PHYSICS

QUESTIONS FOR DISCUSSION

FORM THREE 2023

TOPIC 01: APPLICATIONS OF VECTORS

Question 01: A weight of 25N is suspended from a beam by a string; what horizontal force must be applied to the weight to keep the string at an angle of 20^0 to the vertical. What is the tension in the string? (Answer: F_H = 9.1N, Ts = 26.6N

Question 02: A plane travelling at a velocity of 100km/h to the South encounters a side wind blowing at 25km/h to the West. What is its velocity relative to an observer on the ground? (Answer: V_R = 103.1km/h)

Question 03: A car is travelling at 60m/s due to east and a lorry is travelling at 100m/s due to north. What is the velocity of the car relative to the lorry? (Answer: 116.6m/s at 31^0 NE)

Question 04: An automobile A, travelling relative to the earth at 45km/h on a straight level road is ahead of motor cycle B travelling in the same direction at 90km/h. What is the velocity of B relative to A? (V_{BA} = 45km/h)

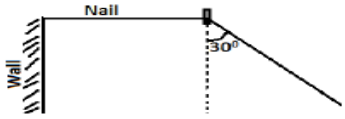
Question 05: A boat heading due north crosses a wider river with a velocity of 36m/s relative to the water. The river has a uniform velocity of 12m/s due south.

(a) Determine the velocity of the boat with respect to an observer on the river bank (Answer: 24m/s)

(b) If the river was flowing due east, determine the velocity of the boat with respect to an observer on the river bank (Answer: 38m/s)

Question 06: A nail is being pulled using a string from a wall. The string forms an angle of 30° with the normal. If the force being used is 10 N, part of the force will tend to bend the nail while the other part will try to pull it out

Figure:



What the magnitude of the force:

(a) Tend to bend the nails? (Answer: 8.66N)

(b) Tend to pull the nails out? (Answer: 5.0N)

Question 07: A body is being acted on by two forces: F_1 = 18N acting at an angle of 25° and F_2 = 30N acting at 140° from due East. Find the resultant of the two forces, F, by separating the forces into x – and y – components (Answer: 27.7N at 1.33^0 NW).

Question 08: A weight of 50.0N is suspended from a beam by a string. What horizontal force must be applied to the weight to keep the string at an angle of 40^0 to the vertical? What is the tension in the string? (Answer: F_H = 42N, Ts = 65.3N)

Question 09: A weight of 4.33N is suspended by a string fastened at its upper end. A horizontal force is applied to the weight so that the string makes an angle of 30^0 with the vertical. Find the force and tension in the string

Question 10: A man using a 70kg garden roller on a level surface exerts a force of 200N at 45^0 to the ground. Find the vertical force of the roller on the ground

(a) If he pulls the roller (Answer: 560N)

(b) If he pushes the roller (Answer: 840N)

Question 11: A motor vessel tows a small dinghy by a rope which makes an angle of 20^0 with the horizontal. If the tension in the rope is 150N; find:

(a) The force which effectively pulls the dinghy forwards

(b) The force which lifts its bows out of water

Question 12: John and Mary starts walking at the same time from the south – west corner of a field whose south side is bounded by a straight stone wall. John walks alongside the wall at 5.5km/hr while Mary sets off at 6km/hr along a straight foot pass across the field which makes an angle of 50^0 with the wall. Find by means of an accurate scale drawing the velocity of Mary relative to John and their distance apart after 10minutes.

Question 13: An airplane is to fly horizontally in a straight line from **A** to **B** 320km east of A. The average airspeed the airplane can maintain is 400km/h, if the height the airplane is flying there is a jet – stream (strong wind) of 100km/hr blowing from the north. What course must the pilot steer, and how long will his journey take?

Question 14: A man was swimming at 20m/s across a river which is flowing at 10m/s. Find the resultant velocity of the man attempted to swim perpendicular to the water current.

Question 15: A wind is blowing 30^0 west of north at 20km/h. A bird is flying in the wind and its velocity relative to the ground is 90km/h at 75^0 west of north. Find the course and velocity of the bird.

Question 16: A man can row a boat in still water at 6km/hr. He wishes to row due to north across a river 3km wide which is flowing due to east at 2km/hr. Either by scale drawing or calculation find:-

(a) The direction in which he must head the boat

(b) The time taken to reach other bank

(c) How far from his destination he would land if he mistakenly steer due north

Question 17: Two athletes Baraka and Glena are both running at a speed of 30kph. Glena is running towards the south and Baraka is running towards the west. Find the magnitude of the velocity of Glena relative to Baraka.

Question 18: A speed boat capable of 30km/h is to cross a river to a point directly opposite its straight point. The river flows at 4km/h. At what angle to the bank must the boat be steered? How long will it take to cross if the river is 150m wide?

Question 19: A hydrogen balloon is weighted so that it rises vertically at 240m/min in still air. When observed at a height of 2000m it is seen to be rising at 76^0 to the vertical. What value does this observation give for the horizontal (wind velocity) in km/hr at this height?

Question 20: The velocity of car B relative to car A is 8m/s when the two cars are moving in the same direction and 28m/s when the two cars are moving in opposite directions. Determine the velocity of each car

Question 21: An aeroplane is taking off at a velocity of 20m/s. Find the components of the plane's velocity if the take – off angle is (a) 70^0 (b) 45^0 (c) 60^0

Question 22: A river is flowing at a velocity of 2m/s due south. A person in a boat wants to move across the river at 10m/s.

(a) In which direction should the person move?
(b) At what velocity should the person move the boat?

Question 23: A car moves 5km east, 3km south, 2km west and 1km north. Find the resultant displacement (Answer: 3.6km 34^0 south of east)

Question 24: A plane is flying at a velocity of 100km/h and wind is blowing at a velocity of 25km/h if the blowing wind is (a) head (b) tail

Find the resultant plane velocity relative to an observer on the grounds

Question 25: A motorboat travelling 5m/s, East encounters a current travelling 2.5m/s, north

(a) What is the resultant velocity of the motor boat? (5.59m/s at 26.6^0)
(b) If the width of the river is 80meters wide, then how much time does it take the boat to travel shore to shore? (Answer: 16s)
(c) What distance downstream does the boat reach the opposite shore? (Answer: 40m)

Question 26: A man is walking inside a bus which is travelling at 56.2km/h. If the speed of the man relative to the ground is 55.8km/h, is the man walking towards the front or the back?

Question 27: A boat is travelling at 8.9km/h relative to the water in a river. The boat aims to straight for the opposite bank of the river which is 120.9km wide. If the speed of the water in the river is 2.9km/h, how far downstream will the boat be when it reaches the opposite side?

Question 28: A boat is travelling at 9.8km/h relative to the water in a river wants to get a fishing camp that is 5.2km upstream. If the speed of the water in the river is 6.0km/h, how long will it take the boat to reach the camp?

Question 29: A plane is flying at a velocity of 300km/h, relative to the air towards 300^0 from due east. The plane is flying a midst a wind blowing at 85km/h relative to the ground towards 225^0 from due east. What will the velocity of the plane be as observed on the control tower on the ground?

Question 30: A plane is flying due east with a velocity of 100m/s when it encounters a wind moving at a velocity of 20m/s. Find the resultant velocity of the plane if the direction of the wind is due:-

(a) East (b) West (c) South (d) South – East

Question 31: An airplane is flying east at 200km/h, which is its velocity relative to the air, while a 100km/h wind blows towards the north – east. What is its resultant velocity? (Answer: V_R = 280km/h at 14.6^0)

Question 32: A vehicle moving at a speed of 80km/h emits smoke from its exhaust pipe in opposite direction at 50km/h with respect to the vehicle. Determine the speed of smoke with respect to the ground

Question 33: When two motorbikes are approaching each other at constant speed, the linear distance between them decreases at 7km/h. When moving in the same direction, the linear distance between them decreases at 3km/h. Determine the velocity of each motorbike

Question 34: A car is travelling due north at 45km/h. It turns and then travels due east at 72km/h. Find the magnitude and direction of the resultant velocity of the car

Question 35: A mass 3kg hangs at the end of a string. Find the horizontal force needed to pull the mass sideways until the string is at 30^0 to the vertical. Find also the tension in the string

Question 36: An air craft heads north – west at 320km/h relative to the wind. The wind velocity is 80km/h from the south. Find the velocity of the aircraft relative to the ground

Question 37: A deep sea diver dives at an angle of 30^0 with the surface of water and follows a straight – line path for a distance of 220m. How far is the diver from the surface of water?

Question 38: A velocity of magnitude 40m/s is directed at an angle of 40^0 east of north. Represent this velocity on paper

Question 39: A car travels 3km due north, then 5km north – east. Represent these displacements graphically and determine the resultant displacement

Question 40: Two forces, one of 12N and another of 24N, act on a body in such a way they make an angle of 30^0 with each other. Find the resultant of the two forces

Question 41: Find the horizontal and vertical components of a force of 10N acting at 30^0 to the vertical

Question 42: A motorboat travelling 4m/s, East encounters a current travelling 3m/s, north

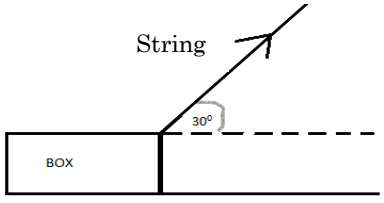
(a) What is the resultant velocity of the motor boat?
(b) If the width of the river is 80meters wide, then how much time does it take the boat to travel shore to shore?
(c) What distance downstream does the boat reach the opposite bank?

Question 43: A plane can travel with a speed of 80km/h with respect to the air. Determine the resultant velocity of the plane if it encounters a:-

(a) 10km/h headwind (b) 10km/h tailwind (c) 10km/h crosswind (d) 60km/h crosswind

Question 44: A car covered a displacement of 10km due 30^0, then 15km due 120^0 and finally 8km due 270^0. Find the total displacement covered by the car

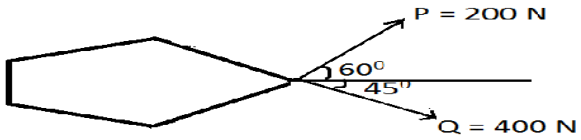
Question 45: A box is being pulled on the floor using a string. The string makes an angle of 30^0 with the box as shown in the figure below.



If the force being applied at the string is 200N, find:

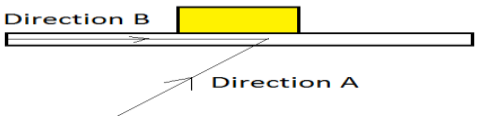
(a) The force which tends to lift the box
(b) The force which tends to pull the box forward

Question 46: Two forces, P and Q are applied on a small boat stuck in a shallow stream as shown below



Determine the magnitude and direction of the resultant of the two forces

Question 47: The diagram in figure below shows a block being pushed along a track. If a force of 20N is applied in direction A at an angle of 600, what is the resolved part of the force in direction B?



TOPIC 02: FRICTION

Question 01: A block of mass 500g is pulled along a horizontal surface. If the coefficient of kinetic friction between the block and the surface is 0.8. What is the friction force acting on the block as it slides?

Question 02: An aluminium block of mass 2.1kg rests on a steel platform. A horizontal force of 15N is applied to the block

(a) Given that coefficient of limiting friction 0.6, will the block move? (Answer: The car will move because force applied is greater than limiting friction)

(b) If will move, what will be its acceleration. Given that coefficient of kinetic friction is 0.47 (Answer: a = 2.44m/s^2)

Question 03: A brick starts sliding with 6m/s across a concrete horizontal surface floor and the coefficient of friction between the two surfaces is 0.4. How far will it travel before coming to rest? (Answer: S = 4.5m)

Question 04: Find the static friction between a block of wood of mass 10kg placed on a table. A minimum force of 50N is required to make the block just move on the top. (Answer: μ = 0.5)

Question 05: A block of wood of 4kg just slides without acceleration down an inclined plane of 40^0 to the horizontal. What is the coefficient of dynamic friction?

Question 06: A mass is placed on an inclined plane such that it can move at constant speed, when slightly tapped. If the angle of the plane makes with the horizontal plane is 30^0. Find the coefficient of kinetic friction. (Answer: μ = 0.56)

Question 07: A mass of 5kg is placed on a plane inclined at an angle of 30^0 to the horizontal. What is the accelerating force required to pull the mass up the plane if the coefficient of friction is 0.5? (Answer: F_a = 46.65N)

Question 08: A block of wood of mass 5kg is placed on a rough plane inclined at 60^0. Calculate its acceleration down the plane if coefficient of friction between the block and the plane is 0.32 (Answer: a = 7.1ms^{-2})

Question 09: Calculate the coefficient of kinetic friction between the surface of a table and a block of wood when 5kg block of wood is moving on the table and experiencing a frictional of 5N. (Answer: $\boldsymbol{\mu = 0.1}$)

Question 10: A box weighing 2kg is at rest on a wooden floor. The coefficient of static friction is 0.6 and the coefficient of kinetic friction is 0.35.

a) What minimum force is required to start the box sliding?

b) What minimum force is required to keep it sliding at a constant velocity?

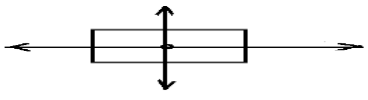
Question 11: A 12kg box is being pulled across a level floor by a force of 60N. If the acceleration of the box is 2ms^{-2}, what is the force of friction between the box and the floor?

Question 12: A 0.5kg object is given an initial velocity of 3m/s after which it slides a distance of 8m across a level floor. What is the coefficient of kinetic friction between the object and the floor?

Question 13: The coefficient of kinetic friction between a block of wood and a wooden inclined plane at an angle of 40^0 is 0.126. If the friction acting on the sliding prism is 42N, calculate the mass of the prism. (Answer: mass = 43.4kg)

Question 14: Calculate the friction force acting on a carton box of mass 9 kg which is moving over a surface .The coefficient of kinetic friction between the two surfaces is given as 0.45. (Answer: F_r = 40.5N)

Question 15: The coefficient of friction between a particle of mass 8kg and a rough horizontal plane is 0.4. Given that a horizontal force of 29N acts on the particle as shown in the figure below; would it start to move? (Answer: Since F_A (29N) < F_r (32N), No motion)



Question 16: A wooden block of mass 8kg is resting on a wooden table. If the coefficient of static friction between the pair is 1.3, Calculate the minimum horizontal force required to just slide the box [Given that g = 10N/ kg]

Question 17: A 3 tones lorry is resting on a tarmac road .The lorry requires a minimum force of 12000N in order for it to just move. Determine the coefficient of static friction between the lorry's tyres and the road

Question 18: A crate of soda with mass 40kg will just begin to slide with constant speed down a rough ramp (slope) at 30^0 to the horizontal. What is the coefficient of static friction? (Answer: $\boldsymbol{\mu}$**=0.5774**)

Question 19: A boy applies a horizontal force of 12N on a metal solid block of mass 3.4kg resting on a concrete floor .Given that the coefficient of static friction between the pair is 0.56 and g = 10N/ kg

Question 20: A box of mass 5kg is at rest on a wooden floor. If the coefficient of static friction between the box and the floor is 0.6, what minimum external force is required to set the box sliding?

Question 21: Define the following terms (a) Rolling friction (b) Sliding Friction

Question 22: A 0.5kg object is given an initial velocity of 3m/s after which it slides a distance of 8m across a level floor, what is the coefficient of kinetic friction between the object and the floor?

Question 23: A box weighing 2kg is at rest on a wooden floor .The coefficient of static friction is 0.6 and the coefficient of kinetic friction is 0.35

(a) What minimum force is required to start the box sliding?

(b) What minimum force is required to keep it sliding at a constant velocity?

Question 24: In a car, the brakes stop the tyres while friction between the tyres and the road surface stops the car. On a wet road the coefficient of kinetic friction between the road surface and the tyre is 0.1. Two cars, A and B, are travelling at a speed of 15m/s and 30m/s, respectively. Brakes are suddenly applied on each of the cars. How far will each of the cars travel before coming to rest?

Question 25: A rectangular box of mass 10kg rests on an incline with a coefficient of static friction of 0.55 and coefficient of kinetic friction of 0.25

(a) At what angle will the box begin to slide?

(b) If the incline is kept at that angle after the box begins to slide, what will be the box's acceleration?

Question 26: The coefficient of kinetic friction between the tyres of a car and the road is 0.7. The car brakes are applied and it travels a distance of 120m before stopping. What was the car's velocity just before the brakes were applied?

Question 27: A box of mass 5kg is at rest on a wooden floor. The coefficient of static friction is 0.42 and the coefficient of dynamic friction is 0.15. Find its acceleration if a force of:

(a) 15N is applied to the box

(b) 25N is applied to the box

Question 28: A 42kg refrigerator is sitting on the back of a stationary pick – up. The coefficient of static friction between the refrigerator and the pick – up bed is 0.44. At what rate can the pick – up accelerate without the refrigerator sliding off the back?

Question 29: A 6kg mass is resting on a horizontal surface. It is determined that a force of 20N will start the object sliding and keep it sliding with an acceleration of $0.83m/s^2$. What are the coefficients of static and kinetic friction between the mass and the surface?

Question 30: What is the normal reaction of the body of mass 10kg placed on an inclined plane of angle 30^0?

Question 31: A concrete block of mass 10kg rests on a table. It is found that when a horizontal force of 4kg weight pulls the mass, it is just begins to slide on the table. Find the coefficient of static friction

Question 32: A block of wood rests on a sloping plank which makes an angle of 31^0 with the horizontal. If the block suddenly begins to slide down hill, what is the coefficient of static friction?

Question 33: A box of mass 50kg is dragged on a horizontal floor by means of a rope tied to its front. If the coefficient of kinetic friction between the floor and the box is 0.30, what is the force required to move the box at uniform speed? (Answer: F = 150N)

Question 34: A car of mass 1200kg is brought to rest by a uniform force of 300N, in 80 sec. What was the speed of the car? (Answer: u = 20 m/s)

Question 35: A loaded trailer weighing 10kg is being towed across level ground. The coefficient of dynamic friction is 0.25. What is the frictional force of the trailer?

Question 36: A block of wood just slides without acceleration down an inclined plane of 25^0 to the horizontal. What is the coefficient of dynamic friction?

Question 37: Define the following terms (a) Limiting friction (b) Normal reaction (c) Viscosity (d) Coefficient of friction

Question 38: (a) State the laws of friction (b) Explain, why Friction is friend and foe?

Question 39: A brick is sliding at 8m/s across a concrete horizontal surface floor and the coefficient of friction between the two surfaces is 0.5 how far will it travel before coming to rest?

Question 40: Show that the acceleration of a stone sliding at a velocity, v across a concrete horizontal surface floor is given by $a = \mu g$ where μ is the coefficient of friction between the stone and the floor and g = acceleration due to gravity

Question 41: A mass of 5kg is placed on a plane inclined at an angle of 30^0 to the horizontal .What is the accelerating force required to pull the mass up the plane if the coefficient of friction is 0.5?

Question 42: A block of metal with a mass of 20kg requires a horizontal force of 50N to pull it with uniform velocity along a horizontal surface. Calculate the coefficient of friction between the surface and the block. (Ans: $\boldsymbol{\mu}$**=0.25**)

Question 43: A Car of weight 1000N is moving with uniform speed. If the kinetic friction acting on the car is 500N, calculate the coefficient of kinetic friction

Question 44: A wooden box of mass 30kg rests on a rough floor. The coefficient of friction between the floor and the box is 0.6. Calculate

(a) The force required to just move the box. (Answer: F = 180N)

(b) If a force of 200N is applied to the box, with what acceleration will it move? ($a = 0.67m/s^2$)

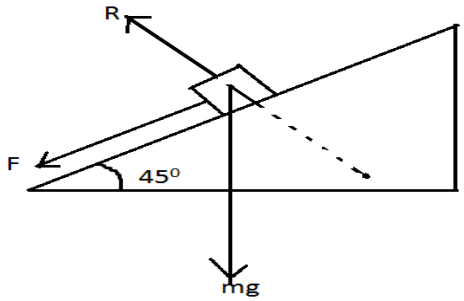
Question 45: Describe how friction is minimized by the following methods: (a) Lubrication (b) Use of bearings (c) Streamline flow

Question 46: A boy is pulling a box of mass 10kg. What is the normal force and the frictional force if the coefficient of static friction? (g = 10N/kg)

Question 47: A 50g mass is placed on a straight track slopping at an angle of 45^0 to the horizontal as shown from the figure below. Calculate:

(a) Acceleration of the load as it slides down the slope

(b) The distance moved from rest in 0.2 seconds



Question 48: A 5 kg block is resting on a horizontal surface. [Given that the coefficient of static friction is 0.57, g = 10 N/kg]

(a) What is the frictional force required to just move the block?

(b) What force must be applied to the block to keep it moving at constant velocity?

(c) Determine its acceleration if a force of 35N is applied

Question 49: A force of 8.0N gives a 3.0kg mass an acceleration of 0.6m/s^2 to the right

(a) What is the limiting friction on the block?

(b) Determine the coefficient of static friction required to produce a net kinetic force of 6.0 N? (g =10 N/kg)

Question 50: A 53.0kg block slowed by friction has an acceleration of -0.1 m/s^2. Determine the force of friction on the block

Question 51: A 10.0 kg solid sliding along a horizontal surface is brought to rest after 30 minutes

(a) Name the force that caused it to stop

(b) Determine the magnitude of the force that caused it to stop (Given that: μ_k = 0.45, g = 9.8 N/kg)

TOPIC 03: LIGHT

Light part I

Question 01: The object is placed 20 cm from a converging lens for focal length 15cm. find the position, the magnification and the nature of the image (Answers: V = 60 cm from the lens, M = 3 and the nature is a real image)

Question 02: Find the nature and position of the image of an object, placed 10cm from a diverging leans of focal length 15cm (concave). (Answers: V = -6 cm from the lens, Virtual)

Question 03: The apparent depth of a certain point at the bottom of water pond is 25cm. find the real depth of this point given that the refractive index is 4⁄3 (*Answer H = 33 cm)*

Question 04: An object stands vertically on the principle axis of a converging lens of focal length 10mm and at a distance of 17mm from the lens. Find the position, size and nature of the image. (Answers: *V = 24.14 mm, H_I = 2.9mm, Real)*

Question 05: Calculate the critical angle for air and water medium if the refractive index of water is 4⁄3. (Answer: The critical angle is 48^0 38')

Question 06: Given that the refractive index of glass is 1.5, what is the value of the critical angle? (Answer: The critical angle is $41^0$49')

Question 07: Given that the refractive index of ethyl alcohol is 1.36. Find the apparent depth in the beaker if the real depth of the optical pin is 52cm. (Answer: h = *38.23 cm)*

Question 08: A fish is located 10m deep in the liquid when viewed from the top. The depth of the fish is 8m. Find the refractive index of the liquid. (Answer: 1.25)

Question 09: If the light has a velocity of $3x10^8$ m/s and has a velocity 1.97 X 10^8 m/s in the glass.

(a) What is the refractive index of the glass? (Answer: 1.52)

(b) Calculate the refractive index for light traveling from glass to air. (Answer: 0.6458)

Question 10: The refractive for light traveling from air to water is 1.3. Find the refractive index of light travelling from water to air. (Answer: 0.7693)

Question 11: A small pin 3cm high is placed 30 cm away from a concave mirror of focal length 12cm. By using the mirror formula, find the position, the height and the nature of the image formed. (Answers: V= 20cm, HI = 2cm high and is It is real)

Question 12: An object 2cm is high erected 8cm in front of a concave mirror of radius of curvature 10cm; by graphical method, find the position, size and nature of the image (Answers: V = 13.3 cm, HI = 3.3 cm. The image is real).

Question 13: A small spring is 4 cm long is kept at 10cm in front of the converging mirror of radius of curvature 12 cm. By scale drawing, determine the position, size and state the nature of the image formed. (Answers: V = 15 cm, HI = 3 cm and it is real.)

Question 14: A convex mirror produces an image that is 22 cm behind the mirror when an object is placed 34 cm in front of the mirror .What is the focal length of the mirror

Question 15: A concave mirror has a focal length of 40 cm. How far from the mirror must an object be placed to produce an image that is (a) Twice the size of the object (b) Half the size of an object (c) 40 times the size of the object?

Question 16: Show that to obtain an image with a magnification of M using a concave mirror with a focal length f, the object distance, u, is given by $\boldsymbol{u} = (\frac{M+1}{M})\,\boldsymbol{f}$

Question 17: What happens to the image formed by (a) A Convex mirror (b) A Concave mirror as the object distance is decreased?

Question 18: Parallel light rays from a distant star are incident on a concave mirror with a radius of curvature of 120 cm .How far from the mirror will the star's image be formed ?

