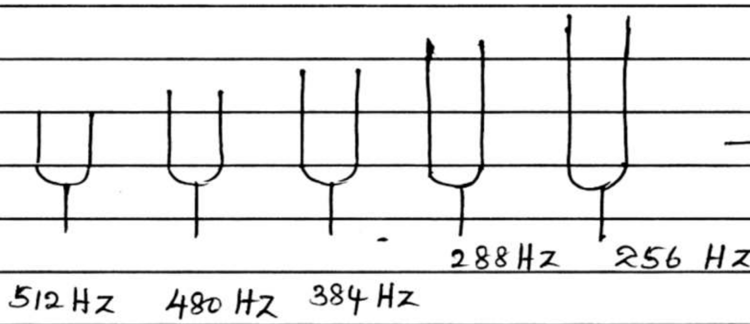
3. **Beats**

The periodic rise or fall of intensity due to a superposition of two waves of slightly different frequencies travelling in the same direction in a medium is called 'beats'.

$f_b = |f_1 - f_2|$ — (02)

f_b - beat frequency

IV



— (01)

V a) frequency of the tuning fork (before loading) = 400 + 7

= **407 Hz** — (01)

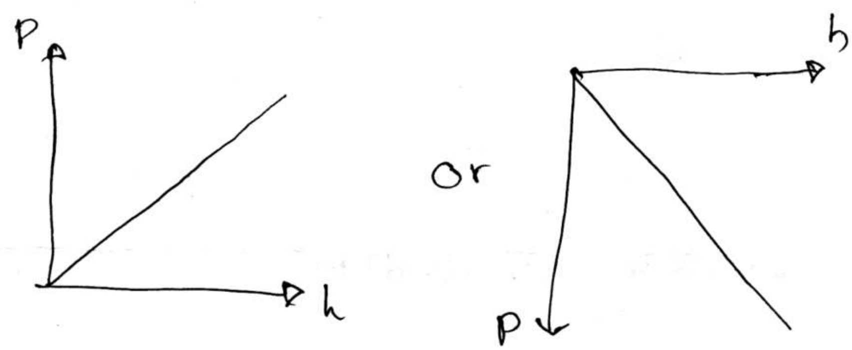
b) Frequency after loading = 400 + 4

= **404 Hz** — (01)

9(A) (I) $P = h\rho g$ - - - - - - - - - (01)

$P = 16 \times 10^3 \times 10 = 160\,000$ Pa - - - - - (01)

(II)



- - - (01)

act on the dam

(iii) If the mean pressure by the water column is P_1,

$$P_1 = \frac{h\rho g}{2} \quad \text{------------ (01)}$$

$$P_1 = \frac{16 \times 10^3 \times 10}{2}$$

$$P_1 = 80000 \, Pa \quad \text{--------- (01)}$$

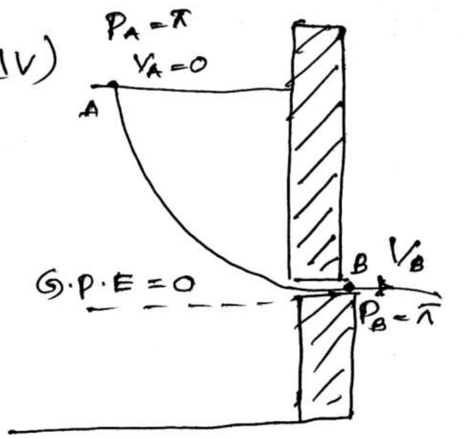
Area of the dam $(A) = 20 \times 100 = \underline{2000 \, m^2}$ -- (01)

If the force act on the dam is F,

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

$$= 80000 \times 2000$$

$$= \underline{16 \times 10^7 \, N} \quad \text{-------- (01)}$$

(iv) 

Applying bernoull's theorem to the points A & B,

$$P_A + \frac{1}{2}\rho V_A^2 + \rho g h_A = P_B + \frac{1}{2}\rho V_B^2 + \rho g h_B$$

$$\pi + \frac{1}{2}\rho (0)^2 + \rho g h = \pi + \frac{1}{2}\rho V_B^2 + 0 \quad \text{---- (1)}$$

$$\rho g h = \frac{1}{2}\rho V_B^2$$

$$V_B^2 = 2gh$$

$$V_B = \sqrt{2gh}$$

$$V_B = \sqrt{2 \times 10 \times 11} \quad \text{---- (1)}$$

$V_B = 14.8 \, ms^{-1}$ — (1)

