G.C.E. A/L Examination March - 2017

Conducted by field Work Centre, Thondaimanaru
In Collaboration with
Northern Provincial Department of Education

FWC

Grade:12(2018)	*Physics*	*Three hours*

Instructions*:*

- *Answer **all** the questions.*
- *Wright your **Index number** in the space provided in the answer sheet.*
- *Choose **correct or most approprite answer** and **mark your response on the answer sheet with a cross** (x)*

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

Part I

01) Unit Volume of energy is equalent to,

(1) Work (2) Moment (3) Pressure (4) Power (5) Force

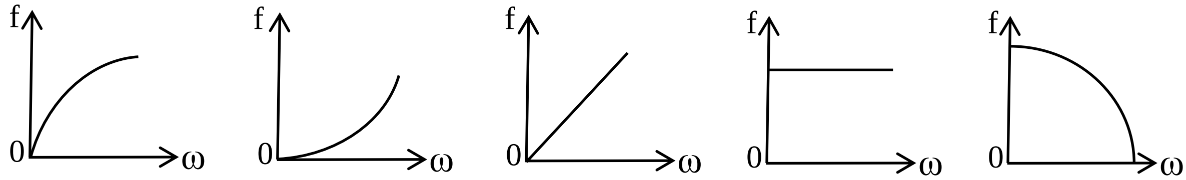
02) The "reaction" force does not cancel the "action" force because

(1) They act on same body.
(2) They are in different line of action.
(3) They do not act on same body.
(4) They are in the same line of action and the same direction.
(5) The reaction exists only after the action force is removed.

03) The following readings x, y and z have been taken using correctly selected instrument

x = 3.32cm	y = 2.433cm	z = 0.354cm
x	y	z
(1) Vernier caliper	Spherometer	micrometer screw gauge
(2) Travelling microscope	Spherometer	micrometer screw gauge
(3) micrometer screw gauge	micrometer screw gauge	Spherometer
(4) Vernier caliper	micrometer screw gauge	Spherometer
(5) Travelling microscope	Spherometer	micrometer screw gauge

04) A particle moves in a fixed circular path constant angular speed (ω). The Variation of the magnitude of the particles acceleration f with ω is best represented by



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

05) A phenomena which can be observed only in transverse waves

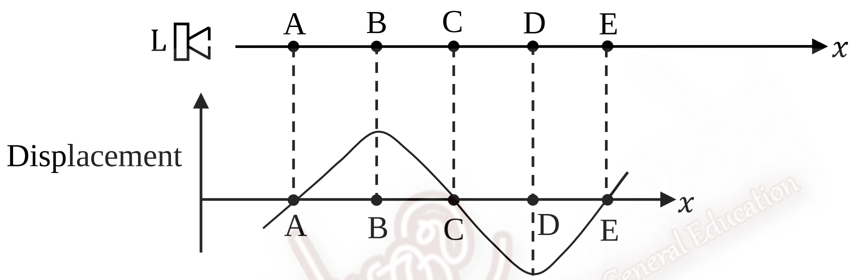
(1) Refraction (2) Diffraction (3) interference

(4) Super position (5) polarization

06) An object starting from rest moves first 50m at constant acceleration, next 200m with uniform velocity and finally comes to rest after travelling a further 30m with constant deceleration. The total time taken for the journey is 30 seconds. The maximum velocity attained by the object is

(1) $2.7ms^{-1}$ (2) $6ms^{-1}$ (3) $6.7ms^{-1}$ (4) $8.7ms^{-1}$ (5) $12ms^{-1}$

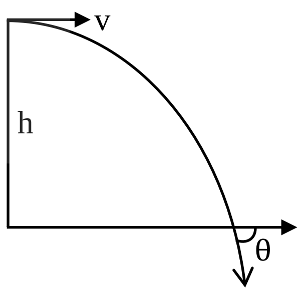
07) The figure below shows a loudspeaker (L) emitting sound continuously at a frequency of 400Hz along a straight line in the positive x direction. The graph represents the displacement of the air particles from their respective equilibrium positions along the x - axis at one particular instant.



The instantaneous pressure maximum point/points is / are

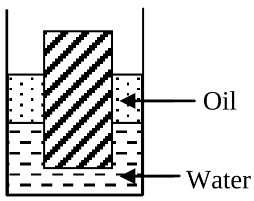
(1) A, C, E (2) B, D (3) A (4) C (5) E

08) A ball is thrown horizontally with a velocity v, from a top of the tower height h, and the ball hits the ground making an angle θ with horizontal as shown in the figure. Which of the values v & h gives maximum value of the θ?



