SENGEREMA SECONDARY SCHOOL
FORM FIVE HOLIDAY PACKAGE
PHYSICS

GRAVITATIONAL MOTION

Question 01

(i) State Newton's law of universal gravitation

(ii) Suppose that the radius of the Earth was to shrink 1% its mass remaining the same. What would the acceleration due to gravity be on the Earth surface? Will it increase and by what percent?

Question 02

(i) State Kepler's laws of planetary motion

(ii) A rocket is fired from the Earth's surface and given just enough energy to make it to the moon. Find a position between the Earth and the moon at which the rocket will have maximum velocity.

Question 03

(a) How are gravitational intensity and gravitational potential related

(b) Taking the Earth to be a uniform sphere a radius 6400km and the value of g at the surface to be $9.8ms^{-2}$. Calculate the total energy needed to raise a satellite of mass 2000kg into orbit at an altitude of 8000km.

Question 04

(a) Explain the term **"parking orbit"** of a satellite

(b) Explain briefly how the satellite is sent orbit when the intended altitude has been reached. What would happen if this procedure of putting satellite in an orbit failed to come into effect?

Question 05

(a) State Newton's law of gravitation. Use the la to drive Kepler's third law

(b) Explain why Newton's equation of universal gravitational does not hold for bodies falling near the surface of the Earth?

Question 06

(a) With regards to Earth – moon system discuss the formation of tides

(b) A satellite of mass 600kg is in a circular orbit at a height of 2×10^3km above the Earth's surface. Calculate the orbital speed, the kinetic energy and its gravitational potential energy.

Question 07

(a) Explain briefly the fact that at one point on the line between the Earth and moon the gravitational field caused by two bodies is zero.

(b) Sketch graphs to show how the gravitational force and gravitational potential on a rocket varies as it moves from the Earth towards the moon in a straight line.

(c) If the Earth's gravitational field is not uniform over large distance, what is the longest period of a sample pendulum on the Earth's surface?

Question 08

(a) List two ways of describing "g" as applied to gravitation. Give appropriate units in each case assuming the Earth to be a uniform sphere of radius 6.4×10^6m and mass 6×10^6kg. Calculate the

(b) Gravitation potential of a point 6.4×10^6m above the Earth's surface

(c) Work done in taking a 50kg mass the Earth surface to a point where the gravitational field of the Earth is negligible.

(d) What is binding energy of the Earth – sun system?

Neglecting the presence of another planet or satellites, calculate the binding energy of this system (Take mass of sun $M_s = 3.3 \times 10^5 m_e$ but $m_e = 6 \times 10^{24}$kg Earth sun orbit 1.5×10^{11}m)

Question 09

The Apollo 11 space craft in its journey from the Earth to the moon had a velocity of 5374m/s when 26,306km from the centre of the Earth. What would have been its velocity at 50,000km from the Earth's centre if the space craft did not fire its motors during the journey?

Question 10

Two small spheres each of mass 10g are attended to a light rod 50cm long. The system is into oscillation and the period of torsion oscillation is found to be 770 seconds. To produce maximum torsion to the system two large spheres each of mass 10kg are placed near each suspended sphere, if the angular deflection of the suspended rod is 3.96×10^{-3}rad and the distance between the centers of large spheres is 10cm, determine the value of the universal constant of gravitation G, from the given information.

ROTATIONAL DYNAMICS

Question 01

A solid circular cylinder and a solid spherical ball of the same mass and radius are rolling together down the same inclined. Calculate the ratio of their kinetic energy. Assume pure rolling motion **Question 02**

A sphere and cylinder of the same mass and radius start from ret at the same point and more down the same plane inclined at 30° to the horizontal

a) Which body gets the bottom first and what is its acceleration

b) What angle of inclination of the plane is needed to give the slower body the same acceleration

Question 03

i) Define the angular velocity of a rotating body and give its SI unit

A car wheel has its angular velocity changing from 2rads^{-1} to $30\ \text{rads}^{-1}$ in 20 seconds. If the radius of the wheel is 400mm. calculate

ii) The angular acceleration

iii) The tangential linear acceleration of a point on the rim of the wheel

Question 04

A 5.0kg disc of moment of inertia 0.1kgm^2 about its centre and radius 0.2m is released from rest on a plane inclined at 30° to the horizontal. Calculate the angular velocity after it has rolled 2m down the plane.

Question 05

A uniform disc of radius R and mass M is mounted on an axle supported in fixed frictionless bearings. A light cord is wrapped around the rim of the wheel and a mass m is attached at the end of the cord. Find the angular acceleration of the disc using relation, $\tau = \frac{dL}{dt}$ and hence the tension in the cord.

