Royal College – Colombo 07

Grade 12

Second Term Test -September 2024

Physics - I

$g = 10\ N\ kg^{-1}$ Time: 1 hour and 40 minutes

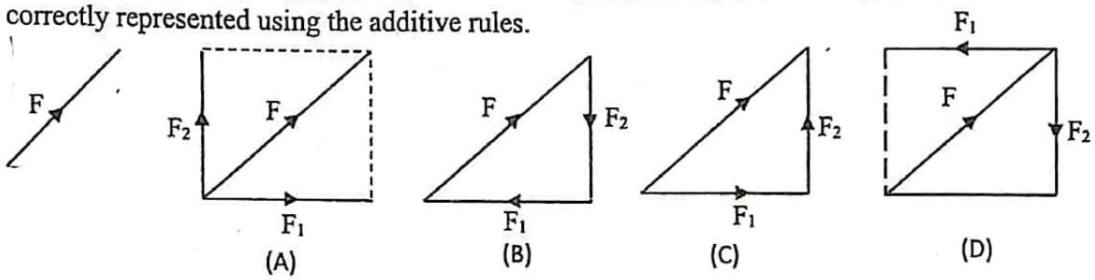
❖ Answer all the questions.

01) Seconds (s) are obtained by simplifying units from which one of the given physical quantity combinations

(1) $\frac{\text{velocity}}{\text{Displacement}}$ (2) $\frac{\text{acceleration}}{\text{velocity}}$ (3) $\frac{\text{angular displacement}}{\text{angular velocity}}$

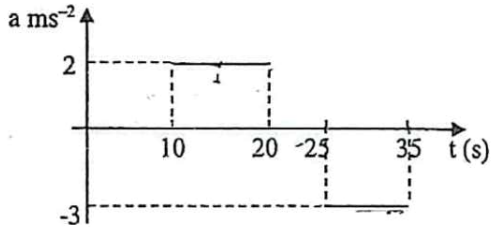
(4) Frequency × period (5) $\frac{\text{velocity gradient}}{\text{Displacement}}$

02) F_1 and F_2 Shows the case where the resultant vector F expressed using the two vectors is correctly represented using the additive rules.



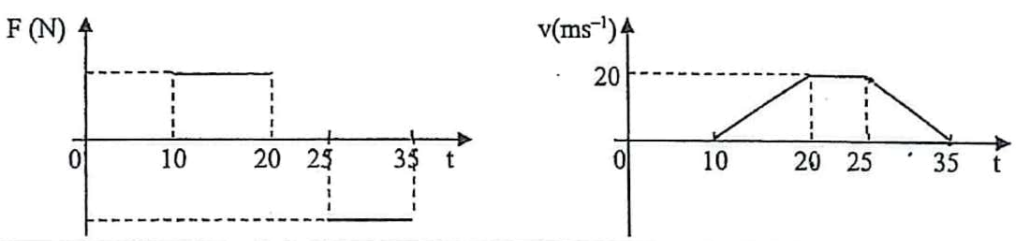
(1) A only (2) C only (3) A and B only (4) A and D only (5) A and C only

03) Below is the variation of acceleration with time due to an external force acting on a stationary object.



Which option correctly describes the variations of force acting on the object and the velocity with time?

(1)



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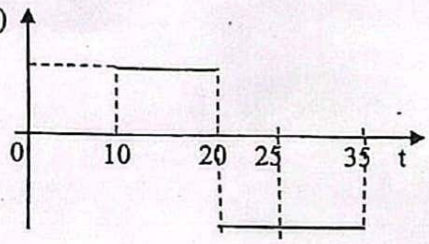

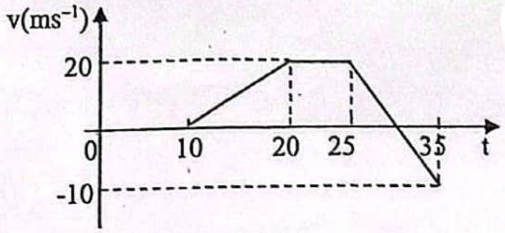

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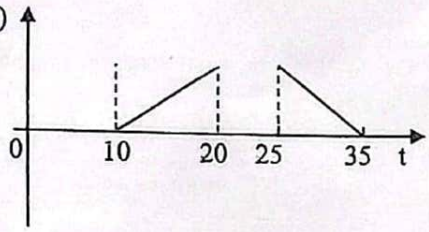

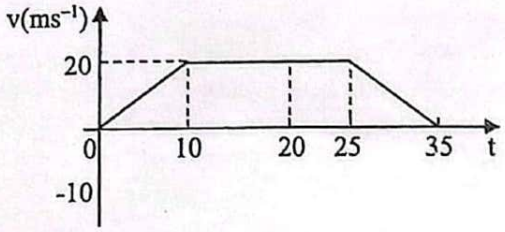

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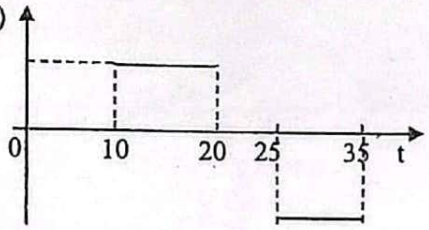

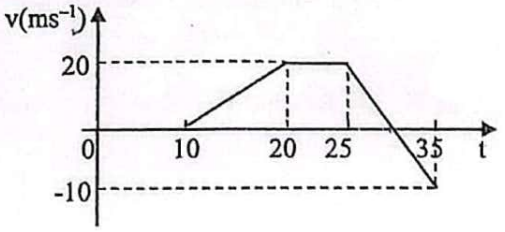

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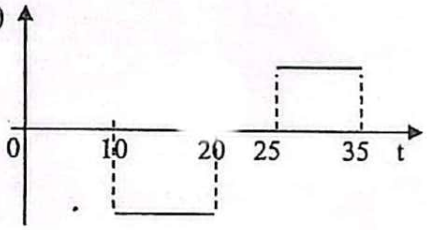
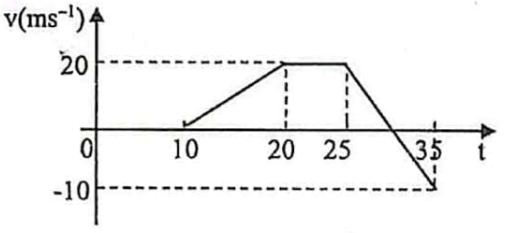




04) Which of the following statement/s is/are always correct?