Question 19: An object is placed 18 cm from a concave mirror. An image that is twice the size of the object is formed .Determine the image distance and the focal length of the mirror

Question 20: A Converging lens forms an upright image that is four times the size of the object .Given that the focal length of the lens is 20 cm, determine the object distance

Question 21: The lens of a slide projector focuses an image of height 1.5 m on a screen placed 9.0 m from the projector. If the height of the picture on the slide is 6.5 cm, determine (a) The distance between the slide (picture) and the lens (b) The focal length of the lens

Question 22: An object 2 cm high is placed 9 cm from a convex lens of focal length 6 cm. Determine the position and nature of the image formed

Question 23: A rectangular glass block 5 cm thick is placed on top of the page of a book, if the refractive index of the glass block is 1.53; calculate apparent depth of the letters on the book

Question 24: A ray of light is incident at an angle of 60^0 on a block of glass of refractive index 1.5. Determine the angle of refraction of the ray

Question 25: A small coin was placed at the bottom of a tall glass containing some water and viewed from above. The real and apparent depths of the coin were then measured. By varying the depth of the water in the jar, the following readings were obtained

Real depth(cm)	8.1	12.0	16.0	20.0
Apparent depth (cm)	5.9	9.0	12.0	15.1

By plotting an appropriate graph from the results, determine the refractive index of the water

Question 26: The refractive index of water is 1.33 and that of glass is 1.5. Calculate the critical angle for:

(a) A glass – air interface

(b) A water – air interface

Question 27: A pin at the bottom of a basin full of water appears to be 6 cm from the surface. Given that the refractive index of the water is 4/3, what is the actual distance of the pin from the surface?

Question 28: Given that the refractive index of water is 4/3, what is the angle of refraction of the ray of light?

Question 29: Paraffin has greater refractive index than water (a) What information does the above statement give with regard to the relative velocities of light in paraffin and in water (b) Draw a diagram to demonstrate the path of a ray of light when passing from water into a layer of paraffin oil floating on top of it

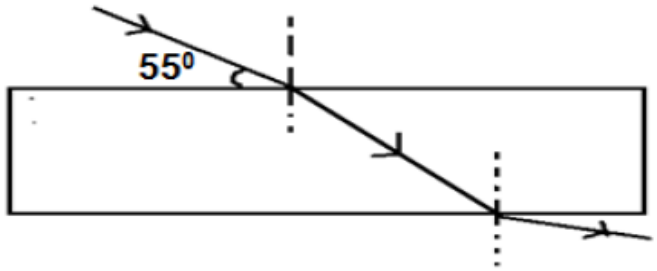
Question 30: When an object is placed 25 cm from a convex lens , an inverted image which is twice as large as the object is formed .How far from the lens must the object be placed to obtain an image four times the size of the object ?

Question 31: An object 5 cm high is placed 25 cm from a convex lens with a focal length of 20 cm using the lens formula, determine position, size and nature of the image formed

Question 32: An object 20cm high is placed 40cm from a concave mirror of focal length 15 cm. Determine the position, nature and size of the image formed by drawing a ray diagram

Question 33: A ray of light strikes a rectangular glass block at an angle of 45^0 to the surface of the glass .Given that the refractive index of the glass with respect to air is 1.5. Determine the angle of refraction

Question 34: A ray of light is shone through a rectangular glass prism at an angle of 55^0 to the air glass interface as shown in the figure below



The glass block is 12 cm long and 10 cm wide. Calculate the distance the ray of light travels through the glass before emerging into the air (${}_a\mu_g$=1.5)

Question 35: Taking the refractive index of glass is 3/2, what is the critical angle?

Question 36: Define angle of incidence and angle of refraction .State the laws of refraction of light

Question 37: What is meant by the refractive index of a substance? If the velocity of light in a vacuum is 3.0×10^8 m/s, find the velocity of light in crown glass of refractive index 1.52

Question 38: Distinguish between (a) Converging and diverging lenses (b) Real and Virtual images. Draw two diagrams, one showing a converging lens producing a real image and the other showing the same lens producing a virtual image

Question 39: A 4.0 cm bulb tall light bulb is placed a distance of 8.3 cm from a concave mirror having a focal lens of 15.2 cm. Determine the image distance and the image size. What additional information do the answers give?

Question 40: An object is at a distance of 30 cm from a convex lens of focal length 10 cm. Find by graphical method the position and nature of the image formed

Question 41: An object is placed 20 cm from (a) convex lens of focal length 16cm (b) Concave lens of focal length 16 cm. Find the position, nature and linear magnification of the image produced in each case

Question 42: List out the factors on which the refractive index of a medium depends

Question 43: What is meant by the refraction of light? Define incident, refracted and emergent rays of light

Question 44: A glass prism has three sides of angle 60^0 .A ray of light falls on one of the faces and the angle of incidence is 48^0. The ray is refracted and now travels parallel to the second face. When it reaches the third face it is again refracted and emerges from the prism. Find:

(a) The refractive index of the glass prism

(b) The angle between the ray entering the prism and the ray leaving the prism

Question 45: A glass prism has two parallel sides which are 6 cm apart. A ray strikes one of the two parallel sides at an angle of incidence of 50^0. Find by drawing the perpendicular distance between the ray entering the prism and the ray leaving the prism

Question 46: A Swimming pool is 2 m deep. Given that μwater = 1.33. How deep does it appear to be when:

(a) Completely filled with water?

(b) Filled halfway with water?

Question 47: Give scientific reasons for the following observations:

(a) A pencil dipped obliquely into water appears to be bent at the point where it enters the water

(b) A light ray passing from air to glass bends closer to the normal

(c) The speed of light in diamond is less than the speed of light in ice

Question 48: Explain the meaning of the following terms

(a) Refraction of light

(b) Angle of incidence

(c) Angle of refraction

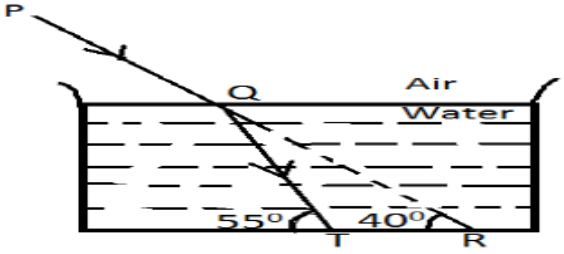
(d) Refractive index

Question 49: A ray of light is passing from air into water along PQ. The ray strikes the bottom surface at T instead of R as shown in the figure below calculate

(a) The angle of incidence

(b) The angle of refraction

(c) The refractive index



Question 50: A ray of light passing from air into oil at an angle of incidence 30^0 .Calculate the angle of refraction in oil if the velocity of light in air is 3.0 x 10^8 m/s and that in transparent oil is 2.2 x 10^8 m/s

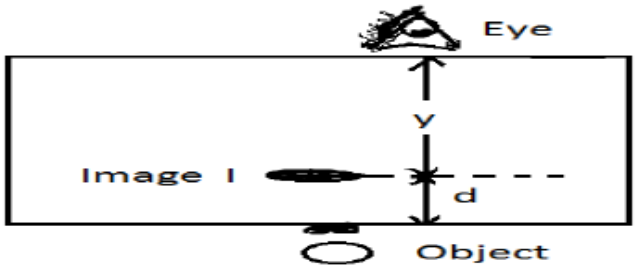
Question 51: The light ray passing from glass to air is monochromatic and has a frequency of 4 x 10^{14} Hz and a wavelength of 5 x 10^{-7} m in glass

(a) What is meant by monochromatic?

(b) Calculate the velocity of light in glass

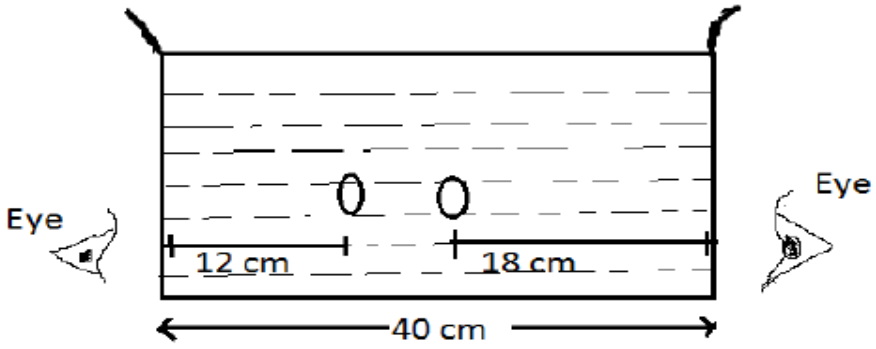
(c) Calculate the velocity of light in air (refractive index of glass is 1.50)

Question 52: In an attempt to determine the refractive index of a glass block , a student finds the displacement produced due to refraction by glass as **d** and apparent thickness of the block as **y** as shown in the figure below. Show that the refractive index of glass may be expressed as $\boldsymbol{n} = (\mathbf{1}+\frac{d}{y})$

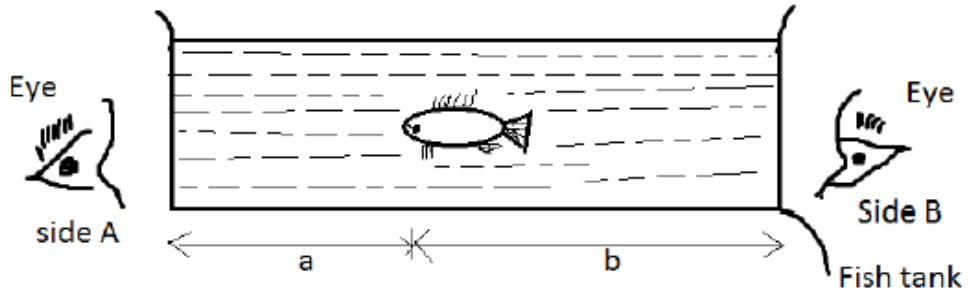


Question 53: A ray of light passes from a liquid to air. Calculate the critical angle for the liquid – air interface, if the velocity of light in the liquid is 2.4 x 10^8 m/s, while in air is 3.0 x 10^8 m/s

Question 54: In a transparent liquid container, an air bubble appears to be 12 cm when viewed from one side and 18 cm when viewed from the other side (see the figure below). Where exactly is the air bubble, if the length of the tank is 40 cm?



Question 55: In a fish aquarium (as shown in the figure below) the image of a fish seems to be 30 cm when seen from side A and 42 cm when seen from side B. Calculate the length of the fish tank, if the refractive index of water is 1.33.



Question 56: Calculate the critical angle of a material of refractive index 2

Question 57: Sunlight making an angle of 60^0 with the horizontal enters a pool which is 50 cm deep. Determine the distance travelled by the sunlight in the water (Refractive index of water = 1.33)

Question 58: An observer looks into a water tank half filled with water .If the height of the tank is 180 cm. A solid that is 80 cm beneath the water surface is seen to be 60 cm below the water surface. Determine:

(a) The Refractive Index of water

(b) The vertical displacement of the solid

Question 01: How a plant with green leaves and red flowers will appear when is placed in?
(a) Green light (b) Red light (c) Blue light
Ans:

(a) In green light	(b) In red light	(c) In blue light
❖ Green leaves will appear green ❖ Red flowers will appear black	❖ Green leaves will appear black ❖ Red flowers will appear red	❖ Green leaves will appear black ❖ Red flowers will appear black

Question 02: Why red light is used for danger signals?
Ans: Because red light is scattered the least by air molecules due to its highest wavelength so it is able to travel the longest distance through fog, rain and alike

Question 03: A red bus with blue letter on its sides stops in front of a yellow light at right. Describe the appearance of the bus
Ans: In yellow light
- The red bus will appear red because yellow is composed of green and red
- The blue letters will appear black

***Question 04*:** Explain what is meant by a spectrum. Describe with the aid of a diagram how would you obtain the spectrum of white light?

***Question 05*:** Distinguish between a pure and an impure spectrum. Explain with the aid of a diagram how a pure spectrum can be produced in the laboratory. How are the colours of the spectrum recombined?

***Question 06*:** A beam of white light is allowed into a dark room through a hole. In the dark room, the beam falls on a white screen. How will the screen appear if?
(a) A piece of red glass is placed in the path of the beam
(b) A piece of green glass is placed between the screen and the red glass?

***Question 07*:** Explain by giving examples; what is meant by:
(a) Additive combination of colours
(b) Subtractive combination of colours

Question 08: Why does an object appear coloured when light falls onto it?

Question 09: (a) Explain by giving example; what is meant by:
i. Primary colour
ii. Secondary colour
iii. Complementary colour

(b) A flag has a green disc on a yellow background. How will the flag appear in:
i. green light
ii. red light
iii. blue light

Question 10: State by giving a reason for each answer the colour that results when:
(a) A blue light and a yellow light are mixed
(b) Blue paint and yellow paint are mixed

Question 11: What colour would be seen if white light is viewed through:
(a) A red filter?
(b) A cyan filter?
(c) An orange filter?

Question 12: A book which looks red in white light is viewed in magenta light. In what colour does it appear?

Question 13: White light is viewed through a combination of a yellow filter and a red filter held in contact. What colour is seen?

Question 14: Explain the meaning of the term "dispersion" of white light.

Question 15: **E**xplain why the result of mixing blue and yellow paints is very different from that of mixing blue and yellow lights

Question 16: A painter has a blue – green (cyan) paint which she wants to make pure green. What colour pigment should she add to the paint? Explain your answer

Question 17: Briefly explain, why the sky looks blue**?**

Question 18: Under pure yellow light what will be the appearance of the blue piece of cloth?

Question 19: Danger signs along the road as well as tail and brake lamps of motor vehicles rear are painted red. Briefly explain the reason behind.

Question 20: Explain each of the following:-

(a) The appearance of a blue flag when viewed in day light through a sheet of red glass

(b) The appearance of a red flag with green stripes when viewed in day light through a sheet of green glass

(c) The appearance of a man wearing blue shirt and red trousers, holding a handkerchief of green color when viewed in the pure yellow light

TOPIC 04: OPTICAL INSTRUMENTS

Question 01: A simple microscope with a focal length of 5 cm is used to read division of scale 1.5 mm in size. How large will the size of the divisions as seen through the simple microscope be? (**Ans:** 9 mm when viewed through the simple microscope)

Question 02: A compound microscope consists of two lenses of focal length 12 cm and 6 cm for the objective lens and the eyepiece lens, respectively. The two lenses are separated by a distance of 30 cm. The microscope is focused so that the image is formed at infinity. Determine the position of the object. (Ans: U = 24 cm)

Question 03: A parallel beam of light falls on a converging lens arranged so that the axis lies along the direction of the light which is brought to focus 25 cm from the lens. The light then passes through a second converging lens of focal length 7.5 cm placed at 30 cm from the first lens. Calculate the position of the final image. Draw a ray diagram to show the final image formed. (Ans: D = 15 cm)

Question 04: The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece alone is 5. The microscope is focused on a certain object. The distance between the objective lens and the eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal lengths of the objective and eyepiece lenses.

Question 05: What is the angular magnification of a telescope that has a 100 cm focal length objective and a 2.5 cm focal length eyepiece? (Ans: 40)

Question 06: **F**ind the distance between the objective and eyepiece lenses in the telescope in the above problem needed to produce a final image very far (at infinity) from the observer, (**Ans:** 102.5 cm)

Question 07: A large reflecting telescope has an objective mirror with a 10.0 m radius of curvature. What angular magnification does it produce when a 3.0 m focal length eyepiece is used?

Question 08: **A s**mall telescope has a concave mirror with a 2.0 m radius of curvature for its objective. Its eyepiece is a 4.0 cm focal length. What is the telescope's angular magnification? What angle is subtended by a 25,000 km diameter sunspot?

Question 09: A 7.5X binocular produces an angular magnification of 7.5, acting like a telescope. If the binoculars have objective lenses with a 75.0 cm focal length, what is the focal length of the eyepiece lenses?

Question 10: A projection lantern is used to project a slide measuring 3 cm x 3 cm onto a screen 12 m from the projection lens. If the size of the screen is 1.5 m x 1.5 m, how far from the lens must the slide be for the image to fill the entire screen? Ans: U = 24 cm.

Question 11: A lens camera of focal length 10 cm is used to take the picture of a girl 1.5 m tall. Determine the magnification of the image if the girl is 11m from the camera. (M = 0.009)

Question 12: A lens camera has a lens of focal length 15 cm and a film (screen) of height 0.35 cm. How far would a boy of height 1.8 m stand from the camera so that his image just fits the film?

Question 13: A professional photograph has a camera of focal length 2.5 cm. He uses it to take a photo of a tree of height 60 m. The distance between the lens of the camera and its film is 2.5 cm. Determine:

(a) Distance between the lens and the tree

(b) The height of the image (c) The magnification of the camera

Question 14: If the focal distance of the converging lens is 5 cm the object distance is 4 cm. Find the magnification of the image *(*Ans: M = 6 cm)

Question 15: Given that the focal length of the simple microscope is 12cm.Find the magnification of the image of the object distances. (Ans: M = 8.1)

Question 16: Given that an object 2m high is placed 2010cm in front of the lens camera of focal length 10cm.calculate the minimum size of the film frame. (Ans: M = 0.0005)

Question 17: The lantern projector uses a slide of 2 cm by 2 cm, 2x2 to produce a picture 1 m by 1m on a screen 12cm from the projection lens. How far from the lens must the slide be?

Question 18: A telescope is consisting of two converging lens of lens at focal length 25 and 4 respectively. The final image is found at distinct vision that is 25 cm in front of the eyepiece lens. Find the position of the first image from the eyepiece. Ans: U_e = 3.4cm

Question 19: An astronomer telescope has its 2 lens 78 cm apart. If the objective lens has a focal length of 75.5 cm, what is the magnification produced by the telescope under normal vision. (Ans: The magnification is 30.2)

Question 20: A compound microscope has an objective lens of focal length 2 cm and eye piece lens of focal length 6cm.An object is placed 2.4 cm from an objective lens. If the distance between the objective lens and eye piece lens is 19 cm. Find

a. The distance of the final image from the eyepiece lens
b. Compound magnification

Ans:

a. The final image is at infinity
b. M = ∞

Question 21: A certain microscope consists of 2 converging lenses of focal length 4 cm and 10 cm for objective 3 eyepiece lenses respectively. The 2 lenses are separated by the distance of 30cm.The instrument is focused so that the image is at infinity. Calculate the position of the object and the magnification of the objective lens. (Ans: The magnification produced by the eye piece lens is 4)

Question 22: A simple microscope has a focal length of 15 cm
(a) What is the maximum magnification of the lens (Ans: 2.667)
(b) What is the magnification of this lens when the eye is relaxed (Ans: 1.667)

Question 23: The near point of a longsighted patient is 90 cm

a. Determine the focal length of a lens that can be used to enable the patient clearly see objects that are 25 cm from the eye
b. What is the power of the lens?
c. What is the magnification of the lens?

Question 24: A short sighted person is unable to clearly see objects that are beyond 150 cm from the eye. Determine the focal length, power and magnification of the lens that should be used to detect the eye defect

Question 25: A patient requires a lens of -5 diopters in order to see far away objects clearly. Determine the (a) Focal length of the lens used (b) Far point of the patient's eye

Question 26: Define the term "accommodation" as used in the human eye

Question 27: Give two similarities and 2 differences between the human eye and the camera

Question 28: State one advantage of human eye over a lens camera

Question 29: The near point of an eye is 50 cm

a. What focal length lens should be used so that the eye can clearly see an object 25 cm away? (Ans: f = 50 cm)
b. What is the power of this lens? (Ans: 2 diopters)

Question 30: (a) State the causes of the short – sightedness and long – sightedness
(b) Use a ray diagram to show how:
(i) Short – sightedness in a human eye can be corrected
(ii) Long – sightedness can be corrected

Question 31: A farsighted man has a near point of 100 cm wearing his glasses; he can see objects that are 25 cm away. What is the focal length of the lens in his glasses?

Question 32: In a compound microscope, the focal length of the objective lens is 4.0 cm and that of the eyepiece is 3.3 cm and they are placed at a distance of 15.0 cm .A real object of size 2 mm is placed 6 cm from the objective lens .By using the lens formula. Calculate:

a. Position of the final image (Ans: V = 12 cm)

b. The size of the final image viewed by the eye (Ans: $V_{final\ image} = 33$ cm)
c. Magnification produced by the arrangement of the lenses (Ans: $H_I = 44$ mm)

Question 33: (a) Differentiate between a simple microscope and a compound microscope
(b) With the aid of a diagram describe how a compound microscope works.

Question 34: A compound microscope has an objective lens of focal length 2cm and an eyepiece of focal length 6 cm. An object is placed 2.4 cm from the objective lens .If the distance between the objective lens and the eyepiece is 17m. Find:
(i) The distance of the final image from the eyepiece
(ii) The linear magnification

Question 35: Small object is placed 3cm from the lens of a simple microscope. If the focal length of the lens is 5 cm. Find the linear magnification produced by the simple microscope. How far from the lens would you place the object in order to obtain maximum magnification of the image?

Question 36: A compound microscope expected to have a magnification of X600 has a tube length of 12 cm and the focal length of the objective lens is 0.5 cm. Determine the expected focal length of the eye piece

Question 37: A magnifying glass of focal length of 15 cm is used to view an object so as to obtain maximum magnification
a. Where the object should be placed?
b. What is the magnification of the magnifying lens?

Question 38: A compound microscope has an objective lens of focal length 25 cm and an eyepiece with focal length 14 cm. If it has a tube of length 36 cm determine the magnification of the microscope

Question 39: A lens of focal lens 10 cm is positioned from an object so as to obtain maximum magnification of the image. Determine the:
(a) Object distance (b) Image distance (c) Magnification

Question 40: A lens camera is to be used to take a picture of a man 2 m tall .If the lens of the camera has a focal length of 10 cm. Calculate the minimum size of the film frame required, given that the man is 20.1 m from the camera

Question 41: A certain microscope consists of two converging lenses of focal lengths 10 cm and 4 cm for the objective and eye piece respectively .The two lenses are separated by a distance of 30 cm. The instrument is focused so that the final image is at infinity. Calculate the position of the and the magnification of the objective lens (Ans u = 16.25 cm, M = 1.6)

Question 42: Draw a clearly labeled diagram of a lens camera and explain briefly how the image of an object is focused on the film. A camera with a lens of focal length 15 cm is used to take a photograph of a man standing 4.5 m from the lens. Find the length of the image formed if the man is 1.75 m tall

Question 43: Describe with the aid of a diagram the optical system of the projection lantern .A projection lantern is to be used for the projection of slides measuring 7.5 cm by 7.5 cm onto a screen measuring 2.1 m by 2.1 m .If the distance between the projection lens and the screen is 6 m, Find the focal length of the lens

Question 44: Describe how you would construct an astronomical telescope. What will be the maximum distance between the objective lens and the eyepiece lens? Draw a ray diagram to illustrate the paths of two rays from a point on an object which is not on the axis of the telescope

Question 45: Define and explain the terms near point and far point as applied to the human eye. Draw diagrams to illustrate the defects of long and short sight. How can each defect be corrected by using lenses?

Question 46: A man whose least distance of distinct vision of 75 cm wants spectacles to allow him to read a book held at a distance of 25 cm from his eyes. Find the focal length of the lens he needs. Discuss briefly whether a short – sighted person can use a telescope without wearing any spectacles

Question 47: Draw a clearly labeled diagram of the human eye and explain how it can focus near and distant objects. How does the human eye resemble the lens camera?

Question 48: A telescope of 5.0 m diameter reflector of focal length 18.0 m is used to focus the image of the sun. Using the distance of the sun from the earth and diameter of the sun as 1.5 x 1011 m and 1.4 x 10^9 m respectively, calculate the:

(a) Position of the image of the sun (v = f =18 cm, since the object is at infinity)

(b) Diameter of the image of the sun (image size) ($\boldsymbol{m = \frac{v}{u} = \frac{h}{ho} \rightarrow d_i = 16.8\ cm}$)

Question 49: A person whose sight is normal wishes to view objects which are 5 cm from his eyes. Find the focal length of the lenses needed for his spectacles

Question 50: **W**hen is a person said to be suffering from long sight? Draw a diagram of the eye to show how this defect may be corrected by the use of a suitable type of lens.

Question 51: **Me**ntion two ways in which a photographic camera is similar to the human eye and one way in which it is different

Question 52: **A** converging lens has a focal length of 5 cm

(i) What is the power of the lens? (Ans: P = 20 D)

(ii) If this lens were used in an astronomical refracting telescope, for which part of the telescope would it be most suitable?