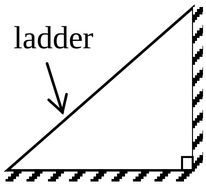
v	10 ms^{-1}	10 ms^{-1}	30 ms^{-1}	30 ms^{-1}	50 ms^{-1}
h	30 m	50 m	30 m	50 m	10 m
	(1)	(2)	(3)	(4)	(5)

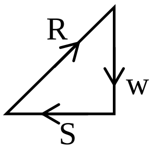
09) A thick layer of oil with density 800Kg/m^3 is floating above water that has density 1000kgm^3. A solid cylinder is floating so that 1/3 is in the water, 1/3 is in the oil as shown in the figure. Additional oil is added until the cylinder is floating only in oil. What fraction of the cylinder is in the oil?

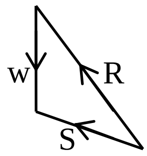


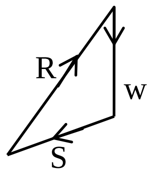
(1) $3/5$ (2) $3/4$ (3) $2/3$ (4) $8/9$ (5) $4/5$

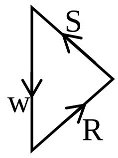
10) A ladder is in equilibrium on a vertical plane which is perpendicular to the wall as shown in the figure below. One end of the ladder is on the rough horizontal ground and the other end is resting against a rough vertical wall. Weight of the ladder (w), reaction forces at upper and lower end of the ladder are S and R respectively which force triangle represents forces act on the ladder?

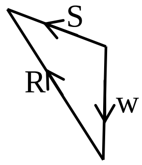


(1) 

(2) 

(3) 

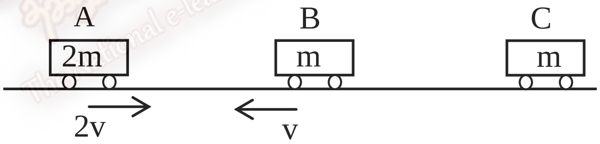
(4) 

(5) 

11) A student holds thin strip of paper below his lower lip and blows air horizontally over it. If the surface area of one side of the paper is A and the mass of the strip is m speed v, with which the air should be blown in order to keep the strip horizontal is (consider the density of air ρ)

(1) $v = \sqrt{\frac{2mg}{\rho A}}$ (2) $v = \sqrt{\frac{mg}{\rho A}}$ (3) $v = \sqrt{\frac{mg}{2\rho A}}$ (4) $v = \sqrt{\frac{mg}{3\rho A}}$ (5) $v = \sqrt{\frac{3mg}{\rho A}}$

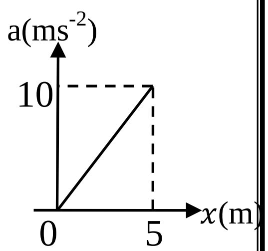
12) Three trolley are free to move on a frictionless horizontal track. Trolley A has a mass of 2m and an initial speed 2v to the right; Trolley B has a mass of and an initial speed of v to the left; Trolley C has a mass of m and is originally at rest. All collisions are perfectly elastic.



The velocity of the center of mass of the system of the three trolleys after the last collision is

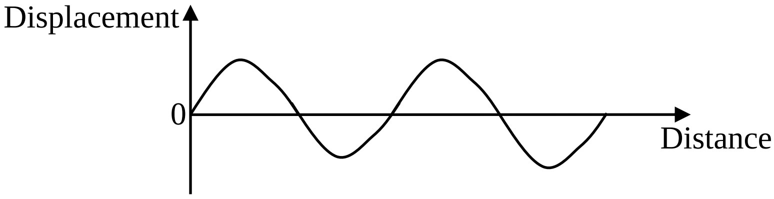
(1) $\frac{2v}{3}$ (2) $\frac{3v}{4}$ (3) $\frac{3v}{2}$ (4) $\frac{3v}{5}$ (5) $\frac{v}{3}$

13) The graph shows the acceleration (a) of a body of 4Kg mass with the distance (x) travelled by it, the work done in travelling a distance 5m is



(1) 10J (2) 20J (3) 50J
(4) 100J (5) 200J

14) A wave moving from to right in a medium is represented graphically by the figure below The graph actually shows the displacement of

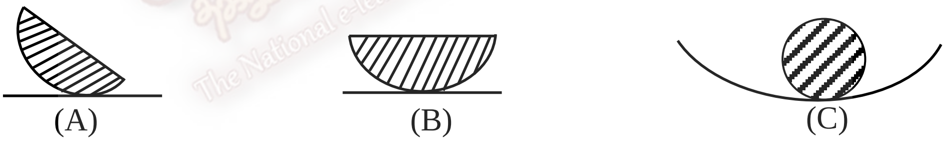


(1) Particles along the medium at various instants.
(2) Particles along the medium at a particular instant.
(3) Any one particle along the medium at various instants.
(4) The particle at the source at the start of the wave motion.
(5) Any one particle along the medium during a complete cycle.