(A) Whenever a force acts on an object, it undergoes a constant acceleration
(B) The kinetic energy of an object projected upward with rotation is zero when it reaches its maximum height.
(C) An object is in equilibrium und he system of forces if the moments of forces are separately zero around any two nts in the coplanar system of forces.

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

05) Two forces of equal magnitude act on a point in the positive direction of the x-axis and in the direction inclined at 60^0 to the positive x-axis. The x-direction component of the inclined force is 10 N. The magnitude of the resultant force of the two forces is

(1) 10 N (2) 20 N (3) $10\sqrt{3}$ N (4) $20\sqrt{3}$ N (5) 50 N

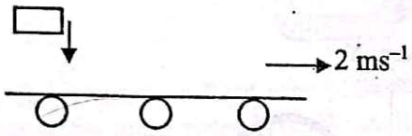
06) A hollow sphere consisting of a uniform crust of mass m_1 and a uniform ring of mass m_2 with unequal radii are released from rest at the same point from the top of a horizontally inclined rough plane. Choose the answer that accurately expresses the ratio of $\frac{\text{frictional force on the ring}}{\text{frictional force on the hollow sphere}}$ (Assuming that both objects roll without slipping, the moment of inertia of the ring is mr^2 and the moment of inertia of the hollow sphere is $\frac{2}{3}mr^2$.)

(1) $\frac{4m_2}{5m_1}$ (2) $\frac{5m_2}{4m_1}$ (3) $\frac{3m_2}{2m_1}$ (4) $\frac{2m_2}{3m_1}$ (5) $\frac{5m_1}{4m_2}$

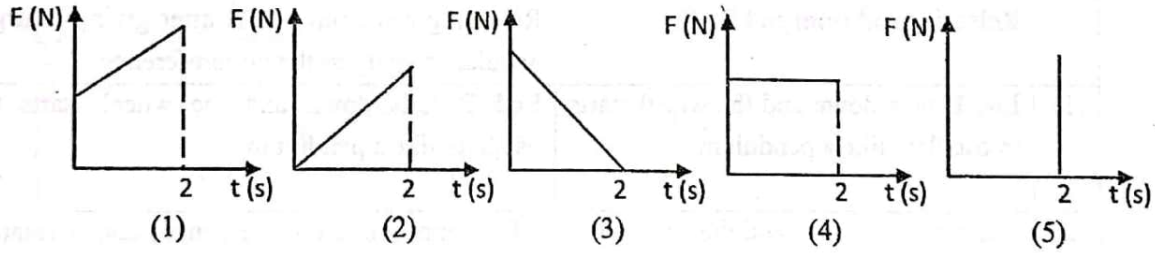
07) The horizontal range of an object projected with an inclination to the horizontal is four times the maximum height. If its initial velocity is $10\sqrt{2}\ ms^{-1}$ and after 0.5 s the velocity with which the object is moving is inclined to the horizontal is α,

(1) $\alpha = \tan^{-1}\left(\frac{1}{2}\right)$ (2) $\alpha = \tan^{-1}\left(\frac{1}{3}\right)$ (3) $\alpha = \tan^{-1}\left(\frac{1}{4}\right)$ (4) $\alpha = \tan^{-1}\left(\frac{1}{5}\right)$ (5) $\alpha = \tan^{-1}\left(\frac{1}{6}\right)$

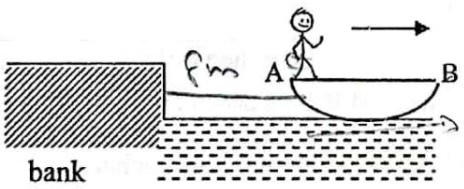
08)



A conveyor belt is moving with a velocity of 2 ms^{-1} as shown in the figure. A pack of cement of mass 50 kg is dropped on it. It acquires a velocity of 2 ms^{-1} in a time of 2 s. When the variation of the frictional force exerted by the belt (F) on the dropped pack of cement is plotted with time (t),



09)



A man of mass 40 kg was at the end A of the boat of mass 20 kg. The length of the boat is 5m. Initially, the distance between the end A of the boat and the bank was 8 m. The man walks to the end B with uniform velocity. When the man reaches the end B the distance between the boat and the bank will be,

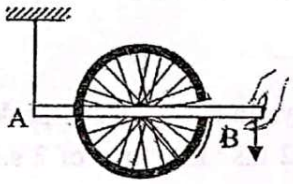
(1) 3.33 m (2) 11.33 m (3) 4.67 m (4) 8.33 m (5) 8 m

10) A man plucks a king coconut, spins it and releases it from the top of the tree. The incorrect physics concept given here is,

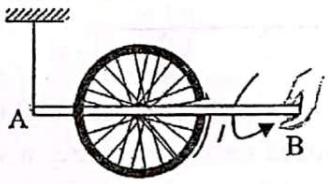
(1) An external unbalanced torque can cause the king coconut to rotate.
(2) Due to rotational inertia, it cannot sustain its rotational motion.
(3) Since the angular momentum of the king coconut is in the vertical direction, it reaches the ground keeping the direction of momentum constant.
(4) If no external torque acts, angular momentum is conserved.
(5) If the king coconut is released without twisting it is more likely to split when it lands on the ground.

11) As shown in the figure, a bicycle wheel is attached to the rod AB and is suspended by a string tied to the end A and held by end B. Choose the correct option about the of motion in each case below.

Case -X

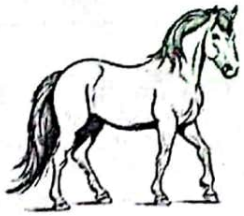


Case -Y



	Case - X Releasing rod from end B	Case - Y Releasing rod from end B after giving a large angular velocity to the circumference
(1)	End B falls down and the wheel starts to oscillate like a pendulum	End B falls down and the wheel starts to oscillate like a pendulum
(2)	The end B is down, and the axis AB is vertical.	AB is approximately horizontal, and it rotates about a vertical axis through A.
(3)	The end B is down, and the axis AB is vertical	It rotates about the vertical axis through A when the end B falls down and the rod AB is vertical
(4)	End B falls down and then travels in a circular path	AB direction remains unchanged
(5)	End B is down, and rod AB is vertical.	End B falls down and begins to oscillate as a pendulum

12) Use the figure below to understand the forward motion of a horse when the horse is pulling a cart and consider the corresponding statements.



