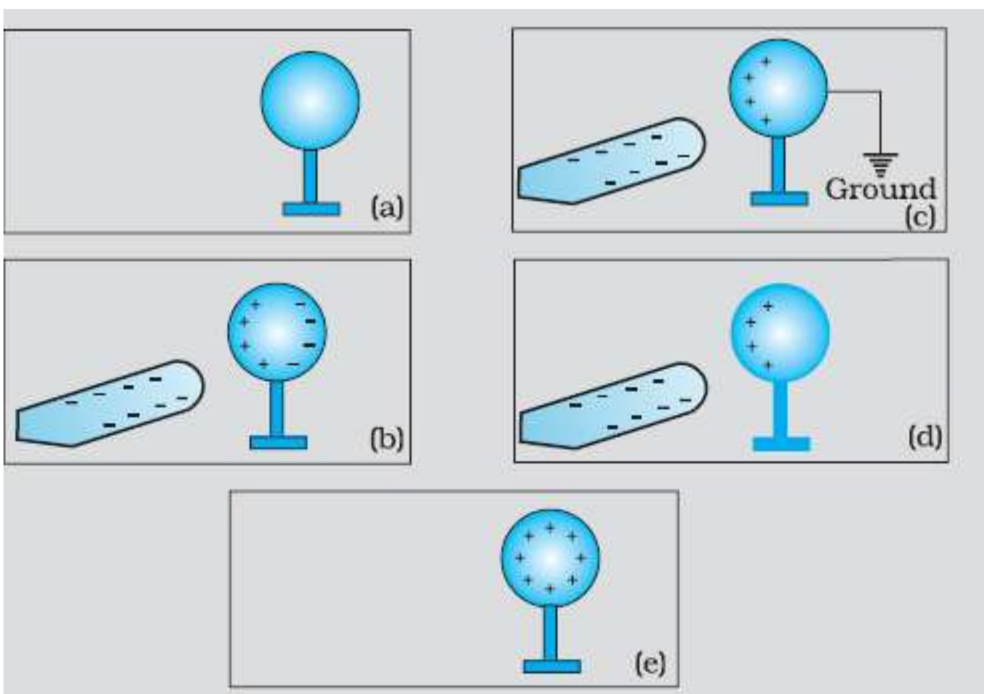
INDIAN SCHOOL MUSCAT

DEPARTMENT OF PHYSICS

CASE STUDY QUESTIONS IN PHYSICS

1. Figure (a) shows an uncharged metallic sphere on an insulating metal stand. Bring a negatively charged ebonite rod close to the metallic sphere, as shown in Fig. (b). As the rod is brought close to the sphere, the free electrons in the sphere move away due to repulsion and start piling up at the farther end. The near end becomes positively charged due to deficit of electrons. This process of charge distribution stops when the net force on the free electrons inside the metal is zero. Connect the sphere to the ground by a conducting wire. The electrons will flow to the ground while the positive charges at the near end will remain held there due to the attractive force of the negative charges on the rod, as shown in Fig. (c). Disconnect the sphere from the ground. The positive charge continues to be held at the near end [Fig. (d)]. Remove the electrified rod. The positive charge will spread uniformly over the sphere as shown in

Fi g(e)



i) An ebonite rod is charged negatively by rubbing it with

A) Silk cloth

B) fur

C) Plastic sheet

D) cotton

ii) When we Connect the sphere to the ground by a conducting wire the electrons will flow to the ground

A) According to the law of Conservation of charge

B) Because ground is at lower potential

C) Because the Sphere is at lower potential

D) According to the law of conservation of mass.

iii) In this activity the metal sphere in figure e is positively charged by

A) Conduction

B) Induction

C) Friction

D) Action of Points

Iv) the method of Charging in which the charge on the object getting charged is equal and opposite to that of the charging object is

A) Conduction

B) Induction

C) Friction

D) Action of Points

v) The similarity between charging by induction and friction is

a) charge on the two objects involved are of opposite kind

b) charge on the two objects involved are of same kind

c) charge on the charging object and object getting charged are of same magnitude

d) in both the objects are not in contact

2. Historically the credit of discovery of the fact that amber rubbed with wool or silk cloth attracts light objects goes to Thales of Miletus, Greece, around 600 BC. The name electricity is coined from the Greek word elektron meaning amber a resinous material from sea . Many such pairs of materials were known which on rubbing could attract light objects like straw, pith balls and bits of papers.
You can perform the following activity at home to experience such an effect. Cut out long thin strips of white paper and lightly iron them. Take them near a TV screen or computer monitor. You will see that the strips get attracted to the screen. In fact they remain stuck to the screen for a while. It was observed that if two glass rods rubbed with wool or silk cloth are brought close to each other, they repel each other.
The two strands of wool or two pieces of silk cloth, with which the plastic and glass rods respectively were rubbed, also repel each other. However, the glass rod and wool attracted each other. Similarly, two plastic rods rubbed with cat's fur repelled each other ,but attracted the fur. On the other hand, the plastic rod attracts the glass rod and repel the silk or wool with which the glass rod is rubbed. The glass rod repels the wool.

i) The Greek word electron means

A) Wool

B) Amber

C) Glass

D) Silk

ii) A charged glass rod attracts

A) Charged Wool

B) Charged Plastic rod and silk cloth

C) Charged glass rod

D) Charged cat skin

iii) ----------------- is the sure test for the presence of electric Charge on an object .

A) Attraction

B) Induction

C) Conduction

D) Attraction

iv) Amber is a ------

A) resinous substance from trees

B) resinous substance from sea

C) from honey comb

D) from Cat

v) The similarity between charging by conduction and induction is

a) charge on the two objects involved are of opposite kind

b) charge on the two objects involved are of same kind

c) charge on the charging object and object getting charged are of same magnitude

d) in both the objects are not in contact

3.Samir is a student of class XII . His school organises a science exhibition ,In which he wants to keep his exhibit. He requires a capacitance of 2μF having a capacity to operate under 1kV potential .He goes to an electronic shop which has only 1μF capacitors of 400V rating . Samir applies his knowledge about combinations of capacitors and purchases the 1μF capacitors of 400V rating to replace the 2μF having a capacity to operate under 1kV potential.

