Royal College - Colombo 07

Grade 13

01 E I

First Term test – April 2023

Physics I

Time : 2 hours

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

Answer all questions.

(1) The unit of area expansivity is,

1) K^{-1} 2) $K^{-1}m^{-1}$ 3) $K^{-1}m^{-2}$ 4) $K\ m^{-1}$ 5) $K\ m^{-2}$

(2) The dimensionally correct equation is given by

1) $\frac{\text{Pressure}}{\text{Force}} = \text{Area}$

2) $\frac{\text{Power}}{\text{Volume}} = \text{pressure}$

3) $\frac{\text{Impulse}}{\text{Time}} = \text{momentum}$

4) $\frac{\text{centripetal acceleration}}{\text{Force}} = \text{mass}$

5) $\frac{\text{Electrical energy}}{\text{Impulse}} = \text{velocity}$

(3) The variation of displacement (x) of an object of 100 g with time (t) is given by following equation.

$x = 6 \sin (100\,t + \frac{\pi}{2})$ displacement is measured in centi-meters.

The maximum kinetic energy is given by

1) 0.6 J 2) 1.8 J 3) 2.4 J 4) 3.6 J 5) 4.2 J

(4) An object is dropped at 20 m height from the ground. It is explored in to two identical parts at 15 m above from the ground and they reached to the ground at same time. The velocity of one part after the explosion is 12.5 ms^{-1}. The distance between two particles on the ground.

1) 5 m 2) 10 m 3) 15 m 4) 20 m 5) 25 m

(5) The physical quantities which are not existed dimensions are

a. Relative density
b. Relative velocity
c. Angular displacement
d. co-efficient of friction

1) a and b only 2) a, b and c only 3) a, c and b only
4) a and d only 5) all a, b, c and d

(6) Following diagram shows the scale positions of a given Vernier caliper, when its external jaws are touched together. Least count of the caliper is 0.1 mm. The internal diameter of a hollow cylinder is measured by this caliper as 2.72 cm. The corrected reading is given by,

1) 2.69 cm 2) 2.75 cm 3) 2.79 cm
4) 2.72 cm 5) cannot be determined

(7) An object is moving along a linear path towards a given direction. In first $\frac{3}{4}$ seconds it moves under u velocity and the next $\frac{1}{4}$ seconds it moves under v velocity. The mean velocity of the object is,

1) $\frac{uv}{u+v}$ 2) $\frac{u+v}{2}$ 3) $\frac{4uv}{v+3u}$ 4) $\frac{4uv}{3v+u}$ 5) $\frac{3uv}{4v+u}$

(8) A coconut is dropped in to a water and it moved in to the water for a certain deapth and then it floated in the water. If viscous forces are negligible, the variation of the velocity of the coconut with time is given by

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

(9) A vehicle which is starting at rest and moving along a linear path with α uniform acceleration and then β deceleration and become to the rest. The total time taken to the motion is T. The maximum velocity taken by the vehicle is,

1) $\frac{\alpha\beta T}{2\alpha+\beta}$ 2) $\frac{\alpha\beta T}{\alpha+\beta}$ 3) $\frac{2\alpha\beta T}{\alpha+\beta}$ 4) $\left(\frac{\alpha+\beta}{\alpha\beta}\right)T$ 5) $\frac{\alpha}{\beta}T$

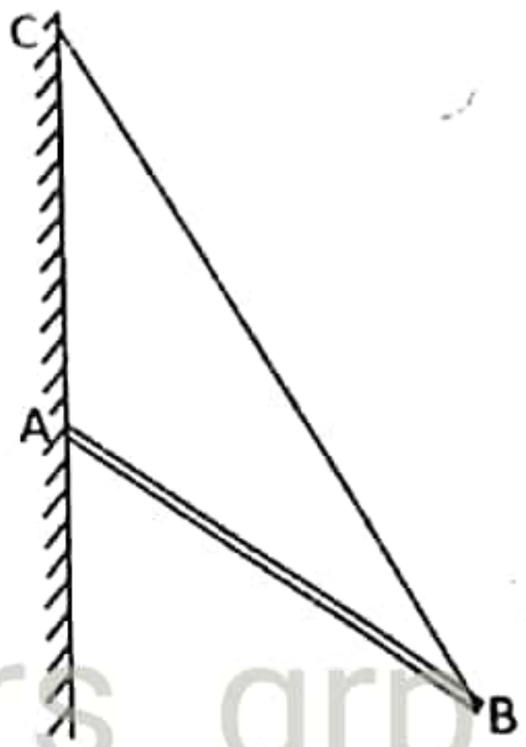
(10) A bullet which emits from an artillery gun is followed a symmetrical projectile. The maximum horizontal displacement is 1 km. The period of the motion and the vertical height is respectively given by,

1) $10\sqrt{2}$ s, 250 m 2) 10 s, 257 m 3) $10\sqrt{2}$ s, 500 m
4) 10 s, 500 m 5) $5\sqrt{2}$, 250 m

(11) 99% of sound which emits from a machine is absorbed by a protective layer. The sound intensity level which reduces by the protective layer is,

1) 1 dB 2) 10 dB 3) 20 dB 4) 99 dB 5) 100 dB

(12) A uniform rod of weight w is hinged at point A and it is under equilibrium with the string connected to the end B of the rod as shown in the figure. AB = AC. The rod is 60^0 inclined to the wall. The tension of the string is given.



1) $\frac{w}{2}$ 2) $\frac{w}{\sqrt{2}}$ 3) $\sqrt{3}$ w

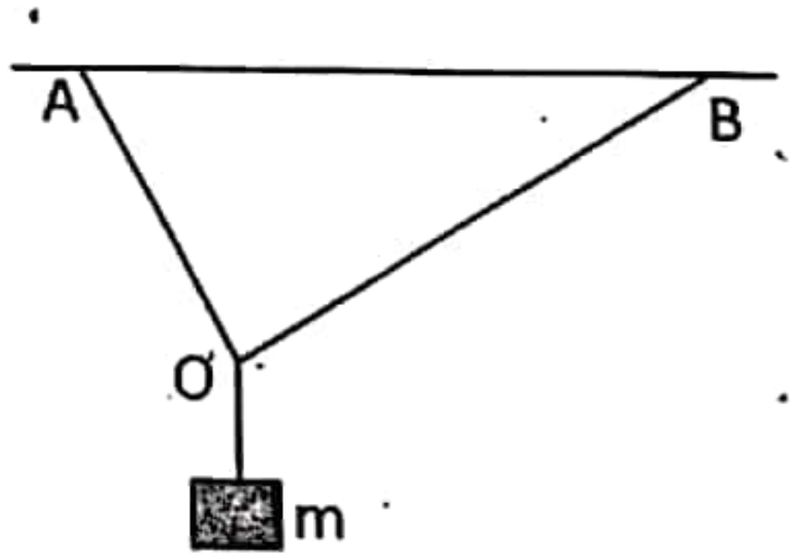
4) $\frac{\sqrt{3}w}{2}$ 5) $\frac{w}{2\sqrt{3}}$

(13) The statement which cannot be explained by the Bernoulli Theorem is,,

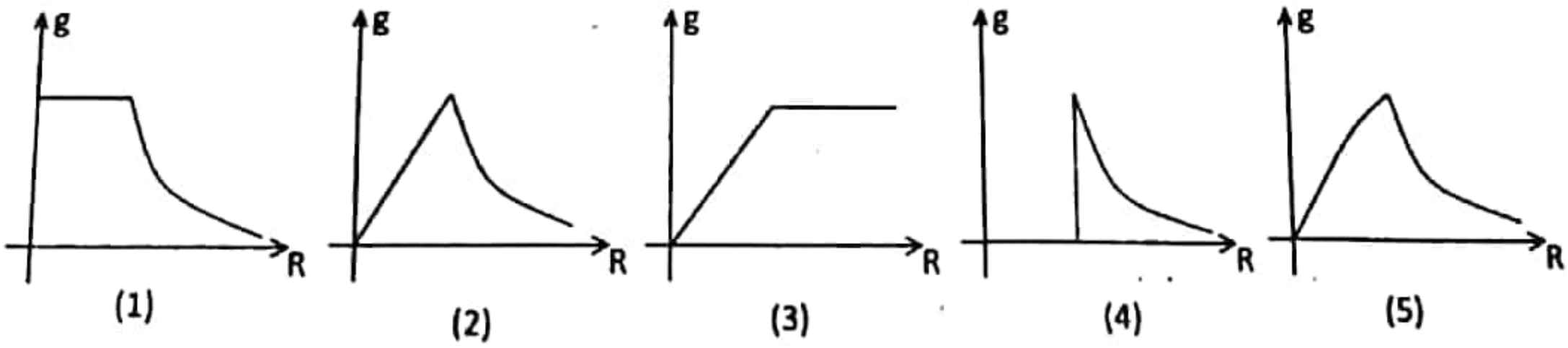
1) Flying a bird.
2) Emitting smoke from a high tube.
3) The motion of a sailing ship
4) Breaking a roof from the wind.
5) The motion of a rocket.

