extra

31.07.2019

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De Mazenod College, Kandana

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Third Term Test – Grade 12 – July 2019

Index Number: ....

PHYSICS I

Time: 2 hours

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

Part A – Multiple Choice Questions

1) The time for 20 oscillations of a simple pendulum measured by a clock is 2.50 s. The percentage error of the measurement is,
   1) 8 %
   2) 0.4%
   3) 4%
   4) 1%
   5) 0.04%

2) The physical quantity which is equal to force x time

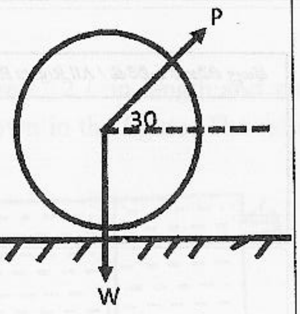
   (A) Impulse (B) Power (C) Momentum (D) Work
   1) A only
   2) A & D only
   3) A & C only
   4) B & C only
   5) B & D only

3) Consider the following facts regarding the zero error of a Vernier caliper.
   a) The zero error depends on the measurement taken by the instrument.
   b) The zero error can be neglected when several readings are taken for a particular measurement.
   c) The zero error can be added or subtracted to correct the measurement in a suitable way.

   The correct statement/s is/are,
   1) a only
   2) b only
   3) c only
   4) a & c only
   5) a & b only

4) The radius of a hollow cylinder is r, and its axis is mounted vertically so that the cylinder can rotate around the axis. When the cylinder is placed with a small mass on the vertical wall of the cylinder, the mass is in static equilibrium when it rotates. If the co efficient of friction of the inner surface is μ, the frequency that the cylinder rotates will be,
   1) $\sqrt{\frac{g}{\mu r}}$
   2) $2\pi\sqrt{\frac{g}{\mu R}}$
   3) $\frac{1}{2\pi}\sqrt{\frac{g}{\mu r}}$
   4) $2\pi\sqrt{\frac{\pi r}{g}}$
   5) $\sqrt{\frac{\pi r}{g}}$

5) Two stones are projected with the same velocity and different angles to the horizontal. The range of their motions are equal. If the angle of projection & the maximum height of one stone are 60^0, y_1. respectively, the maximum height of the second stone is,
   1) $y_1/2$
   2) $y_1/3$
   3) $3y_1$
   4) $2y_1$
   5) $2y_1/3$



6) The minimum value for P in order to move the object as given in the figure is, (the co efficient of friction between the surfaces is 0.25)

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

7) A flywheel of 0.4kg m^2 moment of inertia around the axis of rotation, rotates at a constant angular velocity of 100 rad s^{-1} with the help of an electric motor of power 1 kW. The angular retardation of the flywheel when the electric motor is turned off will be,

1) 1 rad s^{-2}
2) 20 rad s^{-2}
3) 25 rad s^{-2}
4) 200 rad s^{-2}
5) 400 rad s^{-2}

8) The reading of a spring balance of a water container is 10 kg. The reading of the spring balance when an iron block is tied with a string and immersed halfway in the liquid is, (relative density of iron is 7.2)

1) 10 kg
2) 10.5 kg
3) 12 kg
4) 13.6 kg
5) 17.2 kg

9) A bus starts from rest and accelerates at 1 ms^{-2}. A student who is 48 m behind the bus, stars running towards the bus at a constant speed of 10 ms^{-1}, the student will be able to catch the bus,

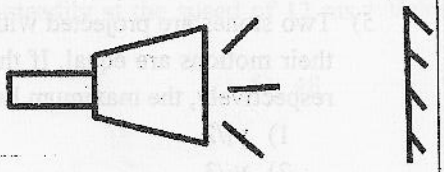
1) Only one time after 8 s from the beginning.
2) Only one time after 12 s from the beginning
3) Only one time after 10 s from the beginning
4) Two times after 8 s & 12 s from the beginning
5) Never happens.

10) The displacement of a simple harmonic motion is given by the equation x = 4. Sin 2t. If the motion starts when t = 0 and x = 0, the time when x reaches its maximum for the first time will be,

1) $\frac{\pi}{4}$
2) $\frac{\pi}{2}$
3) π
4) $\frac{\pi}{8}$
5) $\frac{2\pi}{3}$

11) The figure shows a speaker mounted at a certain distance from a smooth wall & emitting a sound of wave length 0.2m. A sound detector which is sensitive to pressure variation is placed in front of the wall. At what distance from the wall the sound detector will not detect any sound comes from the wall.

1) 0 m , 0.1 m , 0.15 m
2) 0 m , 0.1 m ,0.2 m
3) 0.05 m , 0.1 m, 0.2 m
4) 0 m , 0.1 m , 0.2 m , 0.3 m
5) 0.05 m , 0.15 m , 0.25 m



Physics I
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12) When a wire made of a certain type of metal is under a tension of T, the velocity of a transverse wave passing through it is30 ms^{-1}. The velocity of the transverse wave when another wire of the same material and length but three times the radius under the same tension T is given by,

1) 90 ms^{-1} 3) 30 ms^{-1} 5) 50 ms^{-1}
2) 60 ms^{-1} 4) 10 ms^{-1}

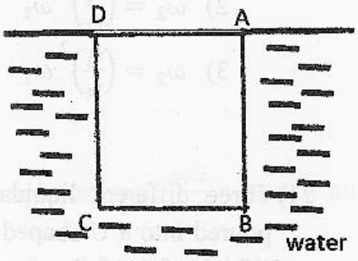
13) The total deviation of a ray of light which incident perpendicular to a surface of a prism of refractive index $\sqrt{2}$ and prism angle 30^0 is given by,

1) 45^0 3) 0^0 5) $sin^{-}(\frac{1}{3})$
2) 30^0 4) 15^0

14) A ray of light incident at 60^0 to a curved surface of a sphere of radius 3 cm and refractive index $\sqrt{3}$. The deviation of the ray when emerges from the surface of the sphere is given by,

1) 0 4) 90^0
2) 30^0 5) 180^0
3) 60^0

15) A glass block ABCD of refractive index 4/3 is vertically immersed in water as in the figure. B edge is seen 3 cm below the point B when viewed through water along AB surface. The depth of BC when viewed through AD surface will be,

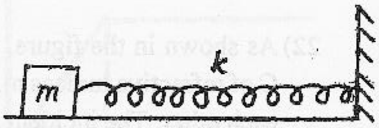


1) 3 cm 3) 2 cm
2) 7/3 cm 4) 8/3 cm 5) 10/3 cm

16) A small sphere of mass m and density d_1 is dropped in a liquid of density d_2. The velocity of the sphere after sometime becomes constant. The frictional force acting on the sphere when moving with a constant speed is given by,