During the exhibition his partner Rahul charges the capacitor continuously . One of the visitors, a small boy was about to touch a capacitor .A college student accompanying the small boy cautions both .

i) What is the minimum number of 1μF capacitors each of rating 400V are to be connected is series to form a row which can with stand 1000 V?

a) 3

b) 2

c) 1

d) 5

ii) How many such rows are to be connected in parallel to get a capacitor of2μF having a capacity to operate under 1kV potential?

a) 3

b) 6

c) 5

d) 2

iii) what is the minimum number of 1μF capacitors each of rating 400V are required to get a capacitor of2μF having a capacity to operate under 1kV potential?

a) 6

b) 5

c) 10

d) 18

iv) Why do we not supply charge to a capacitor continuously ?

a) to prevent it from heated up

b) to prevent it from giving electric shock

c) to prevent the break down of the dielectric inside the capacitors.

d) to prevent discharging of capacitor

v) Why one must not touch a capacitor in a circuit ?

a)) to prevent it from heated up

b) to prevent it from giving severe electric shock

c) to prevent the break down of the dielectric inside the capacitors.

d) to prevent damage to the circuit

4 . Installation On 10 June 1960, an accident occurred in which 29 people died in a Fokker F27 aircraft landing at Mackay in Queensland. The subsequent board of inquiry was unable to come to any definite conclusions as to what had caused the accident and recommended that all airliners be fitted with flight recorders. The Federal Government implemented this recommendation the following year. Australia was one of the first countries to introduce this requirement. Today, all aircraft on the Australian register with a maximum take-off weight less than or equal to 5,700 kg,

and which are pressurised and turbine-powered by more than one engine are required to carry a cockpit voice recorder (CVR). All Australian-registered aircraft with a maximum take-off weight greater than 5,700 kg and turbine powered are required to carry both a CVR and FDR. Flight recorders are normally located near the aircraft's tail, as experience has shown that this area generally suffers the least damage during an accident.

The Flight Data Recorder (FDR) The FDR records flight parameters. The data recorded varies widely, depending upon the age and size of the aircraft. The minimum requirement, however, is to record a basic group of five parameters:

» pressure altitude

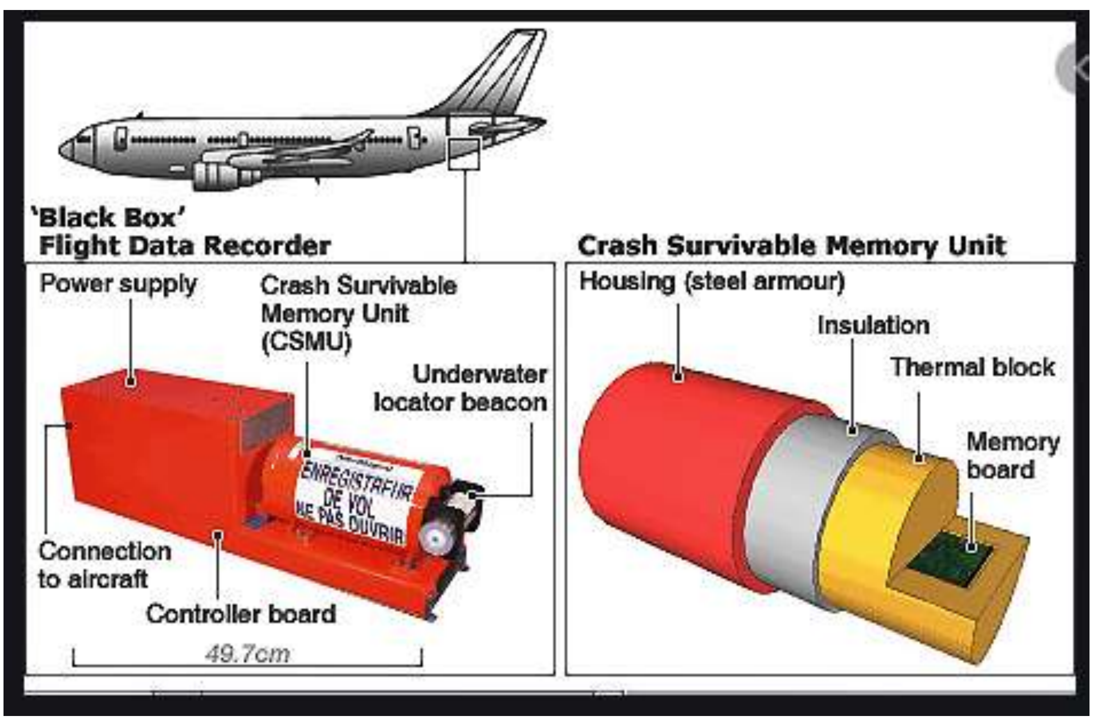
» indicated airspeed

» magnetic heading

» normal acceleration

» microphone keying.

Microphone keying (the time radio transmissions were made by the crew) is recorded to correlate FDR data with CVR information. This basic requirement has existed since the 1960s. Today, modern jet aircraft far exceed this, and are fitted with FDRs that can record thousands of parameters covering all aspects of the aircraft operation.



Careful measurement of the electric field at the surface of a black box indicates that the net outward flux through the surface of the box is 8.0×10^3 Nm^2/C.

i) What is the net charge inside the box?

a) 70.9 nC

b) -70.9 nC

c)1.10×10^{-15} C

d) 0.9 nC

ii) ------------- was one of the first countries to introduce this requirement that all airliners be fitted with flight recorders.

a) Australia

b) USSR

c) Japan

d) Malaysia

iii) The time radio transmissions were made by the crew is recorded as

a) magnetic heading

b) microphone keying.

c) indicated airspeed

d) at change in pressure, altitude

iv) The electric flux Ø is related to the net charge Q and permittivity ε_0 by

a) Ø = Q ε_0

b) Ø= 1/ Q ε_0

C) Ø= Q/ ε_0

d) $Ø = \varepsilon_0 / Q$

v) If the net outward flux through the surface of the box were zero,it implies that

a) there is no charge inside the black box

b) net charge inside the box is zero

c) the charge in the box is infinity

d) permittivity of the medium inside is zero

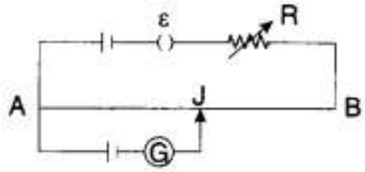
5. Emf of a cell cannot be measured using a voltmeter. When a voltmeter is connected between the terminals of the cell, a current flows through the voltmeter. So the voltmeter measures only terminal potential difference. But a potentiometer does not draw any current from the cell whose emf is to be determined. So a potentiometer is preferred to a voltmeter to measure the emf of a cell.

i) In an experiment to measure the internal resistance of a cell by a potentiometer, it is found that the balance point is at a length 2m, when the cell is shunted by a 5Ω resistance and at a length 3m, when the cell is shunted by a 10Ω resistance. The internal resistance of the cell is then