(iii) What would be the distance between the two lenses if the telescope were in normal adjustment (i.e with the final image at infinity)? (Ans: ($\boldsymbol{l = f_o + f_e}$) $\rightarrow$ ***sum of focal lengths***)

Question 53: Explain the terms real image and virtual image

Question 54: Describe the construction of a photographic camera. If the focal length of the camera lens is 20 cm, how far away from the film must the lens be set in order to photograph an object 100 cm from the lens? (Ans: v = 25 cm)

Question 55: A slide projector using a slide 5 cm x 5 cm produces a picture 3 m x 3 m on a screen placed at a distance of 24 m from the projection lens. How far from the lens must the slide be? (Ans: 40 cm x 40 cm)

TOPIC 05: THERMAL EXPANSIONS

Question 01: A block of concrete 5.0 m long expands to 5.00412 m when heated from 25°C to 100°C. Determine the linear expansivity of concrete (Ans: $\alpha = 1.1 \times \mathbf{10^{-5}}$ °C = $1.1 \times \mathbf{10^{-5}}$ K^{-1})

Question 02: The difference in length between a brass and an iron rod is 14 cm at 10 ^{0}C. What must be the length of the iron for this difference to remain at 14 cm when both rods are heated to 100 ^{0}C? Given that the linear expansivity of brass = 19 x 10^{-6}/K and iron = 12 x 10^{-6}/K. (Ans: l = 38 cm)

Question 03: A metal rod has a length of 100 cm at 200 ^{0}C. At what temperature will its length be 99.4 cm if the linear expansivity of the material of the rod is 0.00002/K (Ans: - 102 ^{0}C)

Question 04: A metal pipe which of 1m long at 40°C increases in length by 0.3% when carrying a steam at 100 °C. Find the Coefficient of Linear Expansion (Ans: $\alpha = 5 \times \mathbf{10^{-5}}$ K)

Question 05: A brick (30 cm x 18 cm x 10 cm) is at 20°C if the brick heated to a temperature of 150°C what will be its new dimensions? (The coefficient of linear expansion of concrete is 1.2 x 10^{-5} K^{-1} (Ans: 30.05 cm x 18.03 cm x 10.02 cm)

Question 06: An iron plate at 20°C has a hole of radius of 8.92 mm in the centre an iron rivet with radius of 8.95 mm at 20°C inserted into the hole. To what temperature the plate heated for the rivet to fit into the hole. (Linear expansivity of iron is 1.24 x $10^{-5}K^{-1}$). (Ans: 291°C)

Question 07: Which is heavier 1 dm^3 of glass at 4 ^{0}C or 1 dm^3 of glass at 10 ^{0}C? Explain your answer

Question 08: Change the following temperatures to Kelvin scale

(a) 33°C
(b) 57°C

Ans:
(a) T (K) = 306 K
(b) T (K) = 330 K

Question 09: Change the following temperatures to Celsius scale

(a) 4K
(b) 292K

Ans:
(a) θ° C = - 269°C
(b) θ° C = 19°C

Question 10: A 0.20m^3 container with a movable piston holds nitrogen gas at a temperature of 20°C. What will be the volume of the gas if the temperature increased to 50°C? (Ans: V_2 = 0.22 m^3)

Question 11: A gas occupies a volume of 20 cm^3 at 27°C and at normal atmospheric pressure. Calculate the new volume of the gas if it heated to 54°C at the same pressure. (Ans: V_2 = 21 cm^3)

Question 12: A gas in a cylinder occupies a volume of 465 ml when the pressure on it is equivalent to 725 mm of mercury. What will be the volume of the gas when the pressure on it rises to 825 mm of mercury while the temperature is held constant? (Ans: V_2 = 408.6 ml)

Question 13: Bubble of gas, which has a volume of 0.4 cm^3 released by a diver 30 m in under the surface of a lake what will be the volume of the bubble when it reaches the surface? (Assume the barometric pressure is 10 m of water) (Ans: V_2 = 1.2 cm^3)

Question 14: A rigid metal container holds carbon dioxide gas at a pressure of 2 x 10^5 Pa and a temperature of 30°C. What temperature the gas be lowered for the pressure to reduce to half (1 x 10^5 Pa)? (Ans: T_2 = 151.5K = -121.5°C)

Question 15: A gas in a fixed-volume container has a pressure of 1.6 x 10^5 Pa at a temperature of 27°C. What will be the pressure of the gas if the container heated to a temperature of 277°C? (Ans: P_2 = 2.93 x 10^5 Pa.)

Question 16: A sample of oxygen gas has a volume of 0.11 m^3 at a temperature of 12 °C and a pressure of 8.1 x 10^5 Pa while a sample of nitrogen gas has a volume of 0.18 m^3 at a temperature of 22 °C and a pressure of 1.03 x 10^5 Pa. Which gas will have the larger volume at STP? (Ans: V_2O = 0.084 m^3, V_2N = 0.17 m^3 At STP, nitrogen gas would have a volume that is more than twice the volume of oxygen gas.)

Question 17: A fixed mass of gas has a volume of 1.25 litres at a pressure of 76.0 cm of mercury and a temperature of 27.0°C. The gas expands to a volume of 1.55 litres raising the pressure to 80.0 cm of mercury. What is the final temperature of the gas in °C?
(Ans: T_2 = 391.58K = 118.58°C)

Question 18: A fixed mass of gas occupies a volume of 0.001 m^3 at a pressure of 76 cm Hg. What volume does the gas occupy at 17.0°C if its pressure is 72 cm Hg? (Ans: V_2 =1.12 x 10^{-3} m^3)

Question 19: 100 cm^3 of gas **A** was collected at 10°C and 78.0 cm Hg pressure, while 120 cm^3 of gas **B** was collected at 50°C and 70.0 cm Hg pressure. Which of the two gases is denser at STP? (Ans: At STP, gas **B** has large volume than gas **A** so gas **A** is denser than gas **B**. That is V_{A2} = 99.00 cm^3 and V_{B2} = 93.42 cm^3

Question 20: 250 cm^3 of a gas are collected at 25°C and 750 mm of mercury. Calculate the volume of the gas at STP (Ans: V_2 = 226.01 cm^3)

Question 21: Define coefficient of linear expansion. A copper pipe which is 1 meter long at 150 C increases in length by 0.15% when carrying steam at 100^0C. Find the coefficient of linear expansion of copper

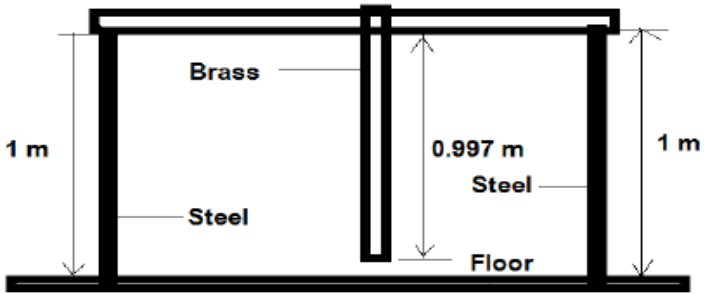
Question 22: Explain why a compound metal bar made up of two strips one of iron and another of brass bends when heated

Question 23: A beaker containing water is heated a temperature of 23 ^{0}C to 90 ^{0}C. State and explain what happens to the mass, volume and density of water

Question 24: An aluminium lid on an ordinary glass jar fits so tightly that it cannot be unscrewed. Should the jar and lid be immersed in hot or cold water to loosen the lid? Explain your answer

Question 25: A steel tower has a height of 324 m at a temperature of 18 ^{0}C. How tall is the tower on a day when the temperature is 35 ^{0}C?

Question 26: A brass road of length of 0.997 m at 20 ^{0}C is hung from a steel framework with a height of 1.00 m at 20 ^{0}C as shown in the figure below



At what temperature would the brass rod just touch the floor?

Question 27: A brass has a hole whose radius is too small for an iron rivet to fit in. Explain two ways the rivet can be made to fit in the hole.

Question 28: Convert the following temperatures on the Celsius scale to temperatures on the Kelvin or absolute scale

(a) 100 ^{0}C
(b) 25 ^{0}C
(c) -100 ^{0}C

Question 29: Convert the following temperatures on the Kelvin scale to temperatures on Celsius scale:
(a) 273K
(b) 400K
(c) 100K

Question 30: (a) State Charles law and describe how it is verified in laboratory.
(b) 1000 cm^3 of air at 0°C are heated to 70°C. What volume will the air occupy if the pressure remains at atmospheric throughout?

Question 31: The pressure of 440cm^3 of the gas is 80cm of mercury. What will be the new pressure of the gas if its volume is reduced to 400cm^3 at constant temperature?

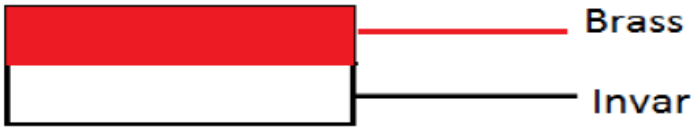
Question 32: The pressure in a metal glass cylinder at 15°C is 2 atmospheres. At what temperature will the pressure be doubled?

Question 33: When is a given mass of a gas said to be at s.t.p? The volume of a gas collected at a temperature of 36° C and pressure of 78 cm of mercury is 230 cm^3. Find its volume at s.t.p

Question 34: A 500 cm^3 Pyrex beaker is 95% full of methanol at 15 ^{0}C. At what temperature will it be 100% full with methanol?

Question 35: A hollow glass sphere has a density of 1.30 g/cm^3 at 20 ^{0}C. Glycerine has a density of 1.26 g/cm^3 at 20^{0}C. At what temperature would the sphere begin to float in glycerine?

Question 36: The figure below shows a brass invar bimetallic strip at room temperature



Given that brass expands more than invar when both are heated equally, sketch the appearance of the strip after being cooled to several degrees below room temperature

Question 37: A glass test tube was heated over a Bunsen burner flame. Cold water was then quickly poured into the test tube. Explain why the test tube would break when cold water is poured in.

Question 38: A rally a car tyre is at an air pressure 3 x 10^5 Pa and a temperature of 27°C at start of the rally. The temperature rises to 57°C when the car is racing. Assuming the tyre does not expand, what is the new pressure in the tyre?

Question 39: The pressure of 3 m^3 at a gas at 27°C is 3 atmospheres. What will be the pressure of the gas if it is compressed into a half the volume and heated to 102°C?

Question 40: (a) Define the term linear expansivity of a solid.
(b) The original length of a metal bar is 101.5cm at 15°C. Determine the linear expansivity of the metal if the bar increases in length by 1.41mm when the temperature is raised to 100°C

Question 41: Why electrical cables are left sagging during installation?

Question 42: A metal rod 80cm long increased in length by 0.09 cm when the temperature was raised by 93.6°C. Determine linear expansivity of metal.

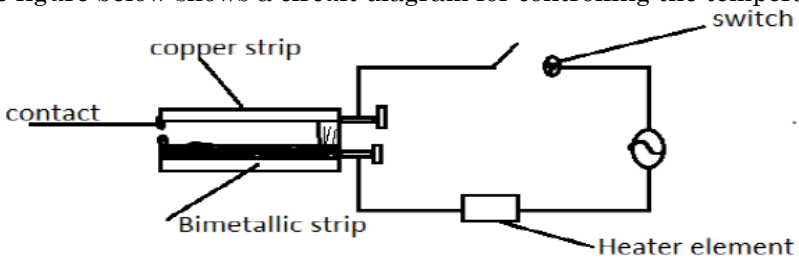
Question 43: The air in a bicycle tyre occupies a volume of 1000 cm^3 when it is at a pressure of 2.5 atmospheres the air is released to the atmospheres.
(a) Assuming that the temperature of the gas does not change, what volume does it occupy at the atmosphere
(b) A pump with a volume of 150 cm^3 per stroke is used to inflate the tyre. What is the pressure of the tyre after two strokes?

Question 44: An iron rod is 100 cm long at 0°C. What must be the length of aluminium rod at 0°C if the difference between the lengths of the two rods is to remain the same at all

temperatures? (Linear expansivities of iron and aluminium are 1.2 x 10^{-5} K^{-1} and 2.4 x 10^{-5} K^{-1} respectively)

Question 45: A gas occupies a volume of 2 m^3 when its pressure is 1140mmHg at a temperature of 27° C. What volume will it occupy at s.t.p?

Question 46: The figure below shows a circuit diagram for controlling the temperature of a room



(a) State and explain the purpose of the bimetallic strip

(b) Describe how the circuit controls the temperature when the switch is closed.

Question 47: A container holds a gas at 0°C .To what temperature must be heated to its pressure to double? (Assume that the volume of the container does not change)

Question 48: Explain why a glass container with thick walls is more likely to crack than one with thin walls when a very hot liquid is poured in each of the glasses

Question 49: A balloon is filled with air to a volume of 200ml at a temperature of 20°C. The balloon is then dipped in water at 80°C. Assuming two leakages occurs and ignoring the pressure change due to the water. Calculate the new volume of air

Question 50: A compound strip of brass and iron 10 cm long at 20^0C is held horizontally with iron uppermost. When heated from below with a Bunsen burner the temperature of the brass is 820 ^{0}C and that of the iron is 770 ^{0}C. Calculate the difference in lengths of the iron and brass (Ans: $\Delta \boldsymbol{l} = \mathbf{0.062}\ \boldsymbol{cm}$)

Question 51: State any three applications of bimetallic strip

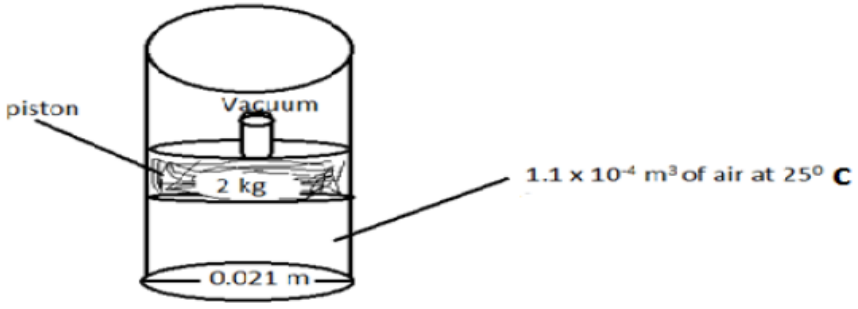
Question 52: Using the kinetic theory of gases to explain how a rise in the temperature of gases causes a rise in the pressure of a gas when a volume is held constant.

Question 53: The pressure indicated by the gauge on a constant -volume gas thermometer in a thermal equilibrium with a room is 97 kPa. When the thermometer was immersed in a bath of ice water, the pressure was 90 kPa. What is the temperature in the room in °C?

Question 54: Helium gas at temperature of -30°C is held in a rigid metal container at a pressure of 1.5 x 10^5 Pa. The container is heated to a temperature of 25°C. What is the new pressure of the gas?

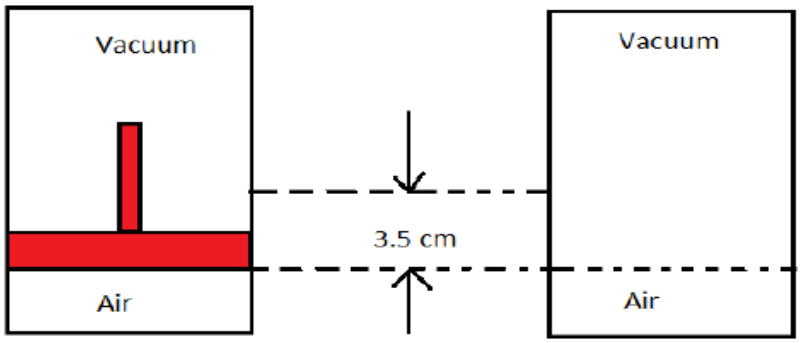
Question 55: A metal rod is 10 m long at 20 ^{0}C. At what temperature would its length increases by 5cm if its linear expansivity is 2x 10^{-6}/K (Ans: temp = 2520 ^{0}C).

Question 56: A cylinder closed at both ends as an inner radius 0.021 m. The cylinder is fitted with a movable piston of mass of 2 kg. The space between the piston and the bottom of the cylinder contains 1.11 x 10^{-4} m^3 of air at 25°C while the space above the piston has been evacuated as shown in the figure below.



(a) Determine the pressure of the air in the cylinder given that the pressure comes from the weight of the cylinder

(b) The cylinder is placed over a source of heat causing the air to expand and push the piston upward a distance of 3.5cm as shown in the figure below



Assuming that the pressure of the air remained constant, what was the change in volume of the air? (Volume of a cylinder = $\pi r^2 h$)

Question 57: Distinguish between heat and temperature

Question 58: (a) State Charles' Law, Boyle's Law and the Pressure Law

(b) Write down the ideal gas equation

(c) The volume of a certain gas at 100 C is 100 cm^3. Calculate the volume of the gas if it is warmed at a temperature of 30 ^{0}C at constant pressure

Question 59: Explain each of the following observations:

(a) A lid on a metal can be unscrewed easily if the can is immersed in hot water for a few minutes

(b) Corrugated iron – sheet roofs make cracking noises on a night preceded by a hot day

(c) It is difficult to unscrew wheel nuts in the morning while it is relatively easy to unscrew them on a hot day.

Question 60: Define

(a) Heat

(b) Thermal expansion

(c) Linear expansivity

(d) Absolute zero temperature

(e) Anomalous expansion of water

Question 61: Differentiate between:

(a) Apparent expansion of liquid and absolute expansion of liquid

(b) Heat and temperature

Question 62: What do you understand by intermediate expansion of liquid?

Question 63: Show how the combined gas law is obtained

Question 64: Explain the following observations:

(a) An inflated balloon hung in the open at a wedding bust when the temperature of the environment rises

(b) A whale cannot survive in shallow water

(c) Soda bottles are thick

(d) Water bubbles seem to increase in size as they rise from the bottom of a tank

(e) Electric wires are seem to sag when they are hot but look very straight when they are cold

(f) Fish living in Polar Regions such as Antarctica do not die even when the temperature fall below 0°C

Question 65: Mention two demerits of anomalous expansion

Question 66: (a) State Boyle's law.

(b) Sketch the graph of pressure (P) against the reciprocal of volume $(\frac{1}{v})$ for air at constant temperature

(c) A bubble of air of volume 50.0mm^3 is released by a diver at a depth where the pressure is 304.0 cm Hg. Assuming that the temperature remains constant ,what is its volume just before reaches the surface where the pressure is 76.0 cm

Question 67: A piece of copper is dropped into water, if the temperature of the water is rising what is happening to the copper?

Question 68: Why are the over head power cables more likely to break and fall during the cold season of the year than during the warm season of the year even though they carry the same weight all year round?

Question 69: A grandfather's clock is controlled by a swinging brass pendulum of length 1.3 m at a temperature of 20°C. ($\propto$ =19 x 10^{-6} °C^{-1})

(a) What is the length of the pendulum rod when the temperature drops to 0°C?

(b) If the period of the pendulum is given by T = $2\pi\sqrt{l/g}$, where l is its length, does the change in the length or the brass rod cause the clock to run fast or slowly?

Question 70: A gas is a contained in an 8 litre vessel at a temperature of 20°C and pressure of 9 atm. At what temperature will the gas fill a 3 litre vessel at a pressure of 13 atmospheres?

Question 71: The temperature of a body is 47°C. What would this temperature be in the absolute scale?

Question 72: Given that at s.t.p a gas occupies 5600cm^3, determine the pressure at which it will occupy the volume of 28.5 litres at a temperature of 220°C.

Question 73: (a) States Charles' Law.

b) An ideal occupies a volume of 500 cm^3 at a temperature of 30 ^{0}C. At what temperature will it occupy a volume of 456 cm^3?

Question 74: Explain why inflated balloon swells up and even bursts when in the open on a hot day?

Question 75: A form three student carried out an experiment on one of the gas laws. She obtained the following results

Temp T (^{0}C)	10	35	60	80	90	110
Volume V (cm^3)	5.0	5.8	6.4	7.0	7.2	7.8

(a) Plot a graph of volume against temperature

(b) From the graph, determine the volume of the gas at 0^0 C

(c) Determine the slope of the graph

Question 76: State Boyle's Law. A gas occupies a volume of 600 cm^3 at a pressure of 760 mmHg. Determine its volume at a pressure of 1085 mmHg

Question 77: The volume of a bubble at the base of a container of water is 3 cm^3. The depth of water is 30 cm. The bubble rises up the column until the surface.

(a) Explain what happens to the bubbles as it rises up the water column

(b) Determine the volume of the bubble at a point 12 cm below the water surface

Question 78: Explain why deep sea animals cannot survive at regions with shallow water

TOPIC 06: TRANSFER OF THERMAL ENERGY

Question 01: Why do we prefer white clothes in summer?

Ans: Because they are poor absorbers and good emitters

Question 02: Explain what is meant by the conduction of heat. Use the kinetic theory to explain how heat is transferred along a metal road

Question 03: Explain briefly the reason why steam pipes are covered with felt or asbestos

Question 04: A piece of iron and a piece of wood are both cooled to a temperature of 0 ^{0}C. When touched with a finger the iron feels colder than the wood. Why?

Question 05: Discuss the uses of good and bad conductors of heat energy in everyday life

Question 06: What do you understand by convection? Describe how you would demonstrate the formation of convection currents in a liquid

Question 07: Explain the following:

(a) Cork is packed between the double walls of refrigerating chambers
(b) Most cooking pots are made of Aluminium
(c) Ice blocks are wrapped in paper when they are stored
(d) Water tanks in the tropics are painted white
(e) White clothes are worn in the Arctic in preference to dark ones

Question 08: A thermometer having a blackened bulb records a higher than an ordinary thermometer when they are both held at an equal distance from a fire. Explain this

Question 09: Explain briefly how a fire can assist in the ventilation of a room

Question 10: (a) Explain how heat transfer by radiation takes place.

(b) Why does heat transfer by radiation not require a medium?

(c) A good cooking vessel should be black on the outside and not shiny white. Explain

(d) Give one way through which heat losses by radiation can be prevented.

Question 11: List three areas where heat transfer through each of the following methods is applied:

(a) Conduction
(b) Convection
(c) Radiation

Question 12: (a) Explain the followings:

(i) How heat transfer by conduction takes place?
(ii) Why are gases poor conductors of heat?
(iii) Why are cooking vessels made of aluminium and not iron?
(iv) Why are stadium seats made of plastic and not steal?

(b) Give two ways through which heat losses by convection can be prevented?

Question 13: Why is it not possible for heat transfer by convection to take place in solids?

Question 14: Explain the importance of making ventilation on the top of the walls in a room

Question 15: Explain briefly how heat travels in metals

Question 16: How is heat loss by conduction, convection and radiation reduced in a vacuum flask?

Question 17: Explain how land and sea breeze occurs

TOPIC 07: MEASUREMENT OF THERMAL ENERGY

Use the following constants where necessary when solving the questions below:

- Specific heat capacity of water = 4200J/(kg^{0}C)
- Specific heat capacity of ice = 2100J/(kg^{0}C)
- Specific heat capacity of steam = 2000J/(kg^{0}C)
- Specific latent heat of fusion of ice = 3.3×10^5J/kg
- Specific latent heat of steam = 2.26×10^6J/kg
- Specific latent heat of vaporization of water = 2.3×10^5J/kg
- Acceleration due to gravity, g = 10m/s^2

Question 01: (a) Define the term heat capacity.