A - When the legs are in contact with the floor perpendicular reaction forces act on the legs.

B - The formation of frictional forces and magnitude of frictional forces are determined by the way and the amount that the feet push the ground.

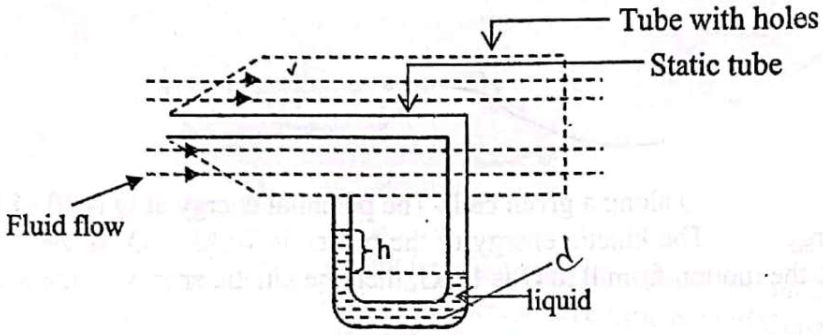
C - There is no force acting on the foot which is not touching the ground.

D- The ground exerts forces on the horse's feet for forward movement

The correct statement/s is/are

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

(13)

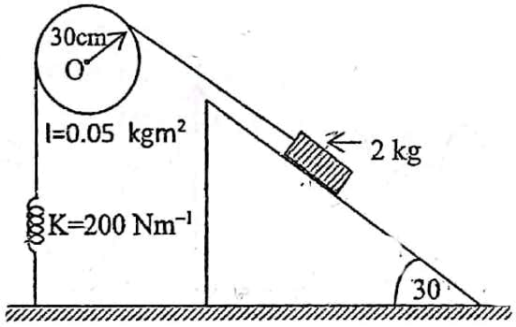


The figure shows a Pitot tube placed in a flowing fluid. The difference between the liquid levels in the manometer is h. When the density of the liquid inside the manometer is d and the density of the flowing fluid is ρ, velocity of the fluid v is given by,

1) $\sqrt{2\rho ghd}$ 2) $\sqrt{2dgh}$ 3) $\sqrt{\rho gh/d}$

4) $\sqrt{dgh/\rho}$ 5) $\sqrt{\frac{2dgh}{\rho}}$

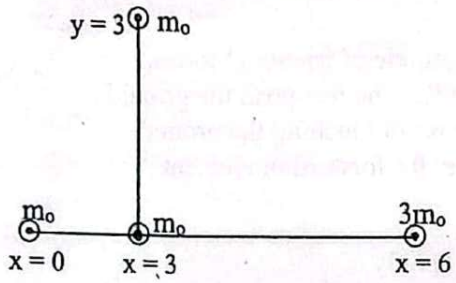
(14)



As shown in the figure, an inelastic string attached to the unstretched spring is passed around a pulley of radius 30 cm and moment of inertia 0.05 kgm^2 and the other end is attached to a mass of 2 kg placed on a smooth inclined plane. The distance the object is displaced along the plane if the system is released and returns to equilibrium.

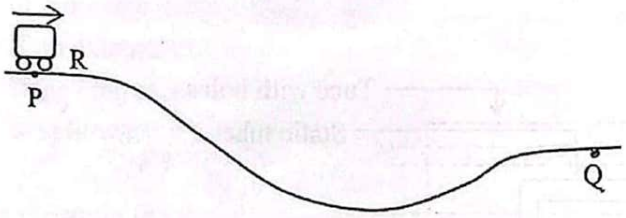
1) 0.01 m 2) 0.05 m 3) 0.1 m 4) 0.2 m 5) 0.6 m

(15) The figure below shows some point masses placed in an x-y axis system. The coordinates of the center of mass of this system are,



1) 4, 0.5
2) 2, 0.5
3) 3, 1
4) 0.5, 4
5) 0.5, 2

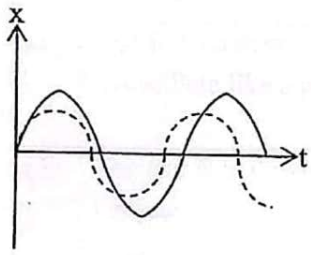
(16)



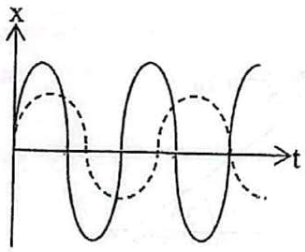
A trolley moves from P to Q along a given path. The potential energy at Q is 40 kJ less than the potential energy at P. The kinetic energy of the trolley is 70 kJ at Q. If the work done against friction in motion from P to Q is 15 kJ, then the kinetic energy of the trolley at P can be,

1) 8 kJ
2) 12 kJ
3) 15 kJ
4) 45 kJ
5) 60 kJ

(17) The displacement (x) - time(t) graph of a simple pendulum when the pendulum is started to oscillate by giving a tangential speed v at the center of oscillation is given by dashed lines in the answers below. Choose the answer that best represents the corresponding displacement-time graph compared to the original graph if the oscillation was started by applying a tangential velocity of 2v.



1)



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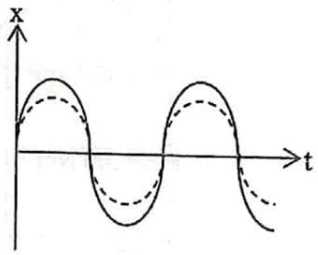

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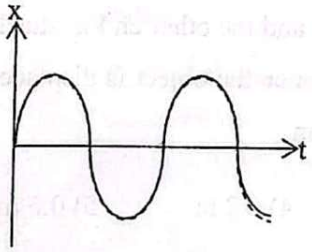