(a) 1Ω
(b) 1.5Ω
(c) 10Ω
(d) 15Ω

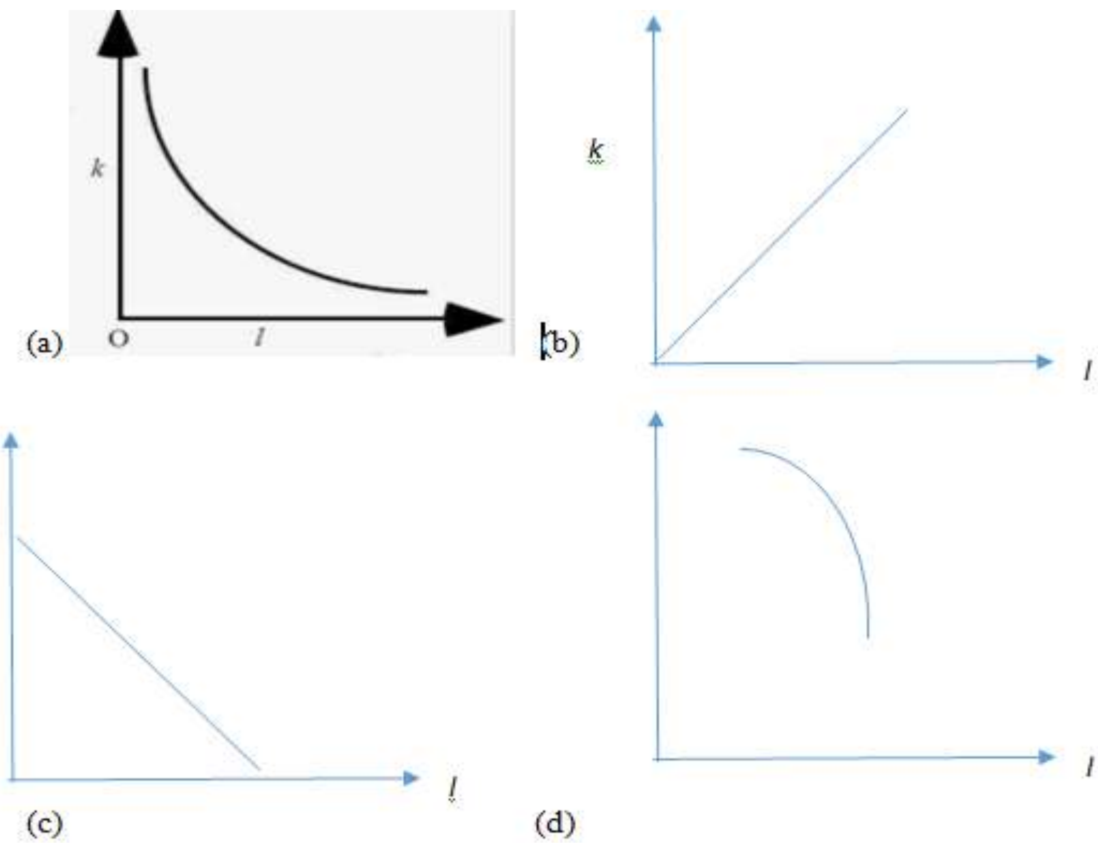
ii) In a potentiometer of 10 wires, the balance point is obtained on the 7^{th} wire. To shift the balance point to 9th wire, we should
(a) decrease resistance in the main circuit.
(b) increase resistance in the main circuit.
(c) decrease resistance in series with the cell whose emf is to be measured.
(d) increase resistance in series with the cell whose emf is to be determined.

iii) AB is a wire of potentiometer with the increase in the value of resistance R, the shift in the balance point J will be



(a) towards B
(b) towards A
(c) remains constant
(d) first towards B then back towards A.

iv) In a potentiometer experiment, if the area of cross-section of the wire increases uniformly from one end to another, draw a graph showing how potential gradient would vary as the length of the wire increases from one end. Which option is correct?



v) Which among the following are the properties of the material used for making the potentiometer wire?

(a) High resistivity and high temperature coefficient of resistance
(b) High resistivity and low temperature coefficient of resistance
(c) low resistivity and high temperature coefficient of resistance
(d) low resistivity and low temperature coefficient of resistance

6. A cylindrical copper conductor AB of length l, area of cross section a has a large number of free electrons, which at room temperature move at random within the body of the conductor, like the molecules of a gas. The average thermal speed of the free electrons in random motion at room temperature is of the order of 10^5 m/s. when a potential difference V is applied across the two ends of a given conductor, the free electrons in the conductor experience a force and are accelerated towards the positive end of the conductor. On their way, they suffer frequent collisions with the ions/atoms of the conductor and lose their gained kinetic energy. After each collision, the free electrons are again accelerated due to electric field, towards the positive end of the conductor and lose their gained kinetic energy in the next collision with the ions/atoms of the conductor. The average speed of the free electrons with which they drift towards the positive end of the conductor under the effect of the applied electric field is called drift speed of the electrons.

i) When a potential difference is applied across the two ends of the conductor, an electric field exists

(a) Outside the conductor
(b) Inside the conductor
(c) Both outside and inside the conductor
(d) No where.

ii) The motion of electrons in between two successive collisions with the atoms/ions follows

(a) A straight path
(b) Circular path
(c) Elliptical path
(d) Curved path

iii) A steady current flows in a metallic conductor of non-uniform cross section. The quantity/quantities constant along the length of the conductor is/are

(a) Current, electric field and drift velocity
(b) Drift speed only
(c) Current and drift speed
(d) Current only

iv) Drift speed of electrons in a conductor is small (=10^4m/s) when the switch is closed, the bulb at a distance glows immediately. It is so because

(a) Drift velocity of electrons increases when switch is closed
(b) The electrons are accelerated towards the end of the conductor and their velocity increases towards the other end of the conductor.
(c) The drifting of electrons take place at the entire length of the connecting wire. This electric effect propagates with the speed of light.
(d) The electrons move towards the positive end and protons of conductor move towards negative end of the conductor.

v) Consider a current carrying wire (current I) in the shape of a circle. Note that as the current progresses along the wire, the direction of $\vec{J}$ (current density) changes in an exact manner, while the current I remains unaffected. The agent that is essentially responsible for is

(a)source of emf

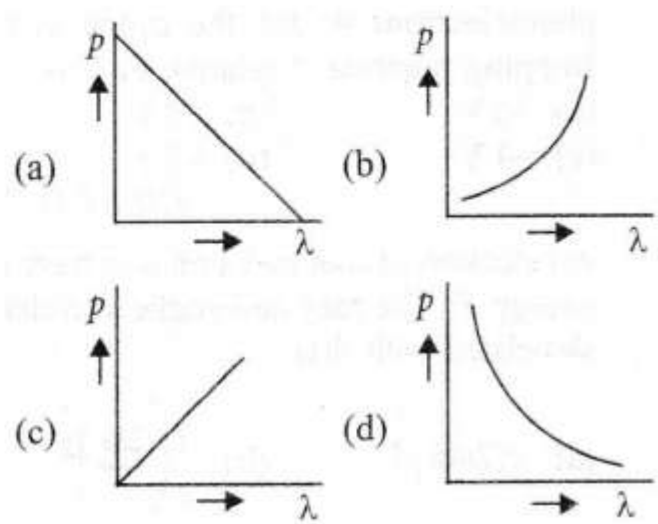
(b)electric field produced by charges accumulated on the surface of wire.