15) Uniform cross section area of the U tube is partially filled with water, the length of the water column is L. Oil with a density 2/3 that of water is added to one side of the tube until the total length of oil equal to the total length of water. At equilibrium the difference in heights of the two liquids columns is equal to

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

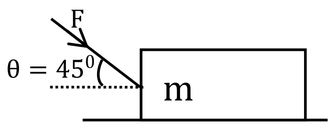
16) The figure shows sphere and hemispheres in contact with various supporting surfaces that are not frictionless of those the following correspond to configurations of stable equilibrium



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

17) When an object is made to perform simple harmonic motion,
(1) The period of oscillation of the object depends on the amplitude of the oscillations.
(2) The force acting on the objects is always directed away from the equilibrium position.
(3) The total mechanical energy of the object depends on the amplitude of the oscillation
(4) The potential energy of the object is always constant.
(5) The kinetic energy of the object is always constant.

18) What is the maximum value of the force F such that the block shown in the figure, does not move? The coefficient of friction between the block and the horizontal surface is 0.5.



(1) 20N (2) 10N (3) 12N (4) 15N (5) 18N

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19) A long glass tube is vertically in water. A tuning fork is struck and held over the open end of the tube. Strong resonances are observed at two successive lengths 0.50m and 0.84m above the surface of water. If the velocity of sound in air is $340ms^{-1}$ then the frequency of the tuning fork and end correction of the tube are respectively

(1) 128Hz and 0.5cm (2) 256Hz and 1cm (3) 500Hz and 0.5cm
(4) 384Hz and 1cm (5) 500Hz and 1cm

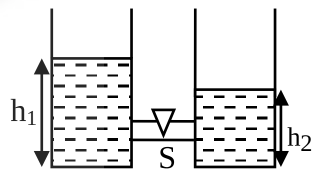
20) A sonometer wire having mass per unit length of $40.0gm^{-1}$ and tension of 36N is simultaneously with a tuning fork of frequency 300Hz while varying its vibration length from a small value. In this process at one stage the wire resonates with tuning fork when number of loops and length of the sonometer wire respectively will be

(1) 1and 5cm (2) 1and 10cm (3) 1and 20cm (4) 2and 20cm (5) 2and 5cm

21) What is the minimum angular speed, should the earth spin in order for a 70Kg human not to be able to walk along the equator on the ground? (consider radius of earth is $6.4x10^{6}m$)

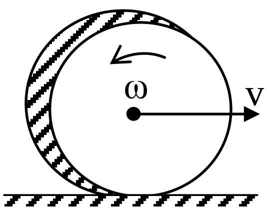
(1) $1.2x10^{-3}rads^{-1}$ (2) $1.25x10^{-3}rads^{-1}$ (3) $1.1x10^{-4}rads^{-1}$
(4) $1.5x10^{-3}rads^{-1}$ (5) $1.2x10^{-4}rads^{-1}$

22) Two identical cylinderical vessels with their base at same level, each contains a liquid of density ρ, the area of either base is A. The height of the liquid in the vessels are h_1 and h_2, controlled by valve S as shown in the figure , If the valve S opens the work done by gravity in the equalizing level will be



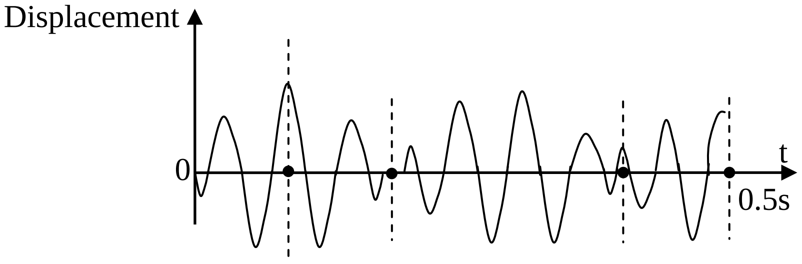
(1) $A\rho g\left[\frac{h_1-h_2}{2}\right]$ (2) $A\rho g\left[\frac{h_1-h_2}{2}\right]^2$ (3) $A\rho g\left[\frac{h_1-h_2}{4}\right]$
(4) $A\rho g\left[\frac{h_1-h_2}{4}\right]^2$ (5) $A\rho g\left[\frac{{h_1}^2-{h_2}^2}{2}\right]$

23) R radius of circular disc with mass m with initial velocity v and an angular velocity ω comes into contact with the ground as shown in the figure. Friction is not negligible, so both the velocity and angular velocity of the disc changes. What is the critical velocity (v_c) when the disc comes to instantaneous rest (in terms of angular velocity ω_c and R)?