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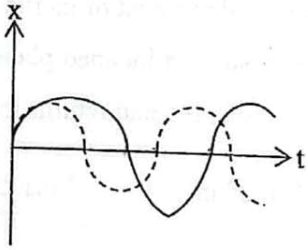
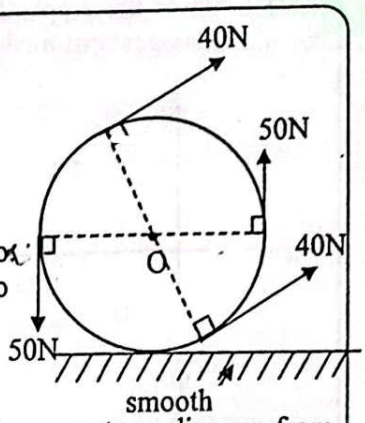


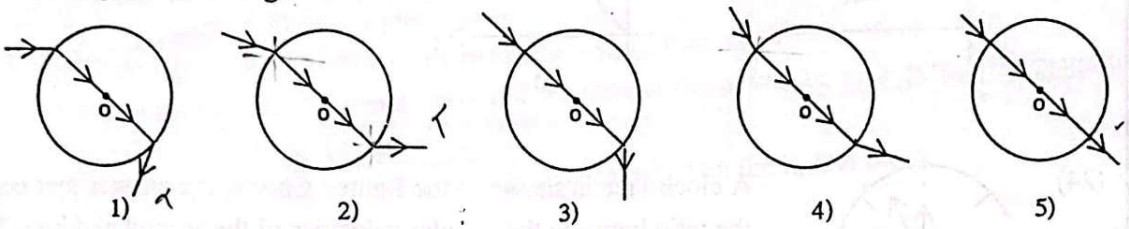
5)

(18) Figure shows four forces acting on a circular disk of mass 10 kg placed on a smooth surface along its circumference. Which of the following statements is most true?

1) The resultant force and resultant torque are zero.
2) The resultant force is zero and the resultant torque is not zero
3) The resultant force is not zero and the resultant torque is zero
4) The disc will rotate along the plane and move forward
5) The disk will not rotate but will move



(19) A ray of light passes through a glass sphere in the air. Select the correct ray diagram from among the answers given below.



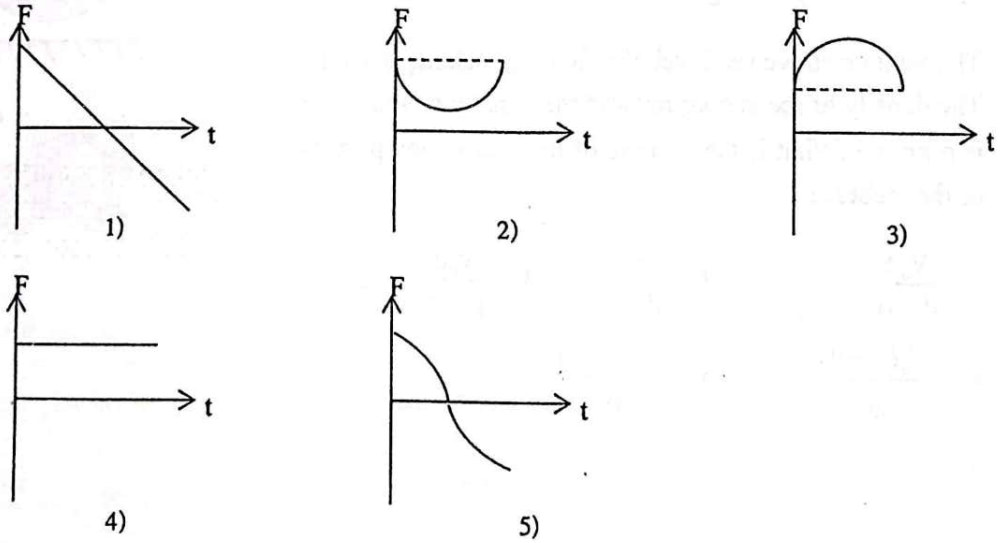
(20) A mass 100 g is suspended from a light helical spring of spring constant 20 Nm^{-1}, then the mass is displaced by 2 cm and released. Find the stored elastic potential energy when the mass is at its center of oscillation in simple harmonic motion.

1) 0 J
2) 4×10^{-3} J
3) 9×10^{-3} J
4) 25×10^{-3} J
5) 49×10^{-3} J

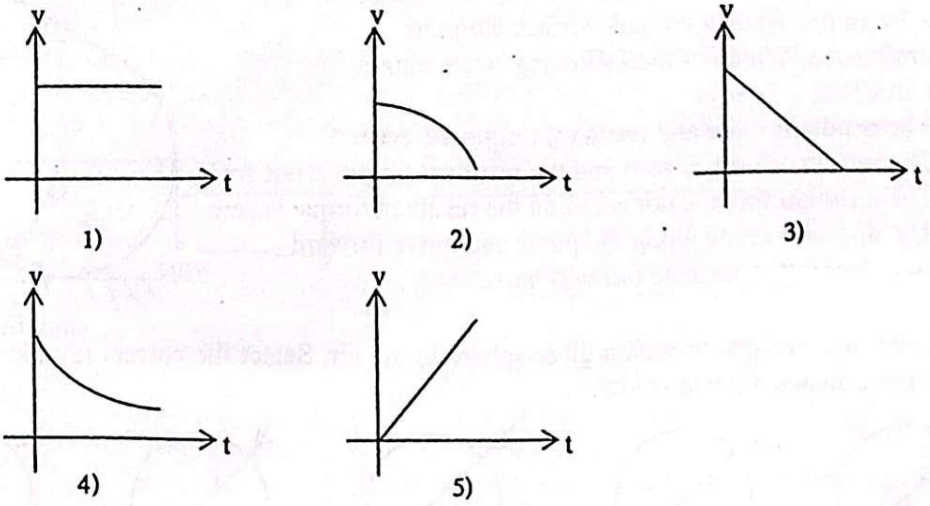
(21) The angular velocity (ω) of a spinning wheel in a student-designed invention and the relationship between time (t) is given by $\omega = 20 - 5t$. Which answer represents the total angular displacement of the wheel from t = 0 to t = 3?

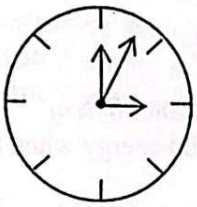
1) 7.5 rad
2) 12.5 rad
3) 13 rad
4) 37.5 rad
5) 75 rad

(22) An object moves in a vertical plane at a constant speed so that the distance to some fixed point remains constant. Select the graph that best represents how the unbalanced force (F) directed at the fixed point on the object changes with time (t).