(14) An object of mass m is hung by two light inextensible strings at point A and B as shown in the figure. AB = 50 cm. The lengths of two strings OA and OB are 30 cm and 40 cm respectively. The tensions of the strings are correctly represented by,

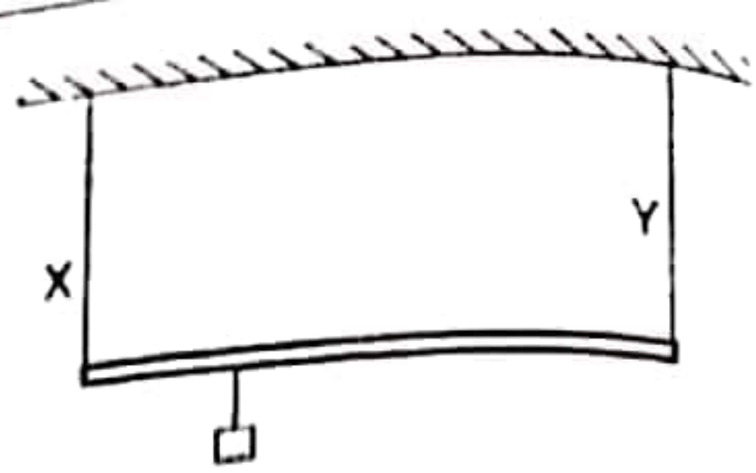
	OA	OB
1)	$\frac{mg}{5}$	$\frac{mg}{5}$
2)	$\frac{mg}{5}$	$\frac{3mg}{5}$
3)	$\frac{4mg}{15}$	$\frac{mg}{5}$
4)	$\frac{mg}{5}$	$\frac{4mg}{15}$
5)	$\frac{3mg}{15}$	$\frac{4mg}{15}$



(15) The variation of gravitational field intensity with the distance measured from the centre of the earth is best represented by, (The density of earth is uniform)

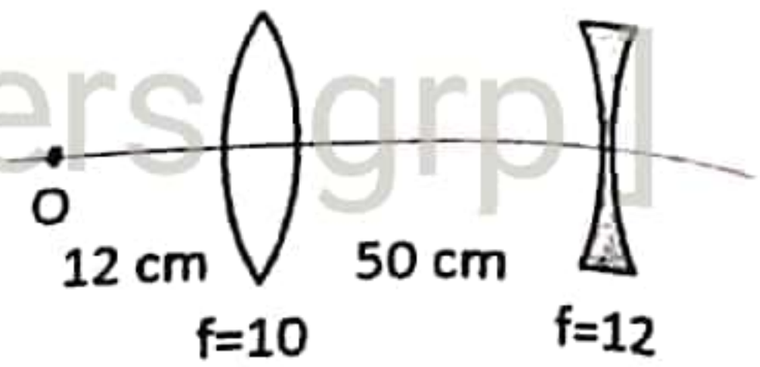


(16) The light rod AB of length L is hung horizontally by two identical wires X and Y by hanging a mass m, at a point of the rod as shown in the figure. The wire X is resonated with the first overtone and the wire Y is resonated with the second overtone with a same tuning fork. The length to the point of hanging mass m from the wire X is



1) $\frac{L}{15}$ 2) $\frac{L}{13}$ 3) $\frac{4L}{13}$ 4) $\frac{5L}{4}$ 5) $\frac{13L}{4}$

(17) Consider the following statements regarding the final image of the object O formed by the above lens combination.

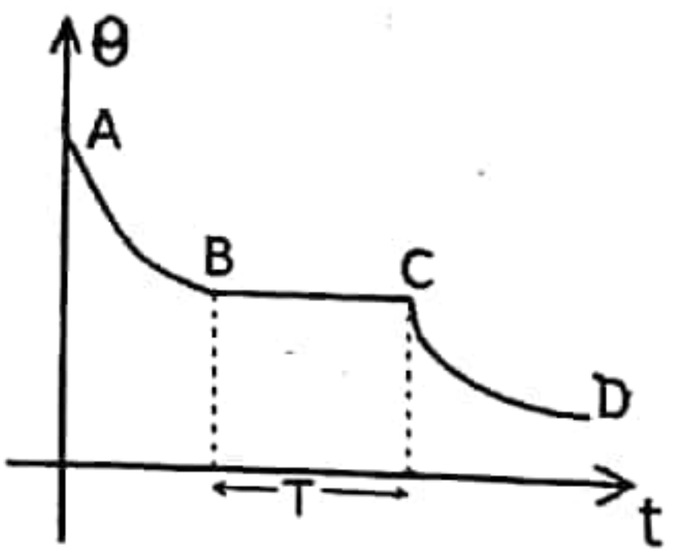


A. A virtual image is formed by the concave lens.
B. The final image is formed at 60cm distance away to the right side from the concave lens.
C. A virtual image is formed by the convex lens at the left side of the convex lens.

The correct statement(s) from above is/are given by

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

(18) A cooling curve is drawn for a liquid vax at 100^0C in a vessel as shown in the figure. The mass of vax is m, the specific latent heat of fusion of vax is L. The gradients drawn to the points B and C are H_1 and H_2 respectively.



Consider the following statements.

A. $H_1 = H_2$
B. When m is increasing T is increasing.
C. The rate of heat loss at point A is greater than that of point C.

The correct statement (s) is (are) given by

1) A only 2) B only 3) C only
4) All A, B, C are true 5) All A, B, C are false

(19) Consider the following statements regarding the Geostationary Satellites.

A. The periodic time of the satellite is equal to the rotational periodic time of the earth.
B. The satellites of higher masses should be orbitalized at higher orbits than the satellites of less masses.
C. The satellites can be orbitalized even right above the Sri Lanka.

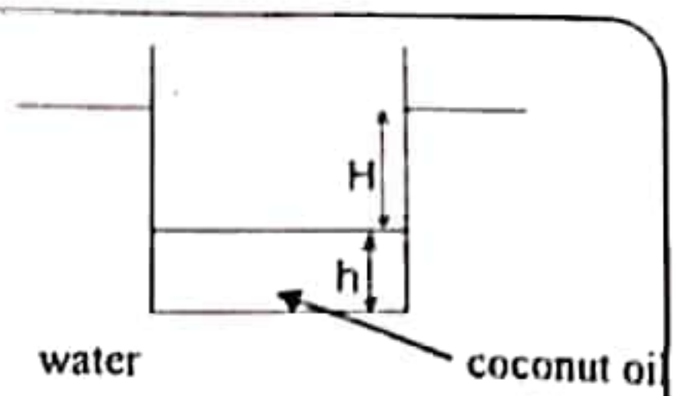
The true statement(s) is/are given by

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

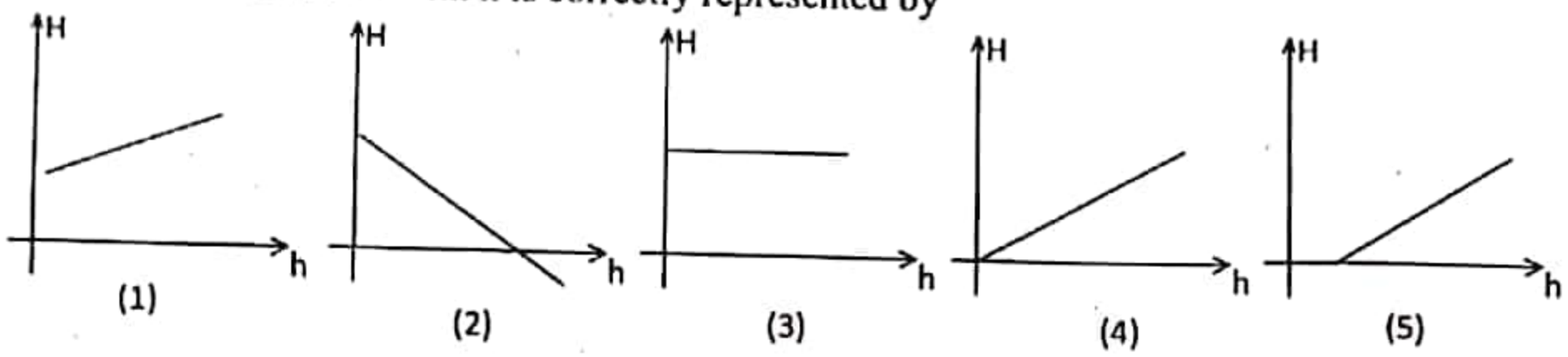
(20) A cylindrical vessel with coconut oil is floating in the water.