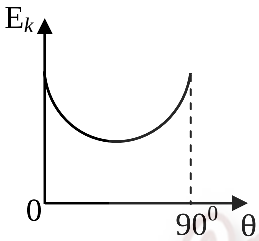
(1) $v_c = R\omega_c$ (2) $v_c = \frac{R}{2}\omega_c$ (3) $v_c = \frac{2}{3}R\omega_c$
(4) $v_c = \frac{3}{2}R\omega_c$ (5) $v_c = 2R\omega_c$

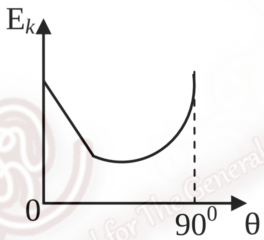
24) The figure shows the resultant wave produced by two sound waves of slightly different frequencies. the beat frequency is equal to



(1) 2Hz (2) 4Hz (3) 5Hz (4) 10Hz (5) 2.5Hz

25) A solid ball is released from rest down inclines of various inclination angles θ but through a fixed vertical height h. The coefficients of static and kinetic friction are both equal. Which of the following graphs best represents the total kinetic energy (E_k) of the ball at the bottom of the incline as a function of the angle(θ) of the incline?

(1)


(2)


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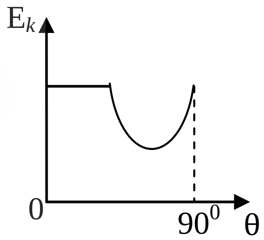

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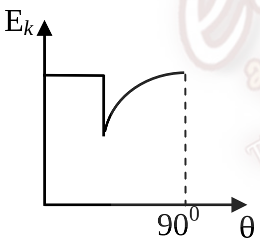

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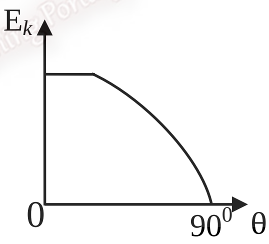
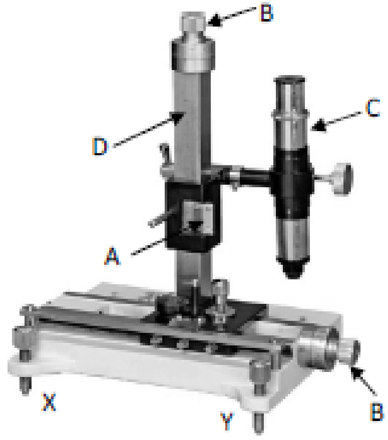


Part -II

Part A – Structured Essay

Answer all questions in this paper

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



01) An Experiment is made to determine the radius of a capillary tube using mercury thread. Travelling microscope, particular mass of mercury, Electronic balance, a watch glass are given to you.

a) i. Identify the parts A,B,C,D of the travelling microscope as shown in the figure below.

A :- ....

B :- ....

C :- ....

D :- ....

ii. What is the initial adjustment for this instrument?

....

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iii. Give a method to insert mercury into the capillary tube.

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b) The length of the mercury thread was measured by using travelling microscope. Find the least count of the microscope if its length of the main division is 0.5mm and the 49 divisions of the main scale were divided into 50 divisions of the vernier scale.

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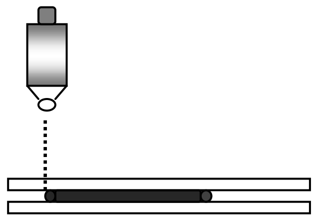
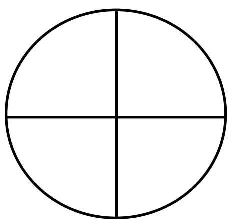
c) The figure illustrates the position for taking measurement for the mercury thread in one position. Draw the correct diagram that is seen when observed through the travelling microscope.





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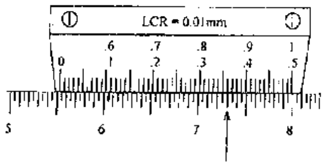
d) As observed in part (c), the figure nearby shows the position of main scale and the vernier scale. What is the reading?



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e) Readings taken to determine the mass of mercury threads are m_1, m_2. Identify these two readings.

m_1 ....

m_2 ....

f) One student suggests using water thread instead of mercury thread. State two reasons mentioning that using water thread is unfit.

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g) Consider the length of mercury thread is 4.000cm, what is the fractional error caused during the measurement of length mercury thread?