(23) Select the graph that best represents the variation of the velocity of light (v) through a homogeneous medium with thickness (t).

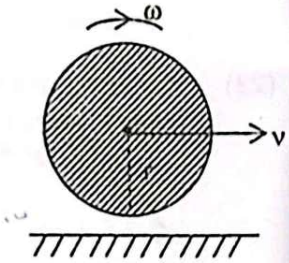


(24) 

A clock face is shown in the figure. Choose the answer that contains the ratio between the angular velocities of the second and hour hands, respectively.

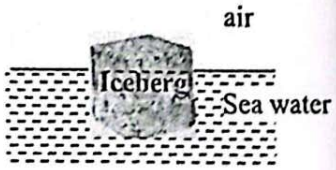
1) 1 2) 12 3) 60
4) 720 5) 43200

(25) The figure shows a circular disk rotating about its center with constant angular velocity along with linear motion with constant velocity v along a horizontal rough plane. Among the following statements made in this regard, the most correct statement is,



1) If $v = r\omega$, the disc does not engage in translational motion.
2) If $v > r\omega$, the disc rotates anticlockwise and moves forward.
3) If $v > r\omega$, the disc rotates clockwise and moves forward.
4) If $v < r\omega$, the disk is in rotational motion only.
5) if $v < r\omega$, the angular momentum of the disk is zero.

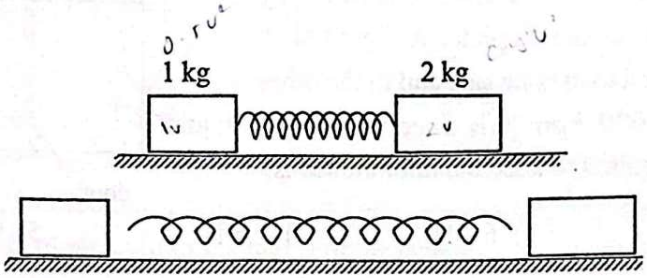
(26) The volume above sea level of a floating iceberg is V_0 m³. The density of ice is d kg m⁻³ and the density of sea water is ρ kg m⁻³ .What is the volume of the submerged portion of the iceberg?



1) $\frac{V_0 d}{d-\rho}$ 2) $\frac{V_0 \rho}{d-\rho}$ 3) $\frac{V_0 d}{\rho-d}$

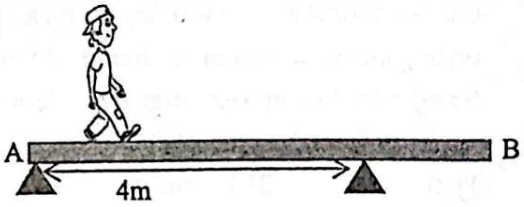
4) $\frac{V_0(\rho-d)}{d}$ 5) $\frac{V_0(d-\rho)}{\rho}$

(27) A 1.0 kg block and a 2.0 kg block are pressed together on a horizontal frictionless surface with a compressed very light spring between them. They are not attached to the spring. After they are released, both move away from the spring.



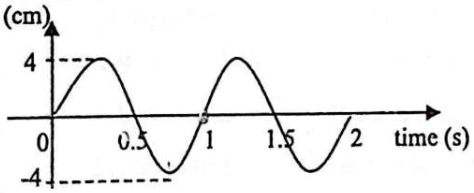
1) Both blocks will have the same amount of kinetic energy.
2) Both blocks will have equal speeds.
3) The lighter block will have more kinetic energy than the heavier block.
4) The magnitude of the momentum of the heavier block will be greater than the magnitude of the momentum of the lighter block.
5) The heavier block will have more kinetic energy than the lighter block.

(28). A uniform board of mass 10 kg and length 5 m is placed between two supports 4 m apart. A man of mass 60 kg walks towards B as shown in figure. The maximum distance he can move from A so that the equilibrium is not disturbed,



1) 0.25 m
2) 2.5 m
3) 4 m
4) 4.25 m
5) 5 m

(29) The displacement-time graph for an object in simple harmonic motion is shown below.



mass of the object is 100 g then the maximum momentum of the particle is ($kgms^{-1}$)

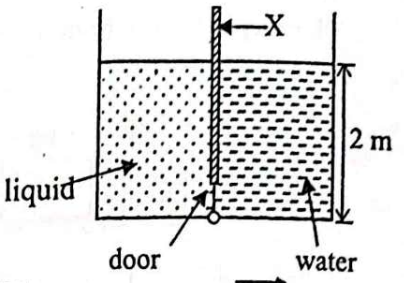
1) $2\pi \times 10^{-2}$ 2) $4\pi \times 10^{-3}$ 3) $8\pi \times 10^{-2}$ 4) $8\pi \times 10^{-3}$ 5) 8π

(30) Select the most correct statement(s) from the following statements made regarding total internal reflection.

(A) A ray of light must travel from the dense medium to the rare medium for total internal reflection.
(B) Total internal reflection can be occurred even if the angle of incidence in dense medium is the critical angle.
(C) Whatever the frequency of an incident ray, the critical angle has the same value.

1) A only 2) B only 3) A and B only 4) C only 5) All A, B and C

(31) A square tank of side length 3 m is divided into two parts by plate X. A small door of 2 cm × 2 cm size is smoothly pivoted at the lower edge of the X plate. A liquid with density 800 kgm^{-3} is filled to the one side and to the other side, water with density 1000 kgm^{-3} is filled to a height of 2 m. The extra force required to keep the door closed is,

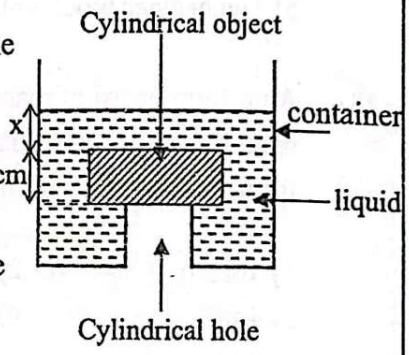


1) $\overrightarrow{8N}$ 2) $\overleftarrow{8N}$ 3) $\overleftarrow{6.4\,N}$ 4) $\overleftarrow{1.6\,N}$ 5) $\overrightarrow{1.6\,N}$

32) A and B are two solid objects made of wood and plastic respectively. An object A floats in water with ¾ of it submerged in water and object B floats with ¾ of it above water. Choose the answer which correctly indicates the density ratio between A and B respectively.