Question 06

i) What I meant by moment of inertia of a body?

ii) State the perpendicular axis theorem for moment of inertia of a rigid body iii) Deduce an expression for the moment of inertia of a disc about an axis at its rim perpendicular to the axis through its centre if the centre of this disc about a diameter is $I = \frac{1}{4}md^2$

Question 07

i) Define the radius of gyration

ii) Calculate the radius of gyration about a tangent of a sphere 0.5m parallel to the axis through its centre.

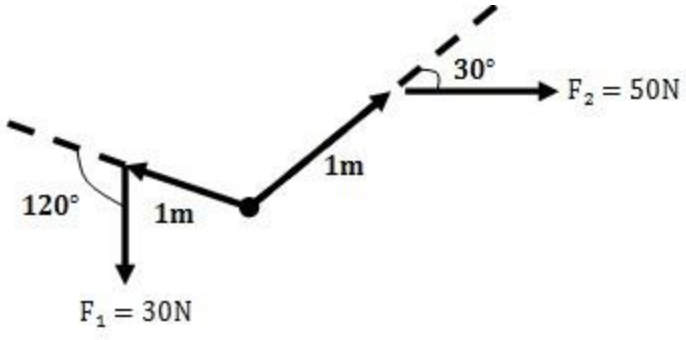
iii) A solid cylinder of mass M and radius r whose moment of inertia I = Mk^2 (k being the radius of gyration) rolls down an inclined plane of angle θ to the horizontal having a length L and height h. find the final velocity V when at the bottom in terms of

a) h, k, r and

b) α, I, k, g and r

Question 08

Calculate the net torque exerted by F_1 = 30N and F_2 = 50N in the figure below. You may assume that both forces act on a single rigid body

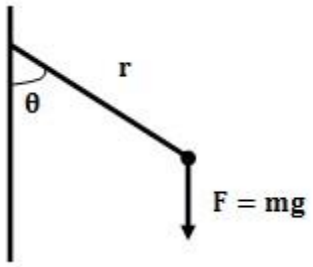


Question 09

Two cylinders of the same mass and shape, one hollow and one solid, are set on a inclined and allowed to roll down. Which cylinder will reach the bottom of the incline first? Why?

Question 10

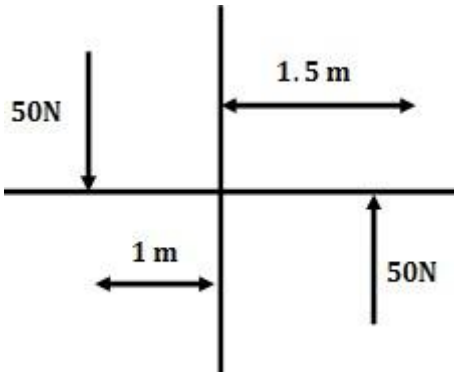
A simple pendulum of mass m on a string of radius r is displaced from vertical by an angle θ, as shown below. What is the torque provided by gravitu at that point?



What is the angular acceleration of the pendulum at that point?

Question 11

A revolving door is common in office buildings. What is the magnitude of the torque exerted on a revolving door of mass 100kg if two people push on opposite sides of the door with a force of 50N at a distance of 1m from the axis of the door, as shown below. Also the moment of inertia of a revolving door is given by $I = \frac{ML^2}{3}$. Find the resultant angular acceleration assuming no resistance.



Question 12

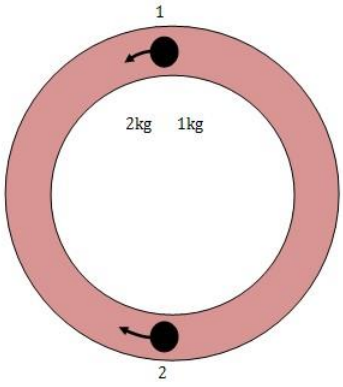
In an isolated system the moment of inertia of a rotating object is doubled. What happens to angular velocity of the object?

Question 13

Explain, in terms of conservation of angular momentum, why comets speed up the as they approach the sun?

