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Provincial Department of Education NWP Provincial Department of Education NWP Provincial Department of Education NWP Provincial Department of Education - NWP

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Provincial Department of Education - NWP

01 | E | I

Second Term Test - Grade 12 - 2019

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.**

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

1. What is the reading out of following that can't be taken using either of Meter ruler, traveling microscope, vernier caliper, micrometer screw gauge or speedometer?
   (1) 3.015 cm (2) 10.122 cm (3) 55.16 cm (4) 91.5 cm (5) 0.12 mm

2. Kinetic energy of a mass 1 kg is 1 J, its velocity is (nearly).
   (1) 0.45 $m\ s^{-1}$ (2) 0.14 $m\ s^{-1}$ (3) 1.0 $m\ s^{-1}$ (4) 1.4 $m\ s^{-1}$ (5) 2.0 $m\ s^{-1}$

3. Which of the following affect the speed of sound in air?
   (A) Frequency of the wave (B) Atmospheric temperature (C) Humidiy
   (1) Only (A) (2) Only (B) (3) Only (C)
   (4) Only (A) and (C) (5) all (A), (B) and (C)

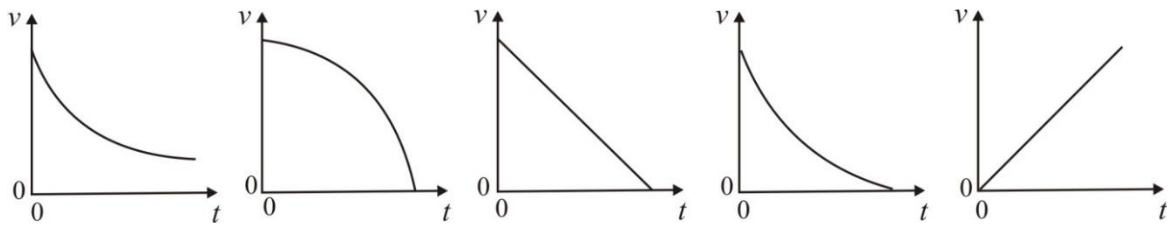
4. Which of the following is a derived physical quantity?
   (1) charge (2) length (3) thermodynamic temperature (4) time (5) current.

5. The amount of work done when 50 kg mass is **kept** 2 m above the ground is
   (1) 1000 J (2) 998 J (3) 100 J (4) 50 J (5) 0 J

6. Consider the following statements.
   (A) Units and dimensions of power are $kg\ m\ s^{-3}$ and MLT^{-3} respectively.
   (B). coefficient of friction is a dimensionless quantity.
   (C) Dimensions of up thrust are MLT^{-2}
   Of the above statements,
   (1) Only A is correct. (2) Only B is correct. (3) Only C is correct.
   (4) Only B and C are correct (5) all are correct.

7. Two pieces of different metals, when completely immersed in water, experience equal up thrust. Then
   (1) both pieces have equal weights in air (2) both pieces have the same density
   (3) both pieces have equal volumes (4) both are immersed to the same depth
   (5) both pieces have equal masses.

8. Which of the following graphs best represents the variation of velocity v with time t of an object being brought to rest by a constant resultant force?



9. Two bullets are fired horizontally with different velocities from the same height. Which will reach the ground first?
(1) Slower one (2) Faster one (3) Cannot be said
(4) Both will reach simultaneously (5) Depend on the velocity of firing.

10. If a body moves with a constant speed in a circle
(A) it experience both centripetal and centrifugal force.
(B) No work in done on it.
(C) Centripetal force is proportional to the angular velocity.
Of the above statements,
(1) Only (A) is true. (2) Only (B) is true. (3) Only (C) is true.
(4) Only (B) and (C) are true. (5) All (A), (B) and (C) are true.

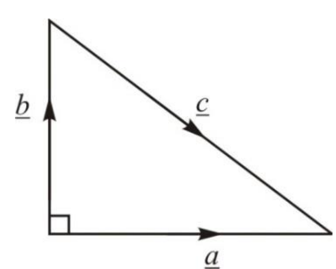
11. In an elastic collision of two particles, which of the followings is/are conserved?
(A) Momentum of each particle.
(B) Kinetic energy of each particle.
(C) Total kinetic energy of both particles.
(1) Only (A) (2) Only (C) (3) Only (A) and (C)
(4) Only (B) and (C) (5) all (A) , (B) and (C)

12. Which of the following properties cannot be demonstrated in the ripple tank?
(1) reflection (2) refraction (3) interference
(4) diffraction (5) polarization

13. You hold a rubber ball in your hand. According to The Newton's third law reaction force to the force of gravity on the ball is the force exerted by the
(1) Earth on your hand. (2) Earth on the ball. (3) hand on the ball.
(4) ball on the hand. (5) ball on the Earth.

14. Which of the following waves can not be polarized?
(A) Transverse waves on a slinkey (B) Light rays
(C) Transverse waves on water surface. (D) Sound propargating through water
(1) Only (A) (2) Only (B) (3) Only (C)
(4) Only (D) (5) Only (C) and (D)

15. Three vectors are represented by the triangle shown in the figure. Which of the following is correct?

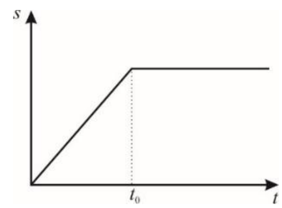


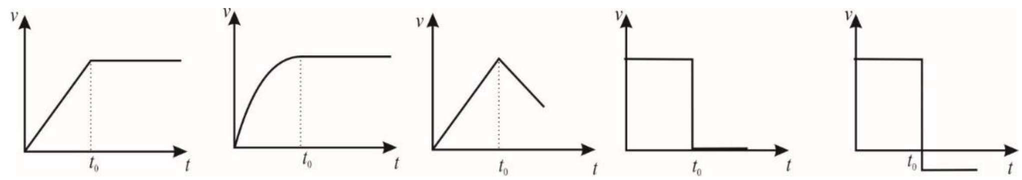
(1) $\underline{c} = \underline{a} + \underline{b}$ (2) $\underline{c} = \underline{a} - \underline{b}$ (3) $\underline{c} = \underline{b} - \underline{a}$
(4) $\underline{c}^2 = \underline{a}^2 + \underline{b}^2$ (5) $c = a + b$

16. Resonance occurs when an object is forced to vibrate by external vibrations that are

(1) at a high frequency. (2) at a low frequency (3) of large amplitude.
(4) of low amplitude, (5) matched to the natural frequency of the object.