(b) 3000 J of heat is lost when the temperature of an iron rod reduces from 50 ^{0}C to 30.5 ^{0}C. Determine its heat capacity. (Ans: C = 153.85 J/K)

Question 02: A solid with a heat capacity of 320 J/K requires 2000 J of heat to raise its temperature to 80 ^{0}C. Find its original temperature (Ans: T_1 = 73.75 ^{0}C)

Question 03: How much heat is required to raise the temperature of a 25kg sample of mercury from 20°C to 30°C? (Ans: H = 348750J)

Question 04: The temperature of a 6kg block of copper rises from 15°C to 30°C on being heated. Determine the amount of heat energy supplied to the block. (Specific heat capacity of block is 390J/(kg°C)) (Ans: H = 35 100J)

Question 05: How much heat energy is given out by an iron block of 20g mass when it cools from 920°C to 20°C? (Ans: H = 8 640J)

Question 06: A piece of copper of mass 40 g at 200 ^{0}C is immersed into a copper calorimeter of mass 60 g containing 50 g of water at 25 ^{0}C. Neglecting heat losses, what will be the final temperature of the mixture? (Ans: 36.0 ^{0}C)

Question 07: A brass cylinder of mass X was heated to 100 ^{0}C and then transferred into a thin aluminium can of negligible heat capacity containing 150 g of paraffin at 11 ^{0}C. If the final steady temperature of the paraffin attained was 20 ^{0}C. Determine the value of X (Ans: X = 0. 116 Kg)

Question 08: 2.5 kg of a metal at 200 ^{0}C is immersed into 1.2 kg of cold water of temperature 20 ^{0}C. The mixture after thoroughly stirring attained a final temperature of 34.5 ^{0}C. Given that the specific heat capacity of water is 4200 J/(kgK). Determine the specific heat capacity of the metal (Ans: C_{metal} = 176.63 J/ (kgK))

Question 09: A block of metal of mass 0.20kg at a temperature of 100°C is placed in 0.40kg of water at 20°C. If the final steady temperature of the water is 24°C, determine the specific heat capacity of the metal. (Neglect heat absorber by the container) (Ans: C = 442.1 J/ (kg K))

Question 10: A block of aluminum of mass 0.5kg at a temperature of 100°C is dipped in 1.0kg of water at 20°C. Assuming that no thermal energy is lost to the environment, what will the final temperature of the water is at thermal equilibrium? (Ans: θ_f = 27.7°C)

Question 11: How much heat is required to change a 500 g ice cube at 0 ^{0}C to water at 0 ^{0}C? (L_f = 3.36 x 10^5 J/kg) [Ans: 186 kJ]

Question 12: How much heat is required to change 100 g of ice from ice at 0 ^{0}C to vapour at 100 ^{0}C (Ans: 301600 J)

Question 13: How much heat would be required to change 1.5kg of ice at -10°C to stream at 120°C? The specific heat capacities of ice, water and steam are 2144J/ (kg °C), 4186 J/ (kg °C) and 2010 J/ (kg °C) respectively (Ans: H_t = 4, 627, 860J)

Question 14: Which one contains the greater amount of heat "a lake of water at 20 ^{0}C or a bowl of water at 90 ^{0}C? Explain

Question 15: An iron bar of mass 80 g is heated from a temperature of 15 ^{0}C to a temperature of 65 ^{0} C. How much heat is absorbed by the bar given that iron has a specific heat capacity of 460 J/ (kg ^{0}C)?

Question 16: Water of mass 20g at a temperature of 42 ˚C is poured into a well lagged copper vessel of mass 27 g at a temperature of 20 ˚C. Find the final temperature of the water. (specific heat capacity of copper = 400J/(kg˚C)

Question 17: Calculate the heat content of a piece of brass of mass 120g at a temperature of 20 ˚C. Find the final temperature of water. (Specific heat capacity of copper = 400J/ (kg ˚C)

Question 18: In an experiment to determine the specific heat capacity of a piece of metal the following results were obtained:

Mass of piece of metal = 200g
Initial temperature = 25 ˚C
Final temperature = 80 ˚C
Heat absorbed by the piece of metal = 1430 J
Calculate the specific heat capacity of the piece of metal.

Question 19: Distinguish between latent heat of fusion and the specific latent heat of fusion of a substance. Find the amount of heat required to change 1kg of ice at 0 ˚C to water at the same temperature.

Question 20: Define the term latent heat of vaporization and specific latent heat of vaporization. Find the quantity of heat required to change 5kg of water at 60 ˚C into steam at 100 ˚C

Question 21: Determine the final temperature obtained when 500 g of water at 100 ^{0}C was mixed with 500 g of water at 100 C and well stirred. (Ans: $T_f = 55\ ^0C$)

Question 22: (a) Differentiate between heat and temperature

(b) The specific heat capacity of a certain substance is 800 J/kg ^{0}C what does this statement mean?

(c) Calculate the specific heat capacity of mercury if 980 J of heat is required to raise the temperature of 7 g of mercury from 0 ^{0}C to 1000 ^{0}C

Question 23: A piece of metal of specific heat capacity 840 J/ (kg ˚C) and mass 30 g is heated to a temperature of 99 ˚C and then dropped into a cavity in a block of ice at 0 ˚C. Find the amount of ice that will melt

Question 24: A refrigerator can convert 0.4 kg of water at 20 ˚C to ice at -10 ˚C in 4 hours. Find the average rate of heat extraction from the water in joules per second.

Question 25: (a) What is meant by the following terms?

(i) Melting point
(ii) Freezing point

(b) Describe how to find the melting point of a substance by means of cooling curve

Question 26: Explain why:

(a) Heat energy has to be supplied to a solid in order to change it into liquid.
(b) Heat energy has to be supplied to a liquid in order to change it to vapor

Question 27: A 0.2kg block of ice at 0 ˚C is placed into a Styrofoam calorimeter cup with unknown mass of water at 20 ˚C. When thermal equilibrium is reached the final temperature is measured to be 5 ˚C. What was the mass of the water initially in the cup?

Question 28: A pressure cooker is a pot with a tight fitting lid that does not allow steam to escape until a preset pressure is reached. Explain how the pressure cooker can cook food faster than a sufuria with a loose – fitting

Question 29: A container holds 1.5kg of ice initially at 40 ˚C. Heat is supplied to the container at the rate of 12.6kJ per minute for 120 minutes.

(a) Plot a graph of temperature versus time for the 120 minutes during which heat is supplied.

(b) What will the temperature of the contents of the container be at the end of the 120 minutes?

(c) What will the mass of the steam in the container be at the end of the 120 minutes?

Question 30: A 0.15kg aluminium cup holds 0.2kg water at 18 ^{0}C. A 0.12 kg iron block at 85 ˚C is placed into the water and the entire system surrounded by an insulating jacket. What will be the final temperature of the system when thermal equilibrium is reached?

Question 31: The temperature of 500 g of a certain metal is raised to 100 ^{0}C and it is then placed in 200 g of water at 15 ^{0}C. If the final steady temperature rises to 21 ^{0}C calculate the specific heat capacity of the metal. (Ans: $C = 128\ Jkg^{-1}K^{-1}$)

Question 32: How much thermal energy is required to raise the temperature of 3kg of aluminium from 15 ˚C to 25 ˚C?

Question 33: Explain the following:

(a) When the brakes of a moving car are applied for an applicable time, they get hot

(b) When the tyre of a car is pumped up the pump gets warm

Question 34: A car of mass 1000 kg travelling at 72 km/h is brought to rest by applying the brakes. Assuming that the kinetic energy of the car becomes transferred to internal energy in four steel brake drums of equal mass, find the rise in temperature of the drums if their total mass is 20 kg, the specific heat capacity of steel is 450 J/ (kgK) and the work done is equal on all four drums**.** (Ans: $\Delta\boldsymbol{\theta} = \mathbf{22.2}\ \boldsymbol{K}$)

Question 35: A bath contains 100 kg of water at 60 ^{0}C. Hot and cold taps are then turned on to deliver 20 kg per minute each at temperatures of 70 ^{0}C and 10 ^{0}C respectively. How long will it be before the temperature in the bath has dropped to 45 ^{0}C? Assume complex mixing of the water and ignore heat losses (Ans: t = 7.5 mins)

Question 36: Some hot water was added to three times its mass of water at 10 ^{0}C and the resulting temperature was 20 ^{0}C. What was the temperature of the hot water? (Ans: T = 50 ^{0}C)

Question 37: A piece of lead of mass 500 g and at air temperature falls from a height of 25 m.

(a) What

(i) Is initial potential energy?

(ii) Is its kinetic energy on reaching the ground?

(b) Assume that all the energy becomes transferred to internal energy in the lead when it strikes the ground; calculate the rise in temperature of the lead if its specific heat capacity is 130 J/ (kgK). State the energy changes which occur from the moment the lead strikes the ground until it has cooled to air temperature again. (Ans: P.E =123 J, K.E =123 J, $\Delta\boldsymbol{\theta} = \mathbf{1.89}\ \boldsymbol{K}$)

Question 38**:** A waterfall is 100 m high and the difference in temperature between the water at the top and that at the bottom is 0.24 K. Obtain a value for the specific heat capacity of water in J/ (kgK) explaining the steps in your calculations. Mention any assumptions you make (C = 4100 J/ (kgK))

Question 39: A 0.5 kg block of aluminium at a temperature of 100 ˚C is placed in 1.0 kg of water at 20 ˚C. Assuming that no thermal energy is lost to the surroundings, what will the final temperature of the aluminium and the water is when they attain the same temperature?

Question 40: When a certain quantity of heat was supplied to a substance its temperature rose from 5 ˚C to 20 ˚C. What will the final temperature of the substance be if twice the amount of heat is removed from the sample?

Question 41: Why is water used as a coolant in car engines?

Question 42: State what changes, if any, take place in the following?

(a) Melting point of ice when salt is added to the ice

(b) The volume of water if it changes into ice

(c) The boiling point of a liquid when the pressure on the liquid is reduced

Question 43: Two substances A and B have the same mass and are at the same temperature. Substance A has a higher specific heat capacity than substance B. Which substance will have a higher final temperature if the same amount of heat is supplied to each substance?

Question 44: An electric heater is rated at 250 W. Calculate the quantity of heat generated in 10 minutes (Ans: H = 150 kJ)

Question 45: A tin contains water at 290 K and is heated at constant rate. It is observed that the water reaches boiling point after 2 minutes and after further 12 minutes it is completely boiled away. Calculate the specific latent heat of steam (Ans: 2092kJ/kg)

Question 46: An insulated cup holds 0.1kg of water at 0 ˚C. 0.1 kg of boiling water at a temperature of 100 ˚C is poured into the cup. What will be the final temperature of the mixture at thermal equilibrium?

Question 47: A 50 watt heater is immersed in a 2 kg block of aluminium which also holds a thermometer. The temperature of the block rises by 8 K in 5 minutes. Neglect heat losses; calculate the specific heat capacity of aluminium. (Ans: 937.5 J)

Question 48: A metal sphere of unknown composition has a mss of 0.4kg. The sphere is heated in a furnace to a temperature of 150 ˚C and then dropped into an insulated cup holding 0.35 kg of water at 20 ˚C. Upon reaching thermal equilibrium, the temperature of the system is measured to be 32.4˚C.

(a) Calculate the specific heat capacity of the metal.

(b) Use the values of specific heat capacity of substances to identify the metal.

Question 49: Differentiate between:

(a) Melting point and boiling point

(b) Evaporation and boiling

(c) Freezing and vaporization

(d) Melting and cooling

Question 50: Explain the following:

(a) The boiling point of water in Dar es Salaam is higher than at the top of Mt. Kilimanjaro

(b) Why does water boil faster at the top of a mountain than at the bottom?

(c) Water being heated while covered boils faster than uncovered water.

(d) When one wipes spirit on the skin he feels cold

(e) When snow is pressed by the hands, it melts to water. The water then immediately freezes.

(f) The use of ammonia as a household refrigerant is discouraged

Question 51: How much heat is required to change 40 g ice cube from ice at –10 ^{0}C to steam at 110 ^{0}C?

Question 52: Describe how a household refrigerator preserves food.

Question 53: If 200 g of water is contained in a 500 g aluminium can at 10 ^{0}C then an additional 100 g of water at 100 ^{0}C is added into the can, what is the final equilibrium temperature of the mixture?

Question 54: An unknown liquid of mass 400 g at a temperature of 80 ^{0}C is poured into 400 g of water at 40 ^{0}C. The final temperature of the mixture is 49 ^{0}C. What is the specific heat capacity of the unknown liquid?

Question 55: 20 g of steam at 100 ^{0}C is added to 50 g of ice at 0 ^{0}C. Find the amount of ice that is melted and the final temperature

Question 56: Explain how the following factors affect the melting and boiling points:

(a) Pressure

(b) Impurities

Question 57: Explain how a refrigerator works.

Question 58: An electric heater rated 1500 W is used to heat water in an insulated container of negligible heat capacity for 10 minutes, the temperature of water rises from 20 ^{0}C to 40 ^{0}C. Calculate the mass of water heated

Question 59: An electric kettle rated 2 kW is filled with 2.0kg of water and heated from 20 ^{0}C to 98 ^{0}C. Calculate the time taken to heat the water assuming that all the electrical energy is used to heat the water in the plastic kettle and the kettle has negligible heat capacity

Question 60: The following data was obtained from an experiment. Mass of copper metal block = 200 g, initial temperature of the block = 220 C, ammeter reading = 0.5 A, voltmeter reading = 3.0 v, final temperature of the block = 300 C, time of heating = 7 minutes. Use the data to calculate the specific heat capacity of copper. What does this value mean? (Ans: $C_{Cu} = 394$ J kg^{-1}K^{-1})

Question 61: In an experiment the following data was obtained. Use the data to calculate the time taken by the heater to raise the temperature of water container and the stirrer from 20 ^{0}C to 23 ^{0}C. What assumption have made in your calculations? Power of electric heater = 30 W, mass of the container and the stirrer = 200 g, specific heat capacity of the container and the stirrer = 400 J/ (kgK), mass of water in the container = 100g, specific heat capacity of water = 200 J/ (kgK) (Ans: t = 50 s)

Question 62: A class of Physics students decided to determine the specific heat capacity of water in a waterfall. They used a sensitive thermometer to find the difference in temperature

of water at the top and the bottom of the waterfalls and obtained the following results; height of the waterfalls = 52 m, temperature of the water at the top = 21.54 ^{0}C and that at the bottom = 21.67 ^{0}C. Stating any assumptions made, calculate a value for specific heat capacity of water

Question 63: A 200 g of liquid at 21 ^{0}C is heated to 51 ^{0}C by a current of 5 A at 6V for 5 minutes. What is the specific heat capacity of the liquid? (Ans: C = 1500 J/ (kg ^{0}C))

Question 64: An electric kettle rated 1 500 W is used to boil 500 g of water into steam at 100 ^{0}C. Calculate the time required to boil off water.

Question 65: Why steam is hotter than boiling water?

Question 66: Explain as fully you can what happens when a liquid boils. Why would you expect the boiling point of a liquid to be lowered when the pressure above the free surface is vapor?

TOPIC 08: VAPOUR AND HUMIDITY

Question 01: The dry bulb temperature reading of a hygrometer is 22 ^{0}C and the wet bulb temperature reading is 18 ^{0}C. What is the RH? (Ans: 18.2%)

Question 02: The dry bulb temperature reading of a hygrometer is 40 ^{0}C and the wet bulb temperature reading is 30 ^{0}C. What is the RH? (Ans: 25%)

Question 03: The relative density of a place was measured at 25 ^{0}C and found to be 53.6%. If the absolute humidity is 23.05g/m^3, determine the actual water vapour density at this experiment (Ans: AVD = 12.35 g/m^3)

Question 04: Define evaporation and state the factors which affect the rate of evaporation of a liquid. How does the kinetic theory account for the cooling produced in a liquid which is evaporating?

Question 05: Distinguish between: (a) snow (b) hailstones (c) mist

Question 06: Define the following terms (a) Dew (b) Dew point (c) Specific humidity

Question 07: What factors determine saturation of vapour pressure?

Question 08: Explain the principles used to measure relative humidity?

Question 09: Explain the factors that affecting evaporation

Question 10: Explain the difference between a vapour and a gas

Question 11: At a given pressure the thermometer of a wet bulb reads 21 ^{0}C. If the Relative Humidity is 30 %, what is the temperature of the air?

Question 12: A mass of air at 20 ˚C has a relative humidity of 39% if the air is cooled to 15 ˚C what will its relative humidity be?

Question 13: A mass of air has a relative humidity of 57% and a dew point of 20˚C. What is the temperature of the air mass?

***Question 14*:** Why does air cool when it rises through the atmosphere? (Ans: As air rises it expands because air pressure decreases with an increase in altitude. When expands it cools adiabatically)

Question 15: A room with dimension of 7m x 10m x2m holds air that is saturated with water vapour. The saturated vapour pressure of the water vapour is 7.37 kPa. If all the water vapour in the room was condensed, what volume would the water occupy? Give your answer in m^3.

Question 16: A sealed box with the volume of 1.2m^3 holds air with relative humidity of 22% at a temperature of 15 ˚C. A beaker of water also at 15 ˚C is placed in the box. After 2 hours, the level of the water in the beaker stopped dropping

(a) What mass of water evaporated from the beaker?

(b) If the temperature of the air in the box is increased to 30˚C, how much more water will evaporate?

Question 17: The table below gives the temperature and dew point in four towns at 12 noon.

City	Temperature (^{0}C)	Dew point
Arusha	16	1
Morogoro	24	12
Zanzibar	3	5
Dar es Salaam	28	4

(a) In which town is the relative humidity the highest?

(b) In which town is the relative humidity the slowest?

Question 18: Briefly explain the reasons for the following:

(a) When a cold bottle is brought into a warm room it becomes misted over

(b) Frost is more likely to occur on a clear night than on a cloudy night.

Question 19: (a) Define the term relative humidity.

(b) At a certain temperature and pressure air holds 120 g of water vapor. If at this temperature and pressure the air is holding only 40 g of water vapor, what is the relative humidity of the air?

Question 20: On a given day,the room temperature is 20 ˚C and the dew point is 5 ˚C. Find the relative humidity,given that saturated vapour pressure of water at 5˚C is 6.54 mmHg and that the saturated vapour pressure of water at 20 ˚C is 17.5 mmHg.

Question 21: (a) What does the term saturation of water vapor mean?
(b) What is the difference between vapour pressure and saturated vapour pressure?

Question 22: Differentiate between:

(a) Absolute humidity and Relative humidity

(b) Evaporation and Boiling

(c) Saturated and unsaturated vapour

Question 23: Explain why dew is formed at night.

Question 24: What are the two processes that change a liquid into a gas? Then state their difference

Question 25: A student is investigating the evaporation of water in the Laboratory. He pours 200 cm^3 of water in a 250 cm^3 beaker. He pours another 200 cm^3 of water in a 1000 cm^3 beaker. The water in both beakers is initially at 50 ^0C

(a) Use the kinetic theory of matter to explain which beaker evaporates faster

(b) List three other factors that affect evaporation of a liquid

(c) Explain why the liquid that remains during evaporation cools

Question 26: The actual vapor density of a region at 23 ^0C temperature is 15g/m^3, if the saturation vapour density at that temperature is 21.3 g/cm^3. Determine the region's relative humidity

Question 27: At a temperature of 30 ^0C the mass of water vapour in town **K** is 22 g while dry air has a mass of 15 g; determine the specific humidity of town **K** at the stated temperature

Question 28: A wet bulb thermometer reads 17.2 ^0C, if the relative humidity of the air is 40%, what is the temperature of the air? (Ans: $T_{air} = 28.7\ ^0C, \rightarrow T_{air} = T_{dry\ bulb}$)

Question 29: A mass of air at 30 ^0C holds 15 g/cm^3 of water vapor. If the saturation point of the air is 30 g/cm^3, calculate the relative humidity of the air

Question 30: If the dry bulb temperature is 32 ^0C and the wet bulb temperature is 24 ^0C, what is the relative humidity of the air?

Question 01: An electric heater draws 3.5 A from a 110 V source. What is the resistance of the heating element? (Ans: R = 31.4Ω**)**

Question 02: A current of 2 A is passed through a conductor of resistance 10 Ω. What is the potential difference between the ends of the conductor? (Ans: V = 20V)

Question 03: A wire of length 40 m and cross – sectional area 0.8 mm^2 has a resistance of 10Ω. What is the resistivity of the material of the wire? (Ans: $\boldsymbol{\rho} = \mathbf{2}x10^{-4}$ Ωm)

Question 04: What is resistance of a copper wire of length 20m and diameter of 0.080 cm? Resistivity of copper is 1.68 x 10^{-8} Ωm (Ans: R = 0.67Ω)

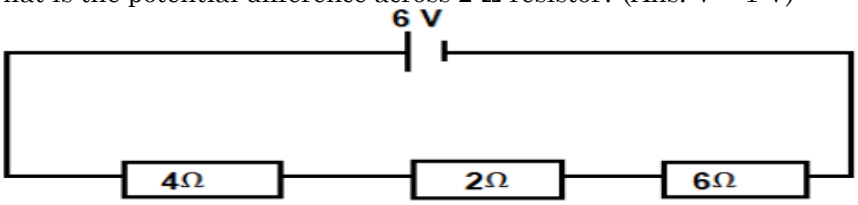
Question 05: A steel bar has a length of 2.3m and diameter of 2 x 10^{-5} m. what is resistance? (Resistivity is 10.5 x 10^{-8} Ωm) (Ans: R = 768.72 Ω)

Question 06: What length of a wire of cross – sectional area 0.2mm^2 and resistivity 0.072μ Ωm is needed to wind a coil of resistance 9 Ω. (Ans: L = 25m)

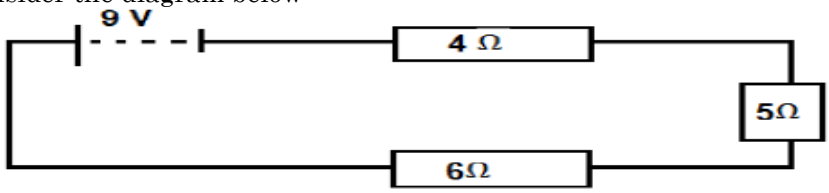
Question 07: The resistance of a certain wire is 12 Ω. What are the resistance of another wire of the same material but with half the length and half the radius of the first wire? (Ans: R_2 = 24 Ω)

Question 08: A resistor is connected across a 50 V source. What is the current in the resistor if the color code is red, orange, and orange, silver? (Ans: I = 2.2 mA)

Question 09: What is the potential difference across 2 Ω resistor? (Ans: V = 1 V)

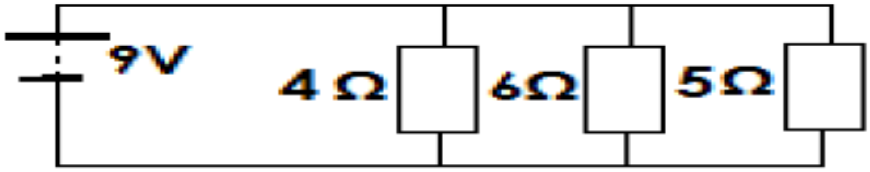


Question 10: Consider the diagram below



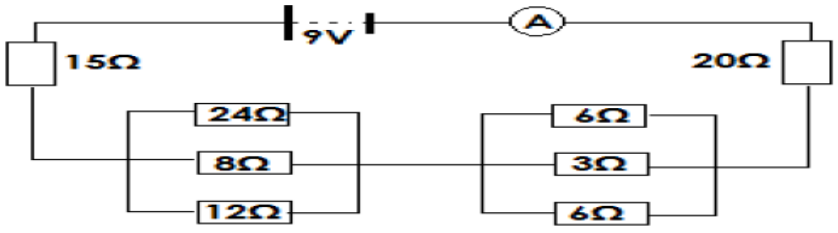
(a) What is the total resistance of the circuit?
(b) What current flows in the circuit?
(c) What is the potential drop across each resistor?
(d) What is the electric potential at point A?
(Ans: (a) 15 ohms (b) I = 0.6 (c) 2V, 3.6V and 3 V (d) V_A= 6.6V)

Question 11: Consider the diagram below



(a) What is the total resistance of the circuit? (Ans: 1.62 ohms)
(b) What total current flows in the circuit? (Ans: 5.55 A)
(c) What current flows through each resistor? (Ans: 2.25A, 1.5A, 1.8A)

Question 12: Determine the current reading on the ammeter in the circuit shown in the diagram below



Question 13: What is the internal resistance of cell when there is current of 0.4A when a battery of 6 V is connected to a resistor of 13.5 Ω? (Ans: r = 1.5 Ω)

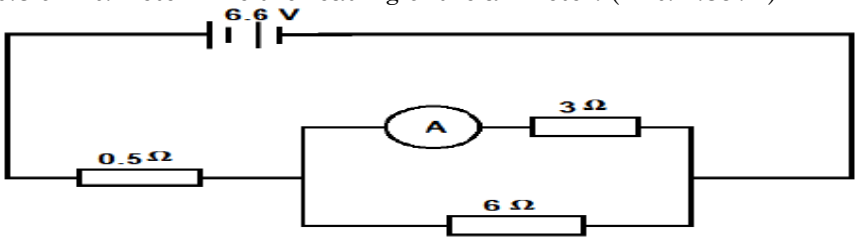
Question 14: What is the maximum current of a battery of e.m.f 3.0 V and internal resistance of 1.0Ω (Ans: I = 3 A)

***Question 15*:** An old cell with an emf of 1.7 V has an internal resistance of 0.8 Ω. How much current will initially flow it its terminals are short – circuited? (Ans: I = 2.13A)

Question 16: A d.c source with an internal resistance of 0.11 Ω is connected across a length of nichrome wire having a resistance of 20 Ω; if a voltmeter across the nichrome indicates a drop of 5 V, what is the emf of the source? (Ans: e.m.f = 5.0275 V)