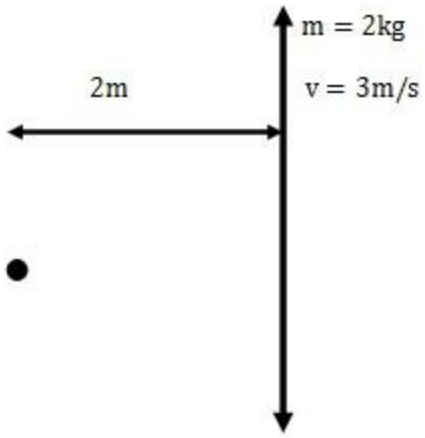
Question 14

Two balls, one of mass 1kg and one of mass 2kg are confined to move in a circular tract. They move at an angle equal velocity, v, in opposite directions on the track and collide at a point. The two balls stick together. What is the magnitude and direction of the balls after the collision, in terms of v?



Question 15

A particle moves in straight line pat a point O, as shown below. At which point is the angular momentum maximum? If the distance between O and the line is 2m, and the object has mass of 2kg and a velocity of 3m/s, what is the maximum angular momentum of the particle with respect to O?

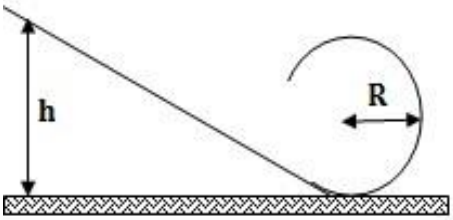


Question 16

Many times a spinning top will not only spin about its axis, but precess about a vertical axis, meaning its point of contact with the ground remains the same, but the top wings around the vertical axis at an angle. What is the direction of the change in angular momentum in this situation? Where does the torque come from which causes this change in angular momentum?

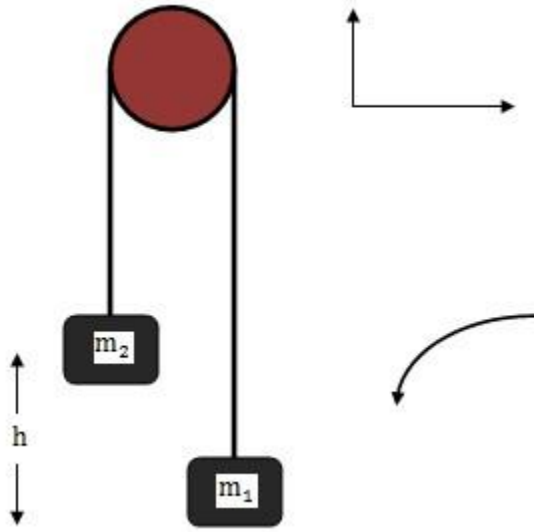
Question 17

A small solid marble of mass m and radius r rolls without slipping along a loop the loop track shown in the figure below, having been released from rst somewhere along the straight section of the track . From what minimum height above the bottom of the track must the marble be released in order not to leave the track at the top of the loop



Question 18

Find the velocity of the following system ($m_1 > m_2$) after it has moved through some height h . the pulley has mas M, radius R, and $I = MR^2$. Note $T_1 \neq T_2$

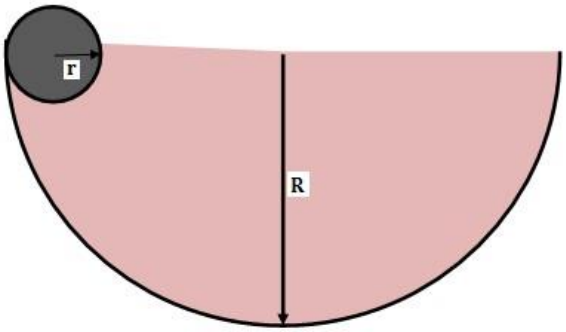


Question 19

A time-honored tradition in Appalachia is boulder trundling where a large round rocks is chucked off a tall cliff just for the sake of mischief. Let‟s say that high school kid heave a large (200kg, 0.6 meters in diameter), roughly spherical boulder over the edge of a 50 meters tall strip mine headwall. It falls down the cliff face, hits the ground and begins rolling 50 meters down a steep incline before crashing into a mining company jeep. What is the velocity of the builder just as it hits the jeep?

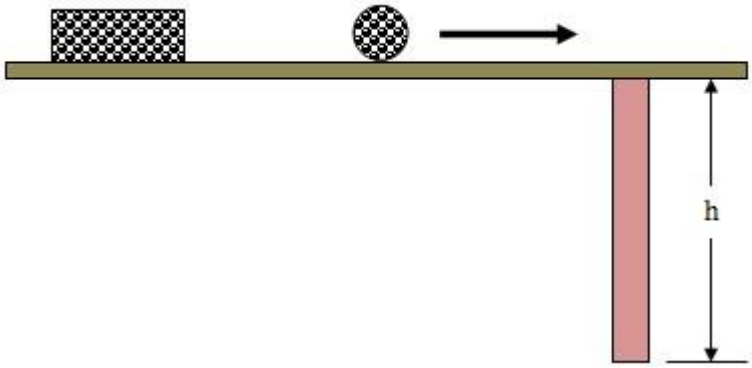
Question 20

A uniform solid sphere of radius r is placed on the inside surface of a hemispherical bowl of radius R. the sphere is released from rest at the edge of the bowl as shown below and rolls without slipping. Determine the translational speed of the sphere when it reaches the bottom of the bowl.