17. The displacement (s) with time (t) of an object is shown in the figure,
Which of the following graphs best represents the velocity (v) of the object with time (t)?





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

18. Consider the following statements on transverse mechanical waves

(A) When propagating through a medium, particles of the medium moves perpendicular to the direction of propagation of the wave.
(B) It does not transform energy through the medium.
(C) The phase difference between consecutive crest and a trough is π/2.

Which of the above is/are correct?

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

19. Consider the following statements made about sound waves,

(A) Sound waves are transverse in solids.
(B) Sound waves are longitudinal in gases,
(C) Velocity of sound waves depends on the properties of the medium.

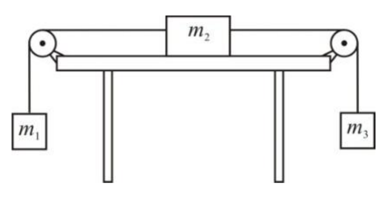
Of these statements.

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

20. An iron piece and a wooden piece have equal weights in air. If they are placed in vacuum

(1) the iron piece appears to weigh more
(2) the wooden piece appears to weigh more
(3) there is no Change in the weight of either
(4) both will show equal weights but less than that of in air.
(5) the information is insufficient to find which one will appear to weigh more.

21. Given three masses are connected as shown in the diagram. If the coefficient of kinetic friction between the large mass (m_2) and the table is μ, what would be the upward acceleration of the small mass (m_3)? The mass and friction of the cords and pulleys are small enough to produce a negligible effect on the system.



(1) $\dfrac{m_1 g}{m_1 + m_2 + m_3}$ (2) $\dfrac{(m_1 + \mu m_2)g}{m_1 + m_2 + m_3}$ (3) $\dfrac{(m_1 + m_2 + m_3)\mu g}{m_1 - m_2 - m_3}$

(4) $\dfrac{(m_1 - m_2 - m_3)\mu g}{m_1 + m_2 + m_3}$ (5) $\dfrac{(m_1 - \mu m_2 - m_3)g}{m_1 + m_2 + m_3}$

22. Consider the following statements on the relationship $V = f\lambda$ which provide the relationship between speed V of the wave, frequency f and the wavelength λ.
(A) It can be used for any wave at any occation.
(B) According to this relation, the frequency of a wave depends on speed of the wave.
(C) This relation is valid only for mechanical waves.

Which of the above statements is/are correct?

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

23. A mass m attached to a spring is rotating in a horizontal circle on a smooth table of radius r with a velocity v. The spring constant of the spring is k and the extension of the spring is x. the net force on the mass is

(1) $\frac{mv^2}{r}$ (2) $\frac{mv^2}{r} - kx$ (3) kx (4) $\frac{mv^2}{r} + mg$ (5) $\sqrt{(kx)^2 + (mg)^2}$

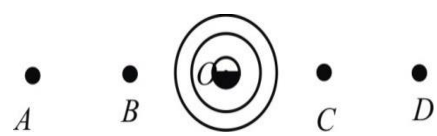
24. A particle is moving eastwards with a velocity 5 m s^{-1}. If in 10 s the velocity changes to 5 m s^{-1} northwards. What is the average acceleration during this time?

(1) $\frac{1}{\sqrt{2}}$ m s^{-2} towards north west   (2) $\frac{1}{\sqrt{2}}$ m s^{-2} towards north est

(3) $\frac{1}{2}$ m s^{-2} towards north west   (4) $2\sqrt{2}$ m s^{-2} towards north est

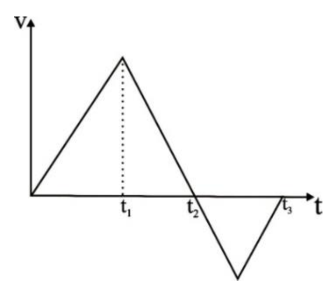
(5) $2\sqrt{2}$ m s^{-2} towards north est

25. The figure shows a target board used for the game of firing. Its center O is performing a simple harmonic motion between A and D. An automatic gun is used for the firing. The player has a certain short time for firing but he must keep gun steady. Keeping the gun aimed at which of the following position he has the best chance of hitting the highest number of bullets on the target?



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

26. The figure shows the velocity-time graph for a particle which starts from rest and moves along X direction. According to this graph,
(A) The direction of motion of particle changes at $t = t_1$ only.
(B) The particle does not return to its original position at time $t = t_3$.
(C) The particle accelerates only during the time interval 0- t_1



Of the above statements,

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

27. Two balls are rolling on a flat surface. One has velocity components 1 m s^{-1} and $\sqrt{3}$ m s^{-1} along the x and y axes respectively and the other has components $2\sqrt{3}$ m s^{-1} and 2 m s^{-1} respectively. If both balls start moving from the same point, the angle between their direction of motion is
(1) 15^0 (2) 30^0 (3) 45^0 (4) 60^0 (5) 90^0

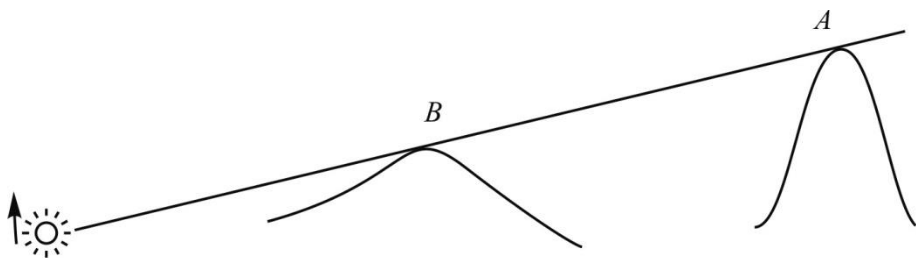
28. When a certain mass is suspended freely from a spring it is extended by a distance l. The spring is now cut into halves and the same mass is suspended freely from one of the halves. The new extension of the spring will be

(1) $2l$ (2) l (3) $\frac{l}{2}$ (4) $\frac{l}{4}$ (5) $\frac{l}{8}$

29. The kinetic energy of a trolley of mass 80 kg moving with a uniform velocity on a smooth horizontal track is 160 J. A mass 20 kg is fallen on to this trolley vertically, then the kinetic energy of the system will be

(1) 64 J (2) 102 .4 J (3) 128 J (4) 156 J (5) 200 J

30. A hill top A receives morning sunlight across a low hill as shown in the figure. People on the hill A observes that sun appear and disappear again in the dawn. This happens few times before they see the complete sun during the morning. The reason for this could be,



(1) Interference of light (2) polarization of light (3) diffraction of light
(4) some paranormal activity (5) an optical illusion.