(c)the charges just behind a given segment of wire which push them just the right way by repulsion

(d) the charges ahead.

7.Phenomena like interference, diffraction and polarisation explained wave nature of radiation. Photoelectric effect and Compton effect successfully explained particle nature of radiation. When radiation interacts with matter to cause emission, the radiation behaves as if it is made up of particles called photons. A source of radiation emits energy in packets when it goes from higher energy state to lower energy state and absorbs energy when it goes from lower energy state to higher energy state.

i) Which of the following figures represent the variation of particle momentum and the associated de- Broglie wavelength?



ii) An X-ray tube operates at 10kV. The ratio of X-ray wavelength to that of de-Broglie is

(a) 10:1
(b) 1:10
(c) 1:100
(d) 100:1

iii) If the kinetic energy of the particle is increased by 16 times, the percentage change in the de-Broglie wavelength of the particle is

(a) 25%
(b) 75%
(c) 50%
(d) 60%

iv) Electrons used in an electron microscope are accelerated by a voltage of 25kV. If the voltage is increased to 100kV, then the de Broglie wavelength associated with the electrons would

(a) Increase by 2 times
(b) Decrease by 2 times
(c) Decrease by 4 times
(d) Increase by 4 times

v) Photon and electron are given same energy (10^{-20}J). Wavelength associated with photon and electron are λp and λe, the correct statement will be

(a) Λp >λe
(b) Λp <λe
(c) Λp =λe
(d) λe/λp =C

8.When a surface is irradiated with a light of wavelength 4950 A^0, a photocurrent appears which vanishes if a retarding potential greater than 0.6 volt is applied across the phototube. When a different source of light is used it is found that the critical retarding potential is changed to 1.1volt.

i) Work function of the emitting surface in the first instance is

(a) 9.1eV
(b) 1.9eV
(c) 0.9eV
(d) 0.6eV

ii)Wavelength of the second source is

(a) $4125A^0$
(b) $4950A^0$
(c) $2145A^0$
(d) $5124A^0$

iii)In photoelectric effect, the number of electrons ejected per second is

(a) Proportional to the work function of the metal
(b) Proportional to the wavelength of light
(c) Proportional to the intensity of light
(d) Proportional to the frequency of light

iv) When green light is incident on a certain metal surface electrons are emitted, but no electrons are emitted by yellow light. If red light is incident on the same metal surface, then

(a) More energetic electrons will be emitted

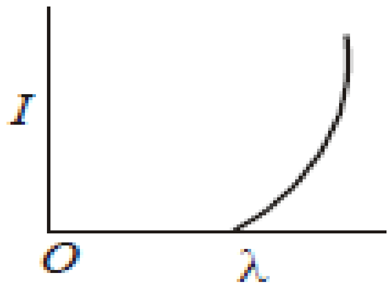
(b)Less energetic electrons will be emitted

(c) Emission of electrons will depend on the frequency of light

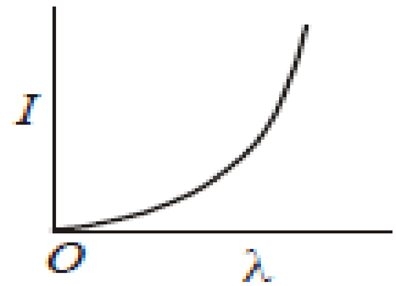
(d) No photoelectrons will be emitted.

v) The anode voltage of a photocell is kept fixed. The wavelength (λ) of light falling on the cathode is gradually changed. The plate current (I) of the photocell varies as

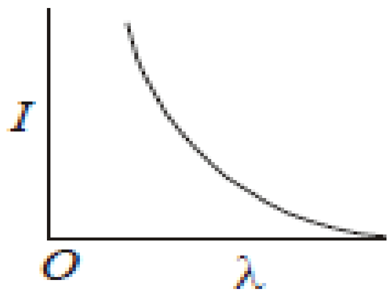
(a)



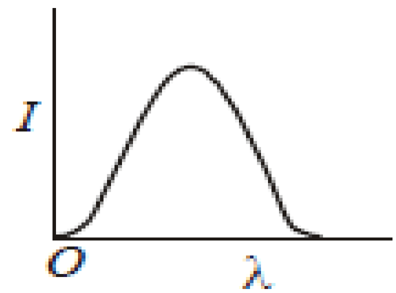
(b)



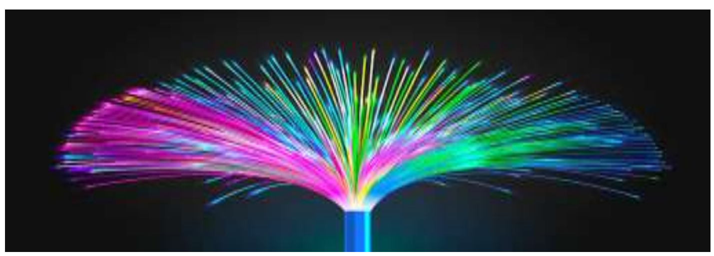
(c)



(d)



9.



These days we find in the market some decorative lamps provided with fine plastic fibres . At their one ends , the fibres are fixed over an electric lamp while their free ends form a fountain like structure . When the lamp is switched on , the light travels from the bottom of each fibre and appears at the tip of free end as a bright spot of light .

i). Which of the following is used in optical fibres ?

a) Scattering

b)Total internal reflection

c)Refraction

d) Diffraction

ii) . A typical optical fibre consists of a fine core of a material of refractive index n_1 surrounded by a glass or plastics cladding with refractive index n_2. Then

a) $n_2$is slightly less than n_1

$b)$$n_2$is slightly greater than n_1

c)$n_2$should be equal to n_1

d) the difference of the refractive indices should be strictly equal to 1

iii)The speed of the light in a medium whose critical angle 30^0 is

a) $3\ x\ 10\ ^8 m\ s\ ^{-1}$

b) $2\ x\ 10\ ^8 m\ s\ ^{-1}$

c) $1.5\ x\ 10\ ^8 m\ s\ ^{-1}$

d) $2.28\ x\ 10\ ^8 m\ s\ ^{-1}$

iv) Which of the following is not due to the principle of optical fibre?