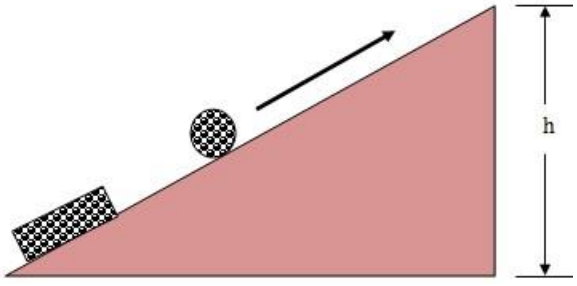
Question 21

The projectile launchers we use in lab a spring to supply the force needed to shoot a projectile across a room. Suppose that the projectile used is a solid metal sphere of mass 100 grams and radius 2cm, the spring constant, k, is 500N/m, the launcher is "cooked" by displacing the spring 10cmfrom its equilibrium position. The launcher is located on a level table. If the table is 1meter in height, were does the projectile land?



Question 22

The projectile launchers we use in lab a spring to supply the force needed to shoot a projectile across a room. Suppose that the projectile used is a solid metal sphere of mass 100 grams and radius 2cm, the spring constant, k, is 500N/m, the launcher is "cooked" by displacing the spring 10cm from its equilibrium position. The launcher is located at the base of a ramp inclined at 300 to the horizontal up which the projectile rolls without slipping once it leaves the barrel of the launcher. If the ramp is 1 meter in height, where does the projectile land?



Question 23

A thin hollow cylinder is released from rest side with a solid cylinder of identical mass and radius. Both roll without slipping down an incline 10 meters in height, across a flat area and up an identical incline on the other side of the flat. To what height do the respective cylinder rise?

a) What is the translatory velocity of the hollow cylinder at the bottom of the incline?
b) What is the translational velocity of the solid cylinder at the bottom of the incline?

FLUID DYNAMICS

Question 01

a) Write down the formula for the viscous drag force on a sphere falling in fluid as stated by stokes. Explain the symbols

b)

i) When a sphere in a liquid starts to move from rest, what is the magnitude and direction of the forces acting on it

ii) Why does the sphere in (i) above has an initial acceleration iii) How does the forces change as the velocity of the sphere increases?

Question 02

A horizontal tube consists of two parts joined together end to end. One part is 100mm long and has a radius of 1.0mm. The other is 140mm long with a radius of 0.5mm. when, water, equivalent to that due to 120mm of water, flows between the tube ends, what are the pressure differences across each of the component tubes? (Give your answer in terms of mm of water)

Question 03

i) State and write down the continuity equation as applicable to fluid dynamics ii) Write down Bernoulli‟s equation and state the condition under which it is applicable.

iii) Air flows over the upper surfaces of the wings of a jet plane at a speed of 340m/s and past the lower surfaces at 280m/s. determine the lift force on the jet plane if it has total wing area of $50m^2$. The density of air flowing is $1.29kg/m^3$

Question 04

a) What is the difference between
i) Inviscid and viscous fluid ii) Newtonian
and Non- Newtonian flow

b) Water flows steadily a long a horizontal pipe which narrow at a constriction; the speed at the narrow part is 12m/s. If the cross sectional area at the constriction part is $\frac{1}{4}^{th}$ of the original cross section area of the pipe. Calculate the pressure difference between the two part in Nm^{-2}.

Question 05

A cylinder tank of diameter 90cm rests on top of a platform 6m high. Initially the tank is filled with water to a depth of 3m. a plug whose area is $3cm^2$ is removed from on the side of the tank of the bottom.

i) At what speed will water strike the ground ii)
How long will it take for the tank to be empty?