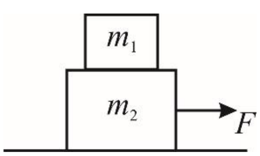
31. If the velocity of sound in air is 330 m s^{-1} , the minimum length of an organ pipe, that is, closed at one end and has a resonant frequency of 440 Hz, is

(1) $\frac{3}{4}$ m (2) $\frac{3}{8}$ m (3) $\frac{3}{12}$ m (4) $\frac{3}{16}$ m (5) $\frac{3}{20}$ m

32. A cork made of a material of density 200 kg m^{-3} is floating in water of density 1000 kg m^{-3}. The fraction of the volume of the cork not submerged in water is

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

33. A block of mass m_1 is on top of a block of mass m_2. The lower block is on a horizontal surface, and a rope can pull horizontally on the lower block. The coefficient of dynamic friction for all surfaces is μ. What is the resulting acceleration of the lower block if a force F is applied to the rope? Assume that F is sufficiently large so that the top block slips on the lower block.



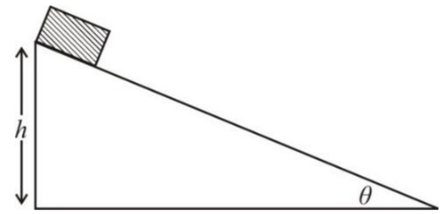
(1) $\frac{1}{m_2}\left(F-\mu g\left(2m_1+m_2\right)\right)$ (2) $\frac{1}{m_2}\left(F-\mu g\left(m_1+2m_2\right)\right)$ (3) $\frac{1}{m_2}\left(F-\mu g\left(m_1+m_2\right)\right)$

(4) $\frac{1}{m_2}\left(F+\mu g\left(2m_1+m_2\right)\right)$ (5) $\frac{1}{m_2}\left(F-\mu g\left(2m_1-m_2\right)\right)$

34. A copper wire with length 5 m has a mass of 0.06 kg and is under a tension of 750 N. The velocity with which transverse waves will propagate along the wire is,

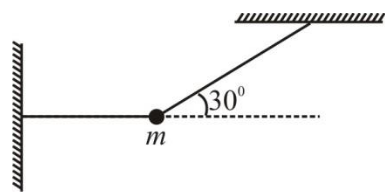
(1) $\sqrt{\dfrac{750\times 5}{0.06}}$ m s^{-1} (2) $\sqrt{\dfrac{5\times 0.06}{750}}$ m s^{-1} (3) $\sqrt{\dfrac{750\times 0.06}{5}}$ m s^{-1}
(4) $\sqrt{\dfrac{0.06}{750\times 5}}$ m s^{-1} (5) $\sqrt{\dfrac{750}{5\times 0.06}}$ m s^{-1}

35. A block of mass m slide down at constant speed is initially at a height h above the ground, as shown in the figure. The coefficient of kinetic friction between the mass and the incline is μ. If the mass continues to slide down the incline at a constant speed, how much energy is dissipated by the time the mass reaches the bottom of the incline?



(1) $\dfrac{mgh}{\mu}$ (2) mgh (3) $\dfrac{\mu mgh}{\sin\theta}$ (4) $mgh\sin\theta$ (5) zero

36. A mass m is hung with a light inextensible string. The tension in horizontal part of string is,

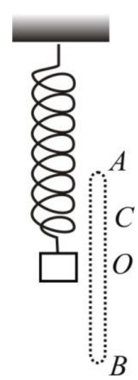


(1) $\sqrt{3}mg$ (2) $\sqrt{2}mg$ (3) $\dfrac{mg}{\sqrt{3}}$ (4) $\dfrac{mg}{\sqrt{2}}$ (5) $\dfrac{mg}{2}$

37. Consider following statements.
(A) By the interference of two waves of same frequency travelling along the same direction a stationary wave is generated.
(B) By the superpotion of two waves of slightly different frequency beats are produced.
(C) Interference of two waves which are inphase of same frequency travelling along the same direction produces destructive interference.

Which of the above statements is/are true,
(1) Only (B) (2) Only (C) (3) Only (A) and (B)
(4) Only (B) and (C) (5) all (A), (B) and (C)

38. An object attached to a vertical spring is performing a simple harmonic motion between A and B. O is the equilibrium position and C is the center of OA. If the period of oscillation of the object is T, the time taken\ to move from O to C is,



(1) T (2) $\dfrac{T}{2}$ (3) $\dfrac{T}{3}$ (4) $\dfrac{T}{6}$ (5) $\dfrac{T}{12}$

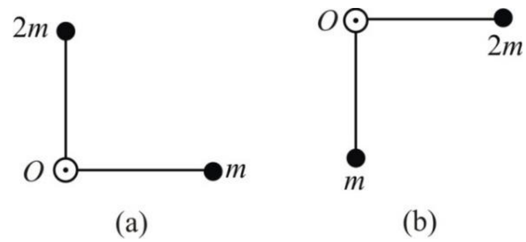
39. A projectile is launched across flat ground at an angle θ to the horizontal and travels in the absence of air resistance. It rises to a maximum height H and lands a horizontal distance R away. What is the ratio H/R?

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

40. The range of a projectile thrown with an initial speed u at an angle of projection 15° is R. what will be the range if it is thrown with an initial speed u at an angle of projection 30°?