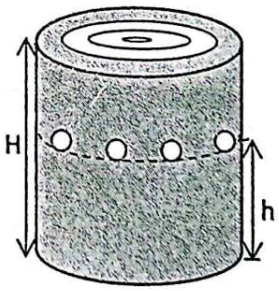
1) 1 : 1 2) 1 : 3 3) 3 : 1 4) 1 : 2 5) 2 : 1

33) To prevent leakage of a liquid from a cylindrical hole at the bottom of a vessel, a cylindrical object of height 6 cm with a density three times less than the density of the liquid and a cross-sectional area four times the area of the hole is placed on the hole as shown in the figure. At what value of x, will the liquid start to leak out from the hole as liquid continues to be removed from the vessel?



1) 0 2) 1.7 cm 3) 3.6 cm
4) 10 cm 5) 12 cm

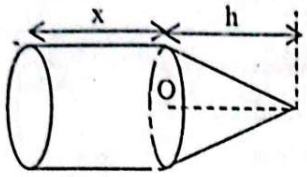
34) In a cylindrical vessel of height H and cross-sectional area A, eight small holes are made around at a height h from the bottom and each cross-sectional area is $\frac{A}{100\sqrt{2}}$. Choose the answer that best illustrates the rate at which the liquid level in the container drops due to leakage of liquid from the holes when the container is completely filled with liquid. (The square of the velocity of the liquid down the vessel can be neglected)



1) $\frac{8\sqrt{H-h}}{125}$ 2) $\frac{4\sqrt{H-h}}{125}$ 3) $\sqrt{\frac{8(H-h)}{125}}$

4) $\sqrt{\frac{2(H-h)}{25}}$ 5) $\sqrt{\frac{4(H-h)}{125}}$

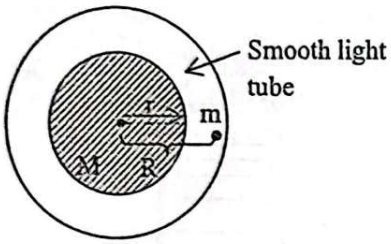
35) The front part of a bullet is shaped like a cone, while the rear part can be considered as a uniform cylinder.



The bottom cross-sectional area of the solid cone section is equal to the cross-sectional area of the cylindrical section. The density of the metal of which the cone is made is twice the density of the metal of the cylindrical part. For the center of gravity of the rod to be at O, the value of x in terms of h is, (x - the length of the cylindrical part, h - the length of the conical part)

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

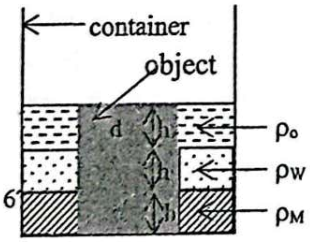
(36)



A small spherical object of mass m with a rough outer surface is kept at rest inside a smooth light tube of uniform cross-section which is rigidly fixed along the circumference on a circular disk of mass M. The disk was then rotated at a constant angular velocity ω about an axis passing through its center. Now choose the answer that best describes the angular momentum of the system. (Moment of inertia of a solid disk of mass M and radius r rotates about an axis passing through its centre is $\frac{1}{2}Mr^2$.)

1) 0 2) $\left(\frac{1}{2}Mr^2+mR^2\right)\omega$ 3) $\left(\frac{1}{2}Mr^2+mr^2\right)\omega$ 4) $\frac{1}{2}mr^2\omega$ 5) $\frac{1}{2}Mr^2\omega$

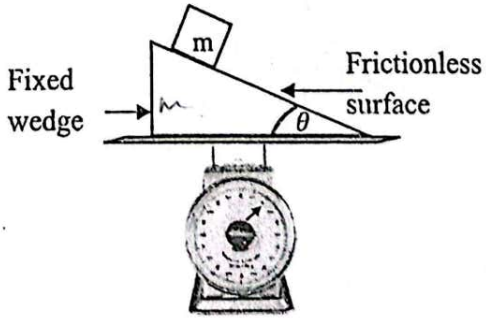
(37)



The figure shows how an object with density d is immersed as equal heights are in three immiscible liquids with densities ρ_M, ρ_w and ρ_0. If the perpendicular reaction at the bottom of the vessel is to be zero, the value of ρ_0 should be equal to,

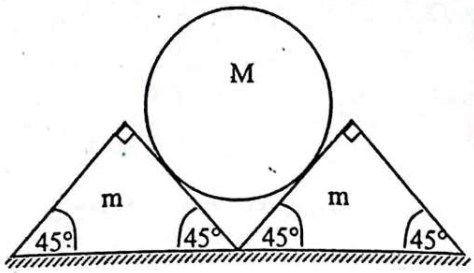
1) $(d-\rho_w-\rho_M)$ 2) $(3d+\rho_w+\rho_M)$ 3) $(3d+\rho_M-\rho_M)$
4) $(3d-\rho_w-\rho_M)$ 5) $(\rho_w-\rho_M-3d)$

(38) A block of mass m slides down on the frictionless inclined surface of a wedge which is fixed on a scale. If the mass of the wedge is also m, find the weight of the system recorded by the scale.



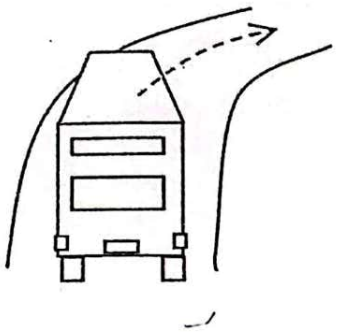
1) mg + mg cos θ
2) mg + mgcos θ sin θ
3) mg + mg $\cos^2\theta$
4) mg + mg $\sin^2\theta$
5) 2mg

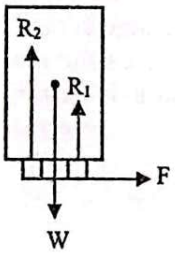
(39) Two identical triangles with mass m are placed on a frictional surface. A sphere with mass M is held by the triangles without falling as shown in the diagram below. Consider that the surface between the sphere and triangles is frictionless. Find the minimum value of the coefficient of static friction between the triangle and the surface such that the triangles will not slide away.