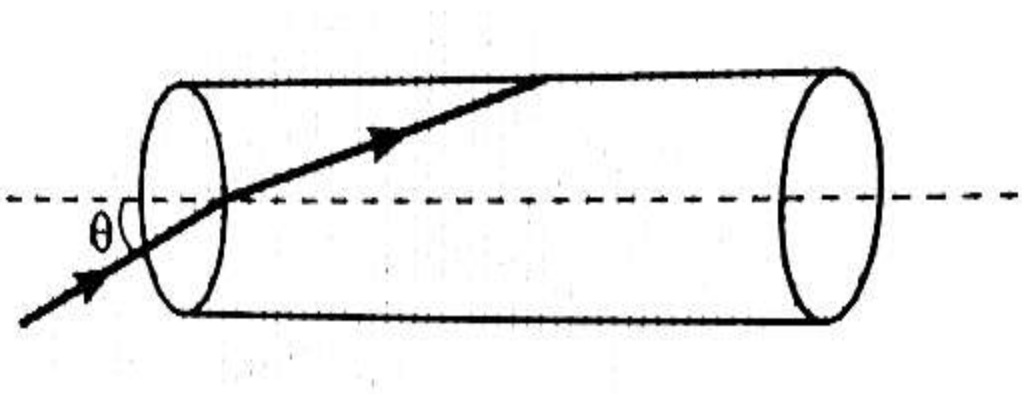
a) Mirage on hot summer days

b) Brilliance of diamond

c) An endoscope

d) Difference between apparent and real depth of a pond

v) A transparent solid cylindrical rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air . A light ray is incident at the mid point of one end of the rod as shown in the figure .



The incident angle θ for which the light ray grazes along the wall of the rod is

a) $sin^{-1}(\frac{1}{2})$ b)$sin^{-1}(\frac{\sqrt{3}}{2})$ c) $sin^{-1}(\frac{2}{\sqrt{3}})$ d) $sin^{-1}(\frac{1}{\sqrt{3}})$

10. A compound microscope is an optical device used to see tiny objects . It consists of two convex lenses . Objective lens is positioned near the object to be magnified . Eyepiece is positioned near the eye for viewing the final image . The distance between the two lenses can be varied by using rack and pinion arrangement.

i)In a compound microscope , the intermediate image is

a) virtual , erect and magnified

b) real , erect and magnified

c) real , inverted and magnified

d) virtual , erect and diminished

ii)The magnifying power of a compound microscope is high if

a) both the objective and the eyepiece have short focal lengths

b) both the objective and the eyepiece have long focal lengths

c) the objective has a short focal length and the eyepiece has a long focal length

d) the objective has a short focal length and the eyepiece has a long focal length

iii) For relaxed eye , the magnifying power of a microscope is

a) $\frac{v_0}{u_0} \; x \; \frac{D}{f_e}$ b) $\frac{v_0}{u_0} \; x \; \frac{f_e}{D}$ c) $\frac{u_0}{v_0} \; x \; \frac{D}{f_e}$ d) $\frac{u_0}{v_0} \; x \; -\frac{D}{f_e}$

iv) You are given two converging lenses of focal lengths 1.25 cm and 5 cm to design a compound microscope. If it is desired to have a magnification of 30 , find out the separation between the objective and eyepiece .

a) 6250 cm

b) 625 cm

c) 6.25 cm

d) 62.5 cm

v) Which two of the following lenses will you select as objective and eyepiece for constructing best possible microscope?

Lenses	Power (P)	Aperture (A)
L_1	3 D	8 cm
L_2	6 D	1 cm
L_3	10 D	1 cm

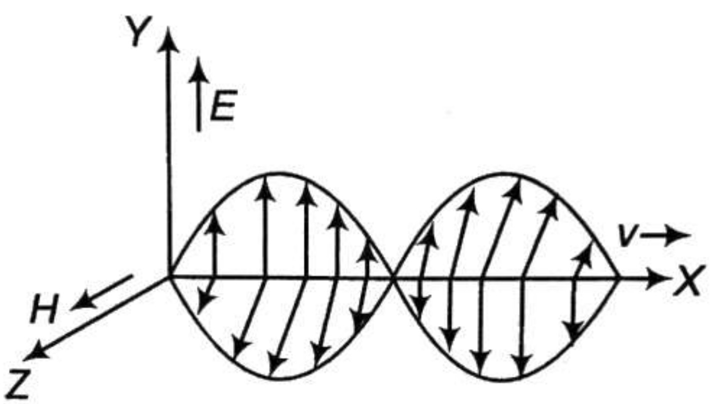
a) L_3 and L_2

$b)$ L_3 and L_1

c) L_1 and L_2

d) L_2 and L_3

11.A changing magnetic field produces a changing electric field and a changing electric field produces a changing magnetic field as predicted by Maxwell. It may be noted that varying electric and magnetic fields are perpendicular to each other as well as to direction of wave propagation



The magnetic field in a plane electromagnetic wave is given by
$B_y = 2\ x\ 10^{-7}\ Sin\ (\ 0.5\ x\ 10^3 x + 1.5\ x\ 10^{11}\ t\ )\ T$. It is propagating in space .

i). What is the frequency of this electromagnetic waves ?

a) $5.0\ x\ 10^{10} Hz$

b) $2.4\ x\ 10^{10} Hz$

c) $1.9\ \ x\ 10^{10} Hz$

d) $1.3\ \ x\ 10^{10} Hz$

ii). Expression for the electric field is

a) $E_y = 60\ \ Sin\ (\ 0.5\ x\ 10^3 x + 1.5\ x\ 10^{11}\ t\ )\ Vm^{-1}$

$b) E_y = 600\ \ Sin\ (\ 0.5\ x\ 10^3 x + 1.5\ x\ 10^{11}\ t\ )\ Vm^{-1}$

c) $E_z = 60\ \ Sin\ (\ 0.5\ x\ 10^3 x + 1.5\ x\ 10^{11}\ t\ )\ Vm^{-1}$

d) $E_z = 600\ \ Sin\ (\ 0.5\ x\ 10^3 x + 1.5\ x\ 10^{11}\ t\ )\ Vm^{-1}$

iii) .What is the wavelength of this electromagnetic waves ?