(1) R (2) $2R$ (3) $2\sqrt{3}R$ (4) $4\sqrt{3}R$ (5) $4R$

41. An L-shaped frame hinged freely at a fixed point O is formed by two identical light rigid rods of length l of negligible mass. The rods are perpendicular to each other and two small particles of masses m and $2m$ are attached to the ends of the rods as shown. The system is first kept as shown in (a) so that $2m$ vertically above O and released from rest. The angular velocity of the system when it is turned in to the position shown in the figure (b) where m is vertically below O is,

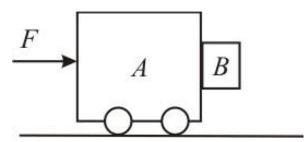


(1) $2\sqrt{\frac{g}{l}}$ (2) $\sqrt{\frac{2g}{l}}$ (3) $3\sqrt{\frac{g}{l}}$ (4) $\sqrt{\frac{3g}{l}}$ (5) $\sqrt{\frac{g}{2l}}$

42. A, B, C and D are points in a vertical line such that $AB = BC = CD$. If a body falls from rest at A, the time of descent of the body through AB, BC and CD are in the ratio of,

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

43. In the system shown to the right, a force F pushes on trolley A, giving the system an acceleration a. The coefficient of static friction between the block and trolley is μ. The requirement for block B not to slip is:



(1) $a > \mu g$ (2) $a < \mu g$ (3) $a > g$ (4) $a > \frac{\mu}{g}$ (5) $a < \frac{\mu}{g}$

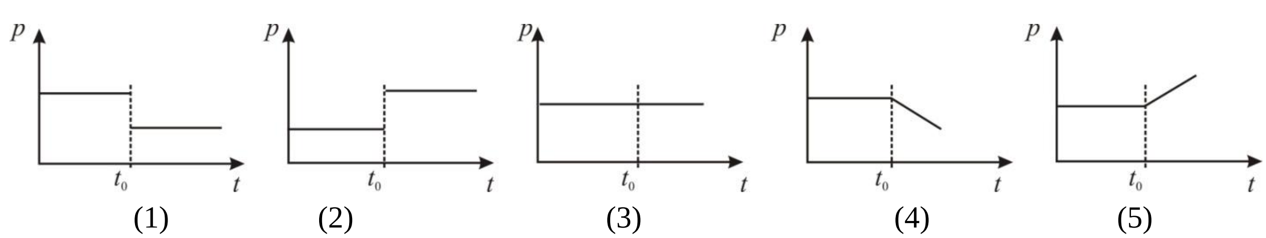
44. There is a fly wheel of moment of inertia 0.001 kg m^2 in a toy car. When this fly wheel is rotating with a rate of 150 revolutions per minute the car is left to move on a horizontal table. There is a constant resistive force of 0.025 N on the car. The distance moved by the car before coming to rest is,

(1) 1.23 m (2) 1.47 m (3) 3.0 m (4) 4.93 m (5) 6.0 m

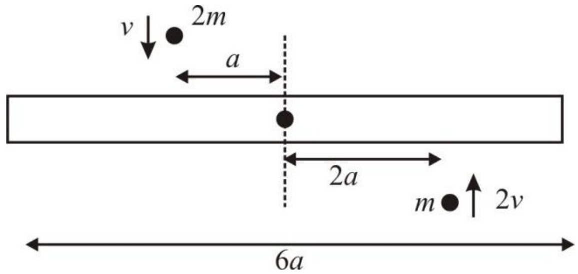
45. An elevator, whose floor to ceiling height is 2 m, starts ascending with constant acceleration of 2 m s^{-2}. 2 s after the starting, a bolt begins to fall inside the car from the ceiling. The free fall time of the bolt

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

46. 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?



47. A uniform bar of length 6a and mass 8m lies on a smooth horizontal table. Two point masses m and 2m moving in the same horizontal plane with speeds 2v and v, respectively, strike the bar simultaneously as shown in the figure and stick to it after collision. Denoting angular velocity (about the center of mass), total energy and centre of mass velocity by ω, E and V_c respectively, we have after collision,



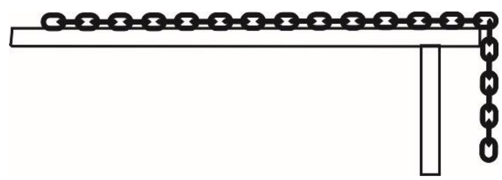
(A) $V_c = 0$ (B) $\omega = \dfrac{v}{5a}$ (C) $E = \dfrac{3mv^2}{5}$

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) all (A), (B) and (C) are true.

48. A projectile has a range R on the surface of the earth. For the same initial speed and angle of projection, its range on a planet where the acceleration due to gravity is one-fourth of that on the earth, is

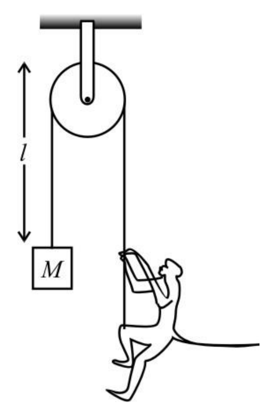
(1) $\dfrac{R}{4}$ (2) 4R (3) $\dfrac{R}{16}$ (4) 16R (5) $\dfrac{R}{3}$

49. A uniform chain of length l and mass m is laid over a table as shown in the figure such that part of it is over hanging. The coefficient of friction between the table and the chain is μ. The maximum length of the chain that can be overhung without sliding down,



(1) $\dfrac{\mu l}{1-\mu}$ (2) $\dfrac{\mu l}{1+\mu}$ (3) μl (4) $\mu l(1 + \mu)$ (5) $\mu l(1 - \mu)$

50. A monkey is hanging at one of a light inelastic string passing over a smooth pulley as shown in the figure. A fixed mass M keeps the monkey and the system at equilibrium. The length of the string on one side is l and equql on either side. The monkey starts climbing up with a uniform acceleration a. Time taken by monkey to reach the top of the pulley is,



(1) $\sqrt{\dfrac{2l}{(g+a)}}$ (2) $\sqrt{\dfrac{2l}{(g-a)}}$

(3) $\sqrt{\dfrac{l}{2(g-a)}}$ 4) $\sqrt{\dfrac{2l}{a}}$

(5) $\sqrt{\dfrac{l}{a}}$

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Provincial Department of Education - NWP

01 E II

Second Term Test - Grade 12 - 2019

Index No : ....