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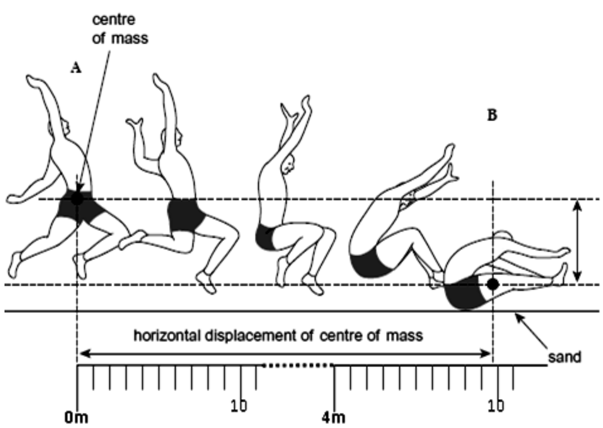
02) The motion of a long jumper during a jump is similar to that of a projectile moving under gravity. The figure shows the path of an athlete above the ground during a long jump from half-way through the jump at position **A**, to position **B** at which contact is made with sand on the ground. The athlete is travelling horizontally at **A** and the horizontal displacement of the centre of mass from **A** to **B** is measured by a measuring tape which is calibrated in **cm** scale as shown in the figure.(neglect the air resistance)



a) i. What is the horizontal displacement of the centre of mass of the athlete from **A** to **B** ?

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ii. What is the estimate error of the measurement?

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b) i. During this part of the jump, the centre of mass of the athlete falls 1.25m, calculate the time taken for the centre of mass to move from A toB .

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ii. Find the velocity of the athlete at **A.**

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iii. Find the horizontal and vertical velocities of the athlete at the point of jumping.

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c) i. The athlete slides horizontally through the sand a distance of 0.41m before stopping. Calculate the time taken for the athlete to stop sliding. (Assume that the horizontal component of the resistive force from the sand is constant)

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ii. The mass of athlete is 75 kg. Calculate the horizontal component of the resistive force from the sand.

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iii. Why the athlete stretched his legs and hands while landing on the sand?

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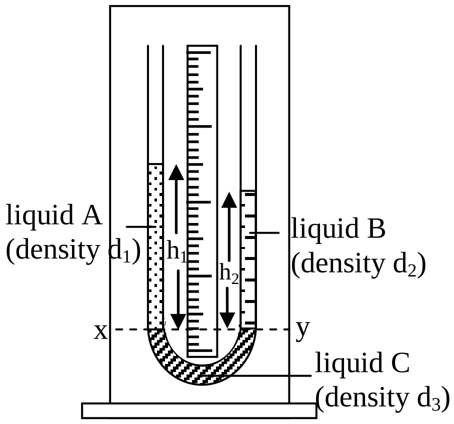
03) Figure shows a modified U tube experimental set up to compare the densities of two liquids A and B, employing a third liquid C which is immiscible with both A and B. The level xy of the liquid C in the two arms of the U tube is horizontal.



a) Write down the inequality relationship among the densities of these liquids (d_1, d_2 and d_3)

....

b) Suppose that the levels of liquids A and B above xy are h_1 and h_2 respectively. Write down an equation relating h_1, h_2, d_1 and d_2

....

c) Why is it necessary to maintain xy horizontal?

....

d) i. State the experimental procedure to determine the ratio of the densities of d_1 and d_2 using graphical method (sufficient amount of liquids are available).

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ii. Comment on the accuracy the measurements of h_1 and h_2 when the density of C differs very much than that of A or B.

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e) i. Draw a rough sketch of the straight line graph denoting h_1 and h_2 on the x and y axis respectively.

ii. The gradient of the straight line is as 0.8 when A, B and C are chosen as water (density $1000 Kgm^{-3}$), copper sulphate solution and mercury (density $13600 kgm^{-3}$) respectively. Find the density of the copper sulphate solution.

....

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iii. If it is desired to measure the height of the liquid column with an accuracy less than 1% what will be the minimum height of the liquid column.

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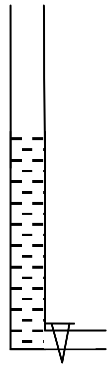
04) During the hot day, A student tended to determine the speed of sound in air (v) and the end correction (e) using the structure expelling water from the tube and the tuning fork with known frequency as shown in the diagram.



a) Mention the additional items that are necessary to carry out the experiment effectively for that student?

....

....

b) State the practical that he has to follow to vibrate the tuning fork?

....

c) Give the procedures that the student has to do in order to get fundamental resonance state.

....