h – height of the coconut oil

H – height to the outer water level from the coconut oil level.



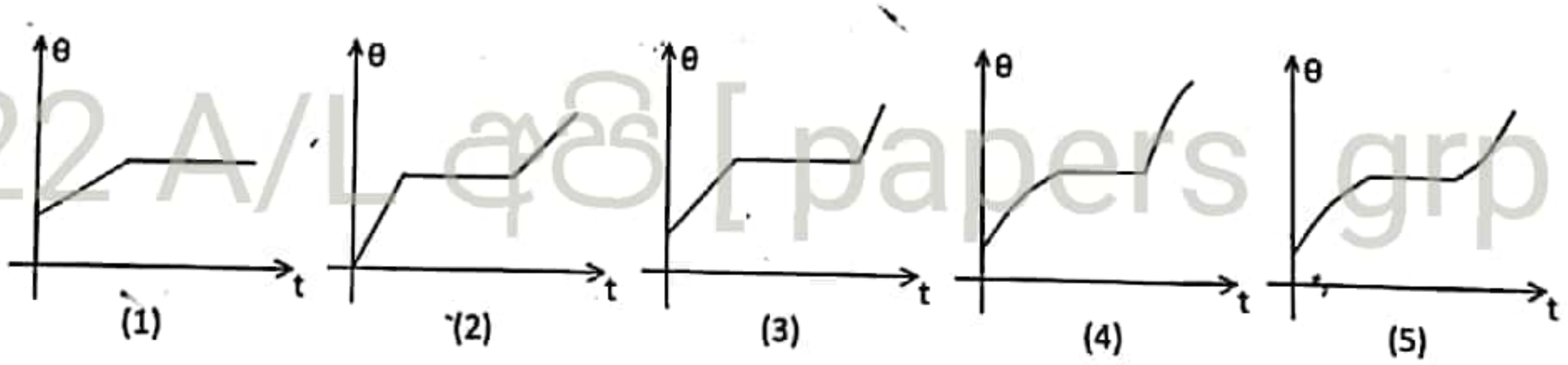
The variation of H with h is correctly represented by



(21) A stone is dropped in to a well of having water at 20 m depth from the ground level. The sound is received after 2.05 s from the moment of dropping the stone. The velocity of sound is

1) 300 ms^{-1} 2) 330 ms^{-1} 3) 334 ms^{-1} 4) 350 ms^{-1} 5) 400 ms^{-1}

(22) A vessel of having thick walls with small amount of water at 30^0C is heated by a gas cooker with uniform heat supply for a long time. The correct variation of the temperature inside the vessel with time is given by,



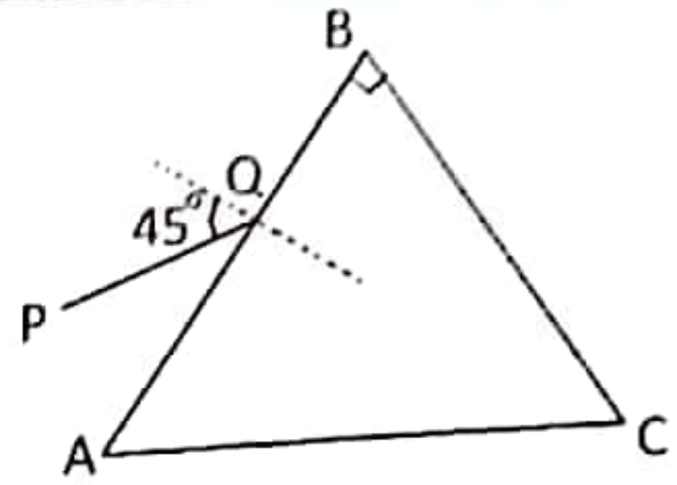
(23) The radius of the earth is R and the gravitational field intensity on the surface is g. The gravitational field intensity at a point of height having two times of the radius is,

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

(24) The wave length of a light emitted by a star is 5% higher than the wave length of that light when measured from the earth. The velocity of light is 3×10^8 ms^{-1}. The star is

1) moving towards the earth with 3×10^7 ms^{-1} velocity.
2) moving outwards the earth with 3×10^7 ms^{-1} velocity
3) moving towards the earth with 1.5×10^7 ms^{-1} velocity.
4) moving outwards the earth with 1.5×10^7 ms^{-1} velocity.
5) moving outwards the earth with 1.7×10^7 ms^{-1} velocity.

(25) The figure shows a prism of having 90^0 refracting angle and 1.5 refracting index. A light ray PQ is incident on AB, surface. The most correct statement is,

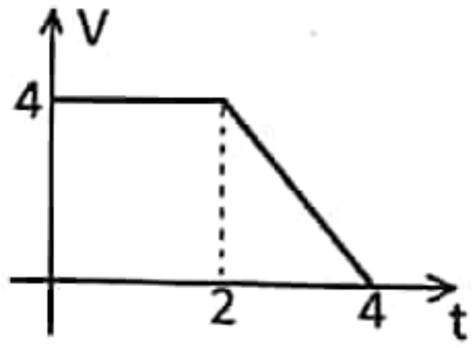


1) The ray undergoes minimum deviation.
2) The minimum deviation can be obtained by decreasing or increasing the incident angle.
3) The ray is never emerged from the BC surface for every incident angles.
4) Even the ray is emerged from the BC surface the minimum deviation can be obtained by varying the angle of incident.
5) The ray is emerged from the BC surface when the angle of incident is zero.

(26) A gas mixture is consisted with H_2 and O_2. The ratio of masses of H_2 and O_2 is 1: 8. The kinetic energy of H_2 gas molecules is E. The kinetic energy of O_2 gas molecules is given by,

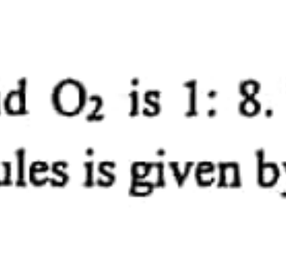
1) $\frac{E}{2}$ 2) E 3) 2E 4) 8E 5) 16E

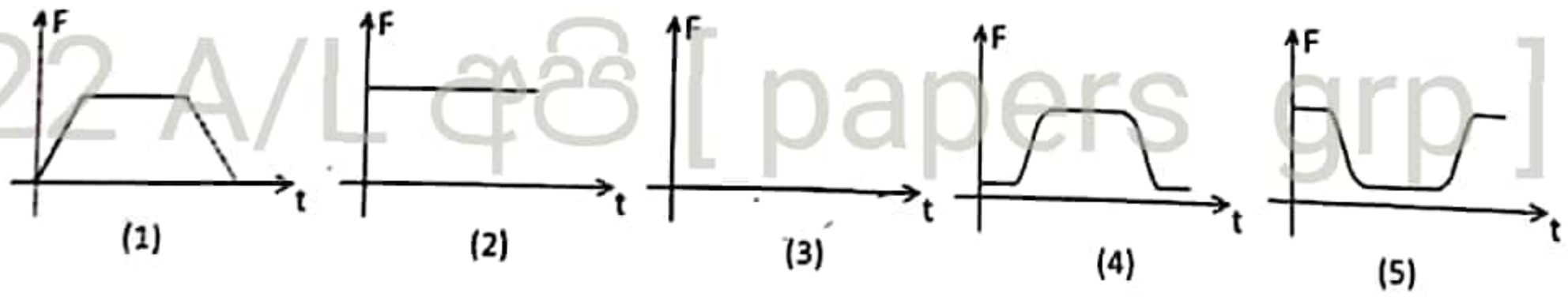
(27) The velocity time graph of an object moving along a linear path is given in the figure. The average velocity of the object is,