Question 06

i) Distinguish between dynamic lift and upthrust ii) A bat of mass 100g hovers upward by bating its wing of effective area $04m^2$.. Estimate the velocity imparted to the air by beatings of the wings . Assume the bat to be of s.t.p weather conditions

Question 07

a)

i) What is meant by viscous drag?

ii) With the aid of dimensional analysis, derive an expression relating viscous drag to other relevant parameter leading to stokes law b)

i) Compare the time taken by two small sphere of the same material to fall the same height though a liquid after reaching their terminal velocity. The diameter of one spheres is three times that of the other

ii) Deduce the terminal velocity of an oil drop radius 3×10^{-6}m falling through air. Neglect the density of air ($\text{pressure is } 1.8 \times 10^{-5}\text{Pa}, \text{density is } 8 \times 10^{2}\text{kgm}^{-3}$)

Question 08

A tank is filled with water to a height H. A small hole is punched at depth h below the water surface. Show that the distance from the base of the tank to the point which the resultant stream strikes the ground is given by $x = 2\sqrt{h(H-h)}$

Question 09

A sprinkler has 20 holes each of a cross section area of $1 \times 10^{-2}cm^2$ and connected to a pipe of cross sectional area $2.4cm^2$. If the speed of the water in the pipe is $15m/s$, estimate the speed of water as it emerges from the holes

Question 10

A static pressure of horizontal pipe line is 4.3×10^4Pa and total pressure is 4.3×10^4Pa and the cross sectional area $20cm^2$. The fluid may be considered to be incompressible and non-viscous and has density of $10^3 kgm^{-3}$ on a pipe line. Calculate

i) The flow velocity in the pipe ii)
The volume rate in the pipe line

Question 11

A small oil drop falls with a terminal velocity of $4 \times 10^{-4}m/s$ what is the new terminal velocity of an oil drop of half radius? Neglect the density of air

Question 12

The pipe shown in the figure has a diameter of 16cm of section 1 and 10cm at section 2. At section 1 pressure is 200kPa, point 2 is 6m, height 1 when oil of density $800kgm^{-3}$ flows at rate of $0.03m^3/s$. Find the pressure at a point 2 if viscosity is negligible.

Question 13

A metallic sphere of radius 1×10^{-3}m and density of $1 \times 10^4 kgm^{-3}$ enter a tank of water after a force fall through a height "h" in the Earth"s gravitational field. Its velocity remains unchanged after entering water. Determine the value of h. $\eta = 1 \times 10^{-3} Nsm^2$ and $g = 10m/s^2$.

Question 14

Two identical drops of water are falling through air with steady velocity of 10m/s. If the drops combine to form a single large drop. What would be the terminal velocity of large single drop?

Question 15

A sphere is dropped under gravity through a fluid a viscosity η taking average acceleration is held of the initial acceleration; show that the time taken to attain terminal velocity is independent of fluid density **Question 16**

Water is flowing through a horizontal pipe having different cross sections at two points A and B. the diameters of the pipe at A and B are 0.6m and 0.2m respectively. The pressure difference between point A and B is 1m column of water. Calculate the volume of water flowing per second

SURFACE TENSION

Question 01

i) Define surface tension in terms of surface energy

ii) Derive an expression of excess pressure inside the spherical bubble in a liquid

iii) A soap bubble of radius 3.0cm and another soap bubble of radius 4.0cm are brought together so that the combined bubble has a common interface of radius r. Find the value of r surface tension of soap solution is 2.5×10^{-2}N/m.

Question 02

i) What is meant by angle of contact?

ii) A u-tube with its upright limbs of diameter 4.0cm and 1.2cm contains water of surface tension 0.72N/m angle of contact is zero and density 1000g/m^3. Find the difference in height level

Question 03

a) How the surface tension of a liquid is affected by temperature and amount of solute in the liquid

b) Derive a formula for excess pressure inside a bubble of air in water

c) The radius of two soap bubbles in vacuum are cm and 6cm. if they are fused into single bubble under isothermal condition calculate the radius of the new bubble

Question 04

A soap solution of surface tension γ is used to form a film between horizontal rods of length λ and a length of weightless inextensible thread attached to each end of the rod. A weight W is attached at the midpoint of the thread. Show that the tension in the thread is $\frac{\lambda\gamma}{\cos\beta - \cos\theta}$

Where β is the angle made at the end of the rod and θ is the angle of the centre due to the weight

Question 05

Explain the following phenomena with reference to surface tension and capillarity

i) When rain drop fall on a greasy glass surface , the water drops bounce off without wetting the surface

ii) Soap solution is sometimes used in gardeners solution for spraying the leaves of plants in order to increase the wetting nature of the solution

iii) Discuss how the rise of water in a capillary tube is used to determine the surface tension of water

Question 06

a) Explain what will happen if two bubbles of unequal radii are joined by a tube without bursting

b) Suppose the xylems in the actively growing outer layer of a tree are uniform cylinders and that the rising of sap is due entirely to capillary with a contact angle of 45° and surface tension $\mathbf{5 \times 10^{-2} N/m}$. What will the maximum radius of the tubes be for a tree 20m tall?