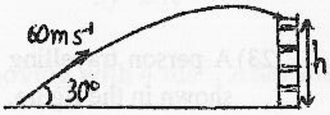
1) $\frac{md_1g}{d_2}$ 3) $m\frac{(d_1+d_2)}{g}$ 5) $mg\frac{(d_2-1)}{d_1}$
2) $mg\frac{(1-d_2)}{d_1}$ 4) md_1d_2

17) The frequency of oscillation of a spring – mass system kept on a smooth surface is f. If the spring constant is increased by 4 times and the mass m is increased by 2 times, the new frequency of oscillation is,



1) $\frac{1}{\sqrt{2}}f$ 3) $2f$ 5) $8f$
2) $\sqrt{2}f$ 4) $4f$

18) A cricket ball leaves a bat after striking at an upward angle of 30^0 to the horizontal with a velocity of 60 ms^{-1}. The ball lands on a roof of a building as shown in the figure. If the flight time taken to land on the roof is 5s, the height (h) of the building is,

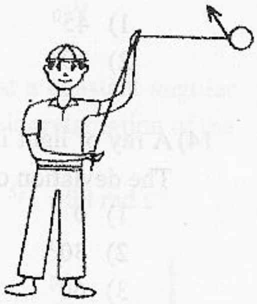


1) 20 m 4) 26 m
2) 24 m 5) 28 m
3) 25 m

19) A box of mass 5 kg is kept on a horizontal surface. The coefficient of static friction between the surface and box is 0.3. If a horizontal force of 10N is applied on the box, the frictional force acting on the box is,

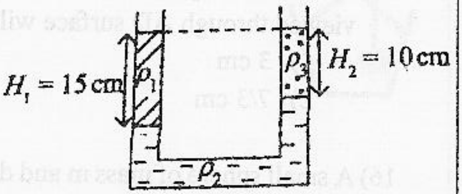
1) 1.5 N
2) 3 N
3) 4.5 N
4) 10 N
5) 15 N

20) As shown in the figure, a fire ball displayer of a procession twirls a fire ball on a horizontal circular path of radius r_1 with a uniform angular velocity ω_1. If he shortens the radius of the path to r_2 without applying an external torque, the new angular velocity ω_2 of the fire ball is given by,



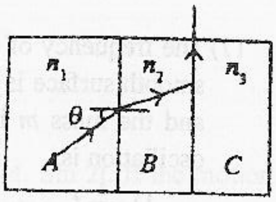
1) $\omega_2 = \frac{r_1}{r_2}\omega_1$
2) $\omega_2 = \left(\frac{r_1}{r_2}\right)^2 \omega_1$
3) $\omega_2 = \left(\frac{r_2}{r_1}\right)^2 \omega_1$
4) $\omega_2 = \frac{r_2}{r_1}\omega_1$
5) $\omega_2 = \omega_1$

21) Three different liquids, with densities ρ_1, ρ_2 *and* ρ_3 are poured into a U-shaped container as shown in the diagram. Which of the following equations gives the correct relation between the densities of the liquids in the container?



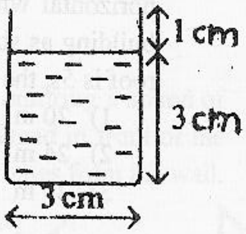
1) $3\rho_1 = 2\rho_3 + \rho_2$
2) $\rho_3 = 2\rho_1 + 3\rho_2$
3) $2\rho_3 = 3\rho_1 + \rho_2$
4) $\rho_3 = 3\rho_1 + 2\rho_2$
5) $\rho_3 = \rho_1 + \rho_2$

22) As shown in the figure, three parallel sided transparent media A, B and C of refractive indices n_1, n_2 and n_3 respectively are placed in contact with each other. The incident angle on the interface of the media A and B is θ. If the ray grazes the interface of the media B and C, $\sin\theta$ is given by,



1) n_1 / n_3
2) n_2 / n_1
3) n_2 / n_3
4) n_3 / n_1
5) n_3 / n_2

23) A person travelling in a car is holding a cylindrical cup of tea vertically as shown in the figure. Neglecting the vibration of the car, what is the maximum acceleration that the car can go without spilling any tea?



1) g / 3
2) g / 2
3) g / 1.5
4) g
5) 1.5 g

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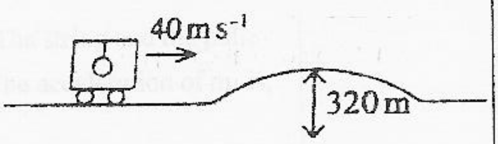
24) The period of a simple pendulum hung on the roof of a vehicle is T when it is moving with a uniform velocity of 40 ms^{-1}. As shown in the diagram the vehicle then enters a bridge with a curved surface of radius 320 m with the same speed. When the vehicle reaches the highest position of the bridge the new period of the pendulum is given by, (diagram is not drawn to the scale)



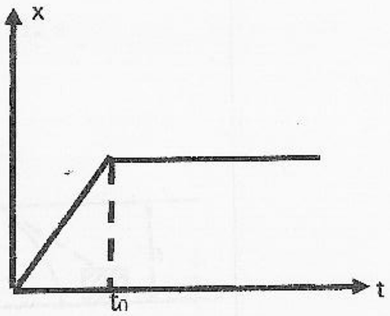
1) $\frac{1}{\sqrt{2}}T$
2) $\sqrt{\frac{2}{3}}T$
3) T
4) $\sqrt{\frac{3}{2}}T$
5) $\sqrt{3}T$

25) Which physical quantities have same dimension?
1) Moment of couple and work
2) Force and power
3) Latent heat and specific heat
4) Work and power
5) None of these

26) The potential energy of a particle varies with distance x from a fixed origin as $u = \frac{A\sqrt{x}}{x+B}$ where A and B are constants. The dimensions of AB ,

1) $M^1L^{\frac{5}{2}}T^{-2}$
2) $M^1L^2T^{-2}$
3) $M^{\frac{3}{2}}L^{\frac{5}{2}}T^{-2}$
4) $M^1L^{\frac{7}{2}}T^{-2}$
5) *None of these*

27) Figure given shows the displacement (x) time (t) graph of a particle moving on the x axis.