1) $2.0\ ms^{-1}$ 2) $3.0\ ms^{-1}$ 3) $3.5\ ms^{-1}$
4) $4.0\ ms^{-1}$ 5) $4.5\ ms^{-1}$

(28) A motor vehicle is moving along a linear path with a constant velocity and then it is taking a bend and again it is moving along a linear path. The variation of the frictional force (F) between the wheels and the road is given by,





(29) A mercury column of l_0 length is existed in a capillary tube. The linear expansivity of the material of the capillary tube is α. The volume expansivity of mercury is γ. The length of the mercury column when it's temperature is increased in θ is

1) $l_0(1+\gamma\theta)$ 2) $\frac{l_0(1+\gamma\theta)}{(1+\alpha\theta)}$ 3) $\frac{l_0(1+\gamma\theta)}{1+2\alpha\theta)}$
4) $\frac{l_0(1+\gamma\theta)}{1+3\alpha\theta)}$ 5) $\frac{l_0(1+3\gamma\theta)}{1+2\alpha\theta)}$

(30) When two ice blocks are compressed together, they are combined each other. Consider the following statements regarding this phenomenon.

A. There is an attraction force between two ice blocks.

B. When pressure is increased, melting point of ice is decreasing.

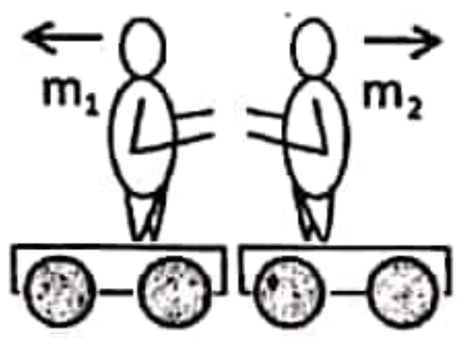
C. Ice cubes are combined together as the gravitational force created due to compressing is greater than the intermolecular bonds.

The true statement (s) is/are

1) A only. 2) B only. 3) C only .

4) B and C only. 5) A and B only.

(31) Two children on two trollies of mass m_1 and m_2 are pushed each other. The coefficient of friction between wheels of the trollies and the floor is μ . when they are stopped, the distance travelled by m_1 and m_2 are x_1 and x_2 respectively. The $\frac{x_1}{x_2}$ is given by,

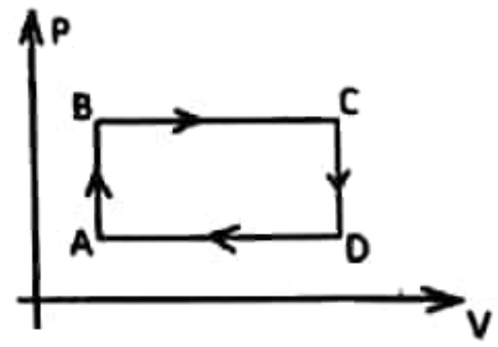


1) $\frac{m_2}{m_1}$ 2) $\frac{m_1}{m_2}$ 3) $\left(\frac{m_2}{m_1}\right)^2$ 4) $\left(\frac{m_1}{m_2}\right)^2$ 5) $\frac{m_1 m_2}{m_1 + m_2}$

(32) A steel bullet at 30^0C is just melted after colliding at a target. The 50% of heat generated by the collision is absorbed by the bullet. The specific heat capacity of steel 150 J kg^{-1} K^{-1}, The specific latent heat of steel 25 x 10^3 J kg^{-1}. The melting point of steel is 330^0C. The velocity of the bullet collided at the target is

1) 100 ms^{-1} 2) $100\sqrt{2}$ ms^{-1} 3) $100\sqrt{5}$ ms^{-1} 4) $100\sqrt{10}$ ms^{-1} 5) $100\sqrt{15}$ ms^{-1}

(33) Consider the following statements regarding the cyclic process represented by the given figure.



A. The temperature of C is greater than that of B.

B. The heat is released during the CD process.

C. The difference of internal energy during the whole process is zero.

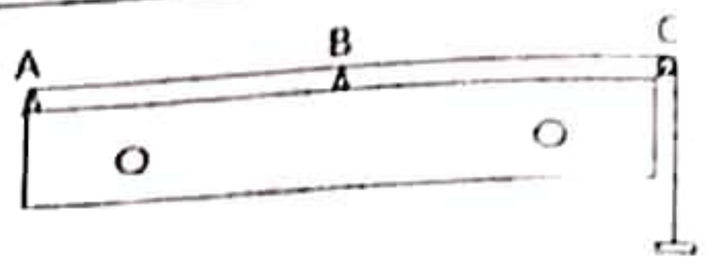
The correct statement(s) from following is/are,

1) A and B only 2) A , and C only

3) B and C only 4) All A, B and C are false

5) All A, B and C are correct

(34) The wire segment AB is resonated with the tuning fork of frequency f_1 and the wire segment BC' is resonated with the tuning fork of frequency f_2 in the fundamental mode. If the bridge B is removed, the frequency of the fundamental mode of the wire AC' is given by

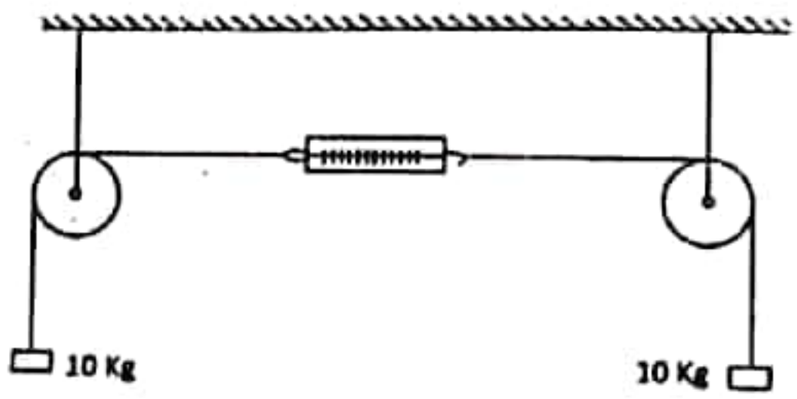


1) $f_1 + f_2$ 2) $\frac{f_1 + f_2}{2}$ 3) $\frac{f_1 f_2}{f_1 + f_2}$ 4) $\sqrt{f_1 f_2}$ 5) $f_1 - f_2$

(35) A metal flute is made to produce to correct notes at 30°C. When this flute is used in a lower temperature,

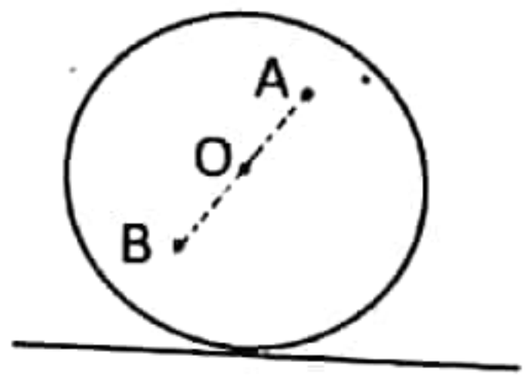
1) The frequency is increased due to the gaps between each and every holes are reduced.
2) The frequency is not changed as no change in gaps between each and every holes.
3) The frequency is decreasing due to the temperature of the air is decreased.
4) The frequency is not changed because the temperature is not affected to the frequency.
5) All statements are wrong

(36) The figure shows that a spring balance is set with two smooth pulleys using a light inextensible string. The hanging masses are 10 kg. The reading of the spring balance is,