Question 17: A cell with an e.m.f of 1.4 V and internal resistance of 0.05 Ω is placed in a circuit with several resistors; the cell provides 0.52 A to the circuit. What is the terminal voltage of the cell? (Ans: V = 1.374 V)

Question 18: In the circuit shown below, the battery has an e.m.f of 6.6 V and internal resistance of 0.3 ohms. Determine the reading of the ammeter. (Ans: 2.357A)



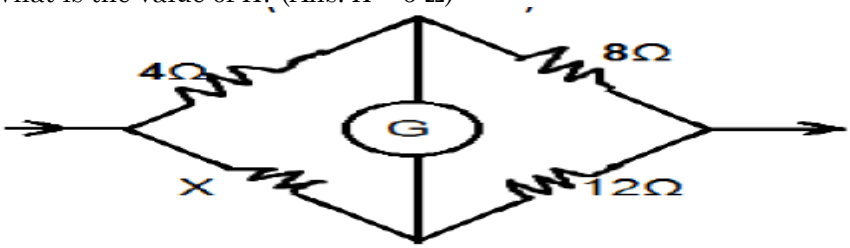
Question 19: A cell supplies a current of 0.6A through a 2 Ω resistor and a current of 0.2A through a 7 Ω resistor. Calculate the e.m.f of the cell and the internal resistance (Answer: E.m.f = 1.5 V, r = 0.5Ω)

Question 20: A complete circuit consists of an 18 V battery and a resistor **R**. The terminal voltage of the circuit is 15.8V and the current is 4A. What:

(a) Is the internal resistance, r of the battery? (Ans: r = 0.55 **Ω**)

(b) Is the resistance R of the circuit resistor? (Ans: R = 3.95 **Ω**)

Question 21: The galvanometer in the bridge network shown in the figure below gives no deflection. What is the value of X? (Ans: X = 6 Ω)



Question 21: An electric kettle draws a current of 10A when connected to the 230V mains supply. If all the energy produced in 5 minutes is used to heat 2kg of water. Calculate:

(a) The power of the kettle

(b) The energy produced in 5 minutes

(c) The rise in temperature (Specific heat capacity of water = 4200 $Jkg^{-1}K^{-1}$)

Ans: (a) 2.3 kW (b) 690 kJ (c) 82.14 K

Question 22: An electric motor powered by a 240 V mains supply requires a current of 30A to lift a load of mass 3 tonnes at the rate of 5 m per minute. Calculate:

(a) The power input (Ans: P_{In} = 7200 W)

(b) The Power output (Ans: P_{Out} = 2500 W)

(c) The overall efficiency of the machine (Ans: Eff = 34.72%)

***Question 23*:** What is the maximum number of 100 W bulbs which can be safely connected from a 240 V source supplying a current of 5 A? (Ans: n = 12 bulbs)

Question 24: An electric cooker has a coil of resistance 5000Ω. If is operated on a 250 V mains supply for 1 hour, how much heat energy does it produce? (Ans: E = 45kJ)

Question 25: A television set rated 200W is switched on for 5 hours every day. How much energy does it consume in 30 days (Ans: E = 1.08 x 10^5kJ)

Question 26: A house has five rooms, each with a 60W, 240V bulb. If the bulbs are switched on 7:00p.m to 10:300p.m determine the power consumed by bulbs per day. (Ans: P = 1.05kWh)

Question 27: A bulb rated 120 V, 75 W burns continuously for two days. Given that the cost of one unit (1kW) is 320 Tsh. Determine the:
(a) Total electrical energy consumed
(b) Total power bill
Ans: (a) 3.6 kWh (b) 1152 Tsh

Question 28: You have a choice of the following fuses 1A, 3 A, 5 A, 9 A, 13 A and 30 A. Select the best fuse for:
(a) A 240 V, 7.2 kW electric cooker
(b) A 240 V, 2kW electric iron
Ans: (a) The best fuse is a 30A fuse (b) The best fuse is 9A fuse

Question 29: A current of 1.5A flows in a wire. Find the total charge passed in 20 seconds (Ans: Q = 30 C)

Question 30: A charge of 3600 C passes through an electric lamp in 3.0 minutes. What is the current in the lamp (Ans: I = 20A)

Question 31: How many electrons pass through a lamp in 10 seconds if the current is a 125mA and the charge of one electron is 1.6×10^{-19} C? (Ans: n = 7.813×10^{18} electrons)

Question 32: Electron in hydrogen atom revolves around the nucleus with frequency 6.0×10^{-4} per second. Calculate the current in the orbit. Given that charge on an electron = 1.6×10^{-19} coulomb. (Ans: I = 9.6×10^{-5} A)

Question 33: If a container of surface area 2.1 m^2 is to be coated with silver about 0.1 mm thick. Calculate the time it will take if a current of 4 amperes has to flow

Question 34: A nichrome wire of radius 0.35 mm has a resistivity of 1.5×10^{-6} Ωm. Given that the wire has a length of 80 cm. Calculate:
(a) Its resistance
(b) Conductance
(c) Conductivity

Question 35: Explain the factors which determine the resistance of a conductor

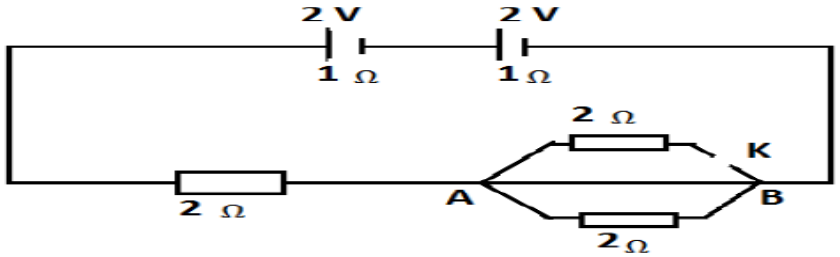
Question 36: When resistors are connected in series, which of the following is the same for all the resistors
(a) Potential difference
(b) Current

Question 37: Find the resistance of a wire of 1100 cm long, 0.2 mm diameter and of resistivity 1.57×10^{-6} Ω *m* (Ans: R = 546.7 **Ω**)

Question 38: Calculate the energy dissipated by a resistor of 12 Ω in 4 seconds if a voltage of 6 V is applied. (Ans: H = 12 J**)**

Question 39: Calculate the heat lost by a wire of resistance 16 Ω when a current of 30 A flows through it in 1 second. (Ans: H = 14 400 J)

Question 40: A battery consisting of two cells of 2 V and internal resistance of 1 Ω each is sending a current through the filament of the lamp as shown in the circuit below



Calculate:
(a) The current in the circuit when
(i) Switch K is open (Ans: I = 0.67 A)
(ii) Switch K is closed (Ans: I = 0.8 A)
(b) The potential difference across the battery of two cells when K is closed (Ans: P.d = 2.4 V)

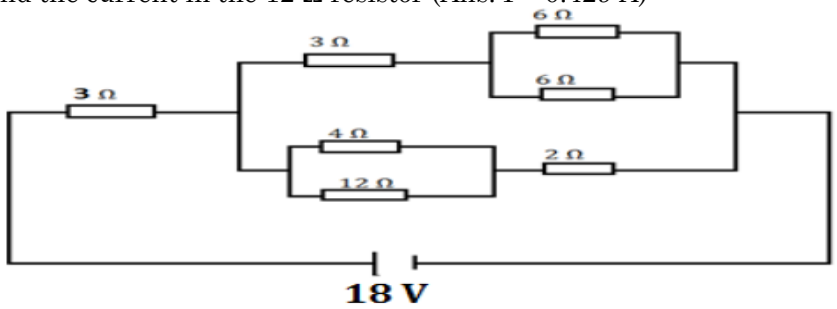
Question 41: (a) Define resistance and state its SI units.

(b) When is the resistance of a conductor said to be one ohm?

(c) A current of 2 A is observed to flow through a conductor when a potential difference of 50V is applied between its ends. Calculate the resistance of the conductor.

Question 42: Distinguish between primary and secondary cells

Question 43: Find the current in the 12 Ω resistor (Ans: I = 0.429 A)



Question 44: (a) State the factors which determine the resistance of a conductor.

(b) Define Resistivity and give its SI unit.

(c) Find the length of constantan wire of diameter 1cm needed to make a resistor of 3Ω. Take the resistivity of constantan as 4.9×10^{-7} Ωm

Question 45: Two wires A and B are made of the same material .A has half the length and twice the diameter of B. What is the ratio of the resistance of B to that of A?

Question 46: A battery consists of three accumulators in series, each having an e.m.f of 2 V. A second battery consists of four dry cells also in series, each having an e.m.f of 1.5 V. What is the e.m.f of each battery? Why could you get a bigger current from the battery of accumulators? (Ans: 6 V each)

Question 47: Each of the two new dry cells has an e.m.f of 1.5 volts and internal resistance of 1.0 ohm. The two cells are connected to a 10 ohm resistor. Find the current and heat developed per second on the 10 ohm resistor

Question 48: A fine wire has a resistance 4.0 Ω/*m*, when a coil made from this wire is connected to a 50 V supply a current of 25 mA flows.

(a) What is the length of wire making this coil?

(b) Determine the resistivity of this wire if its diameter is 0.35 mm

Question 49: Show that if two resistors are joined in parallel and in series, the effective resistance R is given by: $\mathbf{R = \frac{R_1 R_2}{R_1 + R_2}}$ **and** $\mathbf{R = R_1 + R_2}$ respectively, where R_1 and R_2 are the separate resistances

Question 50: Three resistors of resistances 10Ω, 25Ω and 50Ω respectively are to be connected between two points A and B. What will be the resistance between A and B if the three resistors are connected?

(a) In series

(b) In parallel

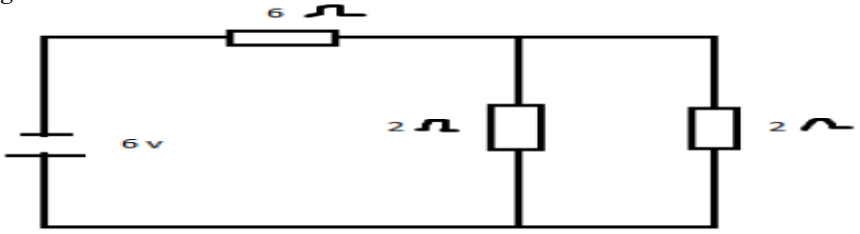
Question 51: Three conductors of resistances 10Ω, 15Ω and 25Ω are joined in series across a 100V supply. Find:

(a) The total resistance

(b) The current in the circuit

(c) The potential difference across each conductor

Question 52: Calculate the current passing through the 6Ω resistor in the circuit shown in the figure below



Question 53: (a) State the main facts about cells connected

(i) In series

(ii) In parallel

(b) Three cells each of e.m.f. 1.5V and internal resistance 0.6Ω are connected in parallel. The group of cells is then connected across a conductor of resistance 1Ω. Calculate the current in the circuit.

Question 54: A cell has an e.m.f of 1.5 V and an internal resistance of 1 Ω is connected to two resistances of 2 Ω and 3 Ω in series. Find the current flowing and the potential difference across the ends of each resistance. (Ans: 0.25A, 0.5 V, 0.75 V)

Question 55: Two cells each having an e.m.f of 1.5 V and internal resistances of 1Ω are connected to a resistance of 4 Ω. What is the current in this resistance if the cells are connected in parallel? (Ans: I = 0.33 A or 1/3 A)

Question 56: Two resistors of resistances 3Ω and 5Ω respectively, are connected in the gaps of a metre bridge. At what point on the wire of the bridge will a centre-zero galvanometer show no deflection?

Question 57: The P.d across the terminals of a cell is 3.0 V when it is not connected to a circuit and no current is flowing. When the cell is connected to a circuit and a current of 0.37 A is flowing across the terminal, its P.d falls to 2.8 V. What is the internal resistance of the cell? (Ans: r = 0.54 Ω)

Question 58: Two resistors of resistance 30 Ω and 80 Ω are connected in parallel. Calculate their equivalent resistance

Question 59: A cell pushes a current of 2.0 A through a 0.6 Ω resistor. When the same cell is connected to a 1 Ω resistor, the current that flows is now 1.2 A. Calculate:

(a) The internal resistance of the cell

(b) The e.m.f of the cell

Question 60: (a) State joule's law of heating

(b) Describe an experiment to show that the heat developed in a conductor by the passage of an electric current depends on the magnitude of the current.

Question 61: Give joule's formula for the quantity of electrical energy generated in a wire carrying a current and define all symbols used. A current of 2A is passed through a conductor of resistance 10Ω for 5 minutes. Calculate the quantity of heat dissipated in the conductor

Question 62: In an experiment to find the resistance of a resistor R using the wheat stone bridge, the balance point was found to be at the 35 cm mark on a 100 cm nichrome wire. If the value of the resistance needed to balance the bridge on the other side was 30 Ω, calculate the value of the resistance of the resistor R. (Ans: R = 16.2 Ω)

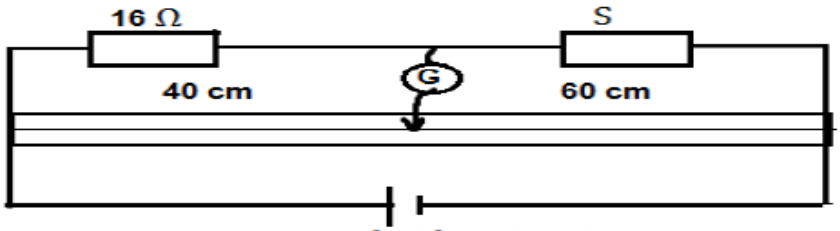
Question 63: (a) When is an electrical conductor said to dissipate one joule?

(b) The current in an electrical appliance operating from a 240V supply is 5A. How much energy is used up in operating it for 20 minutes?

Question 64: The resistance of a heating coil of an electrical hot water system is 100 ohm. If the coil operates from a 240V supply, calculate the rate at which the coil consumes electrical energy.

Question 65: What is the resistance of a wire if it is balances a standard resistor of 2 ohms at the 56 cm from the end of the metre bridge? (Ans: R = 2.54 cm)

Question 66: Find the value of the unknown resistor S in the balanced wheat stone bridge circuit in the figure below



A metre bridge circuit

Question 67: (a) A domestic electric bulb is marked 240 V, 100 W. Calculate:

(i) The maximum current it can take

(ii) The resistance of the filament of the bulb

(b) If the bulb in (a) above is switched on for 8 hours, find the total amount of energy dissipated in the filament

Question 68: (a) The heating coil of an aluminium electric kettle is labeled 240 V, 4 kW. Water of mass 3 kg at a temperature of 25 ^{0}C is poured into the kettle. If the kettle is connected to a 240 V supply when its temperature is 25 ^{0}C, calculate the time taken for the water to reach its boiling point

(b) In what further time will 10% of the water in the kettle evaporates away? (Mass of kettle = 0.5 kg, specific heat capacity of aluminium = 900 $Jkg^{-1}K^{-1}$, Specific latent heat of vaporization of water = 2.268×10^6 $Jkg^{-1}K^{-1}$)

Question 69: If electrical energy is charged at the rate of Tsh 100 per kilowatt – hour, calculate the cost of using:

(a) A 60 W light bulb for 8 hours

(b) A 1 kW electric iron for 1.5 hours

(c) A 6000 W electric cooker for 2 hours

Question 70: An electric iron consumes 2.592 MJ of energy in 1 hour when connected to the mains power supply of 240 V. Calculate the current through the filament in the electric iron. (Ans: I = 3 A)

Question 71: (a) State the properties and functions of a fuse.

(b) How does a fuse in the lighting circuit differ from that used in the heating or power circuit?

Question 72: (a) What is the importance of using a fuse in an electrical appliance?

(b) A refrigerator is marked 250 V, 400 W. Calculate the maximum current that can flow through it?

(c) Discuss what might happen to the refrigerator if it is connected to:

(i) A 230 V supply

(ii) A 110 V supply

Question 73: (a) State and explain the causes of electrical short – circuit.

(b) Explain briefly why cables in a lighting circuit are different from those in a power circuit

(c) Fuse wires are labeled 2 A, 3 A, 5 A ,13 A and 14 A. Which of these is most suitable for?

(i) A 220 V, 2.8 kW electric iron

(ii) A 240 V, 400 kW refrigerator

(iii) A 220 V, 3 kW water heater

Question 74: (a) State the defects of a simple cell and explain how these defects may be minimized?

(b) What is the difference between a dry and a wet Leclanche Cell?

(c) Explain why a Leclanche cell is not suitable for use as a continuous sources of energy.

Question 75: State four household electrical appliances where electrical energy is converted into heat

Question 76: A washing machine is marked 240 V, 3kW. What does this mean? Hence calculate the electrical energy used up by this machine in 1 hour

Question 77: Calculate the (a) current through (b) resistance of the filament of

(a) A bulb rated at 240 V, 60W

(b) An electrical kettle rated at 2 KW, 240 V

Question 78: The filament of the bulb is made of tungsten and the bulb contains a mixture of argon and nitrogen at low pressure

(a) What is the purpose of the presence of the gases inside the bulb?

(b) Why is tungsten a suitable material for the filament?

Question 79: Electrical heaters are said to be environmentally friendlier than the heating devices which use firewood or charcoal. Explain this statement

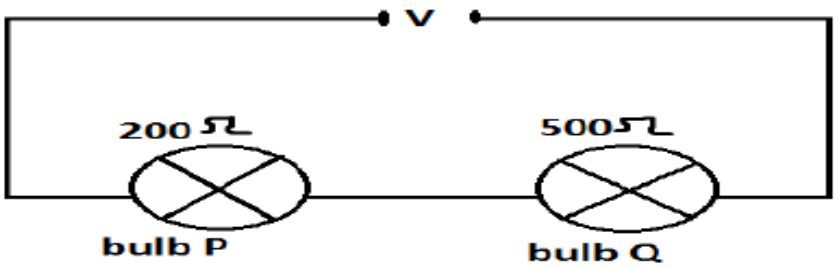
Question 80: Starting from electrical work done W = ItV, show that electrical power (P) generated in a conductor is given by V^2/R, where the symbols have the usual meaning

Question 81: Three cells each of e.m.f 1.5V and internal resistance 0.6 Ω *joined* in series to form a battery and connected across a 0.5 Ω resistor. Calculate:

(a) The current

(b) The P.d between the terminals of the cell

Question 82: Which bulb in the figure below is the brightest? Explain your answer



Question 83: (a) State Ohm's law and state two of its limitations

(b) Determine the internal resistance of a cell and the value of R given that the p.d of the cell in open circuit is 1.5 V, when connected to a 10 Ω resistor its p.d becomes 1.0 V, but when connected to a resistor of R Ω the p.d falls to 0.5 V
(Ans: r = 5 Ω, R = 2.5 Ω)

Question 84: The power rating of an electric bulb is '60 W, 240 V'

(a) Calculate the current through the filament and the resistance of the filament
(Ans: R = 960 Ω, I = 0.25 A)

(b) By comparison with the answers to (a) above determine the current and the resistance of the filament of a '120 W, 240 V' bulb. Explain your answer
(Ans: I = 0.5 A, R = 480 Ω, $\boldsymbol{I} \propto \frac{1}{R}$)

Question 85: An electric bulb is labeled '40 W, 240 V'. Calculate:

(a) The resistance of the filament used I the bulb (Ans: R = 1 440 Ω)

(b) The current through the filament when the bulb works normally (I = 0.167 A)

Question 86: A 3 kW immersion heater is used to heat water. Calculate the electrical energy converted into heat energy in 40 minutes (Ans: E.E = 7.2 MJ)

Question 87: A current of 2 A is passed through a resistor of 20 ohms for 1.0 hour. Calculate the electrical energy converted into heat energy in the resistor (Ans: E.E = 2.88×10^5 J)

Question 88: Why does a bird safely porch on a high potential electric wire? (Ans: When a bird is perched on a single wire, its two feet are at the same electrical potential, so the electrons in the wires have no motivation to travel through the bird's body)

Question 89: A torch bulb is labeled 2.5 V, 0.3 A. Calculate the power of the bulb (Ans: P = 0.75 W)

Question 90: What is the terminal p.d for a cell of e.m.f 2 V and internal resistance 1 ohm when it is connected to a 9 ohm resistor?

Question 91: (a) Explain the terms Live, Neutral and Earth as applied in domestic electrical appliances

(b) What is the color codes used at present in domestic electrical appliances?

(c) An electric stove is rated 1000 W, 250 V. Electricity is charged at Tshs. 45/= per kilowatt – hour, and the stove is used for 30 minutes per day

(i) How much will the cost be in the month of January?

(ii) What is the maximum current that flows through the element without destroying it?

Question 92: When two resistors are connected in series the total resistance is 25 ohm. If they are connected in parallel the total resistance is 6 ohm. Find the resistance of each (Ans: 15 ohm and 10 ohm)

Question 93: The e.m.f of a cell is 12 V and its internal resistance is 2 ohm. Find the current and the terminal potential difference across the cell if it is connected to 4 ohm external resistor

Question 94: Briefly explain what the fuse is?

Question 95: Select the best fuse for the following

(a) A refrigerator rated 250 V, 400 W (Ans: I = 1.6A, the best is 2 A)

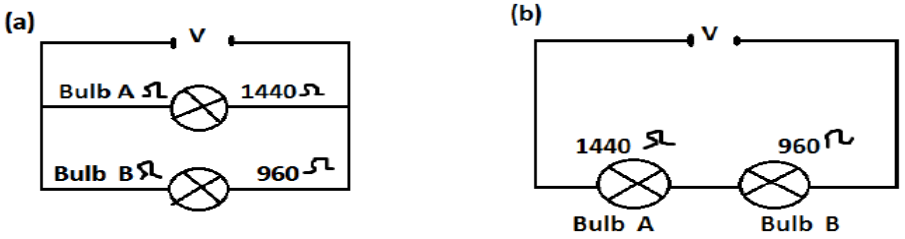
(b) The electric cooker rated 240 V, 7.2kW (Ans: I = 30 A, the best is 30A)

(c) The electric iron rated 240V, 2 kW (ANS: I = 8.3A, the best is10 A)

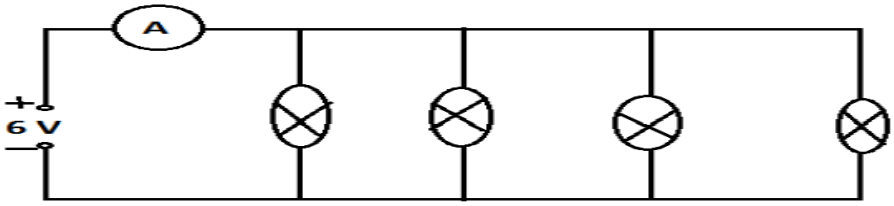
Question 96: The rating of a bulb is 60 W, 240 V. Due to a power outage the voltage drops down to 200 V. Find the new power of the bulb. What would you notice in the bulb?

Question 97: The ratings of an iron is 1200 W, 240 V. Find the current and the energy used up in an hour

Question 98: In the two circuits (a) and (b) shown in the figure below which bulb, A or B is brighter? (Ans: From P $=V^2R = I^2R$, in parallel V is the same while in series I is the same. This gives that in fig (a) Bulb B has more power so it is brighter but in fig (b) Bulb A has more power than B so it is brighter than B)

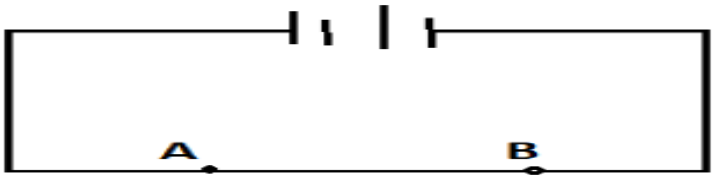


Question 99: In the circuit shown below each bulb is rated at '6 V, 3 W'



(a) Calculate the current through each bulb, when the bulbs are working normally
(b) How many coulombs of charge pass in 6 seconds through each bulb?
(c) What would the ammeter read when all the bulbs are working normally
(d) Calculate the electrical power delivered by the battery

Question 100: Two cells each of 1.5 V are used to drive a current through a wire AB of resistance 90 ohms (see the figure below)



(a) Calculate the current in the circuit
(b) What would be the difference, if any, to the current if the two cells are connected in parallel?

Question 101: A carbon resistor has a value of 20 mega ohms ± 5%. What is the color code for this resistor?

Question 102: A carbon resistor's ABC bands represent yellow, blue and brown colors respectively. Determine the (a) resistance (b) Conductance

Question 103: The p.d across the terminals of a cell is a 1.5 V where there is no current in the cell. Where is a current of 0.50 A in the circuit the p.d falls to 1.3 V
(a) What is the e.m.f of the cell?
(b) What is the terminal voltage at the cell?
(c) Calculate the internal resistance of the cell

Question 104: Explain the term internal resistance of a cell. How does it arise?