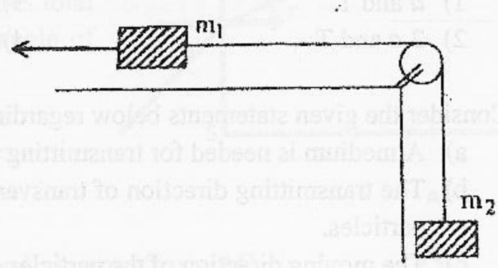


1) The particle is at rest.
2) The particle is continuously going along x direction
3) The velocity of particle increases up to time t_0 and then becomes constant.
4) The particle moves at a constant velocity up to a time t_0 and then stops.
5) The particle is accelerated

28) A projectile is projected with a kinetic energy E. Its range is R. It will have the minimum kinetic energy, after covering a horizontal distance equal to,
1) 0.25 R
2) 0.5 R
3) 0.75 R
4) R
5) 2 R

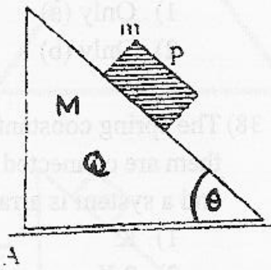
29) A body of 2 kg moving with 3 ms^{-1} collides head on with a body of 1 kg moving with 4 ms^{-1}. After the collision both stick together. What is the common velocity?
1) $\frac{1}{5}ms^{-1}$
2) $\frac{5}{3}ms^{-1}$
3) $\frac{2}{3}ms^{-1}$
4) $\frac{3}{4}ms^{-1}$
5) $\frac{5}{4}ms^{-1}$

30) A constant force F = $\frac{3}{2}m_2g$ applied on the block of mass m_1 as shown in fig. The string and the pulley are light and the surface of the pulley and the surface of the table is smooth. The acceleration of m_1 is,



1) $\frac{m_2g}{2(m_1+m_2)}$ towards left
2) $\frac{m_2g}{2(m_1-m_2)}$ towards left
3) $\frac{m_2g}{2(m_2-m_1)}$ towards right
4) $\frac{m_2g}{2(m_2-m_1)}$ towards left
5) $\frac{m_1g}{2(m_1+m_2)}$ towards right

31) A block Q of mass M is placed on a horizontal frictionless surface AB and a body P of mass m is released on its frictionless slope. As P slides by a length L on the slope of inclination θ, the block Q would slide by a distance.

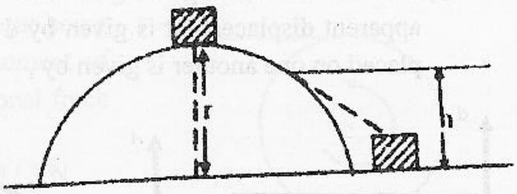


1) $\frac{m}{M}L\cos\theta$
2) $\frac{mL}{M+m}$
3) $(M+m)(ML\cos\theta)$
4) $\frac{mL\cos\theta}{m+M}$
5) $\frac{ML}{m+M}\cos\theta$

32) The moment of inertia of a body about a given axis is 1.2 kg m^2. Initially the body is at rest. In order to produce a rotational kinetic energy of 1500 J, an angular acceleration of 25 rad s^{-2} must be applied about that axis for a duration of,

1) 4 s
2) 2 s
3) 8 s
4) 10 s
5) 12 s

33) A small body of mass m slides down from the top of a hemisphere of radius r, the surface of block and hemisphere are frictionless. The height at which the body lose contact with the surface of the sphere is,



1) $\frac{3}{2}r$
2) $\frac{2}{3}r$
3) $\frac{1}{2}gr^2$
4) $\frac{v^2}{2g}$
5) v^2gr

34) A truck of mass 30 000kg moves up an inclined plane of slope 1 in 100 at a speed of 30 km h^{-1}. The power of the truck is,

1) 25 Kw
2) 10 Kw
3) 5 Kw
4) 2.5 Mw
5) 7.5 Kw

35) A block weight 15 N and 12 N in air and water respectively. When it is immersed in another liquid, it weighs 13 N, then the relative density of the block and the liquid will be,

1) 5, $\frac{2}{3}$
2) 6, $\frac{2}{3}$
3) 10, 5
4) 2, 3
5) 8, $\frac{4}{3}$

36) An object which executing simple harmonic motion with A amplitude and has a maximum acceleration a, it's period of time is T. If the amplitude is doubled, the new maximum acceleration and the period of time of the new simple harmonic should be,

1) a and T
2) 2 a and T
3) 2 a and 2 T
4) 4 a and T
5) 4 a and 2 T

37) Consider the given statements below regarding transverse waves,

a) A medium is needed for transmitting transverse waves.
b) The transmitting direction of transverse wave is in opposite with the direction of the vibrated particles.
c) The moving direction of the particles of subsequent through and crest of a transverse travelling wave is same.

Always correct statement from the above.

1) Only (a)
2) Only (b)
3) Only (c)
4) Only (a) and (c)
5) All (a), (b), (C)

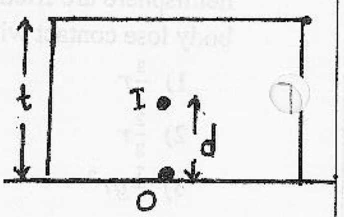
38) The spring constant of a helical spring is K. This spring is cut down into three identical parts. Two of them are connected parallel, and the remaining one is connected to serially to the other parallel spri and a system is arranged. The resultant spring constant would be.

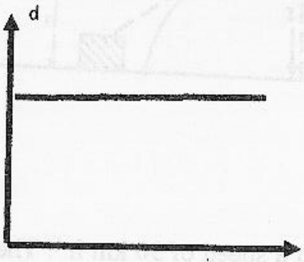
1) K
2) 2 K
3) $\frac{9K}{2}$
4) $\frac{2K}{3}$
5) 4 K

39) When a ray of light travels from one medium to another medium it changes its wave length form 12000 A^0 to 8000 A^0. Find the critical angle for these two media is,

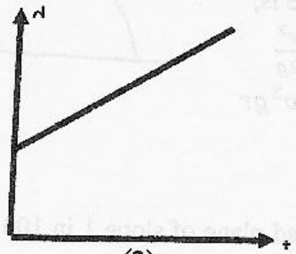
1) $cos^{-}\left(\frac{2}{3}\right)$
2) $sin^{-}\left(\frac{2}{3}\right)$
3) $tan^{-}\left(\frac{3}{2}\right)$
4) $cos^{-}\left(\frac{2}{\sqrt{3}}\right)$
5) $tan^{-}\left(\frac{2}{3}\right)$

40) The thickness of a given glass block is t and a point object is kept at the bottom of the block. The apparent displacement is given by d (OI). The graph of d against t, when identical glass blocks are placed on one another is given by ,

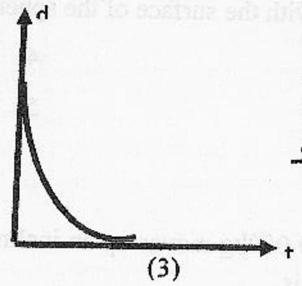




(1)



(2)



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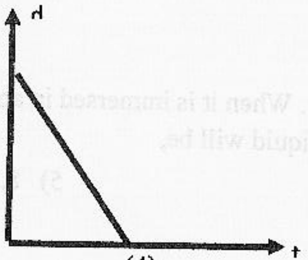