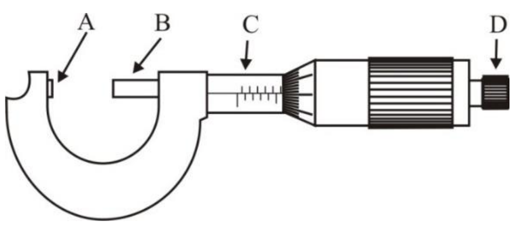
Physics II

3 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

1. (a) (i) Figure shows a micrometre screw gauge used in the laboratory. Name the parts indicated by arrows.



A .... B ....

C .... D ....

(ii) What is the least count of the micrometer screw gauge used in the lab?

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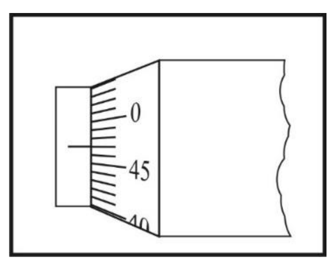
(iii) When *A* and *B* as labelled in the figure in contact with each other, the circular scale and linear scale are shown in the figure.



Determine the zero error of the instrument.

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(iv) Following figure shows the scale when the micrometre screw gauge is adjusted to measure the diameter of a metal ball. What is the correct diameter of the ball?

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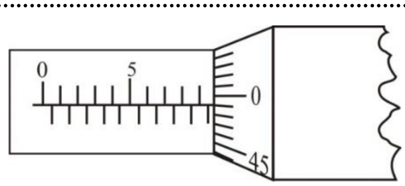

(b) You are asked to determine the length of metal wire which is tangled so that it is impossible to unroll as shown in the figure. Following items are given for this purpose.

Micrometer screw gauge, sensitive spring balance, tall beaker, piece of thread and water of density ρ_w.

(i) What is the measurement that you must obtain is the micrometer screw gauge?

.... $say\ \propto$

(ii) Two measurements must be obtained with the spring balance. What are they? (Write down in the order)

1. .... $say\ \beta$

2. .... $say\ \gamma$

(iii) What are the factors to be considered when the above second measurement is obtained?

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(iv) Get an expression for the length l of wire in terms of α , β, γ, ρ_w.

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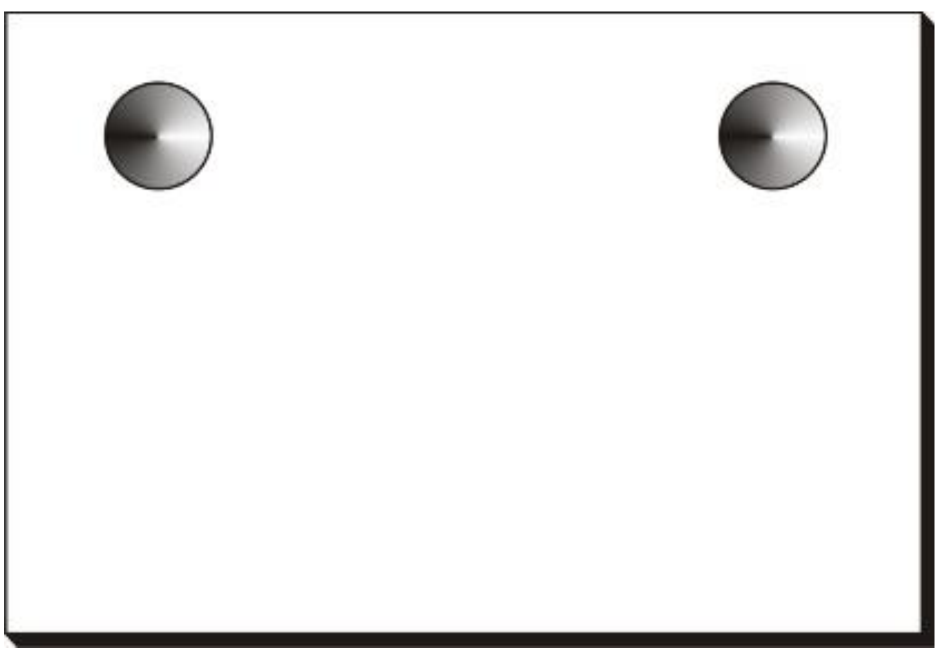
2. You are provided with the parallelogram law apparatus, 3 identical scale pans, box of masses and light inelastic strings.



Show by drowning on the above diagram how the system comes to Equilibrium if you place three **equal** masses on three scale pans.

(a) Student plans to determine the mass of a stone using the parallelogram law apparatus. What are the other items he may needed in addition to those provided above?

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(b) The student uses the shadows of strings to mark the position of Strings on the paper. What is your opinion about this?

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(*c*) Write down the main steps to be taken when the position of strings is marked on the paper using a plane mirror.

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(*d*) What steps you take to show that the friction of the pulleys are negligible.

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(*e*) Why it is important to use strings with negligible small mass in this experiment?

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(*f*) A student suggest that it is better to fix the paper on to the board once the system comes to equilibrium rather than before placing masses. What is the advantage of that?

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(*g*) When you select the scale to draw the parallelogram what are the factors you must concern?

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(*h*) Two weights 10 N and 8 N are placed on two scale pans of the apparatus and the unknown mass is placed on the middle scale pan. Once the parallelogram is constructed, it was found that the angle corresponding to the strings of two scale pans on either sides is 105°. Determine the mass of the stone. ($\text{Sin } 15^0 = 0.2588$)

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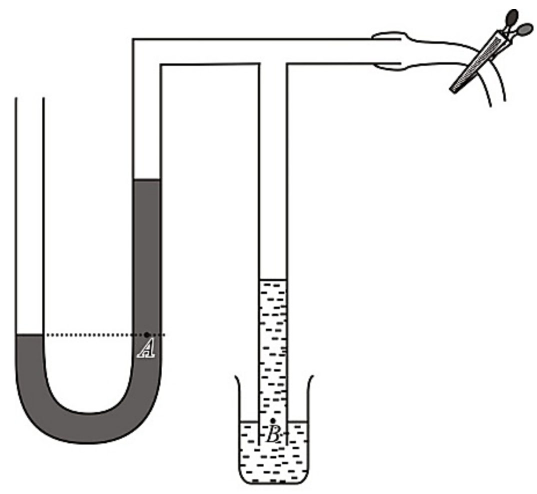
3. The figure shows special apparatus made by connecting U tube and a hare's apparatus. A student plans to determine the density of coconut oil using this Apparatus.