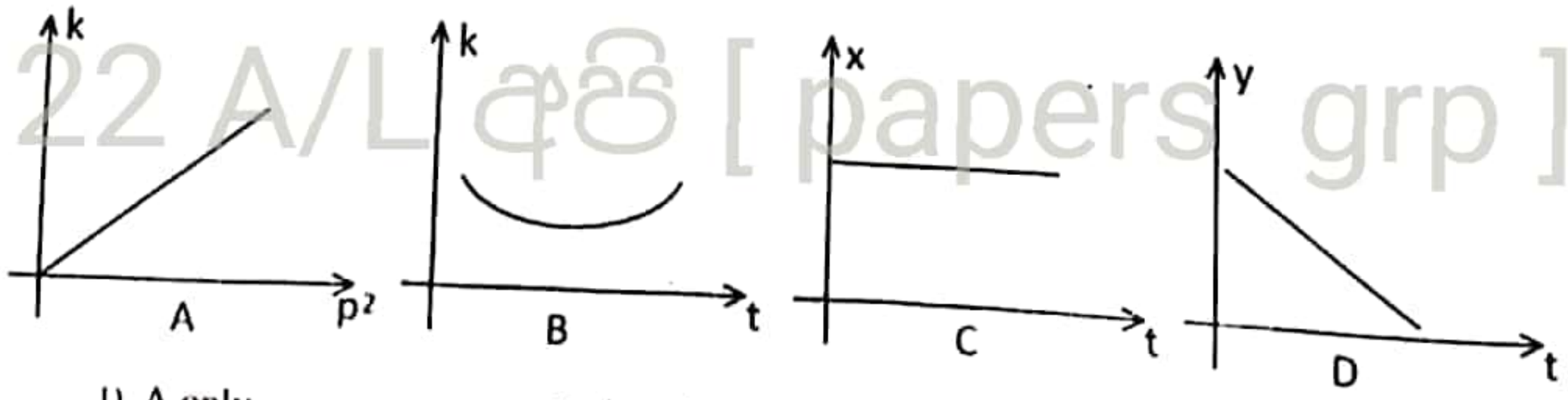
1) 0 N 2) 50 N 3) 100 N
4) 200 N 5) 250 N

(37) A uniform disk is moving with V uniform velocity along a rough path. The velocities of points A, O and B are V_A, V_O, V_B respectively. The correct relationship is,



1) $V_A = V_B = V_O$ 2) $V_A = V_B > V_O$
3) $V_A = V_B < V_O$ 4) $V_A > V_O > V_B$
5) $V_A < V_O < V_B$

(38) A partical is projected to a dirrection of θ degrees inclination from horizontal. After t time duration, the vertical displacement, the horizontal displacement, the linear momentum, the kinetic energy of the particle is y, x, p and k respectively. The correct relationship (s) is (are) given by,



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

(39) The radius and the mass of a role of fabric is R and M respectively. Now it is unrolled on a table until it's radius becomes R/2. The decrement of the potential energy of the fabric role is given by

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

4) $\frac{7}{8}$ MgR 5) $\frac{1}{8}$ MgR

(40) The velocity of sound in a gas which is in a vessel of having a large volume is V_0. Now the volume is decreased up to half while keeping constant pressure. The velocity is sound is given by,

1) V_0 2) $\sqrt{2}\,V_0$ 3) $\sqrt{3}\,V_0$ 4) $\frac{V_0}{\sqrt{2}}$ 5) $\frac{V_0}{2}$

(41) The false statement from following statements regarding the evaporation is,

1) The rate of evaporation will be increased in a windy environment.
2) The rate of evaporation will be increased under high temperature.
3) The temperature will be increased when the rate of evaporation is increased.
4) Evaporation can take place at any temperature.
5) Evaporation is used when producing the salt.

(42) The gravitational acceleration on a surface of a planet of radius R is g. The gravitational acceleration on the surface of a planet having same density and radius 2R is given by

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

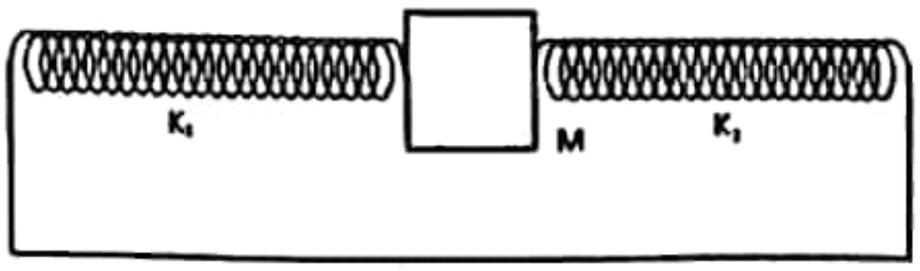
(43) The rate of heat loss of an object which is under convection only is depended on,

A. The nature of the surface.
B. The temperature of the surface.
C. The area of the surface.
D. The temperature of surrounding

The correct statement(s) is/are

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

(44) A block of mass M is connected to two springs of having spring constants K_1 and K_2 as shown in the figure. The maximum acceleration of the block when it is pulled x distance towards left and released, is



1) $\frac{(K_1+K_2)}{M}x$ 2) $\frac{2(K_1-K_2)}{M}x$ 3) $\frac{(K_1-K_2)}{M}x$

4) $\frac{(K_1^2+K_2^2)}{M}x$ 5) $\frac{2(K_1-K_2)x^2}{M}$

(45) The wrong statement regarding the microscopes and telescopes is.

1) The maximum difference of magnifications under normal and special adjustment of simple microscope is 1.
2) In a compound microscope the focal length of eye piece is larger than the focal length of objective piece.
3) A compound microscope can be used as a telescope when observing through the objective lens.
4) The focal length of the objective lens is larger than that of eye piece in a telescope.
5) In telescopes the diameter of the objective lens is larger than that of eye piece

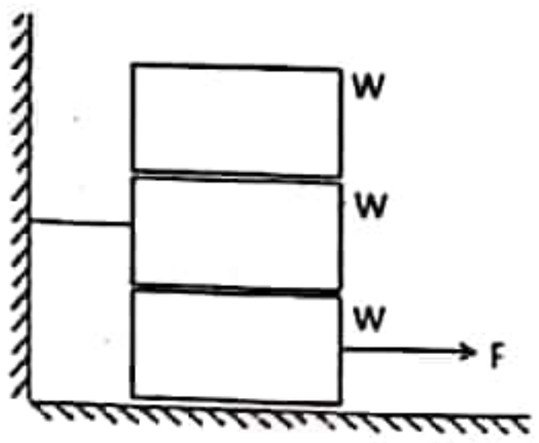
(46) A point light source is kept at a point of 1 m depth from the upper surface of a transparent liquid of refractive index n. The radius of the circular lighting area formed on the surface of the medium is,

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

(47) The range of vision of a person of having a defective eye is 15 cm to 200 cm. The focal length and the type of the lens which is used to correct the defect is,

1) 15 cm, convex
2) 200 cm convex
3) 15 cm concave
4) 200 cm concave
5) 18.5 cm convex

(48) Three identical blocks of weight W are kept as shown in the figure. The co-efficient of friction between each and every surface is μ. The minimum force required to move the lowest block is,