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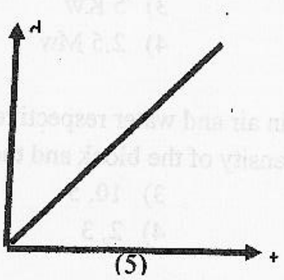
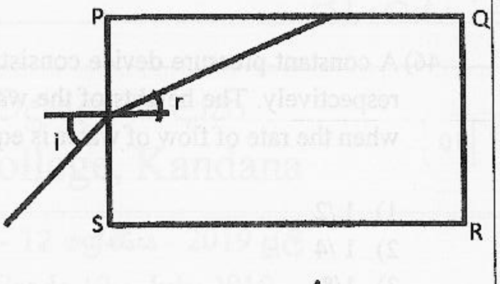


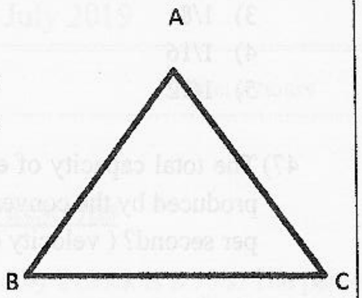
(5)

41) The figure shows of a ray of light, incident on a side of a rectangular glass block. The angle of incident and angle of refracted are i and r respectively. The ray undergoes total internal reflection at PQ surface. If the critical angle of glass – air interface is θ_c,



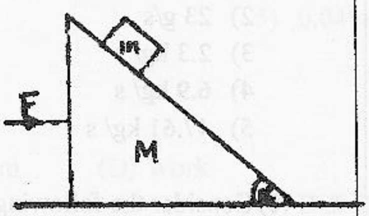
1) $\theta_c \leq 90 - r$
2) $\theta_c \geq 90 - r$
3) $\theta_c = r$
4) $\theta_c > r$
5) $\theta_c < r$

42) A monochromatic ray of light incident at AB and emerges from AC surface of an equilateral triangular prism. If the minimum deviation is 30^0, the refractive index of the prism is,



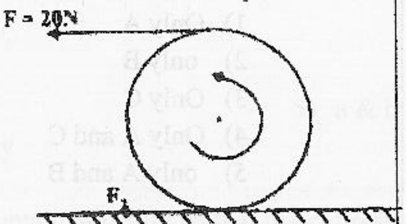
1) 1.41
2) 1.44
3) 1.50
4) $\frac{\sin 45^0}{\sin 15^0}$
5) $\sqrt{3}.\sin 45$

43) As shown in the figure, a cube of mass m is placed on a wedge of mass M which has an angle of inclination of α to the horizontal. If all the surface are frictionless, the force (F) which should be acted in order to keep the cube at a certain height above the horizontal plane is ,



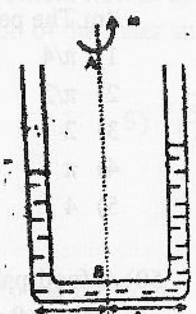
1) $(M+m)$g Sin α
2) $(M+m)g$ Co α
3) (M +m) g $Tan\ \alpha$
4) $\frac{(M+m)g}{Sin\ \alpha}$
5) $\frac{(M+m)g}{Cos\ \alpha}$

44) As shown in the figure, a cylindrical object rotates without being slipped under a force of 20N.The mass, radius and moment of inertia are 4 kg , 1.0 m , 2 kgm^2 respectively. The frictional force acting on the object is ,



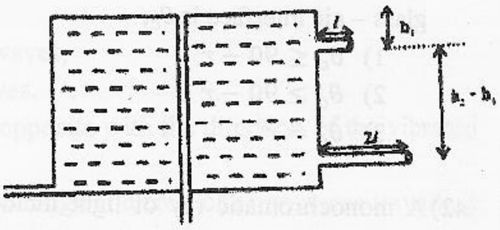
1) 20 N 2) 12 N 3) 10/3 N 4) 20/ 3 N 5) 40 / 3 N

45) A U tube with a uniform cross section rotates at a constant angular velocity of 10 rads^{-1} around the vertical axis of AB. The difference between the water levels of the two arms if it is filled with water as shown in the figure,



1) 0.5 cm
2) 0.8 cm
3) 1.0 cm
4) 1.6 cm
5) 2.0 cm

46) A constant pressure device consists of two thin tubes, which are l , 2 l in length and radius a , a/2 respectively. The heights of the water level in the tubes are shown in the figure. The ratio of h_1 / h_2 when the rate of flow of water is equal in both of the tubes.



1) 1 /2
2) 1 /4
3) 1/8
4) 1/16
5) 1/32

47) The total capacity of electricity generation in Sri Lanka is approximately 2.1 GW. If this power is produced by the conversion of mass to energy, what is the mass that needs to be converted into energy per second? (velocity of light (c) = 3×10^8 ms^{-1} , $E = m c^2$)

1) 0.023 mg/s
2) 23 g/s
3) 2.3 kg/ s
4) 6.9 kg/ s
5) 47.61 kg/ s

48) Consider the following statements about waves.

A) The frequency of waves produced by a vibrating source depend on the quality of the source and does not depend on the quality of the medium.
B) The wavelength does not depend on the properties of the path in which they are traveling
C) The velocity of the waves depends on the properties of the medium.

The correct statement/s is /are

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

49) The maximum acceleration of a particle in simple harmonic motion is 16 ms^{-1}, and the amplitude is 4m. The periodic time of the particle is ,

1) $\pi/4$
2) $\pi/2$
3) 2
4) π
5) 4

50) A food packet is released from a helicopter rising steadily at the speed of 12 ms^{-1} Velocity of the packet after 2 s in ms^{-1} is,

1) 22
2) 20
3) 18
4) 36
5) 48

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De Mazenod College, Kandana

01 E II

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Grade - 12

Third Term Test – Grade 13 – July 2019

Index Number ....

PHYSICS I I

Time : 3 hours

- ❖ Part A – Structured Essay
  Use the space given.

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

PART A – STRUCTURED ESSAY

01.

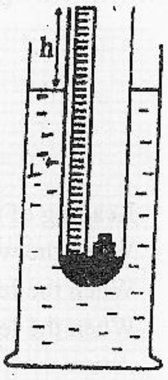
a) State ‘Principle of flotation’

....

....

....

b) A student uses a weighted test tube to find the density of a liquid.



The mass of the tube = M
Mass of additional weights inserted into the tube = m
Area cross section of the cylindrical portion = a
Total volume of the tube = V
The height of the tube above the liquid level = h
Density of the liquid = ρ

i. Write down an equation for the equilibrium of the above tube.