(*a*) Using water and coconut oil the student maintain the liquid columns as shown in the figure. Write down the basic steps that he would have followed to achieve this situation.

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(*b*) Mark the height of water column as h_w and the height of coconut oil column as h_0 in the figure.

(*c*) Does the pressure at A and B are equal? Give reasons for your answer.

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(*d*) Write down an expression between h_0 and h_w. Take the atmospheric pressure as π , the air pressure inside the apparatus P_0 density of water ρ_w , density of coconut oil ρ_0, .

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(*e*) If it is desired to use the graphical method here, rearrange the above expression to plot a graph.

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(*f*) Draw the expected shape of your graph and label axis.

(*g*) When you are given a small amount of a **rare and expensive** liquid to determine in the specific gravity, one student suggest that this apparatus is much better than hare's apparatus. Another student suggests that the hair apparatus is much better. What is the best Apparatus for this purpose? Give reason for your choice.

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04. You are asked to determine the acceleration due to gravity using a simple pendulum.

(*a*) Write down an expression for the period of oscillation T of a simple pendulum using usual symbols.

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(*b*) What is the advantage of measuring time for several oscillations and taking the average other than measuring the period for a single oscillation?

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(*c*) (*i*) There should be an indicator pin to count the number of oscillations. Where is the best place to place the indicator pin?

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(*ii*) This indicator must be very close to the path of pendulum. What can be the reason for this?

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(*d*) Indicate the measurement you take for the length of Pendulum in the following figure.

(*e*) Rearrange relation that you wrote in (a) above for a suitable graph.

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(*f*) Write down how you determine the acceleration due to gravity using the graph.

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(*g*) The average period of oscillation found from this experiment is 2.05 s. If the least count of the stopwatch is 0.01 s find the percentage error of this measurement.

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(*h*) If the gradient of the graph is 4.09 $s^2 m^{-1}$ determine the acceleration due to gravity. Keep your answer to the nearest second decimal places. ($\pi^2 = 10$)

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(*i*) The period of oscillation of the simple pendulum is independent of mass of the bob. But teacher says it is better to use a heavy pendulum bob rather than light one. What can be the reason for this?

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Second Term Test – 2019
Physics Part II - Grade 12
Part - B (Essay)

❖ **Answer four questions only.**

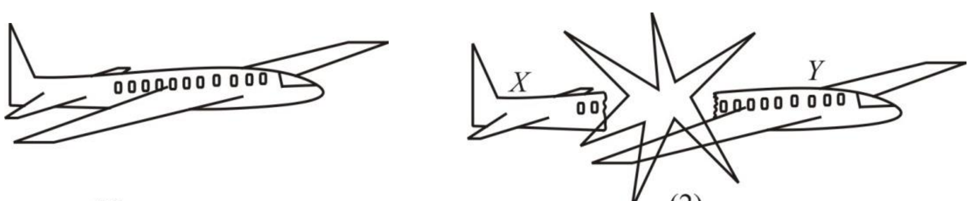
5. (a) Write down the Archimedes principle.

(b) A Boat of volume 4 m^3 floats on sea such that $\frac{1}{8}$ of its volume is submerged. When the boat is loaded with 3060 kg , it is submerged $\frac{7}{8}$ of its volume. This boat after sailing through sea enters in to a lagoon which contain freshwater of density 1000 kg m^{-3}.

(i) Determine the density of sea water.
(ii) Find the mass of the boat.
(iii) Find what fraction of the boat is submerged when it enters into the lagoon.
(iv) Find the maximum load with which the boat can float on freshwater.
(v) When the boat is sailing on freshwater of lagoon with the lord 3060 kg, water star to enter into the boat at rate of 10 liters per second through a hole. At the moment it was started the boat was 6 km from the land. If the maximum speed of the boat is 9 km h^{-1}, show that it can reach the land safely.
(a) It has been found that if the boat is sank in freshwater without the lord, vertical force of 3400 N is required to lift the boat up to the water surface. Find the density of material used to make the boat.

6. (a) Write down the principle of conservation of linear momentum.

(b) A space Shuttle of mass 1×10^5 kg is on a test flight closer to the earth with the horizontal velocity of 800 m s^{-1}. During the journey it was exported into two equal parts *X* and *Y* as shown in the figure. The part *Y* after the explosion starts to move forward with the velocity of 1600 m s^{-2}.



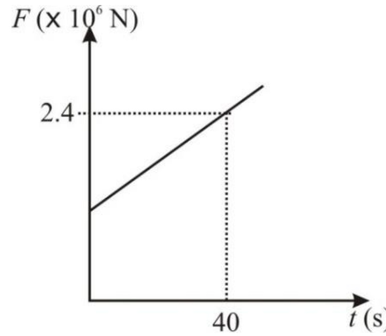
(1) (2)

(i) Determine the speed of the other part *X* with respect to the ground. (Assume that there is no mass lost due to explosion)
(ii) Determine the speed of *X* with respect to *Y*.
(iii) Explain the nature of motion of *X* and *Y* separately as seen by observer on the ground.
(iv) If the explosion last for 0.2 s, determine the average force on each parts.

(c) The force required to take off vertically upwards, this type of space shuttle is produced by burning fuel and ejecting it downloads with the great speed. In this particular space shuttle 1000 kg of fuel is burnt per second and eject it with 3000 m $s^{-1}$with respect to the space shuttle.

(i) If the initial mass of Space Shuttle is 1×10^5 kg, find the initial trust on the space shuttle and initial acceleration.

(ii) Assume that the resultant force on the shuttle which started with above acceleration and initial force changes as shown in the following graph during next 40 seconds. Find the velocity of the rocket at the end of 40 seconds.