a) $0.6\ x\ 10^{-2} m$

b) $1.3\ x\ 10^{-2} m$

c) $1.9\ x\ 10^{-2} m$

d) $2.5\ x\ 10^{-2} m$

v). Maximum value of electric field is

a) $6\ x\ 10^{-16}\ Vm^{-1}$

$b)$ $60\ \ Vm^{-1}$

c) $6\ 00\ Vm^{-1}$

d) $6\ 000\ Vm^{-1}$

12). An electromagnetic wave propagating along north has its electric field vector upwards . Its magnetic field vector point towards

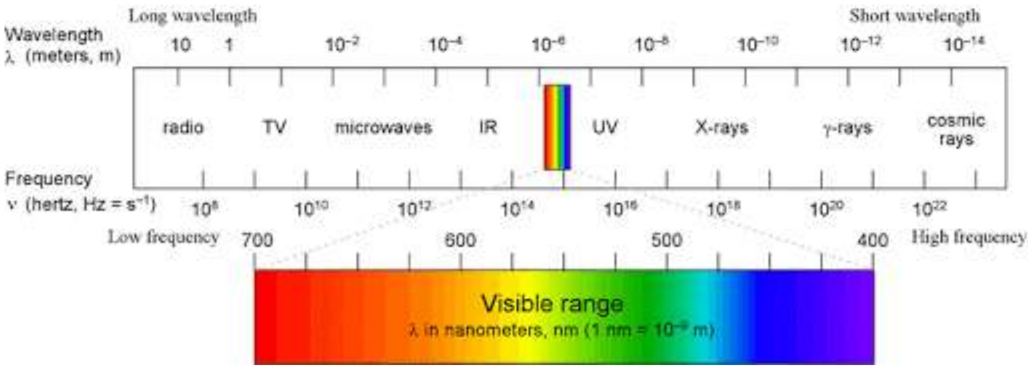
a) North

b) East

c) West

d) Downwards

The array obtained on arranging all the electromagnetic waves in an order on the basis of their wavelength is called the electromagnetic spectrum



i). Which of the following electromagnetic waves have the longest wavelength ?

a) Heat waves

b) Light waves

c) Radio waves

d) Ultraviolet waves

ii). Which of the following rays is emitted by a human body ?

a) X- rays

b) UV rays

c) Visible rays

d) IR rays

iii). Microwave oven acts on the principle of

a) giving rotational energy to water molecules

b) giving vibrational energy to water molecules

c) giving translational energy to water molecules

d) transferring electrons from lower to higher energy levels in water molecules

iv). The structure of solids is investigated by using

a) Infrared rays

b) Ultraviolet rays

c) X – rays

d) Radiowaves

v). Which of the following rays are not electromagnetic waves ?

a) γ – rays

b) β – rays

c) X – rays

d) Heat rays

13. Helmholtz coil is named after the German physicist Hermann von Helmholtz. It is comprised of two identical magnetic coils positioned in parallel to each other, and their centers are aligned in the same x-axis. The two coils are separated by a distance equal to the radius like a mirror image as shown in figure. When current is passing through the two coils in the same direction, it generates a uniform magnetic field in a three-dimension region of space within the coils.

i)Which of the following particles moving in the region inside the Helmholtz coil will not experience a force

(a) Proton
(b) Neutron
(c) Electron
(d) Alpha particle

ii) The Helmholtz coil is used to produce

(a) Uniform magnetic field
(b) Non uniform magnetic field
(c) Uniform electric field

(d) Non uniform electric field

iii) If a current of 5A is flowing through the two coils of the Helmholtz coil in the opposite direction the magnetic field at the centre will be

(a) $\frac{5\mu_0}{2r}$

(b) $\frac{5\mu_0}{r}$

(c) zero

(d) infinite

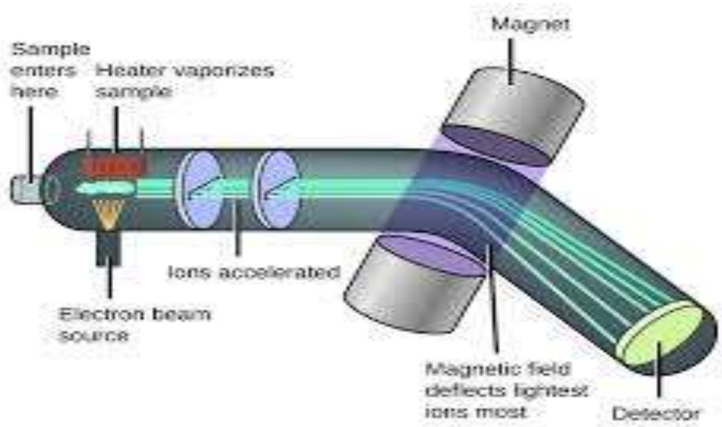
iv) The force experience by the moving charged particle at the centre of the coil is given by the formula

(a) $\vec{F} = q(\vec{v} x \vec{B})$
(b) $\vec{F} = q(\vec{B} x \vec{v})$
(c) $\vec{F} = q\vec{E}$
(d) $\vec{F} = q\left(\overrightarrow{(v x B)} + \vec{E}\right)$

v) If only one coil was present ,the magnetic field at the centre of the coil would be

(a) $\frac{\mu_0 I}{2r}$
(b) $\frac{\mu_0 I}{4r}$
(c) 0
(d) $\frac{\mu_0 I}{8r}$

14. The mass spectrometer is an instrument which can measure the masses and relative concentrations of atoms and molecules. It makes use of magnetic force acting on a moving charged particle. A charged particle moving perpendicular to a magnetic field travels in a circular path having a radius r. This can be used to find the mass of charged particles.



i) A charged particle moving in a magnetic field has increased its velocity, then its radius of the circle
(a) Decreases
(b) Increases
(c) Remains the same
(d) Becomes half

ii)A proton and alpha particle moving with the same velocity enter the field acting perpendicular to the plane of their motion. The ratio of the radii of the circular paths described by the proton and alpha particle is
(a) 1:2
(b) 1:4
(c) 1:16
(d) 4:1

Iii)A positively charged particle moving due east enters a region of uniform magnetic filed directed vertically upwards. The particle will
(a) Get deflected in vertically upward direction

(b) Move in circular path with a decreased speed
(c) Move in a circular path with an increased speed
(d) Move in a circular path with uniform speed

iv) The force on a charge due to the magnetic field can act

(a) On a charge which is at rest
(b) Which is moving in the direction of magnetic field
(c) Moving in the opposite direction of the magnetic field
(d) Moving in the perpendicular direction

v) What happens to the speed of the charged particle moving in the magnetic field of mass spectrometer