....

ii. Rearrange the above equation to find the density of the liquid using a graphical method.

....

....

a) What is the independent variable? ....

b) What is the dependent variable? ....

iii. If the gradient of the graph is $-1.61\ m\ kg^{-}$ and the external radius of the tube is 1.4 cm, find the density of the liquid.

....

....

....

iv. What is the reason for adding an initial weight to the test tube mention above?

....

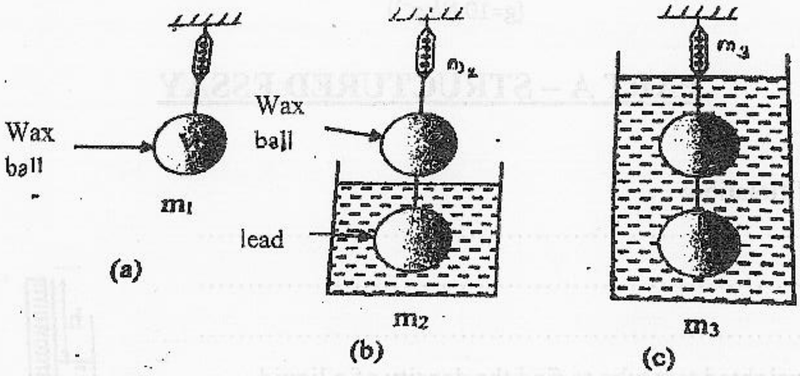
....

v. Why does the hydrometer scale is not uniform as the thermometer scale?

....

....

c) The readings of an experiment which is used to find the relative density of a substance which floats in the water (ex : wax) are given as bellow



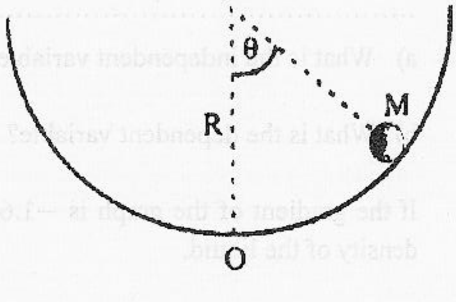
Reading of the spring balance,
When the wax ball is in air (figure a) $= m_1$
When the lead sphere is immersed in water (figure b) $= m_2$
When the lead & wax both immersed in water (figure b)$= m_3$

Write down an expression for relative density of wax

....

....

02. A ball bearing of radius r undergoes a simple harmonic motion around a point 'O' with small amplitudes inside a smooth semicircular metal bowl of radius R. A student is required to find the value for gravitational acceleration by observing the motion of ball bearings with different radii.



a) Mark the forces acting on M in the diagram

b) Use F = ma equation towards the center of oscillation of M.

....

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Grade - ~~B~~ 12
Physics II

c) If the displacement from the center of oscillation of M is x, find a relation between the acceleration and the displacement using the above equation.

……………………………………………………………………………………………

……………………………………………………………………………………………

d) Find an expression for the periodic time (T) by using the above equation (c)

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e) Rearrange the above expression (for T) to find the gravitational acceleration in this experiment.

……………………………………………………………………………………………

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f) Write 3 procedures to minimize the errors which can be occurred in this experiment.

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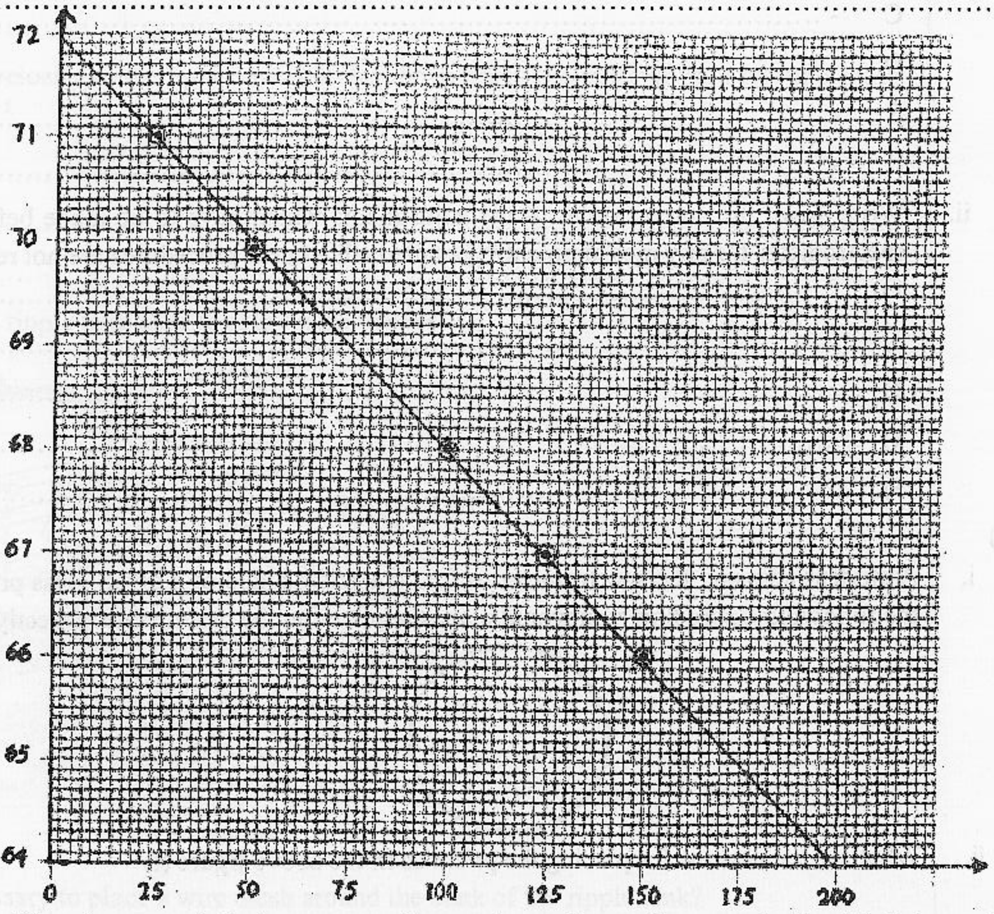
g)



i. The above graph is drawn according to the readings taken practically. Find the gradient of the graph.

……………………………………………………………………………………………

……………………………………………………………………………………………

ii. Find a value for gravitational acceleration ($\pi = 3$)

....

....

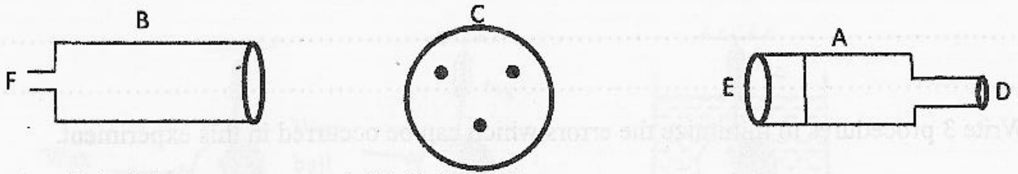
iii. Find a value for the radius of curvature of the metal bowl

....