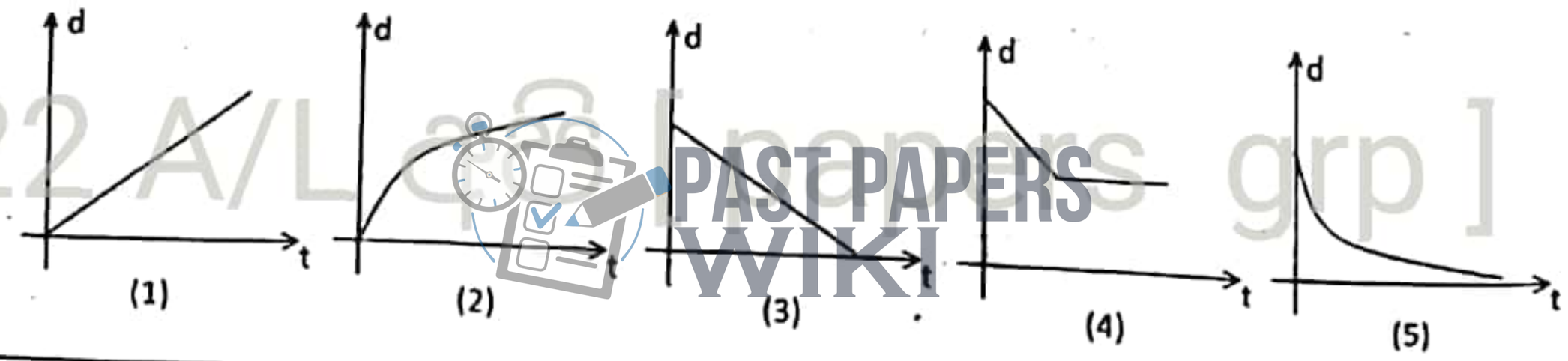


1) μW 2) $2\mu W$ 3) $3\mu W$
4) $4\mu W$ 5) $5\mu W$

(49) At the practical of determination of prism angle using a spectrometer, two readings were taken as $310^0\ 17^1$ and $70^0\ 17^1$. The prism angle would be,

1) 59^0 2) 60^0 3) 61^0 4) $70^0\ 34^1$ 5) $58^0\ 30^1$

(50) The variation of the thickness (d) of an ice block which is forming on the surface of water in an environment of temperature of -10^0C with time(t) is correctly represented by,

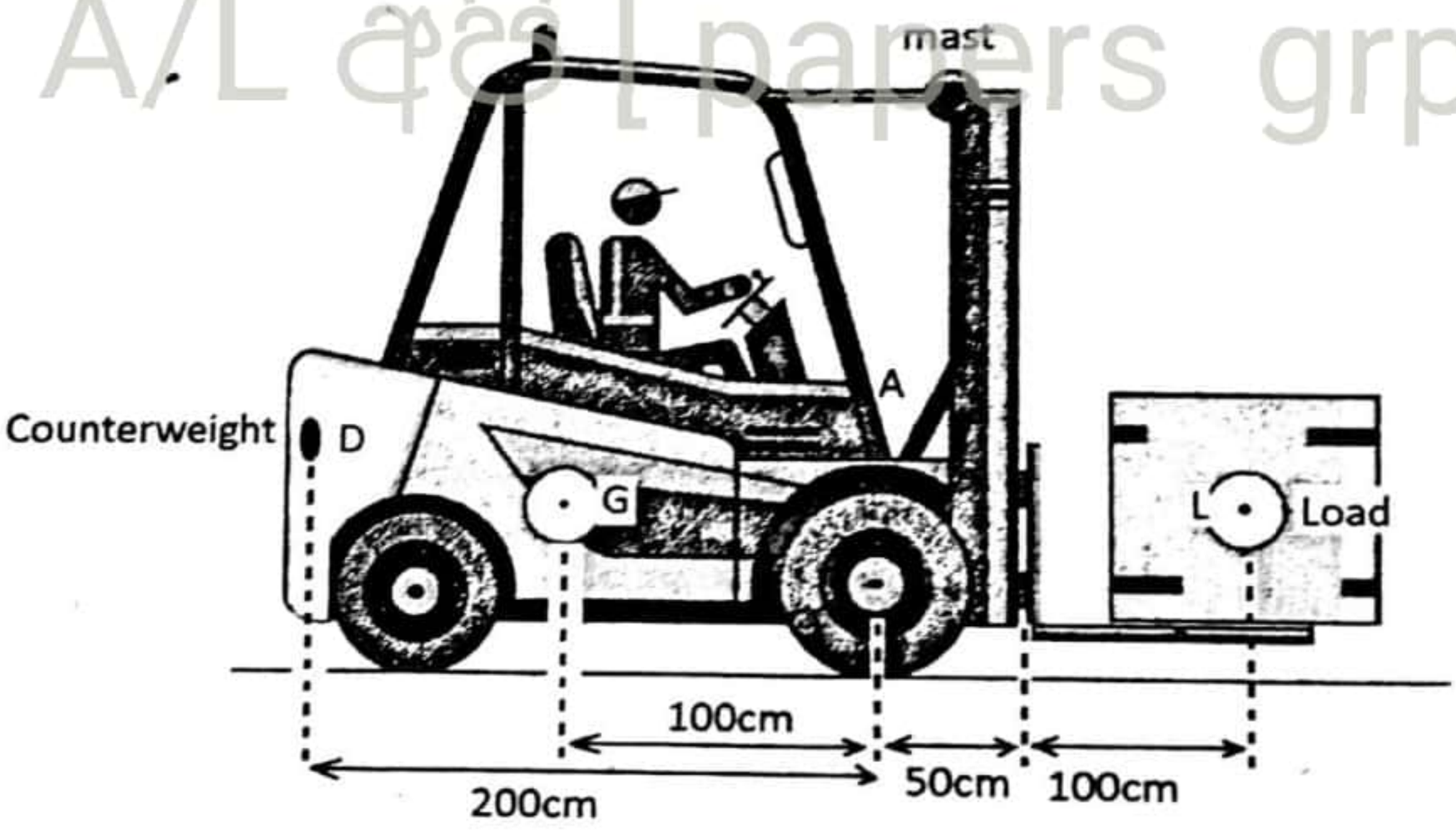


Part B – Essay

Answer 4 questions only.

(5) a) Write down the principle of moment.

b) Forklifts are designed to lift heavy loads safely that are beyond human capabilities. These forklifts are electrical or gas powered industrial equipment with a metal fork platform attached to it's front that can be used to lift heavy loads. The truck frame of a forklift includes wheels, counter weights, a carriage and a mast.



A forklift balances a load with a counter weight at the back. Hydraulic system is used to lift the load.

i) If the mass of the forklift is 1000 kg and the mass of the load is 2000 kg. The relevant distances are shown in the figure. Calculate the mass of counter weight which should be fixed to the back of the forklift.

ii) The total coefficient of friction of the forklift when it is moving to the front is 0.8. Calculate the frictional force acting on the forklift.

iii) When this forklift is moving at uniform velocity of 10 ms^{-1} on the horizontal road, calculate the power exerted by the engine. Neglect the air resistance forces.

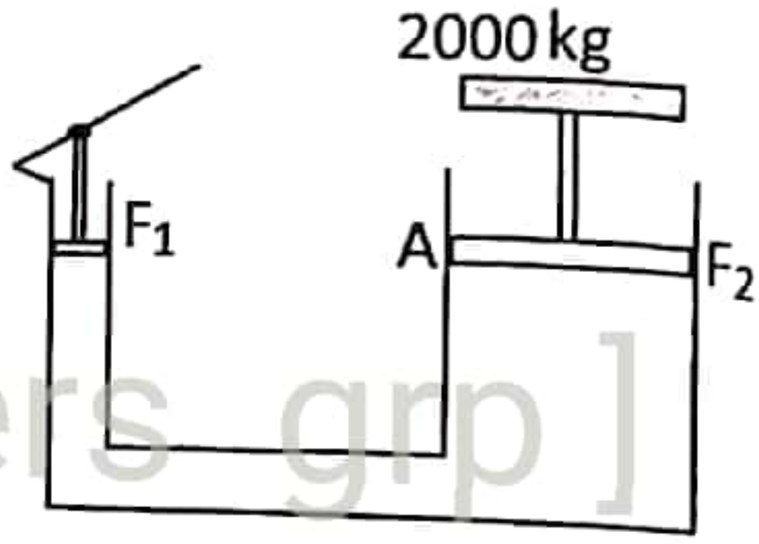
iv) The air resistance acting on the forklift is given by the equation $F_d = K\rho AV^2$. K is the drag coefficient. ρ is the density of air. A is the effective frontal area of the forklift and V is the speed of the forklift. If K is a dimensionless constant show this equation is dimensionally correct.

v) Take K = 0.2, ρ = 1.2 kgm^{-3}, A = $2m^2$ and V = 10 ms^{-1}. Calculate the value of F_d. Assume that air is at rest relative to the ground.

vi) Calculate the new power should be exerted by the engine to overcome this drag force (F_d) and above (b) (ii) calculated frictional force when the forklift is moving at constant velocity of 10 ms^{-1}

vii) This 2000 kg of load is to be raised to a vertical height of 1.5 m. What is the corresponding increase in potential energy?