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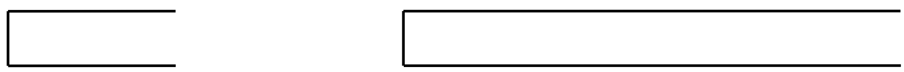
d) What is the ***medium*** and ***periodic force*** in this experiment?

i. medium :- ....

ii. periodic force :- ....

e) Draw the structures of wave of first two resonance states including the end correction on the sketch given below.



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f) Find the end correction of the tube and the speed of sound in air if the length of the first two resonance as mentioned in part (e) are 17cm, 49cm respectively.

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g) If alcohol is used instead of water, the speed of sound and end correction calculated in part (f) would be changed. (assume the environmental temperature is constant).

speed of sound : ....

Explanation : ....

....

End correction : ....

Explanation : ....

....

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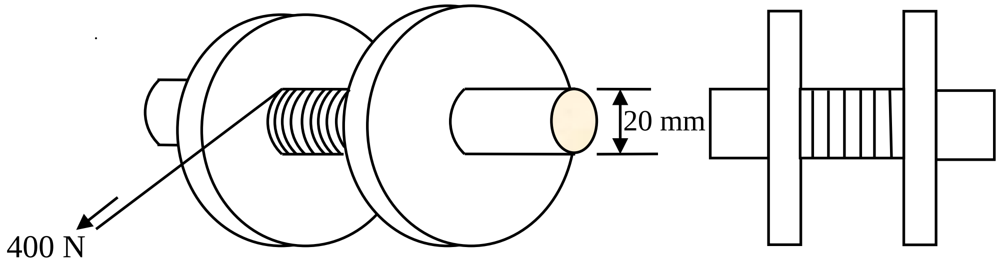
Part -II

Part B – Essay

Answer two questions only

01) A flywheel is made by joining two large discs together with a smaller disc of radius 20 mm in the middle and it is free to rotate about an axis passing through their centres. A light, thin cord is wound round the inner disc 8 times as shown in figures 3 and 4.



Figure

When the flywheel is at rest a steady force of 400 N is applied at the end of the cord and it unwound fully in 4.0 seconds. (Take $\pi = 3$)

a) i. Calculate the angular acceleration of the flywheel;

ii. Calculate the maximum angular velocity attained by the flywheel;

iii. Sketch a graph showing the variation of angular velocity with time;

iv. Sketch a graph showing the variation of angular displacement with time and

v. Calculate the work done by the applied force on the flywheel.

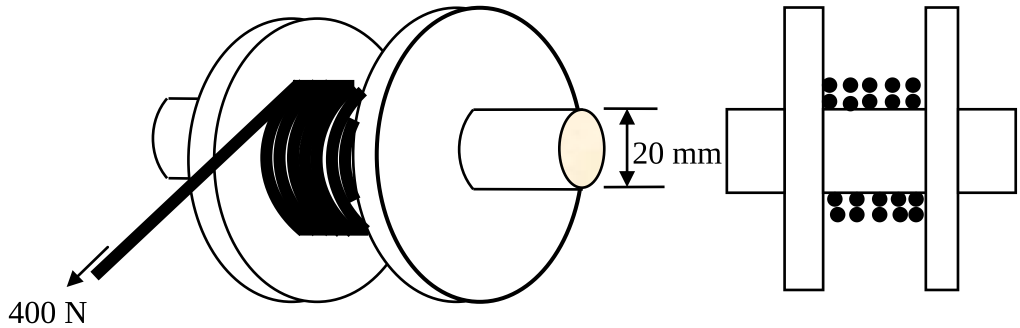
b) There is always a constant frictional torque of 2.0 Nm comes into action when the flywheel is rotating about its axis.

i. Calculate the moment of inertia of the flywheel.

ii. When the cord is fully unwound, it detaches from the flywheel. Calculate the angular deceleration of the flywheel;

iii. Calculate the duration of time for which the flywheel was in rotation.

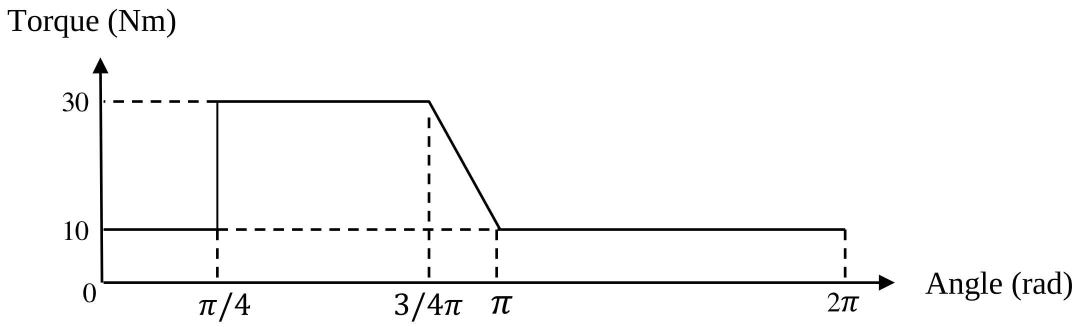
c) When thin cord is now replaced with a light but thicker cord of **same length**, the overlapping of the cord itself, as shown in figures, when wounded on the inner wheel.