....

03.

a) Figure shows a spectrometer arrangement used in an experiment



i. Label the components A, B, C, D, E, F

A - ....

B - ....

C - ....

D - ....

E - ....

F - ....

ii. Write down the correct order of the adjustments which have to be made before using the spectrometer for any measurement? (Detailed adjustment procedures are not required)

1) ....

2) ....

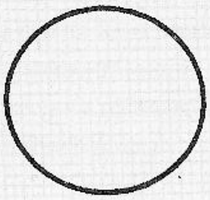
3) ....

4) ....

5) ....

b)

i. A student adjusted the spectrometer to find the prism angle of a given glass prism. Show in the following figure how you would place the prism on the prism table correctly



ii. What are the reasons for placing the prism as in the above figure (i)

....

....

....

iii. The prism that the student used in this experiment was an acute angled prism, and the readings were $30^0 20'$ and $310^0 10'$ calculate the prism angle.

....

....

....

iv. If the main scale of the spectrometer is calibrated in degrees and 29 degrees are coincided with 30 divisions of Vernier scale; find the least count of the spectrometer in minutes.

....

v. Calculate the percentage error of the reading of $30^0 20'$ taken by the student.

....

....

vi. The minimum deviation for the above prism was $35^0 25'$ calculate the refractive index of the prism.

....

....

....

....

vii. Calculate the velocity of the light travels in the above prism (velocity of light through space $= 3 \times 10^8 ms^{-1}$

....

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04. Below is a diagram of a ripple tank used to study water waves.

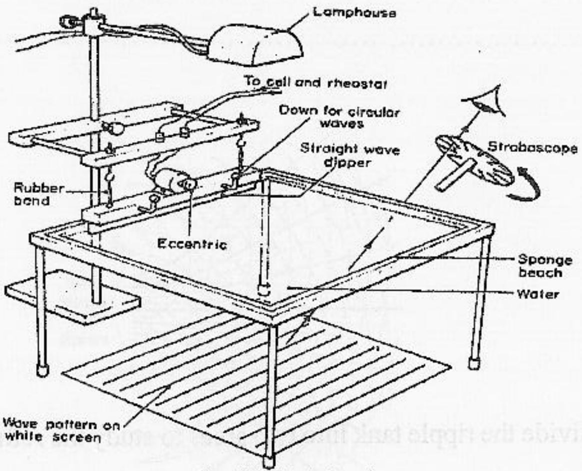


Fig. 26.3. The ripple tank

a) .

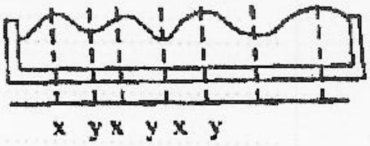
i. Why is it necessary to place a wire mesh around the bank of the ripple tank?

....

....

....

ii. **When the waves in the tank are created and a light source is placed above them, there will be dark and bright areas appeared on the white paper.**



what regions correspond to x and y

region correspond to y.......................................

region correspond to x.......................................

explain your answer

iii. Are water waves transverse or longitudinal?

Explain your answer

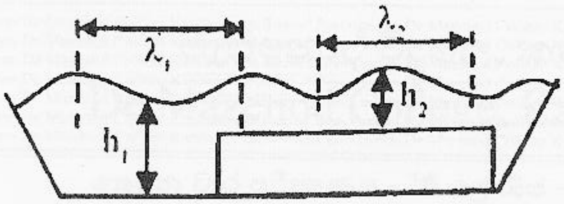
b) What type of barrier can be placed in front of the linear wave to create a circular wave?

Draw a suitable diagram to explain the above (b)

c) .

i. Why is it necessary to divide the ripple tank into two areas to study the refraction of the waves?

ii.



Refraction can be demonstrated by placing a thick glass plate on the bottom of the tank. If the depth of water is h , the velocity of the water wave can be written as $V = \sqrt{gh}$. Write down an expression for λ_2 in terms of h_1 , h_2, λ_1

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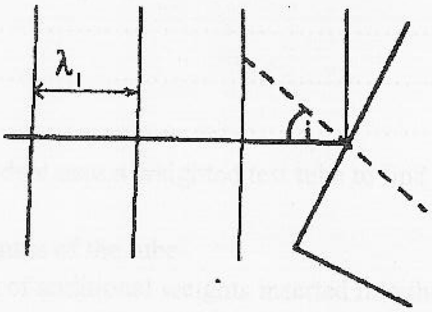
iii. Draw the wave front passing through the glass plate as shown in the diagram below



d) What characteristics of the waveform is shown in the following figure?

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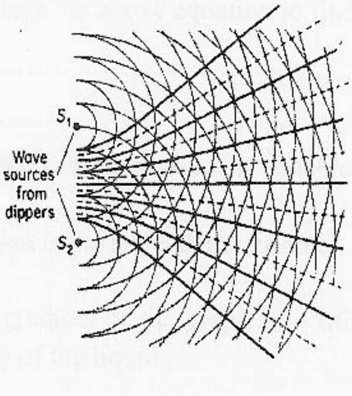

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De Mazenod College, Kandana

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Third Term Test – Grade 12 – July 2019

Index Number ....

PHYSICS I I

Time : 3 hours

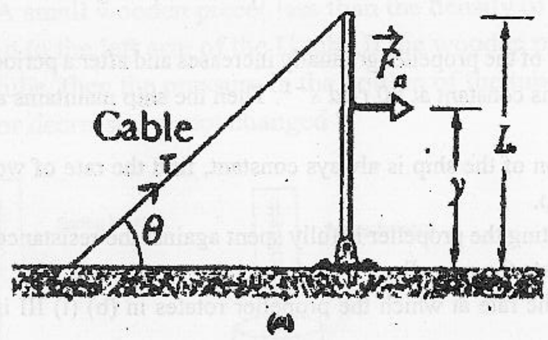
❖ Part B – Essay

Answer four questions only.

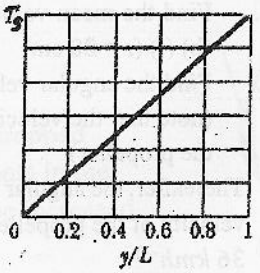
(g=10 Nkg^{-1})

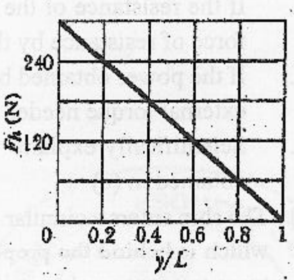
PART B – ESSAY

05. A uniform straight pillar of length L is hinged at its bottom end. The diagram shows that a horizontal force of $\overline{Fa}$ acts at a point which is y distance away from the bottom. The pillar is kept vertically by using a cable attached to the top of the pillar and the other end to a point on the ground by making an angle of θ to the horizontal. The tension of the cable is T.