10

(v) ↓ $s = ut + \frac{1}{2}at^2$

$$3 = 0 + \frac{1}{2} \times 10 \times t^2$$

$$t^2 = \frac{6}{10} = \frac{3}{5} = 0.6 \, s$$

$$t = \sqrt{0.6} \, s = 0.8 \, s \; (\text{or } 0.77)$$

→ $s = ut$

$$x = 15 \times 0.8 \; (\text{or } 0.77)$$

$$= \underline{12 \, m} \text{ or } \underline{11.61 \, m}$$

(9 B)

(a)(i) $P + \frac{1}{2}\rho v^2 + \rho g h = k$

P = pressure

$\frac{1}{2}\rho v^2$ = Kinetic energy per unit volume — (01)

$\rho g h$ = potential energy per unit volume

Dimensions of $P = \frac{[F]}{[A]} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

Dimensions of $\frac{1}{2}\rho v^2 = \frac{M}{L^3} \cdot (LT^{-1})^2 = ML^{-1}T^{-2}$ — (01)

Dimensions of $\rho g h = \frac{M}{L^3} \cdot LT^{-2} \cdot L = ML^{-1}T^{-2}$

(ii) Streamlined flow of a incompressible, nonviscous liquid. — (01)

(b) (i) In a time interval (Δt), the volume of fluid entering to the tube of flow is equal to the volume leaving at the other end.

$A_1 V_1 \Delta t = A_2 V_2 \Delta t$ — (01)

$A_1 V_1 = A_2 V_2$ — (01)

$V_2 = \frac{A_1 V_1}{A_2}$

(ii) Work done = pressure x volume — (01)

Input work done = $P_1 V_0$

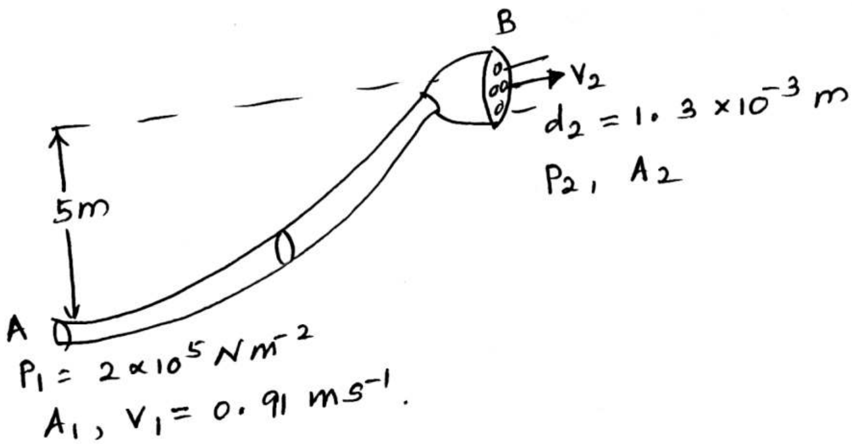
Out put work done = $P_2 V_0$

Resultant work done = $(P_1 - P_2) V_0$ — (01)

When $V_0 = 1$ (unit volume of the liquid) ;

→

Workdone against pressure = $\underline{\underline{P_1 - P_2}}$.



i) $A_1 V_1 = V_2 A_2 n$

$V_2 = \dfrac{A_1 V_1}{A_2 n}$ — (01)

$A_1 \propto d_1^2$
$A_2 \propto d_2^2$

ii) $V_2 = \left(\dfrac{A_1}{A_2}\right) \cdot \dfrac{V_1}{n} = \left(\dfrac{d_1}{d_2}\right)^2 \cdot \dfrac{0.91}{24}$ — (01)

$= \left(\dfrac{1.9 \times 10^{-2}}{1.3 \times 10^{-3}}\right)^2 \cdot \dfrac{0.91}{24}$ → substitution — (01)

$= \underline{\underline{8.1 \ ms^{-1}}}$ — (01)

iii) $P_1 + \frac{1}{2}\rho V_1^2 + 0 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h$ — (01)

$P_2 = P_1 + \frac{1}{2}\rho (V_1^2 - V_2^2) - \rho g h$

$= 2 \times 10^5 + \frac{1}{2} \times 10^3 (0.91^2 - 8.1^2) - 10^3 \times 10 \times 5$

sub^n — (01)

$= \underline{\underline{1.18 \times 10^5 \ Nm^{-2}}}$ — (01)

iv) Power = force × velocity

$= \underline{\underline{P_1 V_1 A_1}}$ — (01)