Question 07

With a very thin film between surfaces can be quite considered. Thus for a 10m diameter circular water film. Given surface tension $\mathbf{0.72\ N/m}$, thickness 0.01mm. find the force to keep the plates together.

Question 08

a) Define coefficient of surface tension of a liquid in terms of
i) Surface energy ii)
Surface force

b) Illustrate the surface force acting on a molecule of water (at the meniscus) which is responsible for causing capillary rise of water in a clean glass tube

c) Derive of formula for the capillary rise "h" if water is in clean glass tube of radius r

Question 09

Describe a method of measuring variation of surface tension of water with temperature. If water rises to a height of 8.0mm in a capillary tube off a certain diameter. Explain the effect when the capillary tube of the same diameter but cm in a height placed in the water

Question 10

Briefly explain measurement of surface tension using bubble drop method

Question 11

A spherical soap bubble of radius R is floating inside the cylinder fixed with frictionless piston. The piston is slowly withdraws with a rise in temperature of the gas until the radius of the bubble is double. Shown that the final pressure P of the gas in the cylinder is given by

$\mathbf{P = \frac{P_0}{8} - \frac{3\gamma}{16R}}$

Where P_0 is the original pressure of the gas in the cylinder and γ is coefficient of surface tension

Question 12

Two soap bubbles of radius a and b coalesce to form a single bubble of radius C. if the external pressure is P, show that the surface tension γ of a soap solution is $\mathbf{\gamma = \frac{P(c^3 - a^3 - b^3)}{4(a^2 + b^2 - c^2)}}$

Question 13

Two spherical soap bubble combine. If V is the change in volume of the contained air, a is the change in total surface area, show that: $\mathbf{3P_0V + 4A\gamma = 0}$

Where γ is surface tension and P_0 is atmospheric pressure

Question 14

Calculate the change in surface energy of a soap bubble, when its radius decreases from 5cm to 1cm.

Surface tension of soap solution is $0.02\mathrm{N/m}$.

Question 15

Two soap bubble in a vacuum fuse into a single bubble. If the radii of the bubble are 4cm and 6cm. what is the radius of the resulting single bubble? Under what condition in your calculation valid?

Question 16

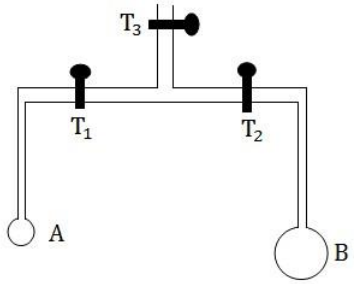
A block 6cm long, 1.5cm wide and 0.2 cm thick is laid with its face vertical and its longer side horizontal. A beaker of a liquid is raised until the lower face of the block just touches the liquid. If an additional mass of 0.88g on the other side of the pan is required to raise the block clear of the liquid, determine the surface tension of the liquid

Question 17

A circular ring of thin wire of radius 2cm is suspended horizontally by a thread passing through the 5cm mark of the metre rule pivoted at its centre, and the ring is balanced by a 5g mass suspended at the 70cm mark. A beaker of liquid is raised until the ring just touches the surface of the liquid. Find the surface tension of the liquid

Question 18

The diagram below shows two soap bubbles blown separately by the apparatus. Explain what happens to the bubbles when taps T_1 and T_2 are opened while T_3 kept closed



Question 19

A soap bubble of radius 4cm and surface tension 0.03N/m is blown at the end of a tube of length 10cm and internal radius 0.2cm. If the coefficient of viscosity of air is $1.85 \times 10^{-5}\mathrm{Nsm}^{-2}$, find the time taken by the bubble to be reduced to a radius of 2cm.

Question 20

A vertical capillary tube 10cm long tapers uniformly from an internal diameter of 1mm at the lower end to 0.5mm at the upper end. The lower end is just touching the surface of a pool of liquid of surface tension $6.0 \times 10^{-2}\mathrm{N/m}$, density $1200\mathrm{kg/m}^3$ and zero angle of contact with the

tube. Calculate the capillary rise. Explain what will happen to the meniscus if the tube is slowly lowered vertically until the upper end is level with the surface of the pool.