(a)





(c)

a) Considering the vertical and horizontal components of the reaction at the hinge as F_v an F_h, mark all the forces act on the vertical pillar.

b) Find an expression related with T and y.

c) Find an expression related with Fh and y.

d) Find the value of $\overline{Fa}$. In (b) and (c) graphs the horizontal axis y is calibrated in L
Vertical axis (T) in graph (b) has calibrated as Ts = 600 N

e) Find the angle θ

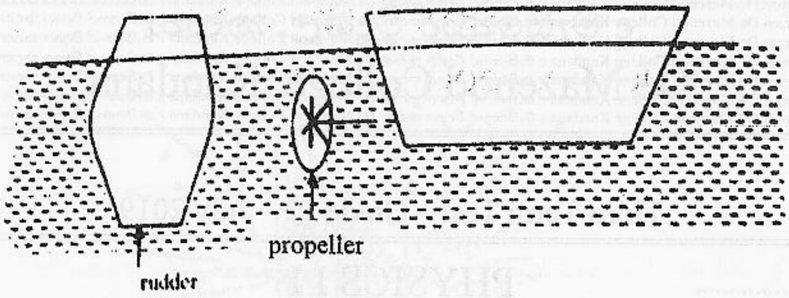
f) Now the length of the cable is gradually increased without the force ($\overline{Fa}$) and the pillar is then lowered to the right. If the vertical height h at the top of the pillar will change with the tension (T) of the cable, draw a rough sketch to show the variation of T against h.

g)

i. If the pillar rotates around the hinge and falls without the tension of the cable and $\overline{Fa}$ force, calculate the angular velocity when the pillar comes to the horizontal position.
(The moment of inertia of a uniform rod around one end is $\frac{ML^2}{3}$, M is the mass of the pillar)

ii. State the law, you used here.

06. The mass of a small ship used for military activities is 8 x 10^3kg, and when it is floating in still water 1/3 of its volume is submerged.



When it is loaded with water, food, and equipment before it begins to sail, ¾ of its volume is submerged.

a) If the density of water is 1000 kgm^{-3}, what was the mass of the goods loaded into the ship?

b) The horizontal resistance of water against the motion of the ship, just before it begins to sail is 0.735 Nkg^{-1}

i. Find the minimum external force to be used to start the motion of the ship.

ii. To obtain this force, the propeller mounted at the back of the ship rotates rapidly, pushing the still water backwards. By considering the length of the blade of the propeller as r, the density of water as ρ and the mean velocity of the water pushing backwards by the propeller as v,

iii. Write down an expression for the mass of the water pushing backwards in 1 s.

iv. Find the mean velocity that the water should be pushed backwards to obtain the minimum force in (b) (i) (r = 20 cm)

v. Find the angular velocity at which the propeller rotates to obtain the above velocity. (note that the velocity of water moving backwards is equal to the tangential velocity of the blade of the propeller)

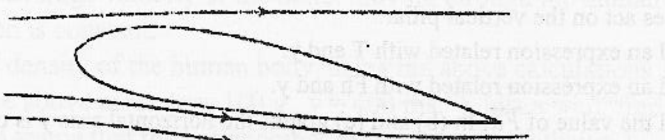
c) Thereafter, the angular velocity of the propeller gradually increases and after a period of time, the angular velocity of the propeller remains constant at 80 $rad\ s^{-1}$. Then the ship maintains a uniform velocity of 36 kmh^{-1}.

i. If the resistance of the motion of the ship is always constant, find the rate of work done, against the force of resistance by the ship.

ii. If the power obtained by rotating the propeller is fully spent against the resistance of the ship, find the external torque needed to rotate the propeller.

iii. Scientifically explain why the rate at which the propeller rotates in (b) (i) III is less than the value obtained in (c)

d) The ship enters a circular orbit at a uniform velocity of 36 km/h^{-1}. For this purpose, the section (rudder) which is behind the propeller is slanted vertically. Therefore, the water which was flowing backwards, turns to move as shown in the figure below.



Stream lines of water around the rudder are shown in the diagram. The velocity of the water on either side of the rudder is v and v/30 , v is the mean velocity of the water, pushed backwards by the propeller.

i. Find the pressure difference on either side of the rudder assuming that the water flow is stream lined & steady.

ii. Find the force on the rudder if the effective area of pressure is 0.5 m^2

iii. If this force (ii) gives the centripetal force required to move the ship in a circular path, find the radius of this circular path.

31.07.2019 Physics II Grade - 12

10.

a) Figure shows a modified U tube experimental set up to find the density of an oil.The diameter of the uniform U tube is 0.850cm.The level AB of mercury in the two arms of the U tube is horizontal.

(density of water -1000kgm^{-3})

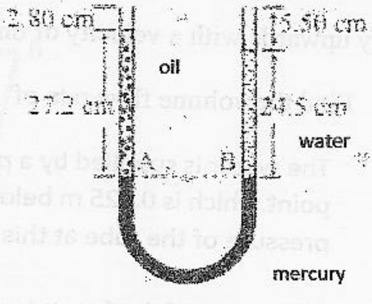


Figure 1

i. Calculate the density of oil

ii. Calculate pressure at mercury-water common interface(B)

The left arm of the above U tube now changed to a conical shape tube. The same amount of mercury is used in the new U tube.(same levels of mercury are mentioned in figures 1 and 2 using the dotted lines). The same amount of oil and water are now added to the left and right arm respectively.

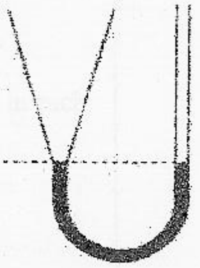


Figure 2

iii. Mention the new position of B respective to the level A. (above A, below A or same as level A)

iv. A small wooden piece(less than the density of oil)is dropped in to the left arm of the U tube.If the wooden piece floats in the tube, then the pressure in the bottom of the tube will be increased, or decreased or not changed ?

b)

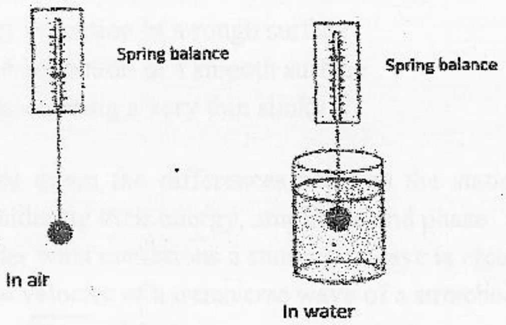


Figure 3

An object is suspended using a spring balance as shown in the above figure.The reading of the balance in the air is17.8N and the reading when the object is fully immersed in the water is 16.2N.(density of water is 1000kgm^{-3})

i. Calculate upthrust force when the object is in the water.

ii. Calculate the volume of the object.

iii. Calculate the density of the object.

iv. When the object is removed , how does it affect with the pressure at the bottom of the container. Explain your answer.