Figure

i. A steady force of 400 N is applied at the end of the cord as before. Will the time taken by the thicker cord to unwrap and detach from the flywheel be longer, shorter or same as for the thin cord? **Support your answer with explanation**.

ii. What is the purpose for which flywheels are used in automobile engines?



d) The variation of resisting torque on the rotating shaft driving the needle of an electric sewing machine is shown above. A stitch is made for each cycle of operation and for every second it makes 2 stitches. The efficiency of the sewing machine and the electric motor are 78% and 40% respectively.

Calculate

i. The amount of work done by the sewing machine during a cycle of operation;

ii. The useful power output by the sewing machine;

iii. The power supplied by the electric motor to the sewing machine;

iv. The power drawn by the motor from the electrical power source;

v. The total consumption of electrical energy in kWh if sewing is done for 2000 h.

02) a) i. State the necessary and sufficient conditions under which Bernoulli's principle can be applied for a fluid flow.

ii. Write down the Bernoulli's equation in usual symbols and identify the symbols used in the equation.

iii. When an incompressible fluid flow from wider tube to narrow tube, what happens to

α) the speed of the fluid?

β) the pressure of the fluid?

iv. How the upward lift in an aeroplane is achieved on flight ?

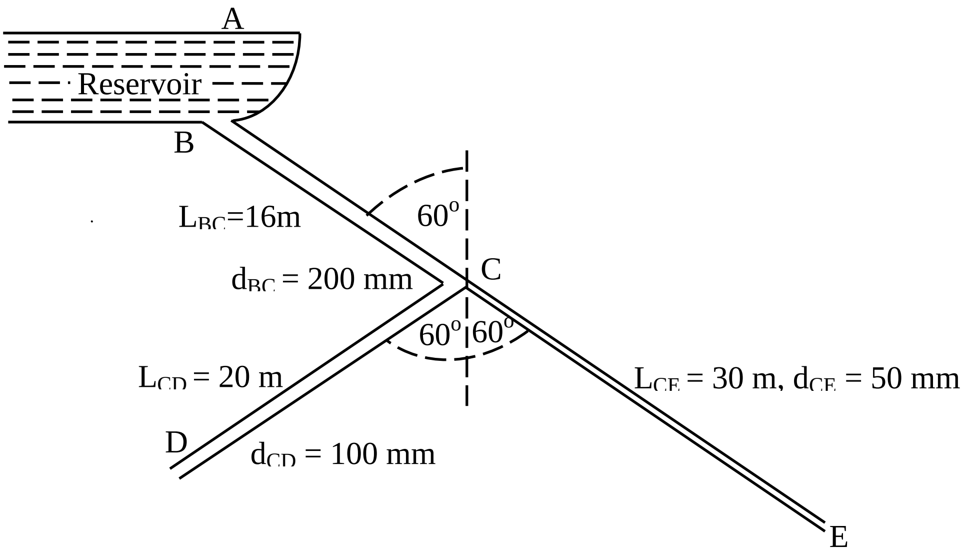
v. A cricket ball is thrown by a bowler towards the batsman. Sketch the path taken by the ball in a wind free day when the ball is thrown

α) without spin,

β) with backward spin, and

ϒ) with forward spin.

b)



The figure above shows a large water reservoir (A) on a hill which supplies water for the irrigation of vegetable farms in a valley. The depth of water in the reservoir is 2 m. The lengths of the water supply pipes BC = 16 m, CD = 20 m and CE = 30 m. The diameters of the pipes BC, CD and CE are 200 mm, 100 mm and 50 mm respectively. All three supply pipes are fixed in a vertical plane and each of them make 60° with the vertical.(Assume that the water is a non viscous fluid and $\sqrt{5} = 2.24$)

i. Find the speed of water
   α) at the outlet point D,
   β) at the outlet point E.

ii. Find the flow speed of water in the pipe BC.