Question 105: The e.m.f of a cell is given by the expression E = I(R + r). Explain the meaning of each term in the expression

Topic number	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
Questions	47	51	78	55	78	17	66	30	105
Grand total	**527**								

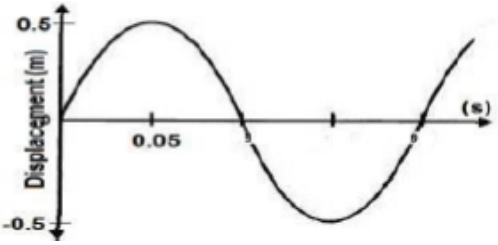
PHYSICS

QUESTIONS FOR DISCUSSION

FORM FOUR 2022

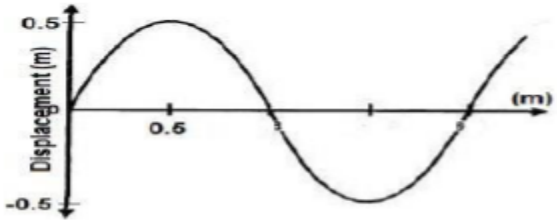
TOPIC 01: WAVES

Question 01: From the diagram below determine the amplitude, period and frequency of the wave

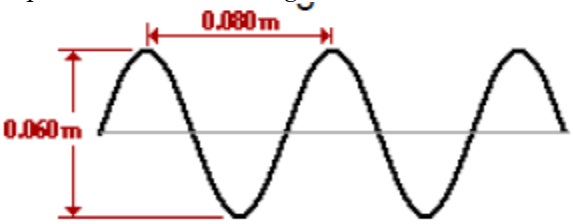


Ans: Amplitude, A = 0.5m Period, T = 0.2 Frequency = 5Hz

***Question 02*:** From the diagram below determine the wavelength, velocity of the wave and frequency of the wave is 5Hz (Ans: V = 10m/s)



Question 03: What is the amplitude and wave length of the wave in the diagram below?



Ans: A = 0.03m, Wavelength = 0.08 m

Question 04: A periodic and repeating disturbance in a lake creates waves which emanate outward from its source to produce circular wave patterns. If the frequency of the source is 2.00 Hz and the wave speed is 5.00m/s then the distance between adjacent wave crests is ___ meter (Ans: Wavelength = 10 m)

Question 05: Calculate the wavelength of red light in air if the frequency of red light is 4.3×10^{14} Hz, C = 3.0×10^{8} m/s (Ans: 6.98×10^{-7}m)

Question 06: A pendulum makes exactly 40 vibrations in 20.0 s. Its period is (Ans: 0.5 s)

Question 07: If the frequency of a wave is doubled and if the speed remains constant, its wavelength is ___ (Ans: halved)

Question 08: A wave whose speed in a snake is 4.4 m/s enters a second snaky. The wavelength changes from 2.0 m to 3.0 m. The wave in the second snaky travels at approximately ____ (Ans: 6.6 m/s.)

Question 09: A 2.0-meter long rope is hanging vertically from the ceiling and attached to a vibrator. A single pulse is observed to travel to the end of the rope in 0.50 s. What frequency should be used by the vibrator to maintain three whole waves in the rope? (Ans: 6.0 Hz)

Question 10: Transverse stationary waves are set up in a long string using a suitable vibrator of frequency 60 Hz. The average distance between successive nodal points is measured to be 50 cm. Calculate the velocity of transverse waves in the string (Ans: V = 60 m/s)

Question 11: The distance between successive crests of water ripples in a ripple tank experiment is 3.2 cm and their wave speed is 26 cm/s. Determine the wavelength, frequency and period of the ripples (Ans: f = 8.125 Hz, λ = 3.2cm, T = 0.123 Hz)

Question 12: During the day sound from distant sources are not very clear unlike during the night. Why?
(Ans: During the day sound waves are refracted upwards from the hot earth, while at night, sound waves are refracted downwards, hence are much louder)

Question 13: Give reason why the amplitude of the wave does not change as it crosses the boundary
(Ans: Because there is no loss of energy therefore amplitude does not change)

Question 14: A gun was fired and the echo from a cliff was heard 8s later. How far was the gun from the cliff? (Ans: d = 1400m)

Question 15: (a) Define an echo
(b) Name any two factors that affect the speed of sound in air
(c) Explain briefly why sound produced in hall with many people is heard more clearly than when the hall has few people? (Ans: When a hall has many people, most of the sound (including echoes) is absorbed by clothes and skins of the audience, thus echoes do not occur)
(d) A person standing 99m from the foot of mountains claps his hands and hears an echo 0.6 second later. Calculate the speed of the sound in the air (Ans: V = 330m/s)

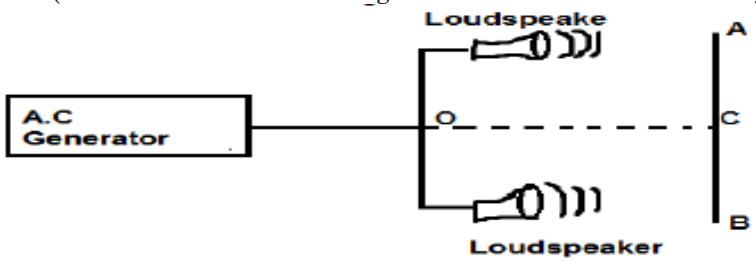
Question 16: It is possible to hear sound round obstacles but not possible to see light. Give reason

Question 17: Two sets of transverse waves arrive at the same time. Under what conditions do they?
(a) Cancel out (Ans: trough from one arrive at the same time as crest from the other)
(b) Produce a larger wave (Ans: A crest from one arrive at the same time as a crest from the other (constructive interference))

Question 18: A fathometer produces sound in a ship and receives two echoes where there is a raised sea bed one after 2.5 seconds and the other after 3.0 seconds. Find the height of the raised sea bed (Take V in water = 1460 m/s). (Ans: $h_1 - h_2 = 365$ m)

Question 19: A girl standing 200 m from the foot of a high wall claps her hands and the echo reaches her 1.16 seconds later. Calculate the velocity of sound in air using this observation (Ans: V = 344.8 m/s)

Question 20: From the figure below, give reason why, an observer moving along the line AB hears loud sound at same point and soft sound at other points. How is the sound along the line OC? (Ans: When he moves along line OC hears loud sound only)



Question 21: A person stands 100 m from the foot of a tall building clap his hands and hears an echo 0.588 seconds later. Calculate the velocity of sound in air (Ans: 340 m/s)

Question 22: The velocity of sound in air is 330 m/s; Find the wavelength in water of sound wave of frequency 660 Hz if the velocity of sound in water is 1. 32 km/s

Question 23: A source of sound produces waves of wavelength 0.8 m in air. The same source of sound produces waves of wavelength 4.0 m in air. If the velocity of sound in air is 332 ms^{-1}, find the velocity of sound in water (Ans: V = 332 m/s)

Question 24: How far does sound travel in air when a turning fork of frequency 250 Hz completes 50 vibrations? The speed of sound in air is 340 m/s. (Ans: $\boldsymbol{\lambda}$**=1.36** $\boldsymbol{m}$)

Question 25: A bat emits ultrasonic sound of frequency 100 kHz in air. If this sound meets a water surface, what is the wavelength of (i) the reflected sound (ii) the transmitted sound? If the speed of sound in air = 340m m/s and in water = 1486 m/s (Ans: (i) $\boldsymbol{\lambda}$ **= 3.4** x 10^{-3} m (ii) $\boldsymbol{\lambda}$= 1.486 x 10^{-3} m)

Question 26: If the frequency of radio waves is 600 kHz find the wavelength of the waves. The speed of radio waves = 3 x 10^8 m/s. (Ans: $\boldsymbol{\lambda}$=**500** $\boldsymbol{m}$)

***Question 27*:** A stone is dropped into a well 19.6 m deep and the impact of sound is heard after 2.056 seconds. Find the velocity of sound in air (Ans: V = 350 m/s)

Question 28: A personal with deep voice singing a note of frequency 200Hz is producing sound waves whose velocity is 330m/s; find the sound's wave length. (Ans: λ = 1.65m)

Question 29: A hospital uses an ultrasonic scanner to locate tumours in a tissue. What is the wavelength of sound in a tissue in which the speed of sound is 1.7 kms^{-1}? The operating frequency of the scanner is 4.2 MHz. (Ans: $\boldsymbol{\lambda}$ = **0.405** $\boldsymbol{m}$)

Question 30: Calculate the velocity of the wave whose wavelength is 1. 7 x10-2m and frequency 2x10^{14}Hz (Ans: 3.4 1x10^{12} m/s)

Question 31: Find the wavelength of sound wave whose frequency is 550Hz and speed is 330m/s (Ans: The wavelength is 0. 6m) NB: The higher the frequency of a wave, the shorter the wavelength and the lower is the frequency on the wave, the longer is the wavelength.

Question 32: The radio waves have a velocity of about 3.0 x108m/s and the wavelength of 1500m. Calculate the frequency of these waves? (Ans: f = 2. 0 x 10^5 Hz)

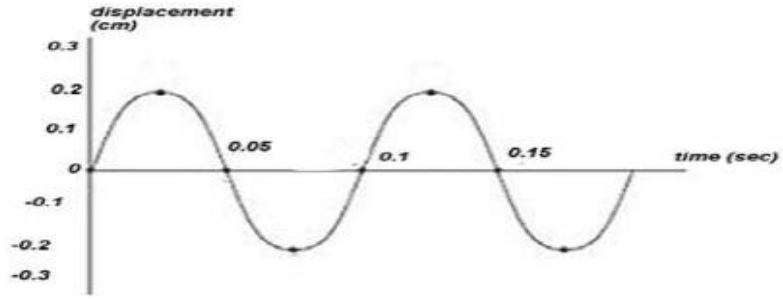
Question 33: Consider the figure below illustrates part of a wave traveling across the water at a particular place, Calculate;

(a) The frequency of the wave (Ans: f = 10 Hz)

(b) The wavelength of the wave (Ans: $\boldsymbol{\lambda}$ = 0.1 m)

(c) The amplitude of the wave (Ans: A = 0.2 m)

(d) The velocity (Ans: V = 2m/s)



Question 34: The wavelength of signals from a radio transmitter is 1500m and the frequency is the 200 KHz. To what speed does the radio wave travel? What is the wavelength of a transmitter operating at 1000 KHz**?** (Ans: V = 3 x 10^8 m/s, $\boldsymbol{\lambda}$ = 3. 0 x 10^2 m)

Question 35: A certain wave has a periodic time of 0.04 second and travels at 30 x 107 m/s find its wavelength. (Ans: $\boldsymbol{\lambda}$ = 1.2 x 10^7 m)

Question 36: A signal is sent to the seabed from the bottom of a ship. The signal comes back in one – fifth of a second .How deep is the water?

Question 37: The commercial Programme of radio Tanzania is broadcast on wavelengths of 1500m and 247 m. The frequency of the 1500 m wave is 200 kHz. What is?

(a) The velocity of the wave

(b) The frequency of the 247 m wave

Question 38: Sound travels 1.7 Km in 5 seconds. The time between a flash of lightning and the thunder is 10 s. How far away is the storm?

***Question 39*:** Explain how bats can fly in the dark without hitting anything

(For question 40 – 72; use acceleration due to gravity, g = 10 m/s² where necessary)

Question 40: A string has a length of 75cm and a mass of 8.2g, the tension in the string is 18N. Calculate the 1st harmonic and 3rd harmonic (Ans: f_1 = 27Hz, f_3 = 81Hz)

Question 41: A string of length 1 m and mass 5 x 10^{-4} kg fixed at both ends is under a tension of 20 N. It is plucked at a point situated 25 cm from one end. What would be the frequency of vibrations of the string? (Ans: f = 200 Hz)

Question 42: A wire of length 140 cm and mass 0.52 x 10^{-3} kg is stretched by means of a load of 16 kg. Calculate the frequency of the fundamental note (Ans: f = 234 Hz)

Question 43: The vibration length of a stretched wire is altered at constant tension until the wire oscillates in unison with a turning fork of frequency 320 Hz. The length of a wire is again altered until it oscillates in unison with a fork of unknown frequency. If the two lengths are 90 cm and 65.5 cm, respectively, determine the unknown frequency (Ans: f_2 = 440 Hz)

Question 44: The length of a sonometer wire between two fixed ends is 110 cm. Where the two bridges should be placed so as to divide the wire into three segments whose fundamental frequencies are in the ratio 1:2:3?
(Ans: From: $f \propto 1/l$; $f_1L_1 = f_2L_2 = f_3L_3$, Thus L_1=60 cm, L_2 =30 cm and L_3 = 20 cm)

Question 45: A 90 cm long wire of a sitar has a fundamental frequency of 256Hz. At what distance from the upper end should the wire be compressed so that a note of frequency 384 Hz is produced? (Ans: L = 30 cm)

Question 46: A nylon string is stretched between supports 1.2 m apart. Given that the speed of sound in the string is 800 ms^{-1}, find the frequency of the fundamental vibration and the first two overtones (Ans: f_0 =333 Hz, f_1 = 666 Hz and f_3 = 1000 Hz)

Question 47: A Sonometer wire of length 40cm between two bridges produces a note of 512Hz when plucked at the midpoint. Calculate the length of the wire that would produce a note of 256Hz with the same tension (Ans: L_2 = 0.8m)

Question 48: A sonometer wire of length 40 cm between two bridges produces a note of 512 Hz when plucked at the midpoint. Calculate the length of the wire that would produce a note of 256 Hz with the same tension

Question 49: The frequency obtained in a plucked string is 500Hz when the tension is 3 N. Calculate:

(a) The frequency when the tension is increased to 10 N (Ans: f = 912.8 Hz)

(b) The tension needed to produce a note of frequency 800 Hz (Ans: T =7.7 N)

Question 50: A plucked string of length 30 cm has a mass per unit length of 0.5 kg/m. If the tension in the string is equal to 40 N, Find:

(a) The fundamental frequency (Ans: f_0 = 14.9 Hz)

(b) The first overtone frequency (Ans: f_1 = 29.8Hz)

(c) The second overtone frequency (Ans: f_2 = 44.7 Hz)

Question 51: A plucked wire of 10 m long and radius of 7mm has a density of 500 kg/m^3. Calculate:

(a) The fundamental frequency (Ans: f_0 = 0.5 Hz)

(b) The first overtone frequency needed to produce a tension of 8 N (Ans: f_1 = 1.0 Hz)

Question 52: A string has a length of 75cm and a mass 0f 8.2g. The tension in the string is 18N. Calculate the velocity of the sound wave in the string. (Ans: V = 40.5m/s)

Question 53: Given that the velocity of the sound wave emitted from a string is 50m/s the length of the string is 40cm and the mass of the string is 0.0004kg; calculate the tension of the string. (Ans: T = 2.5N)

Question 54: A sonometer wire of length 50cm vibrate with frequency 384 Hz. Calculate the length of the sonometer wire so that it vibrates with frequency of 512 Hz (Ans: 37.5 m)

Question 55: A sonometer wire of length 40cm between two bridges produces a note of frequency 512Hz when plucked at midpoint. Calculate the length of the wire that would produce a note of frequency 256Hz with the some tension (Ans: L = 80cm)

Question 56: The frequency obtained from a plucked string is 400Hz when the tension is 2 Newton. Calculate:

a) The frequency when the tension is increased to 8N (Ans: f = 800Hz)

b) The tension needs to produce a note of frequency 600Hz (Ans: T = 4.5N)

Question 57: Given that the frequency obtained from a plucked string is 800Hz when the tension is 8N. Calculate;

(a) The frequency when the tension is doubled (Ans: f = 1131. 2 Hz)

b) The tension required when the frequency is halved (Ans: T = 1.414 N)

***Question 58*:** Under constant tension the note produced by a plucked string is 300Hz when the length is 0.9m;

a) At what length is the frequency 200Hz? (Ans: $L_2 = 1.35m$)

b) What frequency is produce at 0.3m (Ans: f = 90Hz)

Question 59: A string fixed between two supports that are 60cm a part. The speed of a transverse wave in a string is 420m/s. Calculate the wavelength and the frequency for Fundamental note, Second overtone and Fifth overtone (Ans: $f_o = 350$ Hz, $\lambda = 1.2$ m, $f_3 = 1050$ Hz, $\lambda = 0.4$ m , $f_5 = 2100$ Hz, $\lambda = 0.2$m)

Question 60: A string is fixed two ends 50cm a part. The velocity of a wave in a string is 600 m/s. Calculate:

(a) The first five over tone (Ans: 1200Hz, 1800Hz, 2400Hz, 3000Hz, and 3600Hz).

(b) The tenth overtones (Ans: The tenth overtone is 6600Hz) (Note: In stationary wave a string does note compose up to ten overtones, though mathematically is possible. In real practical of the sonometer by using turning, is possible for the second and third overtone).

Question 61: Given that the refractive index of glass is 1.52. The wavelength of the radio waves in vacuum is 1.5×10^3m. Calculate the wavelength of the radio waves in glass. (Ans: λ = 986.8 m)

Question 62: A guitar wire fixed between two supports 60cm a part produced wave of frequency 500Hz. Calculate;

(a) The frequency of a wave when the length of the guitar wire is reduced to quarter (Ans: f = 2000Hz)

(b) The length of the guitar wire when the frequency of the wave produced is 2000Hz (Ans: L = 150m)

Question 63: A string A is 2m long and has a linear mass density of 9 g/cm^3. String B has a linear mass density of 18g/cm^3. If the tension in both strings is the same, how long must string B be for it to be raised to hear the next peak in intensity?

Question 64: What is the approximate distance of a thunderstorm when you note a 3 s delay between the flash of lighting and the sound of thunder? (Ans: d ≈ **1000 *m*** ≈ **1 *km***)

Question 65: How long does it take for a radio signal sent from the earth to reach the moon? The distance from the earth to the moon is 3.84×10^6 m

Question 66: During a storm, thunder is heard 7 s after the lightning is seen. If the temperature of the air is 28 ^{0}C, how far away is the storm ($C = 3 \times 10^8$ m/s)

Question 67: In a resonance tube experiment, the smallest value of L for which a peak in sound intensity occurs is 9.0 cm. How much must the tube be raised to hear the next peak in intensity?

Question 68: A helicopter is hovering at an altitude of 200 m above the surface of a lake. A speaker on the helicopter is sending out sound waves which are reflected from both the surface of the water and the bottom of the lake. If the difference in arrival times of the two echoes is measured to be 0.24 s, what is the depth of the lake? (The atmospheric temperature is 20 ^{0}C) (Ans: h ≈ **700 *m***)

Question 69: Matter expands when heated and contracts when cooled. Explain why a musician must re – tune a stringed instrument if its temperature changes

Question 70: Explain why it is not advisable for soldiers to march across a bridge in rhythm.

Question 71: Guitars have strings of varying thickness. Which of the strings (thickest or thinnest) produces the highest frequency of musical notes? Explain your answer.

Question 72: A loud sound is made and the echo from a distant cliff is heard 8 s later. If the atmospheric temperature is 22 ^{0}C, how far away is the cliff?

Question 73: A turning fork of frequency 512 Hz is sounded at the mouth of a tube closed at one end with a movable piston. It is found that resonance occurs when the column of air is 18cm long and again when the column is 51cm long. Find wave length and velocity of sound in air (Ans: $\boldsymbol{\lambda} = 0.66$m and $V_A = 338$m/s)

Question 74: In a closed pipe, the first resonance is at 23cm and second at 73cm. Determine the wave length of the sound and the end correction of pipe (Ans: $\boldsymbol{\lambda}$= 1.0 m, c = 0.002 m)

Question 75: A resonance tube produces a loud sound for the first time when the length of the air column is 17 cm and a loud sound at the second time when the length of the air

column is 51 cm. The turning fork frequency used is 500 Hz. Determine the speed of the air in the tube (Ans: V = 340 m/s)

Question 76: The first resonance in the tube of resonance occurs when the length of the air column is 20 cm. What are the lengths of air column in the second resonance and third resonance respectively (Ans: 60 cm and 100 cm respectively)

Question 77: (a) Identify three characteristics of sound which distinguish one note from another. Hence state the physical factors which correspondingly define the mentioned characteristics (Ans: Frequency, Loudness (amplitude) and Quality of music note (Timbre))

(b) A resonance tube whose one end is closed and other open, resonance to a note of frequency 560Hz when the length of the air column is 15cm; determine the wave length of this sound in air. What is the shortest length of the air column which resonates in similar conditions to a note of frequency 1000 Hz (Ans: $L_2 = 0.0504$m)

Question 78: A turning for**ns**k of frequency 250Hz is used to produce resonance in an opened pipe; Given that the velocity of sound in air is 350m/s. Find the length of tube which gives (a) First resonance (b) Third resonance (Ans: L = 1.4m)

Question 79: The length of a closed pipe is 160mm. Calculate the wavelength and the frequency of (i) The first overtone (ii) The third harmonic (Ans: $\lambda = 0.213$, $f_2 \approx 1500$Hz, $f_3 = 2500$Hz)

Question 80: A pipe closed at one end has a length of 100 cm. If the velocity of sound in air of the pipe is 340m/s; calculate the frequency of:

(a) The fundamental ($f_0 = 85$ Hz)

(b) The first overtone ($f_1 = 255$ Hz)

Question 81: The speed of sound waves in air is found to be 340m/s. Find;

(a) The fundamental frequency

(b) The frequency of the 3rd harmonic

(c) The frequency of 9th harmonic

(d) The frequency of 51st harmonic

Given that the sound waves are probating in a closed pipe of length 700m.

(Ans: $f_0 = 121.5$Hz, $f_3 = 850.5$ Hz, $f_9 = 2308.5$ Hz, $f_{51} = 12514.5$ Hz)

Question 82: In a closed pipe, the first resonance is at 23 cm and second at 73 cm. Determine the wavelength of the sound and the end correction of the pipe. (Ans: $\boldsymbol{\lambda}$**=1** $\boldsymbol{m}$, $\boldsymbol{c}$ **= 2** $\boldsymbol{cm}$)

Question 83: A pipe closed at one end has a length of 10cm. If the velocity of sound in the air of the pipe is 340m/s; calculate the frequency of:

(a) The fundamental

(b) 1st overtone

(Ans: $f_0 = 850$ Hz, $f_1 = 2550$ Hz)

Question 84: A pipe closed at one and has a length of 2.46m. Find the frequency of the fundamental and the first two overtones. Take 343m/s as the speed of sound in air. (Ans: $f_0 = 34.85$Hz, $f_1 = 104.55$ Hz, $f_2 = 174.25$ Hz)

Question 85: When a tuning fork of 512Hz is sounded at the top of the measuring cylinder which contains water, the first resonances are observed when the length of the air column (the distance from the mouth to the level of the water is 50 cm) and the second resonance is observed when the length of the air column (the distance from the mouth to the level of water) is 80 cm; using these observations. Calculate the velocity of water in air (Ans: V = 307.2m/s)

Question 86: A 256Hz turning fork produces sound at the same time with a 249Hz turning fork. What is the beat frequency? (Ans: $B_f = 7$Hz)

Question 87: What is the beat frequency when a 262 Hz and 266 Hz turning forks are sounded together? (Ans: $B_f = 4$ Hz)

Question 88: (a) Explain why radio waves are similar to light waves but not sound waves

(b) A radio station transmits a signal of wave 1500m. Calculate the frequency of this signal (Ans: $f = 200$ kHz)

Question 89: Light of frequency 4.6×10^{14}Hz travels at a speed of 1.24×10^{8}ms^{-1} in diamond. Calculate the refractive index of diamond for this color of light. (Ans: $\boldsymbol{\mu} = 2.42$)

Question 90: (a) What is diffraction of wave?

(b) Illustrate how plane water wave fronts are diffracted on passing through a narrow gap

(c) (i) Is it possible for light to be diffracted on passing through an open window?
(ii) Give an explanation on your answer above

Question 91: (a) What is the fundamental frequency of a vibrating string?

(b) Sonometer consists of a taut steel wire fixed between two bridges 100cm apart. Defining the first harmonic, second harmonic, third harmonic and fourth harmonic, explain how overtones can be obtained

Question 92: How an echo differs from the reverberation?