(a) Doubles
(b) Becomes half
(c) Remains same
(d) Become zero

15. In polar regions like Alaska and Northern Canada, a splendid display of colours is seen in the sky.During a solar flare, a large number of electrons and protons are ejected from the sun. Some of them get trapped in the earth's magnetic field and move in helical paths along the field lines. The field lines come closer to each other near the magnetic poles. Hence the density of charges increases near the poles. These particles collide with atoms and molecules of the atmosphere. Excited oxygen atoms emit green light and excited nitrogen atoms emits pink light. This phenomenon is called Aurora Borealis

i)The earth behaves as a magnet with magnetic field pointing approximately from the geographic
(a) North to South
(b) South to North
(c) East to West
(d) West to East

ii) The strength of the earth's magnetic field is
(a) constant everywhere.
(b) zero everywhere.
(c) having very high value.
(d) vary from place to place on the earths surface.

iii) Which of the following independent quantities is not used to specify the earth's magnetic field?
(a) Magnetic declination (θ).
(b) Magnetic dip (δ).
(c) Horizontal component of earth's field (B_H).
(d) Vertical component of earth's field (B_V).

iv) The vertical component of the earths magnetic field is zero at
(a) Magnetic poles
(b) Magnetic equator
(c) Geographic poles
(d) Geographic equator

v) The magnetic field of earth is due to
(a) the magnetic dipole buried at the centre of the earth
(b) the motion and distribution of some material inside the earth
(c)the induction effect of the sun
(d) the interaction of cosmic rays with the crust of the earth

16. A dip needle is just like a conventional compass, but instead of holding it horizontally, it is held vertically. It is a magnetic needle used for navigational purposes just like a compass, but is used predominantly when traveling around the north and south poles. Instead of measuring horizontal magnetic deflection, the dip needle measures vertical magnetic inclination.This needle aligns with the Earth's magnetic field. It should be horizontal at the equator, perpendicular at the poles, and somewhere in between for other latitudes.

i) The Earth's magnetic field at a certain place has a horizontal component 0.3 gauss and the total strength is 0.5 guass. The angle of dip is ____.

(a) $\tan^{-1}(3/4)$

(b) $\sin^{-1}$(3/4)

(c) $\tan^{-1}(4/3)$

(d) $\sin^{-1}(3/5)$

ii)At a certain place, the horizontal component of the earth's magnetic field is $\sqrt{3}$ times the vertical component. The angle of dip at the place is .

(a) 75°

(b) 60°

c)45°

d)30°

iii)The angle of dip is the angle ____.

(a)between the vertical component of earth's magnetic field and the geographical meridian

(b)between the horizontal component of earth's magnetic field and the geographical meridian

(c)between the magnetic meridian and the geographical meridian

d)between the earth's magnetic field direction and the horizontal direction

iv) At magnetic poles, the angle of dip is ________.

(a)45°

(b)30°

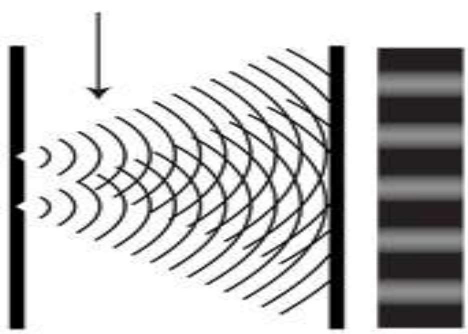
c) zero

(d)90°

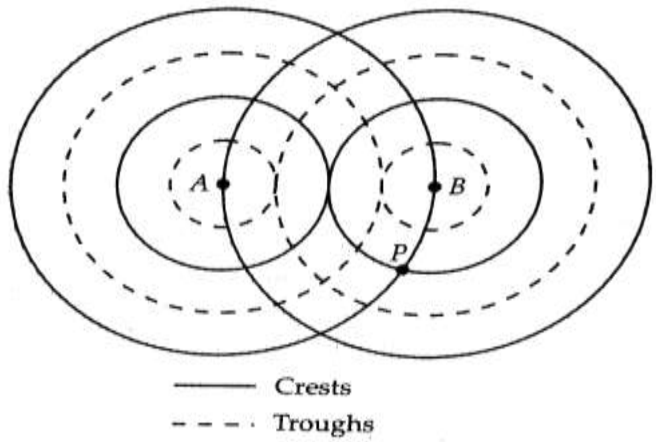
v)The angle of dip at a certain place where the horizontal and vertical components of the earth's magnetic field are equal is

a) 30°
(b) 75°
(c) 60°
(d) 45°

17. When a number of waves travelling through a medium superpose on each other , the resultant displacement at any point at a given instant is equal to the vector sum of the displacements due to the individual waves at that point .



The diagram below shows two sources A and B , vibrating in phase in the same uniform medium and producing circular wave fronts



i) Which phenomenon occurs at point P?

a) Destructive interference

b) Constructive interference

c) Reflection

d) Refraction

ii) Two waves are said to be coherent , if they have

a)same phase and different amplitude

b) different frequency , phase and amplitude

c) same frequency but different amplitude

d) same frequency , phase and amplitude

iii) In Young's double slit experiment, the separation between the slits is halved and the distance between the slits and screen is doubled . The fringe width is

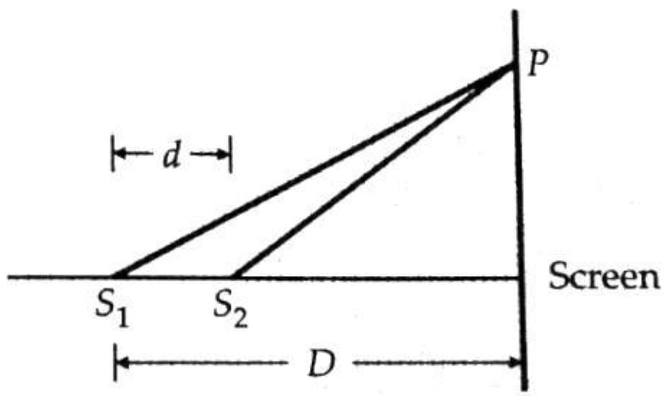
a) unchanged

b) halved

c) doubled

d) quadrupled

iv) Two coherent point sources S_1 and S_2 are separated by a small distance d as shown



The fringes obtained on the screen will be

a) points

b) straight lines

c) semicircles

d) concentric circles

v. In Young's double slit experiment , the slit separation is 1 mm and the screen is 1 m from the slit . For a monochromatic light of wavelength 500 nm , the distance of 3 rd minima from the central maxima is