7. Read the following passage carefully and answer the questions given.

Electromagnetic waves are used for many communication purposes. For television and FM radio broadcast, specific range of electromagnetic waves are used. UHF (Ultra High Frequency) and VHF (Very High Frequency) electromagnetic waves are used for televisions. At some places television, radio or other communicational media does not function well. At such places they produce noise. Whereas some nearby other places TV radio or other communication sources provide very sharp signals.

In the communication using electromagnetic waves transmission and receiver antenna are used. Electronic wave transmitter from such an antenna can be reflected nearby mountain, water reservoir or land. Then the direct transmitted signal and the reflected signal interfere at the receiver. If these two waves interfere destructively the signal strength become poor and the communication become noisy and unclear. On the other hand, if two waves interfere constructively the signal strength becomes strong and the communication is clear and sharp. The constructive or destructive interference occur according to, the difference between path length of the direct signal and that of the reflected signal.This is called the path difference.

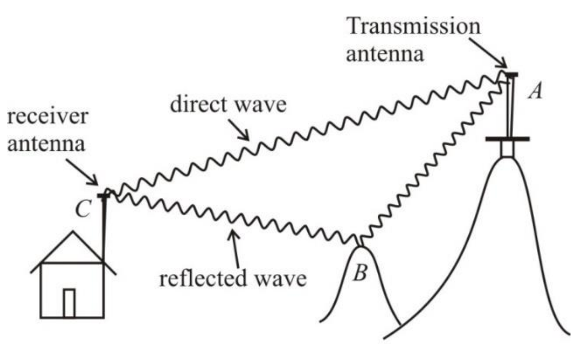


Figure (a)

AC – path of direct signal from antenna.

AB + BC – path of reflected signal.

Then the path difference = AC – (AB + BC) Or (AB + BC) – AC

If the if the path difference is an integer multiple of wavelength of the wave, constructive interference take place. Then the received signal will be sharp and clear.

For constructive interference AC – (AB + BC) = $n\lambda$ Or (AB + BC) – AC= $n\lambda$

If the path difference is an odd multiple of half of the wavelength, a destructive interference take place. Then the signal strength will be poor, Then the sound and image maybe unclear and noisy.

For destructive interference

path deference $= AC - (AB + BC) = (2n+1)\frac{\lambda}{2}$ Or $(AB + BC) - AC = (2n+1)\frac{\lambda}{2}$

The intensity of a wave is proportional to the square of amplitude. Electromagnetic waves in the range 87.5 MHz –108 kHz are used in radio communication. For VHF broadcast electromagnetic waves of 174 MHz – 216 MHz frequency range is used and that for UHF broadcast is in the range of 470 MHz – 806 MHz.

The speed of electromagnetic wave in the air is 3×10^8 m s^{-1}

(a) (i) Television and radio waves belongs to which category of wave?
(ii) What stands for UHF and VHF
(iii) Why it is possible to consider that the electromagnetic waves are a kind of transverse waves.
(iv) Introduce the path difference.
(vi) What is the requirement to be satisfied by the path difference for the constructive and destructive interference?
(vi) What is the principle that can be used to explain the constructive and destructive interference?
(vii) What are the ranges of wavelength for the range of frequency of electromagnetic waves which are used in Radio Communication?
(viii) If the intensity of the wave is *I*, what is the intensity of the wave when a constructive interference occurs?
(ix) In order to exhibit the interference, what are the requirements to be satisfied by two waves?

(*b*) A signal is transmitted from and antenna located near the shore send a signal of frequency 150 MHz. It is received by a ship in the sea as shown in the figure (b).

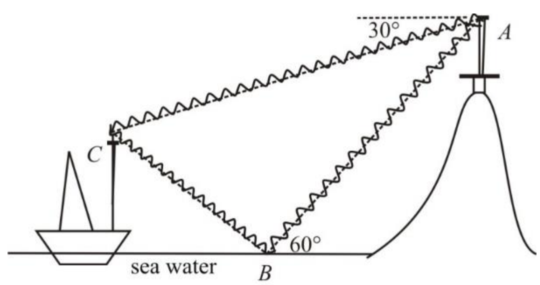


Figure (b)

Part of the wave is transmitted to the receiver after the reflection on the water. AC = 3000 m take $\frac{1}{\sqrt{3}} = 0.58$

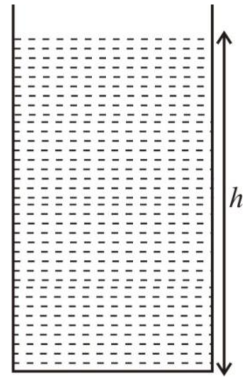
(i) Calculate the path difference between two waves received by the receiver C.
(ii) Then determine what kind of interference take place at C and explain your decision.

08. (a) (i) Write down the Bernoulli principle as a mathematical expression.

(ii) Identify each term of the Bernoulli's principle you wrote above and show that it is dimensionally correct.

(iii) Write down the conditions under which Bernoulli's expression is valid.

(b) A tank used to store water in a farm is filled up to a height h as shown in the figure. The cross sectional area of the tank is A. Suddenly water starts to leak out through a considerably large hole at the bottom. The cross-sectional area of the whole is a.



(i) Get an expression for the speed of water flow out through the hole. (Assume that water behave according to the conditions you mentioned under a(iii) above.) assume h remain constant.

(ii) If the cross sectional area of the tank is much greater than the cross-sectional area of the hole, get an expression for the speed of water flow through the hole.

(iii) Which speed of water flow out of about speed is Greater. What can be the reason for this?

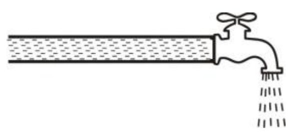
(iv) Water from the above tank is spread throughout the farm. At the steady state the rate of water flow through a tube of cross section area 20 cm^2 is found to be 8×10^{-3}. Find the speed of water flow through this tube.

(v) At a certain position part of the tube is blocked and the cross sectional area of water flow became 16 cm^2. Determine the speed of water flow at this position.

(vi) If the pressure at a position where the cross-sectional area is 20 cm^2 is 2×10^5 Pa determine the pressure at the position where the cross sectional area is 16 cm^2. (Density of water 1000 kg m^{-3}

(vii) Crops of the farm are watered using a shower with small holes each of cross sectional area $4 \times 10^{-5} m^2$. Then the speed of water flow is found to be 2.5 m s^{-1}. How many holes can be there in the shower?