Ans:

- Echo occurs when long distances are considered ***while*** reverberation is when short distances are considered.
- Echo is due to the reflection of sound wave by obstacles or end points like wall etc. **But** Reverberation is due to the collection of reflection sounds from the surface which is enclosed completely

Question 93: Sound travelling towards a cliff 700m away takes 4.2 seconds for an echo to be heard. Calculate the velocity of sound in air. (Ans: V_a = 333.33m/s)

Question 94: A boy standing 100m from the foot of a high wall claps his hands and the echo reaches him 0.5 second later. Calculate the velocity of sound in air using this observation. (Ans: V in air is 400m/s)

Question 95: A student standing between two vertical walls and 480m from the nearest wall, shouted. She heard the first echo after 3 seconds and the second after two second later use this information to calculate;

(a) Velocity of sound in air (Ans: V_a =320m/s)
(b) Distance between the two walls.(Ans: d =1280m)

Question 96: An old woman sitting in a gorge between two large cliffs gives a short sharp sound. She hears two echo, the first after 1 second and the next after 1.5sec. The speed of sound is 340m/s what is the distance between the two cliffs? (Ans: d = 425 m)

Question 97: A sonar signal (a high frequency sound wave) sent vertically downwards from the ship is refracted from the ocean floor and detected by a microphone on the keel 0.4 sec after transmission; if the speed of sound in water is 1550m/s. What is the depth of the ocean in meters? (Ans: The depth of the ocean is 300m)

Question 98: A man sees steam coming out from a factory whistle and 3 seconds later he hears the sound. The velocity of sound in air is 360m/s. Calculate the distance from the man to the factory. (Ans: d = 1080m)

Question 99: (a) (i) Distinguish between longitudinal wave and transverse wave.
(ii) Explain how beats are formed

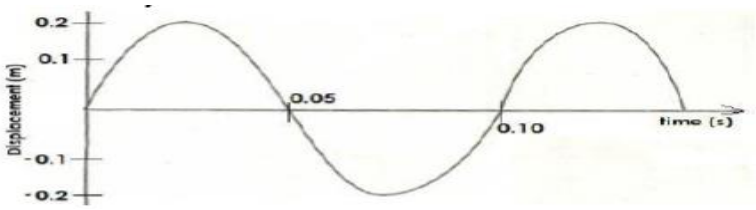
(b) A light wave is refracted into an optically dense medium. What change will occurs in
(i) The frequency?
(ii) The speed?
(iii) The wavelength?

(c) (i) What is an echo
(ii) A sound is sent out from the ship and its reflection from the ocean floor returns one second later. Assuming that the velocity of sound in water is 1500m/s, how deep is the ocean? (Ans: d = 750m)

Question 100: (a) (i) What is a sonometer?
(ii) Briefly explain when resonance is said to occur.

(b) Two boys are stand 200m apart on one side of a high vertical cliff at the same perpendicular distance from it. When one fires a gun, the other hears the sound 0.65 seconds after the flash and the second sound 0.25 second after the first sound. Calculate the perpendicular distance of the boys from the cliff (Ans: d = 84.27m)

(c) A diagram below illustrates part of the displacement-time graph of a wave travel with velocity of 2m/s.



Calculate:

(i) The amplitude (ii) Frequency (iii) Wave length (Ans: (i). A = 0.2m (ii) f = 10Hz (iii). λ = 0.2m)

Question 101: Which of the following has the shortest wavelength?

(i) Radio waves (ii) X – rays (iii) Red light

Question 102: A column of air 26.25 cm long in a closed tube resonates to a sounding tuning fork; if the velocity of sound in air is 33 600 cm/s what is the frequency of the fork? (Ans: f = 320 Hz)

Question 103: If the shortest length of the tube for resonance is 0.12 m and the next resonant length is 0.37 m, what is the frequency of vibrations? Take the speed of sound in air as 340 m/s. (Ans: f = 680 Hz)

Question 104: Explain the following

(a) Strings of different thickness are used on a stringed instrument such as a violin or a guitar

(b) The same note played on a violin and a flute sound different

(c) The strings of a stringed instrument are usually mounted on a hollow box of special shape

(d) Matter expands when heated and contracts when cooled. Explain why a musician must retune a stringed instrument if its temperature changes

(e) How does the size of the gap in the barrier affect the diffraction of waves?

Question 105: The commercial program of Radio Annur is broadcast on wavelengths of 1500 m and 250 m. The frequency of the 1500 m wave is 200 kHz; what is the frequency of 250 m wave?

Question 106: Explain briefly how the concept of wave is applied in each of the following fields:

(i) Medicine (ii) Communication (iii) Scientific research

Question 107: A light wave is refracted into an optical less dense medium. What change will occur in (i) The frequency? (ii) The speed? (iii) The Wavelength?

Question 108: A solid is sent out from the ship and its reflection from the floor of the ocean returns half a second later. Assuming that the velocity of sound in water is 1500 m/s, how deep is the ocean?

Question 109: Gamma rays bursters are objects in the universe that emit pulses of gamma rays with high energies. The frequency of the most energetic burst has been measured at around $3.x\ 10^{21}$ Hz.

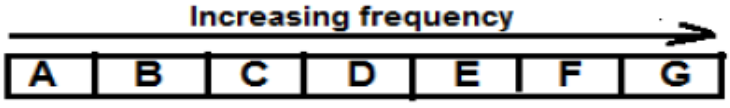
(a) What is the wavelength of these gamma rays? (Ans: $\boldsymbol{\lambda} = 1.0 \times 10^{-13}$ m)

(b) What could be their period? (Ans: $T = 3.33 \times 10^{-22}$ s)

Question 110: Differentiate between ultrasonic and infrasonic vibrations

Question 111: FM radio station broadcasts electromagnetic waves at a frequency of 150 MHz. The radio waves have a wavelength of 2.0 m. Calculate the speed of the radio waves (Ans: $V = 3 \times 10^8$ m/s)

Question 112: The diagram below shows the electromagnetic spectrum. Region D represents visible light



(a) Which region contains radiation produced in nuclear reactors?

(b) Which region represents radiation capable of promoting the production of vitamin D in the skin?

(c) Which region is contains radiation used in radar system?

Question 113: Explain why a duck remains floating at the same place as wave passes by the water in a lake

Question 114: Two similar sonometer wires of the same material produces 2 beats per second; the length of one is 50 cm and that of the other is 50.1 cm. Calculate the frequencies of the two wires (Ans: From: $\boldsymbol{f \propto 1/L}$. f_1 =1002 Hz, f_2 = 1000 Hz)

Question 115: Explain why it is not advisable for soldiers to march across a bridge in rhythm

Question 116: A note of 100 vibrations per second is reflected back to an observer from a wall 34 meters away in 0.2 seconds. Calculate the speed of sound and the wavelength of tone

Question 117: A note of frequency 100 is sounding. What is the frequency of a note (a) one octave higher (b) two octave higher?

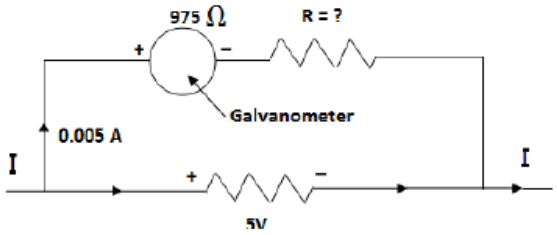
Question 01: A moving coil galvanometer has a coil of resistance 25 Ω and can carry a maximum of 15mA.

(a) What is the value of the shunt required to enable the galvanometer to register 10A full scale deflection. (Ans: $R_S = 0.03\Omega$)

(b) What is the value of the multiplier required to enable the galvanometer to register 10V full scale deflection. How will be connected? ($R_m = 646.67\Omega$)

Question 02: A moving Will galvanometer has a resistance of 20 Ω and gives a full scale deflection when a current of 50mA passes through it. Calculate the value of the resistance which must be used so that the meter may measure the potential difference up to 100V. (Ans: A multiplier of resistance 1980 Ω must be connected in series with the galvanometer so that the meter may measure up to 100V)

Question 03: A moving coil galvanometer which gives a full scale deflection of 0.005A is converted to a voltmeter reading up to 5V using an external 975 Ω, what is the resistance of the galvanometer (Ans: $R_G = 25\ \Omega$)



Question 04: A galvanometer has a resistance of 50mA passes through it. Calculate the value of the resistance which must be used so that the meter may measure the current up to 2A (Ans: A shunt of 0.5128 Ω must be connected to the galvanometer to give a reading of 2A)

Question 05: A galvanometer coil has a resistance of 40 Ω and the full scale deflection current 15mA. If it is to be converted so that it gives a full scale deflection current 1. 5A, then the required shunt will have a resistance of what size? (Ans: $R_s = 0.1\ \Omega$)

Question 06: In the electric bell, explain what would happen if the armature is made of steel.
(Ans: If the armature is made of steel the hammer hits the gong and remains there/ the bell rings once this is because steel acquires permanent magnetism)

Question 07: Why is the core of the electromagnet of an electric bell made of soft iron and not steel?
(Ans: Because iron gains and looses magnetisms easily; it is only magnetized if there is a magnetic field around it and losses its magnetism immediately when the field is removed. It also requires very little energy to magnetize and demagnetize
Reasons for steel:
(i) Steel forms a permanent magnet
(ii) Steel is not easily magnetized and demagnetized)

Question 08: (a) The resistance of a length of power transmitting cables is 10 Ω and is used to transmit 11 kV at a current of 1.0A. Determine the power loss (Ans: P = 10 W)

(b) If this voltage is stepped up to a 160 kV by a transformer, determine the power loss (Assume the transformer is 100% efficient) (Ans: P = 0.048 W)

(c) By what factor is the power loss reduced when the power is transmitted at 16 kV as opposed to 11 kV (Ans: Power factor = $\frac{\text{Real power}}{\text{Apparent power}} = \frac{10}{0.048} = 208.33$ times)

Question 09: A transformer is used to step down 240V mains supply to 12V for laboratory use. If the primary coil has 600 turns, determine the number of turns in the secondary coil (Ans: $N_s = 30$ turns)

Question 10: A current of 0.6A is passed through a step up transformer with a primary coil of 200 turns. A current of 0.1A is obtained in the secondary coil. Determine the number of turns in the secondary coil and the voltage across if the primary coil is connected to 240V mains. (Ans: $N_s = 1200$ turns, $V_s = 1440$V)

Question 11: A step up transformer has 10000 turns in the secondary coil and 100 turns through the primary coil. An a.c of 5A flow in the primary coil when connected to a 12V a.c supply, Calculate:

(a) The voltage across secondary coil (Ans: $V_s = 1200V$)

(b) Current in secondary coil if transformer efficiency is 90% (Ans: $I_s = 0.045A$)

Question 12: With a secondary transformer output of 1,320 watts and a primary input of 1,800 watts, calculate the efficiency of the transformer. (Ans: 73.33 %)

Question 13: How does a transformer work?

Ans:

Transformer consists of two coils. If one coil is connected with a.c voltage source then it will produce alternating flux in the core. Most of the flux is linked with second coil hence mutually induced e.m.f will be produced in the second coil as per faraday's law of electromagnetic induction.

Question 14: Can d.c be applied to transformers?

Ans: No

Because: Transformer works on Faraday's law of Electromagnetic Induction for which current in coil must change. If d.c is applied current will not change and transformer will not work. Practically winding resistance is very small. For d.c, inductive reactance is zero and frequency is zero. Therefore impedance is low. Thus winding draws more current which may damage the winding.

Question 15: What is the difference in energy transformation between a d.c motor and a d.c generator?

Question 16: State five ways by which the electric motor can be made to rotate faster (Ans: - (i) By increasing the current flowing through the coils (ii) By using stronger magnets (iii) By using many number of turns of the wire (iv) By increasing the area of the coil in the magnetic field (v) By using many coils with more split ring parts in many planes

Question 17: What is the main structural difference between the d.c generator and the a.c generator? (Ans: In the d.c generator a **split ring** (commutator) is used while in an a.c generator a set of **slip rings** are used)

Question 18: A power line from a power substation to a town some distance away has a resistance of 0.4 Ω per kilometer. Determine the current flowing through the power lines if the rate of energy loss in the transmission of power over 100 km is 100,000 W (Ans: P = 50 A)

Question 19: What is meant by the national grid system?

Question 20: What is the advantage of having a national grid in power transmission?

Question 21: Why is the electricity transmitted at very high voltage and low current?

Question 22: During the transmission of electricity over long distances, an alternating current is passed over aluminium cables at high voltages and low current.

(a) Why is alternating current (a.c) used in preference to direct current (d.c)?

(Ans: (i) Alternating current can be easily stepped up and down since transformers work only on a.c not on d.c

(ii) Direct current requires thick overhead cables which will be expensive to buy and support)

(b) Why is aluminium cables preferred to copper for long distance transmission of electricity?

(Ans: (i) Aluminium has lower density than copper. (It is lighter than copper, therefore easy to support. Use of copper wires will require very strong poles to support since copper wires are fairly heavy)

(ii) Aluminium is a better conductor of electricity than copper

(iii) Aluminium does not corrode easily unlike copper)

Question 23: A transformer is used to step down 120V mains to 24volts for kitchen use. If the primary coil has 400 turns, find the number of turns is the secondary coil (Ans: n = 80)

Question 24: Explain why soft iron is better material to be used for the core than steel?

Question 25: A step up transformer has 5000 turns in the secondary coil and 500turns through the primary coil. An alternative current of 5A flows in the primary coil when connected to a 12V a.c supply.

(a) Calculate the voltage across the secondary coil. (Ans: $V_s = 120V$)

(b) If the transformer has an efficiency of 90% what is the current in the secondary coil? (I_s = 0.45A)

Question 26: A step down transformer is used to light a 12V, 24W lamp from 240 volts mains. The current through the primary coil is 125mA. What is the efficiency of the transformer? (Ans: Eff = 80%)

Question 27: A transformer is used to step down 24V mains supplier to 12V for laboratory use, if the primary coil has 600turns. Find the number of turns in the secondary coil. (Ans: N_s = 30 N)

Question 28: A current of 0.6A is passed through a step up transformer with a primary coil of 200 turns. A current of 0.1 A is obtained in the secondary coil. Find the number of turns in the secondary coil and the voltage across if the primary coil is connected to 240V mains (Ans: N_s = 33 N, V_s = 39.6V)

Question 29: The figure below shows a step – down transformer connected to a 240 V mains socket. The primary coil P, has 4000 turns while the secondary coil, S, has 200 turns. The efficiency of the transformer is 60% and a current of 50 A flows through P. Calculate the current through S

Question 30: A Transformer has 1000 turns in its primary coil which is connected to a 250 V a.c supply. The secondary coil is connected to an ammeter via a 100 ohm resistor. Determine the number of turns in the secondary coil if the ammeter reads 1.5 A (Ans: Ns = 600)

Question 31: A student is designed a transformer to supply a current of 10 A at a potential difference of 60 V to a motor from an a.c mains supply of 240 V. If the efficiency of the transformer is 80%; calculate:

(a) The power supplied to the transformer (Ans: P_{in} = 750 W)

(b) The current in the primary coil (Ans: Ip = 3.125 A)

Question 32: A low voltage outdoor lighting system uses a transformer to step down a 240 voltage house hold voltage to 24 voltages. The lighting system has 6 lamps with a total resistance of 10Ω

(a) What is the current in the secondary coil of the transformer (Ans: I =24 A)

(b) What is the current in the primary coil (Ans: I = 2.4 A)

Question 33: The ratio of the number of in the secondary coil in a transformer to that in the primary coil is 16:1. If the current in the secondary circuit is 4.0A; what is the current in the primary circuit? (Ans: I_s = 0.25A)

Question 34: Could a transformer be used to increase the voltage of a battery? Explain

Question 35: Explain the function of the commutator in a d.c electric generator

Question 36: A transformer is used on a 240 V a.c supply to deliver 12 A at 120 V to a heating coil. If 20% of energy taken from the supply is dissipated in the transformer

(a) What is the current in the primary coil? (Ans: I_p = 7.5 A)

(b) Give three causes of 20% energy dissipation in the transformation above

Question 37: Sketch the magnetic field patterns due to a current passing through:

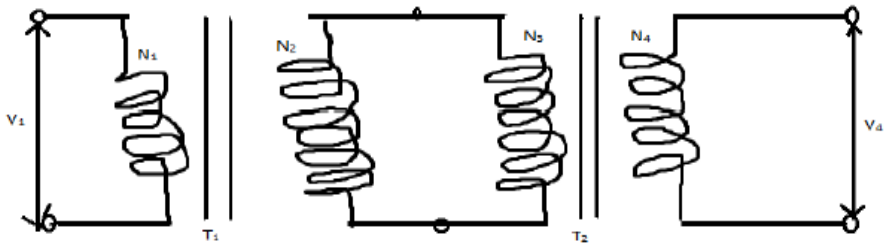
(a) A long straight line

(b) A circular coil

(c) A long solenoid.

In each case, indicate clearly the direction of current and magnetic field

Question 38: Two transformers T_1 and T_2 are connected as shown in the figure below



Given that N_1 =10, N_2 = 200, N_3 =100, N_4 = 50 and V_1 =240 V, what is the value of V_4?

Question 39: A laptop computer is plugged into the 230 V mains. The laptop is left on standby. Its power consumption from the mains is 3.2 W. The laptop's transformer changes the 230 V mains to 9.2 V which goes to the laptop. What is the current passing through the laptop?

Question 40: Transformers are designed to use alternating current. Describe what change happens when a step – up transformer is used

Question 41: What is meant by the national grid system?

Question 42: Explain how transformers are used to improve the efficiency of power transmission in the national Grid.

Question 43: A step – down transformer in a mobile phone charger converts 230 V mains into 5 V. The phone needs a current of 3 A when charging. What current is required from the mains?

Question 44: Describe the structure and working of a simple d.c motor

Question 45: A d.c generator has a resistance coil of 10 ohms and is connected to a bulb of resistance 100 ohms. Calculate the induced e.m.f if the current flowing in the bulb is 5 amps

Question 46: A step – down transformer has a secondary winding of 100 turns and primary winding of 200 turns. If the output voltage is 150 V, find the input voltage, assuming the transformer is 100 % efficient

Question 47: Describe the structure of a step – up transformer

Question 48: A transformer with primary and secondary windings of 200 turns and 100 turns respectively is connected to 250 V mains. Calculate the secondary voltage if the transformer is 75 % efficient

TOPIC 03: RADIOACTIVITY

Question 01: Tin (Sn) has a total of twenty – five isotopes; the lightest is represented by the symbol $^{108}_{50}Sn$. Given that all twenty – five isotopes of tin exist, write down the symbol for the heaviest tin isotopes (Ans: $^{132}_{50}Sn$)

Question 02: Uranium $^{238}_{92}U$ emits an alpha particle to become another element as shown in the following equation $^{238}_{92}U \rightarrow ^{Z}_{A}X + Alpha\ partice$. Determine the value of A and Z
(Ans: A = 234, Z = 90)

Question 03: The element Thorium (Th) has atomic number 90 and mass number 234. The element decays by emitting a beta particle to form Protactinium (Pa). Write a nuclear equation for this decay (Ans: $^{234}_{90}A \rightarrow ^{234}_{91}Pa + ^{0}_{-1}e$)

Question 04: The following reaction is part of a radioactive series. Identify the reaction X and determine the values of C and Z: $^{210}_{83}A \xrightarrow{X} ^{210}_{84}A \xrightarrow{\alpha} ^{C}_{Z}Q$ (Ans: X is beta particle, C = 206, Z = 82)

Question 05: (a) Define the terms isotope

(b) Uranium $^{238}_{92}U$ decayed to Polonium $^{222}_{84}Po$ by α-particle emission at each stage via $^{234}_{x}Th, ^{230}_{x}Ra$ and $^{226}_{z}Rn$. Following this stage $^{224}_{84}Po$ decayed to $^{q}_{86}Rn$ by β-particle only

(i) Write balanced equation of the stage decay process from $^{238}_{92}U\ to\ ^{226}_{z}Rn$ and determine the value of x, y, z and q

(ii) Identify isotopes and isobars (Ans: Isotopes is Radon; $^{226}_{86}Rn$ and $^{222}_{86}Rn$, Isobars is $^{222}_{84}Po$ and $^{222}_{86}Rn$)

Question 06: A uranium nucleus, U – 238 with atomic number 92, emits two α-particles and two β-particles and finally forms a thorium (Th) nucleus. Write the nuclear equation for this process (Ans: $^{238}_{92}U \rightarrow \mathbf{2}\,^{4}_{2}He \rightarrow \mathbf{2}\,^{0}_{-1}e \rightarrow ^{234}_{90}Th$)

Question 07: Radioactive uranium $^{238}_{92}U$ emits a α-particle to become thorium. Thorium emits a β-particle to become praseodymium which then emits another β-particle. What are the atomic number, mass number and name of final atom produced?

Question 08: A sample of a radioactive contains 120 nuclei. Calculate the number of half – life it takes for the sample to decay so that there are only 15 nuclei left undecayed (Ans: n = 3)

Question 09: What is the half life of a radioactive material if its activity falls to 1/8 of its value in 3360 seconds?

Question 10: The half – life of iodine-131 is 8 days; a sample contains 800g of iodine-131. How much of the sample will remaining undecayed after 40 days (Ans: 25 g)

Question 11: The half-life of iodine-131 is 8 days; a sample contains 16g of iodine-131

(a) Draw a graph to represents

(b) From the graph determine mass of the sample which will remain undecayed after 20 days

Question 12: Archaeologist can determine the age of organic matter by measuring the proportion of carbon -14 present in a sample. Assuming that carbon-14 has a half – life of 5600 years, Calculate the age of a piece of wood found to contain 1/8 as much carbon -14 as in a living material (Ans: t = 16 800 yrs)

Question 13: Explain why long half –life of nuclear waste products presents a health hazard
(Ans: If the half – life is long/large the activity remains at a very high level for a very long time resulting in a health hazard)

Question 14: A radioactive isotope M decays by emitting two alpha and beta particles to form $^{214}_{83}Y$.

(a) What is the atomic number of M? (Ans: Atomic number = 87)

(b) After 224 days, 1/16 of mass of M remained. Determine the half life of M. (Ans: $\mathbf{t_{1/2}}$ = 56 days)

Question 15: The activity of a radioactive element when measured using the Geiger Muller tube was found to be 63 counts per minute; Given that the background radiation was 8 counts per minute, determine:

(a) The actual activity of the radioactive element (Ans: Actual Activity = 63 – 8 = 55 c.p.m)

(b) The half –life of the element if the activity dropped from 128 counts/minute to 23 counts per minute in 6 hours (Ans: t = 2hrs)

Question 16: In an experiment to determine the half –life of the radioactive element, the following data was obtained.

Activity (counts) per minute	52	44	34	28.5	24	19.0	17.5	15
Time (minutes)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5

(a) Given that the background radiation is 10 counts per minute, Plot a decay curve for the element

(b) Estimate from your graph, the half – life of the element (Ans: $t_{1/2}$ = 1.15 minutes)

Question 17: A Geiger Muller tube connected to rate meter is hold near a radioactive source, the corrected count rate(allowing for Background count rate is 400 c.p.s. 40 min the corrected count rate is 25c.p.s. What is the half-life of the source? (Ans: $t_{1/2}$ = 10 min)

Question 18: A rate meter records a background count rate of 2 c.p.s when a radioactive source held near the count rate is 162 c.p.s. If the half-life of the source is 5 min; What will the recorded count rate be 20 min? (Ans: N = 10 c.p.s)

Question 19: A patient suffering from cancer of thyroid glands is given a dose of radioactive iodine – 131 with a half – life of 8 days to combat diseases. He is temporarily radioactive and his nurse must be changed regularly to project them. If his radiation is initially 4 times the acceptable level how long is it before the special nursing radiations can be dropped (Ans : t = 16 days)

Question 20: The half life of iodine – 131 is 8 days; A sample contains 16 g of iodine – 131

(a) Draw a graph to represent the decay of the sample

(b) From the graph determine mass of the sample which will remain undecayed after 20 days (Ans: 3g)

Question 21: A sample contains 800 g of iodine – 131. How much of the sample will remain undecayed after 40 days? (The half life of iodine – 131 is 8 days) (Ans: 25 g)

Question 22: Isotope A has a half – life of 36 s and decays by emission of alpha particle to isotope B. Isotope B has a half life of 18 s and decays by emission of beta particle to isotope C which is stable. A sample initially contains 120 mg of pure isotope A. After 72 s:

(a) What mass of Isotope A remains?

(b) What mass of Isotope B has been produced?

(c) Of the mass of Isotope B produced, how much remains?

(d) What mass of Isotope C has been produced?

(e) After which of the following times would there be less than 1 mg of isotope A remaining?