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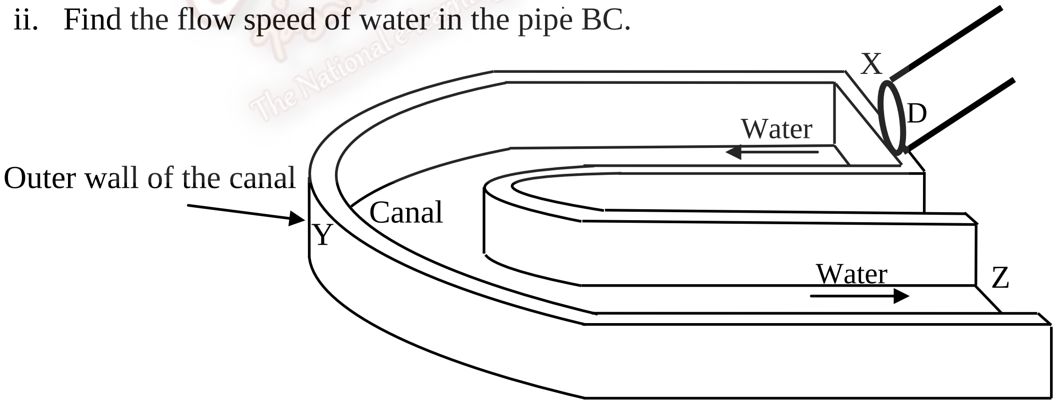

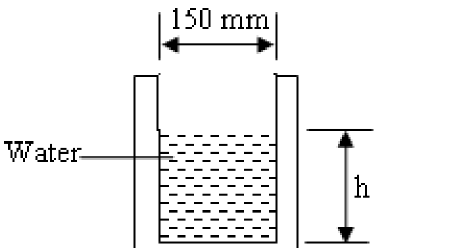

The cross section of the canal

c) The water from the outlet D of the pipe CD is completely delivered to end X of a horizontal irrigation canal XYZ having a rectangular cross section of width 150 mm. There is no splashing of water from the canal. (Assume $\pi = 3$)

Calculate the following:

i. The volume rate of delivery of the water into the canal.

ii. The height, h, of water in the canal assuming that the speed of the water in the canal is same as that of the delivery speed at the outlet D.

iii. The mass rate flow of the water in the canal. (The density of water = 1000 kgm^{-3})

iii. Find the thrust exerted on the outer wall Y due to the flow of water.

03) Read the following passage and answer the questions.

Sesmic waves are the waves of energy caused by the sudden breaking of rock within the earth or an explosion. These sesmic waves travel in all directions from the point where the energy is released, and this point is known as the focus of the earthquake. The corresponding point on the Earth's surface directly above the focus is called epicentre of the earthquake.

The waves which travel through the earth's inner layers are called body waves and those travel on the earth surface are called surface waves. The frequency of the body waves higher than surface waves. The body waves consist of P waves and S waves. P waves are longitudinal waves whereas the S waves are transverse waves.

The P waves from an earthquake arrive at a given location before S waves and surface waves, the P waves can travel through any kind of any material, solid or fluid, S waves do not exist in a fluid. Richter scale is most accepted method used to estimate the strength of an earthquake. Most tsunamis are caused by underwater earthquakes. Some of them are caused a volcanic eruption, an Sub-marine, rock slide and an asteroid or meteoroid crashing into in the water, from space. The wave length of tsunami is very high in deep ocean that is wave length of tsunami is greater than depth of the deep ocean, than the speed of tsunami is given by $V= \sqrt{gh}$ where h - depth of the ocean, g - gravitational acceleration.

a) Why seismic waves incidence occurs in the earth?

b) What do you mean by the focus of the earthquakes?

c) What is the relationship between focus and epicentre of an earthquake?

d) Compare the properties of S and P waves. (at least three)

e) Arrival time difference of P and S waves from epicentre to seismic data recording station is 50 sec, speed of the P and S waves are $5kms^{-1}$ and $3kms^{-1}$ respectively. Find the distance of the epicentre from the data recording station.

f) What is the scale for measuring strength of earthquake?

g) i) How do most of the tsunami waves creates in Earth?

ii) Whether tsunami waves, longitudinal or transverse waves?

h) The speed of a tsunamis $720 kmh^{-1}$ in the open ocean and the wave length 6km long.

i) Find the depth of the open ocean.

ii) What is the period of oscillating of the tsunami wave?

iii) The maximum vertical oscillating speed of the ship is $0.4 ms^{-1}$ in the open ocean while the engine of the ship ceased and couldn't move forward. Find the amplitude of oscillation of the ship. (take $\pi = 3$)

iv) What is the minimum vertical oscillating speed of the ship?

v) Draw a rough sketch of the kinetic energy (E_k) of the ship verse time (t) graph for the period of a oscillation. (Consider at time t = 0 the ship oscillates minimum vertical speed)

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