(viii) The figure shows water tap in the farm. When the tap is closed the static pressure is 1.5×10^5 Pa . Find the static pressure when the tap is open. (Assume water flow with 10 m s^{-1})



09.

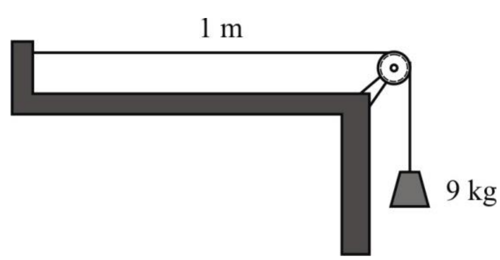
(a) (i) A string fixed at two ends under tension is plucked at the middle. What type of waves is generated on the string?

(ii) How this type of wave is generated by plucking the string.

(iii) State two properties of this type of waves.

(iv) Write down an expression for the speed of transverse waves on the string in terms of its tension. Identify any other parameters you use.

(b) A wire of uniform cross section passing through a smooth pulley is fixed at one end and holds a mass of 9 kg at the other end as shown in the figure. The string is plucked at the middle and vibrates with the fundamental state of vibration. The length of the horizontal part of the wire is 1m and the fundamental frequency of the wire is 750 Hz.



(i) Draw the fundamental mode of vibration pattern on the string.(Copy this diagram into your answer script.)

(ii) Determine the speed of transverse waves on this string.

(iii) Determined the mass per unit length of the wire.

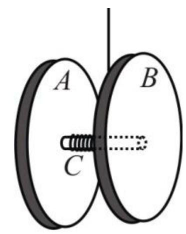
(iv) The speed of sound in air is 330 m s^{-1} at 27 °C. Determine the wavelength of the sound wave produced by the string at this temperature.

(v) Determine the speed of sound in air at the temperature 37 °C.

(vi) Now the message is completely immersed in a liquid of density ¾ if its density. Determine the new speed of transverse waves on the string.

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

10. **(A)** Two discs *A*nd *B* each of mass *m* and radius *R* connected by a rod *C* with negligible mass as shown in figure 1.



(1)

A Light string of length *L* is wrapped around the road *C* and the system is hanging buy the free end of the string. Then the system is released to fall.

(The moment of inertia of a uniform disc around an axis through its centre and perpendicular to the plane of the disc is $\frac{1}{2}mr^2$ with usual notations)

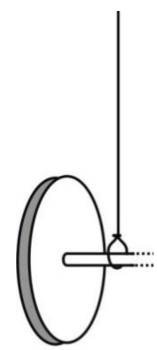
(a) (i) When the system is falling down, take the tension in the string as *T*. Write down an expression for the torque on the system in terms of *T* and *r* wherer is the radius of the rod *C*.

(ii) Take the linear acceleration that the system fall down as *a*. Write down an expression for tension of the string applying $\tau = I\alpha$.

(iii) Get an expression for tension T applying $F = ma$ to the system.

(iv) get an expression for acceleration *a* of the system in terms of *g*, *R* and *r* using the expressions you wrote under (ii) and (iii)

(*b*) This string has been connected to the rod *C* by a loop which is loose to the rod as shown in the figure (2). Therefore once the system reach end of the string the system keep on rotation round rod *C*. Show that the angular velocity of the system when reach this position is given by $\sqrt{\frac{4gL}{R^2+2r^2}}$

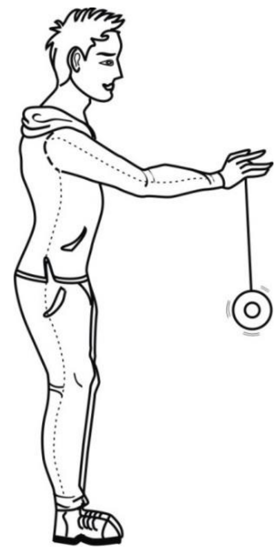

(2)

(*c*) Assume that due to the function between the road and stringa constant fictional torque of τ act on the road. Write down the expression for the loss of energy due to friction after the system rotate true *n* revolutions.

(*d*) The toy called Yo-Yo used to perform some fun activities is also based on the principal discussed above. The Yo-Yo is thrown down vertically by the player after wrapping the string around the short axel at the middle of yoyo. Once Yo-Yo reach the bottom of the stream it rotates freely. Then the player yank (gives jerk in a special manner) the Yo- Yo began to rise along string. The radius of the axis as 1 cm, the length of string is 105 cm and the radius of gyration of yoyo is 10 cm. (If the radius of gyration of an object of mass M is k its moment of inertia can be written as $I = Mk^2$)

(i) The player throws the Yo- Yo down providing 50*m* J of kinetic energy. (*m* is the mass of Yo-Yo) determine the angular velocity of Yo - Yo when it reach the bottom of string. (Take $\sqrt{101} \approx 10$)

(ii) Assume that there is no friction between the string and the axel. Now the player yank the system and let the yoyo roll alone the string upward. Show by calculation that the Yo-Yo reach hand of the player.



(3)

(B) (a) A sound wave propagating in air is given by the relation $y = a \sin(\omega t)$.

(i) identify parameters given by y, a and ω.

(ii) draw this wave for two periods from $t = 0$. Label it as (A).

(iii) $y = a \sin(\omega t + (\pi/6))$ is another such wave. Find the displacement of this wave at $t = 0$ in terms of a. Draw this wave on the same diagram as above and label it as (B).

(b) A sound wave reflects from a wall perpendicular to the direction of propagation of sound. Then a stationary wave can be observed.

(i) Reflection of sound has a different term in the general usage. What is this?

(ii) Write down the principle of superposition of waves.

(iii) Explain how a stationary wave is formed and write down two differences between stationary waves and progressive waves.

(c) When the room temperature is 27 °C a sound wave of frequency 500 Hz produce a stationary wave after the reflection from a wall as described above. The distance between consecutive nodes of the stationary wave has been found as 34 cm.

(i) Determine the speed of sound in air.

(ii) Find the distance between two consecutive nodes of the stationary wave with the temperature is rice 57.75 °C.