c) The given hydraulic fluid compression is used to provide the necessary force to lift the load



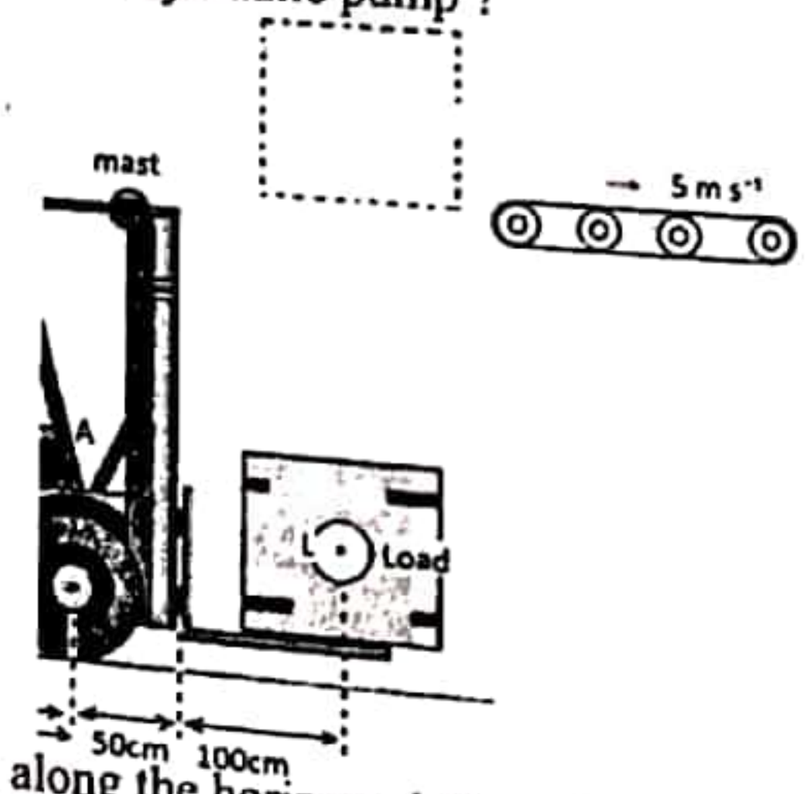
The cross sectional area of the master pump is $5cm^2$ and the cross sectional area of the piston at point A is 100 cm^2. A force F_1 has to be applied to the piston of the master pump in order to lift the load.

i) Name the principle that must be used to calculate force F_1

ii) Find the value of F_1

iii) What is the pressure of the compressed fluid in the hydraulic pump ?

d) Then this load is transferred instantaneously with a negligibly small speed on to the belt which is moving horizontally at a constant speed of 5 ms^{-1}. The load acquires the speed of the belt after 2s when it touches the belt.



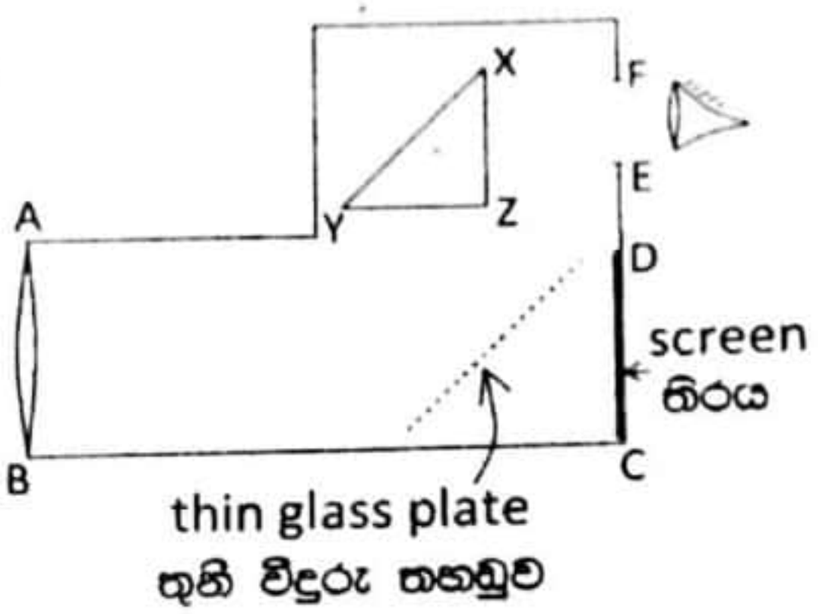
i) What is the change in momentum of the load along the horizontal direction?

ii) Calculate the magnitude of the force acting on the load during 2s, in order to acquire the above momentum. Explain how this force originates.

(6) The camera is a sensitive apparatus for light. The light entering it will be focused to the screen by the lenses inside it. A shadow is made on the screen from that light. Below figure shows a rough sketch of a camera consisting of one convex lens which has a focal length of 50 mm.

a) i) Write down the Cartesian sign convention related with lenses.

ii) The light entering the camera is refracted by the convex lens and focus on to the screen though the thin glass plate. Part of light that falls from the lens on the screen is reflected from the thin glass plate. Draw the convex lens and the screen on to your answer script and construct the image of an object, of Height H, placed close the camera (the distance from the convex lens is about 200 mm), by using two rays.



iii) On the diagram you have drawn

1) Mark the focal length f_0 in the both sides of the lens.
2) Mark the object distance u and the image distance v
3) Mark the object height H and the image height h.
4) Write down the magnification of the image (M) by using the object height and the image height.

iv) If the magnification of the image (M) is given by the equation $M = \frac{1}{f_0} V - 1$. Obtain this equation. Symbols are given in above.

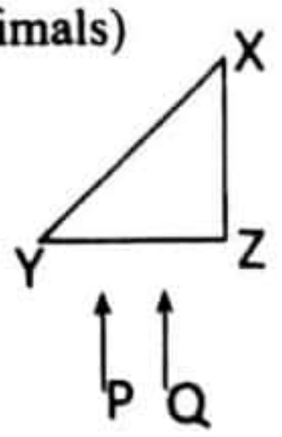
v) 1) If the object which is needed to be photographed is placed 1000 mm distance from the lens, obtain the distance from the camera lens to the screen in mm (Obtain your answer in two decimals).

2) What is the magnification of the image?

vi) After obtaining the photograph of the object when it is at 100 mm distance, to obtain the photograph when the object is at 1000 mm distance, the convex lens of this camera:

1) Should be moved towards the object or towards the screen?
2) Calculate the distance moved in mm (Answer should be in two decimals)

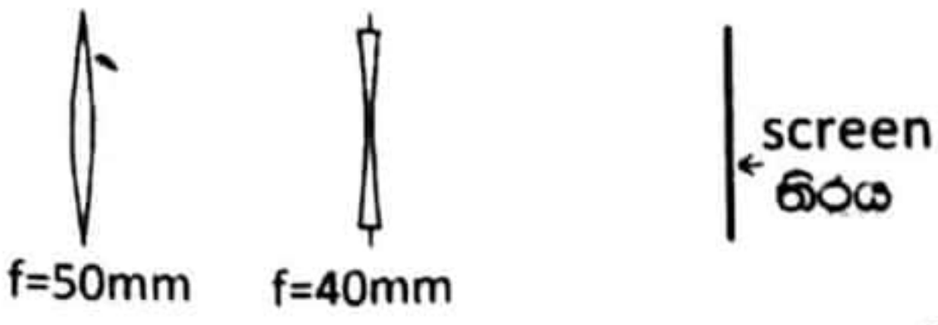
vii) Due to the partial reflection from the thin glass plate of the above camera, the light enters the prism and total internal reflection takes place. Then the light rays exit from EF hole. The user of the camera can see the object due to this light entering the user's eye.



1) What is the "total internal reflection"?
2) If the refractive index of the prism material is 2.0, what is the minimum value that should be taken for the incident angle for the total internal reflection takes place?
3) Draw the above prism onto your answer script and construct the path of the above P and Q rays. The prism is an isosceles right angled prism.

viii) Some cameras form images by combing convex lenses and concave lenses. Consider the given combine lens.

Draw the figure onto your answer script and construct the image formed the screen of a



point object placed in front of the convex lens.