(Ans: (a) 120 s (b) 160 s (c) 240 s (d) 280 s)

Question 23: The half life of Technetium 99m is 6h. If 12 mg of Technetium 99m is injected into a patient and starts to decay into Technetium 99m. Calculate the amount of Technetium 99m present in the patient after 24h

Question 24: After 24 days, 2 mg of an original 128 mg sample remains. What is the half – life of the sample? (Ans: 4 days)

Question 25: U – 238 has a half life of 4.46 x 109 years. How much U – 238 should be present in a sample 2.5 x 10^9 years old if 2 g was present initially? (Ans: 1.36 g remain)

Question 26: How long will it take for a 40 g sample of I –131 (Half – life = 8.04 days) to decay to 1/100 its original mass? (Ans: 53.4 days)

Question 27: If a radioactive element has a half – life of 40 minutes. Initial count rate was 1000 per minute, then how long will it take for count rate to drop to 125 per minutes? (Ans: t = 120min)

Question 28: A particular radioactive has a half-life of 2.0 hours. A sample gives a count rate of 2400 per second at 11:00 am. When will the count have dropped to approximately 300 per second in the same counting system?

Question 29: 8 x 10^8 atoms of Radon were separated from Radium. The half life of Radon is 3.82 days. How many atoms will disintegrate after 7.64 days? (Ans: = 6 x 10^8 atoms)

Question 30: The half life of a radioactive element is 10 minute; calculate how it takes for 90% of a given mass of the element to decay. (Ans: t = 33min)

Question 31: A radioactive material has a half life of 16 days. How long will it take for the count rate to fall from 160 counts /min to 20counts/min? (Ans: t = 48 min)

Question 32: The half life of the Bismuth is 20min, what fraction of a sample of this radioactive bismuth $^{214}_{83}$Bi remains after 2 hours? (Ans: $\boldsymbol{N/N_0 = 1/64}$)

Question 33: A radioactive nucleus is denoted by the symbol $^{288}_{92}$Y; write down the composition of the nucleus at the end of each of the following stages of disintegration.

(a) The emission of an alpha particle. (Ans: $^{288}_{92}Y \rightarrow {}^{284}_{90}X + {}^{4}_{2}H$)

(b) The further emission of a beta particle. (Ans: $^{284}_{90}X \rightarrow {}^{284}_{91}M + {}^{0}_{-1}e$, $\boldsymbol{p = 91}$, $\boldsymbol{n = 193}$)

Question 34: The count rate recorded by Geiger Muller tube and counter close to an alpha particle source is 400 per minute after allowing for the back ground count, if the half life of the source is 4 days.

(a) What will be the count rate 12 days later?

(b) What should be determined over period of several minute rather than over a few second?

Question 35: A rate meter record a background count rate of 2 counts per second when a radioactive source is held near the count rate is 162 counts per second. If the half life of the source is 5 minute what will be the recorded count rate be 20min later? (Ans: Therefore C = 10counts /sec, Hence the recorded count rate = 10 + 2 = 12 counts/sec)

Question 36: A Geiger Muller tube connected to a rate meter is held near a radioactive source. The correct count rate allowing for background count is 400 counts per second. 40 min later the corrected count rate is 25 counter rates per second. What is the half – life of the source? (Ans: Half – life = 10 minutes)

Question 37: The rate of disintegration of a radioactive substance is recorded after every 3 days as shown in the table below. Back ground radiation is 10 counts/day; Plot an appropriate graph and use it to determine the half – life of the substance. Show how you obtained your answer

Time (days)	0	3	6	9	12	15
Counts/day	123	95	66	47	34	25

Question 38: The following symbol represents an isotope of nickel: $^{60}_{28}$Ni

(a) What do the superscript and subscript represent?

(b) How many protons and neutrons are there in the nickel isotope?

Question 39: The half – life of Thorium – 234 is 24 days; calculate the mass remaining unchanged of 0.64 g of the substance after (a) 48 days (b) 72 days (c) 96 days

Question 40: Chlorine exists in two forms – chlorine – 35 and chlorine – 37. The atomic number of chlorine is 17

(a) What name is given to different forms of the same element?

(b) Write down the number of protons and neutrons in each type of chlorine atom

Question 41: Radon has a half – life of 91 h and 12 min. How long will it take until only 1/8 0f a sample of radon remains unchanged?

Question 42: A radioisotope has a half – life of 8 hours. At 12 noon on 2 March a GM tube measures an activity of 2400 Bq.

(a) Calculate the activity at 4.00 am on 3 March

(b) Determine the time at which an activity of approximately 75 Bq will be measured

Question 43: The limit of carbon dating is about 50 000 years. Explain why?

Question 44: Archaeologists are analyzing ancient bones from a human settlement. They discover that a sample of bone has one – sixteenth of the carbon – 14 of modern human bones. Determine the age of the settlement (Given that the half – life of a crbon – 14 is 5700 years)

Question 45: A radioactive material has a half life of 2 minutes.

(a) Explain what that means.

(b) Determine how much of the material will be left after 8 minutes

Question 46: A radioactive source is known to emit one type of radiation only, i.e $\propto$, β *or* γ. The source was placed in a holder as shown in the figure below, first without a magnet and then a magnet was introduced. A detector was placed at positions 1, 2 and 3 and the count rates recorded in the table below

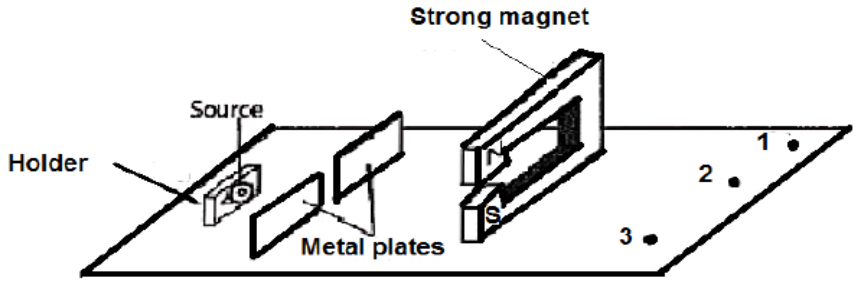


Table:

Detector position	Counts per minute	
	Magnet not present	Magnet present
1	26	295
2	300	28
3	28	26

(a) What is the reason for placing the two metal plates in front of the source?

(b) What is the value of the background counts per minute? (Ans: 27 c.p.m)

(c) Define the background count

Question 47: A radioactive element has an initial count rate of 1200 counts per minute measured by a scale and this falls to 150 counts per minutes in 15 hours

(a) Determine the half – life of the element (Ans: Half – life = 5 hours)

(b) If the initial number of atoms in another sample of this element is 3.0 x 10^{20} atoms, how many atoms will have decayed in 25 hours? (Ans: 9.375 x 10^{18} atoms)

Question 48: Give any four uses of cathode ray oscilloscope (CRO)

Question 49: State two ways in which X – rays differ from gamma rays

Question 50: A radioactive nucleus is denoted by the symbol $^{284}_{90}X$. Write down the composition of the nucleus at the end of the following stages of disintegration

(a) Emission of an alpha ($\propto$) particle

(b) Further emission of beta (β) particle

(c) Further emission of a gamma (γ) radiation

Question 51: A particular radioactive has a half – life of 2.0 hours. A sample gives a count of 2400 per second at 11:00 a.m. When will the count have dropped to approximately 300 per second in the same counting system? (Ans: will be 5:00 p.m)

Question 52: Identify the type of radiation from the evidence supplied below:

(a) Absorbed in a few centimeters of air deflected by a magnetic field.

(b) Very penetrating rays, not deflected by a magnetic field, harmful to living things

(c) Mostly absorbed by a few millimeters of aluminium, deflected by a magnetic field

(d) Has a wavelength of several meters, an aerial is required for the transmission of these waves

Question 53: Complete the following decay equation

(a) $^{3}_{1}H \rightarrow \_\_\_ + {}^{0}_{-1}e$

(b) $^{14}_{6}C \rightarrow \_\_\_ + {}^{0}_{-1}e$

Question 54: Determine the superscripts and subscripts of the following

(a) $^{14}_{6}C$

(b) $^{238}_{92}C$

(c) $^{32}_{20}C$

TOPIC 04: THERMIONIC EMISSION

Question 01: (a) State one way in which cathode rays differ from electromagnetic waves and describe an experiment which illustrates this difference

(b) Draw a labeled diagram of a longitudinal section view of the cathode ray oscilloscope tube showing its main features

Question 02: (a) (i) What are the two types of X – rays?

(ii) X – Rays are said to have harmful effect to human beings when used for a long time. Explain the effect that X – rays cause to human beings

(b) Describe how X – rays are produced in X – ray tube

(c) Show the three main parts of cathode ray oscilloscope on a well labeled diagram

Question 03: (a) Write two properties of:

(i) X – rays

(ii) Cathode rays

(b) (i) Give any four uses of cathode ray oscilloscope (CRO)

(ii) State two ways in which x – rays differ from gamma rays

Question 04: (a) Explain briefly the following

(i) Thermionic emission

(ii) The production of a stream of electrons in cathode ray oscilloscope (C.R.T)

(b) What method in a device using the thermionic emission principle ensures that the electrons produced?

(i) Do not accumulate at the source?

(ii) Reach their range undeviated?

(iii) Travel without meet other forms of particles on their way to the target?

Question 05: (a) (i) Explain why cathode ray tube (CRT) are evacuated

(ii) What happens to the CRT when a gas is maintained?

(iii) If gas is maintained in a CRT, will the image be formed onto the screen? Explain

(b) In the production of X – rays what are roles of:

(i) Low voltage

(ii) High voltage?

(iii) Tungsten target?

(c) How is hard X – rays produced?

Question 06: (a) (i) Define thermionic emission

(ii) What is X – rays?

(iii) Mention two uses of X – rays

(b) With the aid of a diagram, explain how X – rays are produced

(c) Draw a well labeled diagram of a cathode ray oscilloscope.

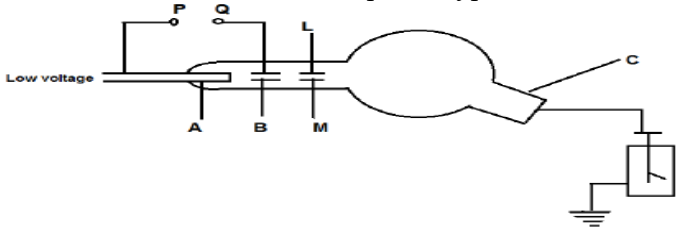
Question 07: State one property of X – ray which makes it possible to detect fractured bones

Question 08: The penetrating power of x –rays is normally varied depending on the intended use. Explain briefly how this is done

Question 09: X –rays are passed through the air surrounding a charged electroscope. State what is observed.

Question 10: How can the intensity of X-rays in an X – ray tube be increased?

Question 11: The figure below shows a circuit of a special type of a cathode ray tube



(a) Name the parts labeled A and B (Ans: A = Cathode B = Grid)

(b) C is a metal can mounted inside the tube and is connected externally to a negatively charged electroscope with its casing earthed. The p.d across the metal L and M was then adjusted so that the cathode rays were deflected into the can and it was observed that the electroscope leaf rose steadily

(i) Why did the leaf rise steadily? (Ans: The leaf rose steadily due to the extra accumulation of negative charges. Like charges repel)

(ii) What does the result in (i) above tell you about the charge on the cathode rays (Ans: cathode rays are negatively charged)

(iii) State one other property of cathode rays not mentioned above

Question 12: (a) What is thermionic emission?

(b) Name two factors on which the rate of emission depends.

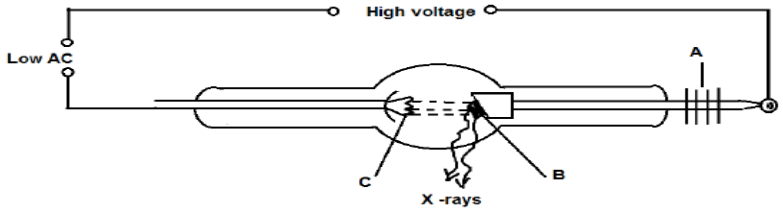
Ans:

(a) Thermionic emission is the phenomenon due to which free surface of the metal emits electrons on being heated

(b) Factors determining the rate of emission of thermion:

* It is inversely proportional to the work function of a material
* It is directly proportional to the temperature of the surface emitting thermions
* It is directly proportional to the surface area of the surface emitting thermions

Question 13: The figure below shows an X –rays tube



(a) Name the parts labeled A, B and C (Ans: A = cooling fins B = metal target C = Filament cathode)

(b) Explain how X –Rays are produced in a tube

(c) Why it is necessary to use an evacuated tube? (Ans: In order to minimize the chance of electrons colliding with air molecules)

(d) What are the purposes of high and low voltages?

Ans:

- Low voltage heats up the cathode filament to emit electrons
- High voltage accelerates electrons towards the metal target

(e) With reason, state the most appropriate metal to be used to make part B

(Ans: tungsten/molybdenum, it has a high melting point)

Question 14: In the production of X – Rays what are the roles of

(a) Low voltage?

(b) High voltage?

(c) Tungsten target?

Ans:

(a) Used for heating the cathode

(b) Used to provide a high p.d between the electrodes, for accelerating the electrons

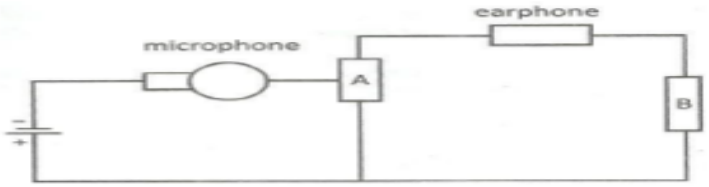
(c) Used for absorbing highly energetic electrons and emit X – Rays. (Converting K.E of electrons into electromagnetic waves and heat)

TOPIC 05: ELECTRONICS

Question 01: (a) Explain how an extrinsic semiconductor is constructed

(b) Describe the model of action and application of PN junction diode

(c) The diagram below shows a circuit in which important components A and B are removed



Answer the following questions

(i) What does A and B represents?

(ii) Describe briefly the purpose of component A and B

(iii) Draw a well labeled circuit diagram for the circuit above

Question 02: Explain why an ordinary junction transistor is called bipolar?

(Ans: Because the transistor operation is carried out by two types of charges carriers (majority and minority carriers))

Question 03: Why transistor is called current controlled device?

(Ans: Because, the output voltage current or power is controlled by the input current in a transistor)

Question 04: What is the significance of the arrow –head in the transistor symbol?

(Ans: Is to show the conventional direction of current flow. (From emitter – to – base in case of p-n-p transistor and from base – to – emitter in case of n – p –n transistor))

N.B: Arrow head is always marked on the emitter and not for collector, since collector always reverses its leakage current opposite to the direction of emitter current

Question 05: Discuss the need for biasing the transistor.

(Ans: For normal operation, base – emitter junction should be forward biased and the collector base Junction reverse biased)

Question 06: What are the differences between a semiconductor and an insulator in terms of their conductivity?

Question 07: In case the transistor is not biased properly, what would happen?

Ans: It would

- Work inefficiently
- Produce distortion in the output signal
- With the change in transistor parameters or temperature rise, the operating point may shift and the amplifier output will be unstable

Question 08: Which of the transistor currents is always the largest? Which is always the smallest? Which two currents are relatively close? (Ans: The emitter current IE is always the largest one. The base current IB is always the smallest one. The collector current IC and emitter current IE are relatively close in magnitude)

Question 09: Why collector is made larger than emitter and base? (Ans: Collector is made physically larger than emitter and base because collector is to dissipate much power)

Question 10: Why silicon type transistors are more often used than germanium type?

Ans: This is because:

(i) At room temperature, Silicon crystal has fewer free electrons than Germanium crystal. This implies that Silicon will have much smaller collector cut off current than Germanium

(ii) The variation of collector cut off current with temperature is less in Silicon compared to Germanium

(iii) The structure of Germanium crystals will be destroyed at higher temperature while Silicon crystal are not easily damaged by excess heat

Question 11: Why the width of the base region of a transistor is kept very small compared to other region? (Ans: In order to pass most of the injected charge carriers to the collector)

Question 12: Why emitter is always forward biased? (Ans: Emitter is always forward biased with respect to base so as to supply the majority charge carriers to the base)

Question 13: Why collector is always reverse biased with respect to base? (Ans: In order to remove the charge carriers from the base – collector junction)

Question 14: A diode has a certain characteristic when operating. Explain this characteristic

(Ans: The main operating characteristic of a diode is that it allows current in one direction and blocks current in the opposite direction)

Question 15: Distinguish between semiconductors and conductors and give one example for each

Question 16: What must the conditions be for a LED to emit light? (Ans: A LED emits light when the diode is forward biased allowing current to flow)

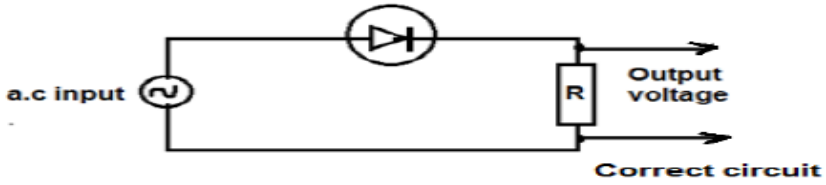
Question 17: Transistors have two main functions, what are they? (Ans: Amplification and switching)

Question 18: Define doping. (Ans: The process of adding impurities to the intrinsic or pure semiconductor)

Question 19: What are the differences between a conductor, semiconductor and insulator in terms of their energy levels?

Question 20: You are provided with a diode, a resistor R an a.c source of low voltage and connecting wires, Sketch the circuit diagram for a half – wave rectifier and indicate the terminals where the output voltage V_o may be connected

Ans:



Question 21: What is meant by Donor impurity in semiconductors?

(Ans: Is an atom introduced into the semiconductor (doping) to provide an extra electron for conduction)

Question 22: Explain how intrinsic semiconductor can be changed into a transistor

Question 23: Mention two types of:

(a) Semiconductors

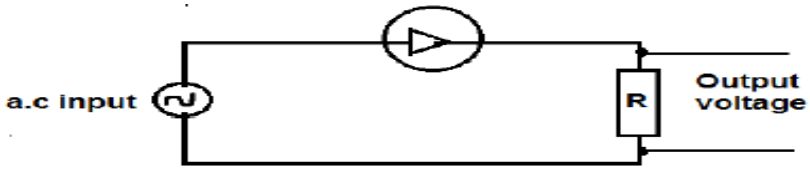
(b) Diode

Question 24: What is the difference between analogue and digital signals?

Question 25: (a) What is the difference between PNP and NPN transistors?

(b) Draw their circuit symbols, label them and describe each connection

Question 26: The semiconductor diode can be used as a rectifier as used in the circuit below



(a) What does the term rectification means?

(b) The rectification described by the circuit above is half wave rectification. Sketch its waveform which would be seen on a suitably adjusted CRO and explain why the output voltage is so rectified

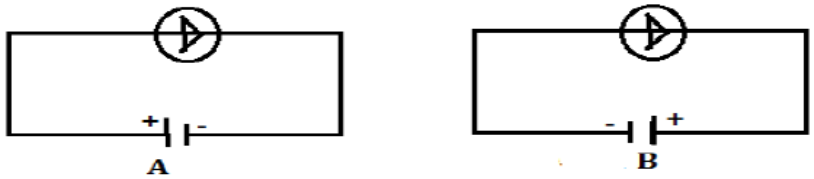
Question 27: The output power of a signal is 50 W and the input power is 0.1 W. Calculate the power gain

Question 28: What is an IC?

Question 29: State the majority carriers for a p – type semi conductors

Question 30: Explain how doping produces an n – type semiconductor

Question 31: Study the circuit diagrams in the figure below carefully. Which of the two circuits will light a bulb?



Question 32: Name two semiconductors which are widely used in electronics

Question 33: Explain why semiconductor solid state diodes are fast replacing the vacuum type diodes in many applications

Question 34: (a) Give an illustration of a p – n junction diode and its symbol

(b) How does a junction diode work?

Question 35: How is an intrinsic semiconductor different from an extrinsic semiconductor? Explain how an extrinsic semiconductor is constructed?

Question 36: Define the following terms

(a) Transistor

(b) Doping

(c) Rectification

Question 37: Draw the circuit diagram of the

(a) Half wave rectification

(b) Full wave rectifier (use 2 diodes)

TOPIC 06: ELEMENTARY ASTRONOMY

Question 01: Mercury is the closest planet to the sun but not hotter than Venus, Why?

Ans:

→ This is because any heat that mercury receives from the sun is quickly lost back into space because it does not have any atmosphere to trap and hold heat

→ Similarly Venus is the hottest due to presence of very thick atmosphere of carbon dioxide. This atmosphere makes the surface of Venus hotter because heat does not escape back into space (Greenhouse effect)

Question 02: Why stars twinkle at night?

(Ans: Stars are so distant such that they appear as pinpoints of light in the night sky, even when viewed through a telescope. This is because all the light is coming from a single point, its path is highly susceptible to atmospheric interference)

Question 03: What is solar system?

Question 04: How many known planets are there in our solar system? Name them.

Question 05: Briefly explain how astronomy gave rise to the 12 months of the year

Question 06: Why is Pluto not a planet as it used to be?

Question 07: (a) Which one is the largest planet in our solar system? (Ans: Jupiter)

(b)Which planets in the solar system have satellites?

Question 08: What is Milk Way?

Question 09: What are the real names of objects in the sky which are commonly known by the following names?

(a) An evening star

(b) A morning star

(c) A shooting star

Question 10: Can humans breathe normally in space as they can on Earth? (Give reason)

Question 11: Why Venus is hotter than Mercury, although Mercury is very closer to the Sun than Venus?

Question 12: State reasons why an astronaut in space

(a) Needs a special space suit to prevent blood from boiling

(b) Can float without falling

(c) Uses small jets of gas in his maneuvers (movements) instead of swimming like fish in water

Question 13: What planet is famous for its big red spot on it?

Question 14: What planet is famous for the beautiful rings that surround it?

Question 15: Differentiate between spring and neap tides

Question 16: The distance of Jupiter from the sun is 7.80×10^8 km and one year of Jupiter is equivalent to 12 earth years. Calculate:

(a) The distance of its path in one year (Ans: $d = 4.903 \times 10^9$ km)

(b) Speed of the planet in km per hour (Ans: $V = 46.6 \times 10^3$ km/hr)

Question 17: (a) How a star differs from a planet

(b) Name two objects in space which are the Earth's nearest neighbors

(c) What planet is known as the red planet?

(d) What is the hottest planet in our solar system?

(e) What is the name of the force holding us to the earth?

Question 18: What is the name of Saturn's largest moon? (Ans: Titan)

Question 19: How do the planets stay in orbit around the sun?

Question 20: Who was the first person to walk on the moon? (Ans: Neil Armstrong - 1969)

Question 21: Olympus Mons is large volcanic mountain on which planet? (Ans: Mars)

Question 22: The Earth appears to be stationary, but it is always in motion. Calculate the unnoticed speed of a man along the equator in km/h due to:

(a) Rotational motion of the earth about its axis

(b) Revolution of the earth around the sun (Take 1 year = 365 days)

Question 23: Define star and give the name of the one closest to the earth

Question 24: Mercury planet is 58×10^6 km from the sun and it takes 88 days to complete one orbit around the sun. Calculate the speed of the planet in km/hr to 3 significant figures. (Ans: 1.73×10^5 km/hr)

Question 25: (a) Name two largest planets in the solar system

(b) Name two brightest planets in the solar system

Question 26: **S**tate the following terms

(a) Heliocentric theory

(b) Geocentric theory

Question 27: A communication satellite appears to be stationary over one point on the earth's surface when it is moving in a circular orbit of radius 42,000 km. Find its speed in km/hr given that it must complete one orbit in 24 hours ($V = 11 \times 10^3$ m/s)

TOPIC 07: GEOPHYSICS

Question 01: (a) Define the term earthquake

(b) Briefly explain the meaning of the following terms as used on earthquake

(i) Hypocenter

(ii) Epicenter

(c) (i) What is global warming?

(ii) Name four gases that contribute to global warming and give one source of each

(d) (i) Mention two merits and two demerits of volcanoes

(ii) Briefly explain four hazards associated with earth quakes

Question 02: What is meant by the following terms as used in Geophysics?

(a) Magma

(b) Tsunami

Ans:

(a) Magma are molten rocks inside the earth's mantle which are ejected during a volcanic eruption

(b) Tsunami is a sea wave which is caused by disturbance of the ocean floor either by an earthquake or a volcanic activity

Question 03: Mention five consequences of global warming

Question 04: (a) (i) Explain the force that keeps the Earth in position

(ii) Explain how volcanoes are formed

(b) Describe four signs before an earthquake occurs

Topic	***1***	***2***	***3***	***4***	***5***	***6***	***7***
Questions	117	48	54	14	37	27	04
Grand total	**301**						