STRENGTH OF MATERIALS

What is the percentage increase in length of a steel wire of diameter 4×10^{-2}cm, when a body of mass 5kg is suspended from its end, the other end is securely supported. Young‟s modulus of steel is $2 \times 10^{11}N/m^2$.

Question 02

A mass of 11kg is suspended from the ceiling by aluminium wire of length 2m and diameter 2mm. what is

i) Extension produced ii) Elastic energy stored in the wire

iii) If 11kg is further pulled down, find the period of the system given Young‟s modulus of aluminium is 7×10^{10}Pa

Question 03

A cylindrical copper and a cylindrical steel wire each of length 1m and having equal diameters are joined at one and to from a composite wire 2m long. This composite wire is subjected to a tensile stress until its length becomes 2.002m. calculate

i) The tensile stress applied to a wire ii) Calculate the strain in each wire

iii) Calculate the force applied to the wire if its diameter is 2mm

Take ($E_{steel} = 2 \times 10^{11}N/m^2$ and $E_{copper} = 1.2 \times 10^{11}N/m^2$)

Question 04

A heavy rigid bar is suspended horizontally from a fixed support by two vertical wires A and B of the same initial length and which experience the same extension. If the ratio of Young‟s modulus of A to that of B is 2 and the ratio of diameter of A to that of B is 2.

i) Calculate ratio of the tension in A to that of B

ii) If the distance between wires is D, calculate the distance of wire A from the centre of gravity of the bar

Question 05

A uniform steel wire density $7800kgm^{-3}$ weighs 16g and is 2.5m long. It is elongated by 1.2mm when stretched by a force of 80N. Calculate Young‟s modulus of steel

Question 06

A copper wire, 200cm long and 1.22mm in diameter is fixed horizontally to two rigid supports 200cm long. Find the mass in grams of the load which when suspended at the midpoint of the wire, produces a sag of 2cm of that point ($E_{copper} = 1.23 \times 10^{11}N/m^2$)

Question 07 The rubber cord of catapult has cross-section area $1mm^2$ and a total unstretched length 10cm if it is stretched to 12cm and then released to project missile of mass 5g. calculate the velocity of projection, taking $E_{rubber} = 5 \times 10^8N/m^2$

Question 08

An elastic cable has length of 100m and consists of aluminium wire of diameter 5mm surrounded by six steel wire of diameter 2mm each. It is high between two poles the tension in the cable is 800N. What is the extension of the cable?

Take (Esteel = 2 × 1011N/m2 and Ealuminium = 7 × 1011N/m2)

Question 09

A 20m length continuous still railway line of cross section area $8 \times 10^{-3}m^3$ is wedded into place after heating to uniform temperature of 40℃. Calculate for normal operating conditions at 15℃

a) The tensile strain
b) Tensile stress
c) Elastic strain energy in the rail
d) How much heat would be required to return the rail to 40℃

$E_{steel} = 2 \times 10^{11}N/m^2$ $\alpha = 1.2 \times 10^{-6}k^{-1}$ $\rho = 7800kgm^{-3}$ and specific heat capacity is $500Jkg^{-1}k^{-1}$

Question 10

Consider a diagram below in which a light rigid bar is suspended horizontally from the two vertical wires of steel and one of brass. Each wire is 2m long. The diameter of steel wire is 0.6mm long and length of the bar is 0.2mm when a mass 10kg is suspended from the centre of AB the bar remain horizontal

i) What is the tension in each wire ii) Calculate the extension of the steel wire and energy stored in it
iii) If the brass were replaced by another brass wire of diameter 1mm, where should the mass suspended so that AB would remain horizontal

Take ($E_{steel} = 2 \times 10^{11}N/m^2$ and $E_{brass} = 1 \times 10^{11}N/m^2$)

Question 11

a) Define stress and strain
b) Calculate the workdone in stretching a copper wire 100cm long and $0.03cm^2$ cross section area when a load of 120N is applied. $E_{copper} = 1.1 \times 10^{11}N/m^2$

Question 12

A lift is designed to hold a maximum of 12 people. The lift case has a mass of 500kg and t distance from the top floor of the building to the ground floor is 50m.

a) What is the maximum cross sectional area should the cable have to in order to support the lift and the people?
b) How much will the lift cable stretch if 10 people get into the lift at the ground floor, assuming that the lift cable has cross sectional area of $1.36cm^2$.
Given mass of an average person=70kg, $E_{skate} = 1.23 \times 10^{11}N/m^2$ and Tensile strength of steel is $4 \times 10^{8}N/m^2$

Question 13

A copper wire of negligible mass, 1m long and cross sectional area $10^{-6}m^2$ is kept on smooth horizontal table with one end fixed. A ball of mass 1kg is attached to the other end. The wire and the ball are rotating with an angular velocity of 20rad/s. If the elongation of the wire is 10^{-3}m, find the Young‟s modulus of wire. If on increasing the angular velocity to 100rad/s, the wire breaks down, find the breaking stress.