(7) If a virus enters a human body, the rate of heat generating processes inside the body increase. As a result of this, the rate of heat energy generated inside the body increase. But, the rate of heat energy removed from the body is less than the rate of heat energy generated inside the body. Due to this the body temperature is increased. This increase in body temperature is known as fever:

a) The body temperature of a person is 37°C and his mass is 60 kg. Average specific heat capacity of the body is 3600 $Jkg^{-1}K^{-1}$.

i) Write down an expression for heat absorbed ΔQ by an object of specific heat capacity C and mass m when the temperature is increased by $\Delta\theta$.

ii) If the difference between the rate of heat generated and the rate of heat removed from the body is 1200 W and 75% out of this is caused to increase the body temperature. What is the amout of heat energy generated by this person to increase the body tempreatue during 15 minutes?

iii) Calculate the temperature rise of the body during 15 minutes due to the generated heat inside the body (Only temperature difference).

b) It is common to see that a person suffering from fever sweating when his body temperature is decreased. The body provided the needed heat to evaporate water as sweat.

i) In order to release the heat calculated in (a) (ii), what is the mass of water that should be evaporated? The specific latent heat of evaporation of water at body temperature is 2.4×10^6 Jkg^{-1}

ii) What is the volume of water in milliletres which corresponds to the mass calculated in (b) (i) above? The density of water is 1000 kgm^{-3}.

c) If the body temperature of the above person is 41°C, he decreases his body temperature upto 37°C by using a fan. Consider the total effective exposed surface area of his body is 2 m^2 and the cooling constant (k) is 0.2. If the room temperature is 30°C, calculate the released amount of heat from his body during 10 minutes.

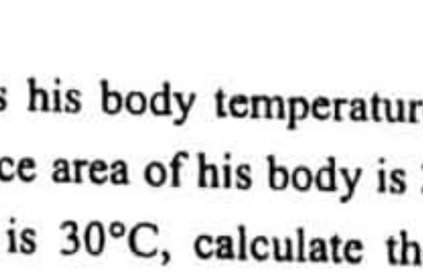
d) If this person is in a room of room temperature 30°Cis and the relative humidity 60%. At 30°C absolute humidity of saturated water vapour is 30 gm^{-3}

i) Write down an expression for relative humidity in terms of absolute humidity.

ii) Determine the mass of water vapor present inside the room. The volume of the room is 100 m^3

iii) The mass of water vapour released by the above person during 15 minutes equals to the value obtained in above (b) (i). Assume that the temperature inside the room does not change. What is the new relative humidity inside the room?

iv) Due to the weather change, the temperature inside the room decreases. Sketch the variation of the relative humidity with the temperature.

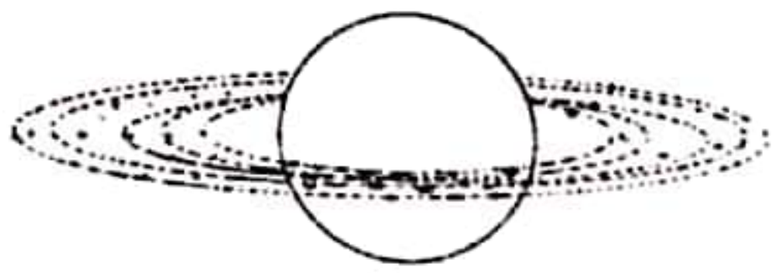


(8) The first four planets in the solar system Mercury Venus, Earth and Mars are know as Terestrial planets and the next four planets Jupiter, Saturn, Uranus and Neptune are know as Giant planets. Terrestrial planet are much smaller in size when compared to Giant planets and their exposed surface is consist of liquid or air or the mixture of liquid and gas. Jupiter and Saturn are known as gas gianst. The reason for this is, most of the volume of the planets are filled with Hydrogen and Helium.

The sixth planet from the sun is Saturn. It is the second biggest planet in the solar system. The surface temperature is –220°C. It has high density Fe and Ni at the center. Outside that a matter like silicate rock. Beyond this, it has liquid Hydrogen and Helium.

On the surface of Saturn, oceans created due to the liquifying of Hydrogen can be seen. Unlike Earth, there are no clear boundaries to be seen between those oceans and the atmosphere. On the surface, there is a matter consisting of constantly changing liquid and air states. It is difficult to explorate the information about this planet as there is no surface to land space crafts.

Due to the nature of the surface of Saturn, frequently heavy winds and whirlwinds (1800 kmh^{-1}) are created. There are about one thousand of nice rings around the Saturn. The main 7 rings out of these are named as A, B,C,..... The scientists say, the moons destroyed by the Asteroids and comets are rotated in a path as rings due to the gravity of Saturn. Billons of very small dust particles, ice pieces and pieces of rock covered with ice can be observed in these rings.



Due to the gravitational force exerted by the ice covered moons on other particals travelling in the rings, these particles are pushed out of the rings. This phenomena is known as the gravitational nudge. If the needed energy is obtained by those particles, they rejoin the path. This occurres in specific time duration. Therefore due the mutual gravitational forces created among the orbital objects, their period of time of revolving constantly occures with constant ratio. This is know as Obital resonance.

If the periodic time of rotating particles and a moon are T_A and T_B, the Obital resonance occurs with a comnstant ratio of $T_A / T_B = x/y$. x and y are numerical values.

The mean radius (R) of Satarn is 58500km and the radius of Earth (R^1) is 6500km. Sturn's period of time of spinning and the period of time of revolving are 10.7 hr and 29.4 years respectively. Due to the increasing rate of spin, diameter at the equator is greater than the diameter at the poles. The mass (M) is 5.4×10^{26} kg . The Saturn has 53 moons and the largest

one is Titan.The distance between the centers of Titan and Saturn (d) is 1.200.000 km. The mass (m) of the Titan is 1.2×10^{23} kg and the radius (r) is 2400 km. The period of time of spinning and the period of time of revolving are equal. Its value is 15 days. The moons are moving in specifi orbits and they are known as satellites.

a) i) The solar system is classified into two categories as mentioned in the paragraph. What are the two categories?

ii) Write down two basic factors which are bases for the above classification?

iii) What is the reason for naming Saturn and Jupiter as "Gas Gients"?

iv) What is the opinion of the scientists on the forming of rings around Saturn?

v) What can be observated inside those rings?

vi) The internal and the external diameters of the ring 'B' of Saturn are 184,000 km and 235,000 km. If the average thickness of the ring is 10 m and the average density is 150 kgm^{-3}. Calculate the mass of the ring B. (Take $\pi = 3$).

vii) Explain how the gravitational nudge occur in these rings.

viii) Explain the meaning of the orbital resonance.

ix) The orbital resonance of the particles which are in the external boundaries of the ring "A" of Saturn and the moon "Janus" is 7:6. If the orbital period of time of the moon "Janus" is 16 hours and 41 minutes, What is the orbital period of time of the particles in the external boundaries of the ring "A" in minutes?

x) Write down two reasons for constantly disturbances in the atmosphere of Saturn.

b) i) Write down the Newton's universal Gravitational Law in words.

ii) Write down that law as an equation by using the used symbols.

iii) Show by using a calculation, that the Saturn is bonded with Titan moon with a large force. $G = 6.67 \times 10^{-11} m^3 kg^{-1} s^{-1}$ (No need to simplify).

iv) Using G, M and d, obtain an expression for the velocity of Titan moving around Saturn.

v) Using that obtain an expression for the period of revolving of Titan moon (T) using G, M and d.

vi) Calculate a value of T from that. No need to simplify.

vii) What is the result due to the equalization of the spining periodic time and the revolving period time of Titan?

c) i) Write down an equation for the gravitational filed intensity (E) on Saturn by using the given symbols.

ii) How many times is that value, when comparing with the gravitational filed intensity of the earth (E^1)? Mass of the earth (M^1) $= 6 \times 10^{24}$ kg.

iii) Write down the reason why the gravitational acceleration near the equator is less than the gravitational acceleration near the poles.

d) i) What is the escape velocity?

ii) Obtain an expression for the minimum velocity which should be given on the surface, to a piece of ice of mass m^1 which is on the surface of Saturn to throw it to a distance of 1000 m.

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