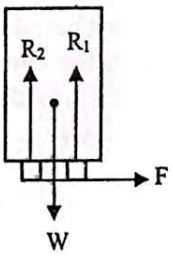


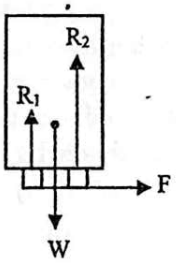
1) $\frac{m}{M}$ 2) $\frac{2M}{m}$ 3) $\frac{1}{2}$ 4) $\frac{M}{m+M}$ 5) $\frac{M}{2m+M}$

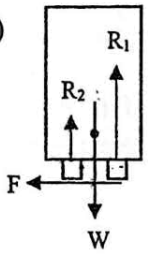
(40) A bus is turning around a corner on a horizontal road. The diagram shows the rear view of the bus, which is turning the right, which of the following diagram best shows the force diagram of the bus.

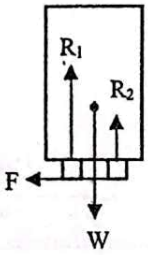


1)


2)


3)


4)


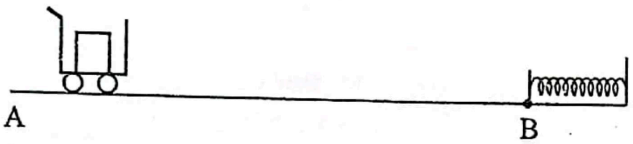
5)


Part B - Essay

- **Answer all the questions.**

04) (a) Using the Newton's second law of motion, derive F = ma equation.

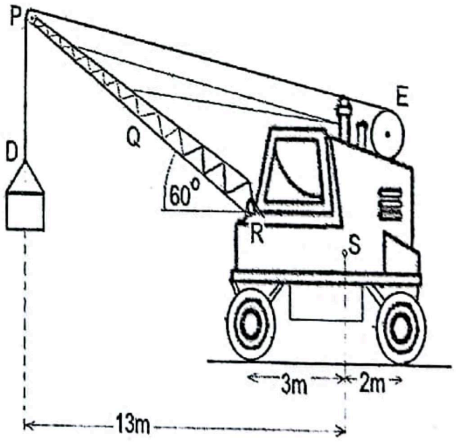
(b) A motor spare parts manufacturing factory packs their items in a wooden box of mass 50 kg. The mass of the packed items is 350 kg and a smooth trolley of mass 100 kg is used to transport these items from the manufacturing place (A) to another place (B). The distance between A and B is 40 m. Initial 20 m of this distance is travelled under a constant force, the remaining half is travelled without a force. The velocity of the trolley at point B is 2 ms^{-1} and the velocity at point A is zero.



(i) What is the constant force applied?

(ii) When the trolley reaches point B, it collides with the spring fixed at that end. The spring is compressed 4.0 cm and then it reaches momentarily rest. Calculate the spring constant.

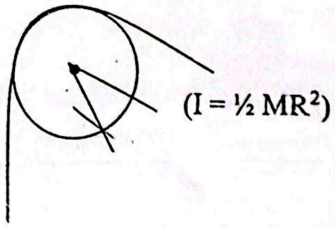
(c) A crane is used to place these items brought to point B on the floorboard of a lorry. The mass of the crane without arm is 20000 kg and the mass of the PR arm , shown in the figure, is 2000 kg. S and Q are the points where the weights act on the crane and the PR arm respectively. Q is the mid point of PR. The vertical cable PD is used to lift the wooden box with the above packed items and this cable is passing over a smooth pulley. The other end of this cable is wound around a cylinder which is connected to a motor. The wooden box can be lifted by the rotation of the cylinder. The radius of the cylinder is 50 cm. ($\pi = 3$)



(i) What is the number of turns that should be rotated to lift the wooden box to 3 m height?

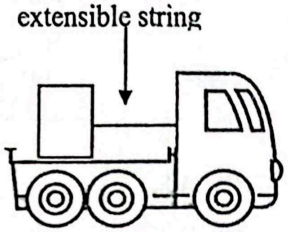
(ii) Calculate maximum mass that can be lifted like this.

(d) A pulley, which looks like a plate, of mass M and radius R with smooth axis and rough edge is placed at P of the crane. The hanging mass of the cable is M_0, when the mass is raised with 'a' acceleration,



(i) Write down an expression for the tension of PD part of the cable.
(ii) Write down an expression for the tension of PE part of the cable.
(iii) The mass of the pulley is 10 kg, the mass of the lifted box is 400 kg and the radius of the pulley is 20 cm. There is an idea to lift the box to 5 m with uniform accleration. When it is lifted 2 m during 2 s time,
  (a) What is the tension of the part of PE cable?
  (b) What is the work done by the motor, when the box is lifted to 2m?
  (c) What is the power of the motor, if the efficiency of the motor is 50%?

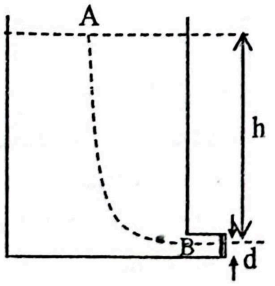
(e) If the above box of mass 400 kg is placed on the floorboard of the lorry as shown and is connected with an extensible string loosely. The frictional coefficient between the box and the floorboard of the lorry is 0.2.



(i) Copy the above figure and mark all the forces acting only on the box when the string is loosely connected, and the lorry is moving forward with a small acceleration.
(ii) What is the frictional force if the lorry is moving with 1 ms^{-2} acceleration?
(iii) If the acceleration of the lorry is 3 ms^{-2}, what is the tension of the string?

05) (a) Obtain an expression for pressure (P) at a point in a static fluid which is in depth h from the surface of the liquid using density of liquid (ρ) and the gravitational accleration (g).

(b) A tank with circular cross section of diameter D is filled with water to height h. There is a hole with diameter d at the bottom of the tank and it is closed with a lid of same diameter. The atmopheric pressure is P_0 and the density of water is ρ.



(i) Write down an expression for the pressure at point B (P_B) using given symbols.
(ii) Write down an expression for the effective pressure (P) acting on the lid using the atmospheric pressure (P_0).
(iii) Find the effective force acting on the lid.

(c) (i) Write down the Bernoulli's principle and name the terms of it.

(ii) Write down the conditions where Bernoullil's principle is valid.