(10 A) (a) (i) $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$200 = 0 + \frac{1}{2} \cdot \alpha \cdot 100$

$\alpha = 4 \text{ rad s}^{-2}$ — (02)

(ii) $\tau = I\alpha$

$100 = I \times 4$

$I = 25 \text{ kg m}^2$ — (01)

(iii) $\omega = \omega_0 + \alpha t$

$\omega = 0 + 4 \times 10$

$\omega = 40 \text{ rad s}^{-1}$ — (01)

(b) (i) $\omega = 2\pi f = 2 \times \frac{22}{7} \times \frac{120}{60} = 12.57 \text{ rad s}^{-1}$ — (01)

$\omega = \omega_0 + \alpha t$

$0 = 12.57 + 120\alpha$ — (01)

$\alpha = -\frac{88}{7 \times 120} = \frac{-11}{105} = 0.104$

$\alpha = -0.10 \text{ s}^{-2}$ — (01)

(ii) If the angle rotated by the saw before coming to rest is θ,

$\omega^2 = \omega_0^2 + 2\alpha\theta$

$0 = 12.57^2 + 2(-0.1)\theta$

$\theta = \frac{12.57^2}{0.2} = 790 \text{ rad}$ — (01)

no. of revolutions $= \frac{\theta}{2\pi} = \frac{790}{2\pi} = 125.7 = 126$ — (01)

(iii) $\omega = \omega_0 + \alpha t$

$= 12.57 + (-0.1) \times 60$

$\omega = 6.57 \text{ rad s}^{-1}$ — (01)

$V = r\omega$

$= 0.5 \times 6.57$

$V = 3.285 \text{ ms}^{-1}$ — (01)

(iv) Tangential acceleration, a_T

$a_T = r\alpha$ — (01)

$= 0.5 \times 0.1$

$= 0.05 \text{ ms}^{-2}$ (01)

Radial acc$^{\underline{n}}$ $a_r = \frac{V^2}{r}$ — (01)

$= \frac{3.285^2}{0.5}$

$a_r = 21.58 \text{ ms}^{-2}$ — (01)

(10 B)

(a) Progressive waves — (01)

eg: 1. Sound waves travelling in air
2. Waves on the surface of water } — (01)

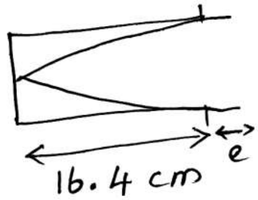
Stationary waves — (01)

eg: 1. Transverse stationary waves in stretched strings.
2. Longitudinal stationary waves in pipes } — (01)

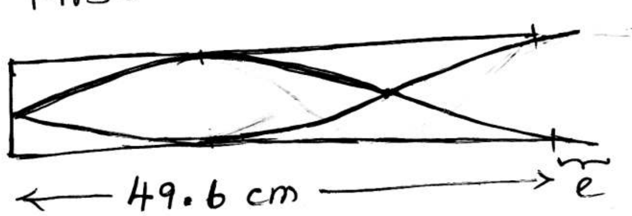
(b) I $V = \sqrt{\frac{\gamma P}{\rho}}$ — (01)

P – pressure of the gas
ρ – density of the gas
γ – ratio of the principal specific heats of the gas } (01)

II (a) Fundamental mode — (01)



First overtone — (01)



22

(b) $16.4 + e = \frac{\lambda}{4}$ — ①

$49.6 + e = \frac{3\lambda}{4}$ — ②

$\lambda = 66.4 \text{ cm}$ — (01)

$49.2 + 3e = 49.6 + e$

$e = 0.2 \text{ cm}$ — (01)

$V = 512 \times 66.4$

$= 339.96 \approx 340 \text{ ms}^{-1}$ — (01)

c) $V = \sqrt{\frac{\gamma RT}{M}}$; $V = K\sqrt{T}$ — (01)

$V' = K\sqrt{273}$

$V = K\sqrt{300}$

$\frac{V'}{V} = \sqrt{\frac{273}{300}} \Rightarrow V' = \sqrt{\frac{273}{300}} \times 340$; $V' = 323 \text{ ms}^{-1}$ — (01)

d) $V = \sqrt{\frac{\gamma P}{\rho}}$; $V^2 = \frac{\gamma P}{\rho}$; $\gamma = \frac{V^2 \rho}{P}$

$\gamma = \frac{323^2 \times 1.2}{1.0 \times 10^5}$ — (01)

$\gamma = 1.25$ — (01)