KINETIC THEORY OF GASES

Question 01

Ten moles of ammonia at present in a $1.0 \times 10^{-2}m^3$ Flask at 27ºC. Calculate the pressure using van der Waals equation. The van der Waal constant for ammonia are: $a = 4.224 \times 10^5$ Nm^4 $Kmol^{-2}$ $b = 3.7 \times 10^{-2}$ m^3 K mol^{-1}

$R = 8.317$ JK mol^{-1}.

Question 02

Calculate the molecular diameter of hydrogen at N.T.P by using Van der waals constants $b = 2.26 \times 10^{-2}m^3$ K mol^{-1}. Given that under the standard conditions of OºC and average atmospheric pressure referred to by the abbreviation S.T.P or N.P.T., one mole of any gas is found to occupy a volume of 2.4 m^3. $N_A = 6.023 \times 10^{23}$ molecule/kmol

Question 03

Calculate the internal pressure for carbon dioxide. Given the value of Van der Waals constant for carbon dioxide is $a = 0.37$ Nm^4 / mol^2 and $V = 22.4$ litre /mol.

Question 04

(a) Assume that the Van der Waals constants for oxygen b to be equal to four time the volume of one mole of oxygen. Find the radius of one molecule of oxygen. Given that $b = 32cm^2$/mole.

(b) Calculate the critical volume for one mole of hydrogen if its critical temperature is 240K and is critical pressure is 12.8 atm. $R = 8.31$ $Jmol^{-1}$ K^{-1}

Question 05

(a) Derive are expression for the pressure exerted by an Ideal gas on the walls of the container.

(b) How does the average translational Kinetic energy of a molecule of an Ideal gas change if

(i) The pressure is doubled while the volume is kept constant.

(ii) The volume is double while pressure is kept constant.

Question 06

A mole of an ideal gas at 300K is subjected to a pressure of 10^5 Pa and its volume is $0.025m^3$ Calculate

(a) The molar gas constant (R)

(b) The Boltzmann constant (K)

(c) The average translation Kinetic energy of a molecules of the gas take

$N_A = 6.023 \times 10^{23} mol^{-1}$

Question 07

(a) A flexible container of oxygen has a volume of $10m^3$. What is the mass of the gas enclosed?

(b) Determine the volume of 1 mol of any gas at S.T.P assuming it behaves like an ideal gas.

Question 08

At 30ºC the volume of a gas is $200cm^3$ keeping the pressure constant of the gas. If a gas is heated to 100ºC, find its volume.

Question 09

The pressure of a gas in a flask is 75 cm Hg at 0ºC keeping the volume constant, the gas heated so that its pressure is 100 cm Hg. Find the temperature of the gas.

Question 10

(a) Define "mean free path for the molecules of a gas

(b) How mean free path for the molecules is is affected by temperature and pressure?

Question 11

(a) What is meant by mean free path?

(b) Show that the mean free path of an ideal gas at pressure P and temperature 1 given by $\lambda = \frac{K_B T}{\sqrt{2} P \pi d^2}$

Where K_B − Boltzmann Constant

d − Molecular diameter

Question 12

(a) What is meant by internal energy of a system

(b) Calculate the mean free path of a gas molecule having a collision diameter 2Aº at S.T.P (Avogadro"s No is 6.023×10^{23})

Question 13

The pressure and temperature at the top of Mount Kilimanjaro is 3.26×10^4 Pa and 250K respectively while at Dar es Salaam they are 1×10^5Pa and 300K. The mean free path of nitrogen at Dar es Salaam is 1.6×10^{-7}m what is the mean free path of the top of Mount Kilimanjaro?

Question 14

Estimate the mean free path of the air molecules of S.T.P. Given that the diameter of oxygen gas and nitrogen gas molecules is about 3×10^{-10}m.

Question 15

Find the Mean free path and collision frequency for nitrogen molecules at a temperature of 20˚C and pressure of 1atm. Assume a molecular diameter of 2×10^{-10}m.Given that the average speed nitrogen molecule at 20˚C is $511ms^{-1}$ and $K_B = 1.38\times 10^{-23}$

THE END, ENJOY YOUR HOLIDAY