(iii) When the lid of the hole at the bottom of the tank which is mentioned in above (b) is removed, consider the water is flowing out of the hole under the conditions mentioned in (c) (ii) above.

(I) If the velocity of water at point A is V_A and at exit velocity of water at point B is V_B, write down the relationship between V_A and V_B.

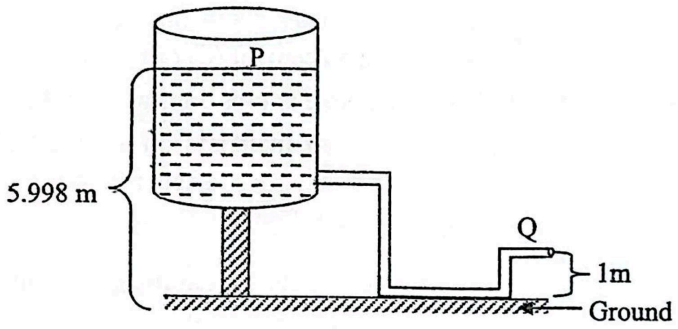
(II) Obtain an expression for V_B using d, D, h, ρ and g.

(III) Write down the mass of water flowing out of the hole during one second (m/t) using the given symbols.

(IV) Consider an instance where the lid is brought very close to the hole to stop the water moving out of the hole. Consider the flowing water does not bounce after hitting the lid. Obtain an expression for the force acting on the lid from water using π, h, ρ, g, d and D.

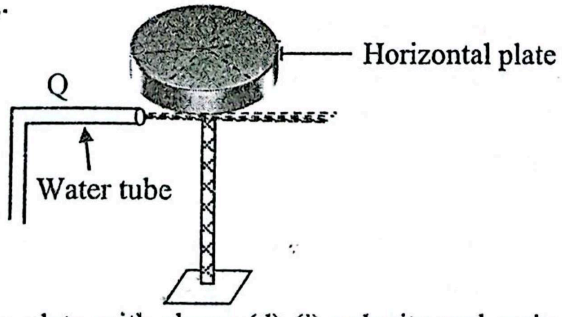
If the diameter of the tank is much greater than the diameter of the hole, this force is two times greater than the force obtained in above (b) (iii).

(d) An instance where the above water tank is raised to a certain height and water is taken out of the tank using a tube is shown in the figure. The tube, out of which the water flows out, is horizontal and the height from the floor to that tube is 1m.



(i) If the diameter of the tube Q is 2 cm and the rate of water flowing out from that tube is 3×10^{-3} m^3 s^{-1}. When an instance of the water level is at 5.998 m height from the ground, find the rate of water level drop. ($\pi = 3$)

(ii) To make the park more beautiful, the water flow ejected from tube Q is arranged in a way that it strike tangentially on a circular plate of radius 20 cm and mass 10 g, which can be rotated horizontally,.



The water flow strikes the plate with above (d) (i) velocity and emits with 15 ms^{-1} velocity. Calculate the angular acceleration of the plate. :The moment of inertia of a plate of mass m and radius r is $\frac{1}{2}mr^2$)

iii) Even though there is an acceleration of the plate due to water striking it, it is observed that the plate is rotated with unifrom velocity. What is the reason for this?

06) X and Y are two transparent media. The absolute refractive index of medium X is 1.5. The refractive index of medium Y relative to medium X is 0.8. The velocity of light in a vaccum is $3 \times 10^8\ ms^{-1}$, $\sqrt{5} = 2.2$, $\tan 47^0\ 15' = 0.8$

$\sin 19^\circ 28' = 0.33$, $\sin 10^\circ 32' = 0.19$, $\sin 41^\circ 45' = 0.66$, $\cos 19^\circ 28' = 0.95$

(A) (i) What is the absolute refractive index of a medium?

(ii) Write down an expression for the refractive index of medium Y relative to the medium X using the velocity of light in a medium.

(iii) Calculate the absolute refractive index of medium Y.

(iv) What is the propagation speed of light through medium Y?

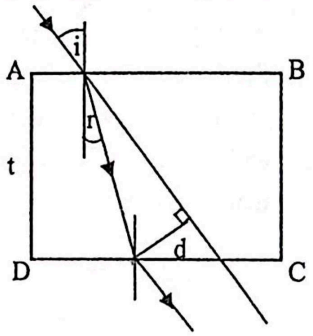
(B) A point object O is placed at the center of the lower surface of a cubical shaped block of which the length of each side is 3 cm and is made with the material X. The image of this O is obeseved by an observer who place his eye at the point P where P is in air above the object.

(i) Draw the ray diagram relevant to the image (I) of the object (O) formed when the observer is in air. (Two rays coming from the object are enough. Using that, show the correct position of the image formed. Clearly mark the incident angle (i), refracted angle (r) at the refracted point and the apparent displacement d.)

(ii) Write down an expression for the relative refractive index of the medium on which the object is placed relative to the medium where the eye is placed, using object depth (t) and the image depth and using that expression construct an expression for the apparent displacement (d) of the obejct.

(iii) Using the above expression, what is the apparent displacement of the object O?

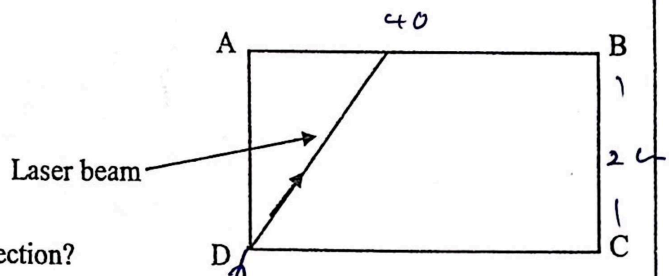
(iv) An incident ray incidents on a cube with sides t and emerges after refraction as shown in below figure.



(a) Show that the above displacement is $d = \dfrac{t\sin(i-r)}{\cos r}$

(b) If this light ray incidents on the AB side of the cube, having a length of 3cm on each side, with an agle of 30^0, calculate the displacement of the immergent ray from the incident ray.

(C) A laser beam enetes a cuboid of height 2 cm, length 40 cm and refractive index 1.5 as shown in the below figure.



(i) What is the total internal reflection?

(ii) With relative to the air, what is the critical angle for the medium which the cuboid is made?

(iii) If the above inscident ray is subjected to the critical refelection at AB surface, how many critical reflections can occur?