(C) The figure 4 shows a water fountain ejects water from a hole of radius 0.015m.

Water ejects vertically upwards with a velocity of $6ms^{-1}$. (density of water is $1000kgm^{-3}$).

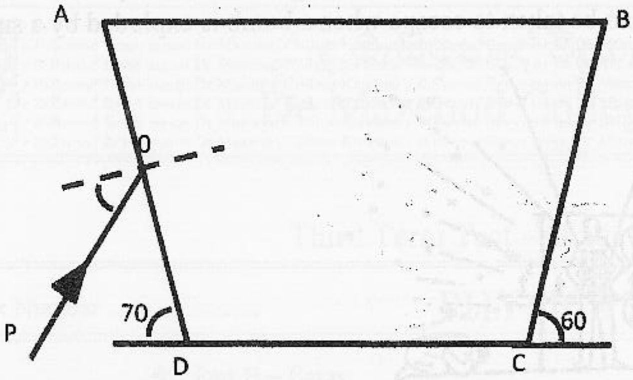
i. Find the volume flow rate of water

ii. The water is supplied by a pipe to this fountain. The radius of the tube is 2.5m at one point which is 0.025 m below the opening of the water fountain. Find the absolute pressure of the tube at this point.

iii. The owner of the fountain wants to increase the height of the water to 4 m with the same initial volume rate. A loop can be attached to change the size of the opening of the fountain for this purpose. Calculate the new radius of this aperture

Figure 4

07. The figure shows a glass block of refractive index 1.67. ABCD is a trapezium shaped cross section of the glass block.



a) Calculate the critical angle for glass – air interface.

b) Find the minimum value for θ, when a monochromatic ray (PO) falls and emerges from AB surface.

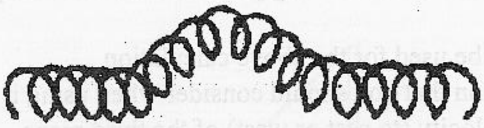
c) Now the BC surface is in contact with another medium of refractive index 1.3. When θ is 50^0, the incident ray emerges from BC surface. Find the angle of emergent at BC surface.

d) If the above prism is made of glass of refractive index 1.5, state whether the ray emerges from AB surface when the incident ray travels along the DA surface. Explain your answer

e) $(\sin 41^0 48' = 0.6667)$

08. .

a) A pulse of a transverse wave in a slinky is given in the following figure. Draw its shape in each of the following cases



- i. After reflection in a rough surface
- ii. After reflection in a smooth surface
- iii. After entering a very thin slinky

b) .

- i. Write down the differences between the stationary waves and progressive waves by considering their energy, amplitude and phase
- ii. Under what conditions a stationary wave is created?
- iii. The velocity of a transverse wave of a stretched string is given by the equation $V = \sqrt{T/m}$. T is the tension and m is the mass per unit length.
  - I. Show that this equation is dimensionally correct.
  - II. If the sting vibrates in fundamental mode, write down an equation for its frequency in terms of length l and velocity V.

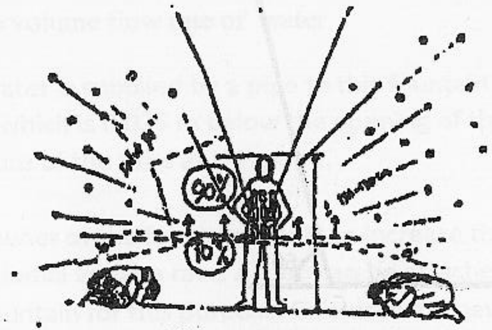
c) A uniform steel wire of diameter 0.36 mm is stretched horizontally, under a tension of 50 N. If the length is 1.25 m and the density of steel is 7800 kg m^{-3}, Calculate the velocity of transverse wave produced in the string.

d) If the above string (c) vibrates in fundamental mode, find its frequency.

e) If the string is horizontal at t = 0, when it vibrates in fundamental, draw the instances of the vibration when t = T/4 , t = T/2 , t = 3T /4 where T is the periodic time.

f) A transverse wave is sent vertically downwards along a stretched slinky. Explain how the velocity of the wave changes with its distance.

09. In the recent past, several places access to Colombo and Negombo have exploded. This question discusses about the steps that can be taken to escape when a bomb is exploded by a suicide bomber.



BOMB BLAST SIMULATION
EFFECT THEORY

Every person should follow the following self-defense measures to escape from this danger
1 running 2 hiding and stay still 3 awareness of police

Prior to these basic methods, you should be lying on the ground when you hear a loud noise. Only 10% of the bomb explode below the horizontal level .

i. Consider a bomb that weighs 10 kg of initial mass and explodes into three parts. A 10 kg piece moves north at a speed of 200 ms^{-1}, while a 5 kg piece moves east at a speed of 150 ms^{-1}. To find the velocity of the third piece,

   I. Write the principle to be used for the above calculation
   II. State a basic assumption that you should consider when using it
   III. Find the horizontal velocity (to east or west) of the third piece.
   IV. Find the vertical velocity (to north or south) of the third piece.
   V. Find the velocity and the direction of the third piece.

ii. In the case of bomb explosion, it can be divided into many smaller pieces. A 100 g of a piece (bullet) travels at a speed of 400 ms^{-1} and hit with a 20 cm fat (width) of a man. If it leaves at 380 ms^{-1} away from the body, calculate the average friction force acting on the piece when it passes through the body.

iii. If the average frictional force is F, it can be calculated by using the equation $F = \frac{1}{2} CA pv^2$, *where C* is a constant, A is the area of the piece p is the density of the human body and v is the average velocity of the piece through the body. If C= 0.6 , A = 1 cm^2 ,

   I. Find the average velocity of the bullet moving through the human body, assuming the force of friction is constant.
   II. Find the density of the human body, using the above calculations
   III. When the above piece (m= 100 g , v = 400 ms^{-1}) hits a wall, find the force acting on the wall in 1 s. (Assume that the bullet comes to rest after the collision)

iv. If a bomb is located 1.5 m above the ground, find the radius of the curvature that can be protected from the moving pieces which make a 10^0 angle downwards with the horizontal

(The velocity of a bullet is 150 ms^{-1} , cos 10 = 0.98 , sin 10 = 0.17)