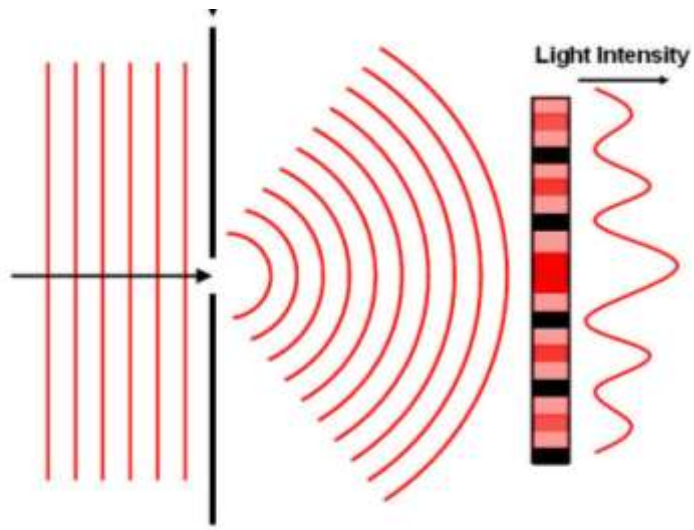
a) 0.50 mm

b) 1.25 mm

c) 1.50 mm

d) 1.75 mm

18.When light passes by an obstacle, it appears to bend round the edges of the obstacle and enters its geometrical shadow. The bending effect is more pronounced if the size of the aperture or the obstacle is of the order of the wavelength of the waves .



i). In diffraction from a single slit , the angular width of the central maxima does not depend on
a) wavelength of light used

b) width of slit

c) distance of slits from screen

d) ratio of wavelength and slit width

ii) .In the phenomenon of diffraction of light , when the blue light is used in the experiment instead of red light ,then

a) fringes will become narrower

b) fringes will become broader

c) no change in the fringe width

d) fringe will gets doubled

iii). The width of the diffraction band varies

a) inversely as the wavelength

b) directly as the width of the slit

c) directly as the distance between the slit and the screen

d) inversely as the size of the source from which the slit is illuminated

iv) . A beam of light of wavelength 600 nm from a distant source falls on a single slit 1mm wide and the resulting diffraction pattern is observed on a screen 2m away . The distance between the first dark fringes on either side of the central bright fringe is

a) 1.2 cm

b) 1.2 mm

c) 2.4 cm

d) 2.4 mm

v). The main difference between the phenomena of interference and diffraction is that

a) diffraction is caused by reflected waves from a source whereas interference is caused due to refraction of waves from a source

b) diffraction is due to interaction of waves derived from the same source , whereas interference is that bending of light from the same wavefront

c) diffraction is due to interaction of light from wavefront , whereas the interference is the interaction of two waves derived from the same source .

d) diffraction is due to interaction of light from the same wavefront whereas interference is the interaction of waves from two isolated sources

19. **BOHR'S THEORY OF HYDROGEN ATOM:**

Hydrogen atom consists of a nucleus having charge +e and an electron having charge –e. The electron is assumed to revolve around the nucleus in circular orbit of radius r.

Coulomb's force of attraction between the nucleus and the electron revolving in an orbit of radius r_n

$$r_n = \frac{n^2 h^2 \varepsilon_o}{\pi m Z e^2}$$

The total energy of an electron in nth orbit is the sum of its kinetic energy and potential energy in that orbit.

$$E_n = -\frac{13.6}{n^2} eV$$

i). Radius of an orbit is

(a) Directly proportional to the principal quantum number.

(b) Directly proportional to the square of the principal quantum number.

(c) Inversely proportional to the principal quantum number.

(d) Inversely proportional tothe square of the principal quantum number.

ii). The radius of the innermost orbit of an electron in hydrogen atom is called

(a) Rutherford's radius

(b) Thomson's radius

(c) Bohr's radius

(d) De-Broglie's radius

iii) Speed of an electron in an orbit of hydrogen atom is

(a) Directly proportional to the principal quantum number.

(b) Directly proportional to the square of the principal quantum number.

(c) Inversely proportional to the principal quantum number.

(d) Inversely proportional to the square of the principal quantum number

iv)The first excited state energy of hydrogen atom.

(a) – 1.51 e V

(b) – 3.4 e V

(c) -13.6 e V

(d) 0 e V

v). The highest energy state of the hydrogen atom.

(a) – 1.51 Ev

(b) – 3.4 e V

(c) -13.6 Ev

(d) 0 e V

20. **The line spectra of hydrogen atom**

According to Bohr, energy is radiated in the form of a photon when the electron of an excited hydrogen atom returns from higher energy state to the lower energy state. The energy of the emitted radiation is given by

$$hv = E_{ni} - E_{nf}$$

When electron jumps from higher energy state to the lower energy in

the hydrogen atom, the radiation of a particular wavelength or frequency is emitted.

(i) The reciprocal of wavelength is known as

(a) Frequency

(b) Time period

(c) wave number

(d) amplitude

(ii) The spectral lines emitted due to the transition of an electron from any outer orbit to the first orbit form a spectral series known as

(a) Balmer series

(b) Lyman series

(c) Paschen series

(d) Brackett series

(iii) The Lyman series lies in the region of electromagnetic spectrum

(a) Visible region

(b) ultra-violet region

(c) Infra-red region

(d) none of these

(iv) The spectral lines emitted due to the transition of an electron from any outer orbit to the fourth orbit form a spectral series is known as

(a) Balmer series

(b) Lyman series

(c) Paschen series

(d) Brackett series

(v) The shortest wavelength of the spectral line of Brackett series

(a) $\frac{16}{R}$

(b) $\frac{25}{R}$

(c) $\frac{9}{R}$

(d) $\frac{1}{R}$

----

21. **Composition of Nucleus, Atomic mass and Size of nucleus**

Atom is very small and its nucleus is very very small. The mass of the nucleus and its constituent particles is expressed by a very small unit called atomic mass unit(a.m.u.). According to Einstein's mass and energy equation this a.m.u. can be converted into energy.

Protons and neutrons in a nucleus are collectively known as nucleons. Size of nucleus can be measured by using scattering experiment. The nuclear size was found to vary linearly with mass number (A).

(1) Atomic mass can be measured with

(a) Simple balance

(b) spring balance

(c) Weighing machine

(d) mass spectrometer

(2) Energy equivalent to 1 a.m.u. is

(a) 1.66×10^{-27}J

(b) 1.49×10^{-19}J

(c) 931J

(d) 931Mev

(3) Calculate the radius of a nucleus of mass number 8

(a) 2.4×10^{-15}m

(b) 2×10^{-15}m

(c) 1.2×10^{-15}m

(d) 2m

(4) Conversion of 1 atomic mass unit into kg

(a) 1.66×10^{-27}kg

(b) 1.49×10^{-19}kg

(c) 931kg

(d) 931kg

(v) What is the nuclear radius of Fe^{125} if that of Al^{27} is 3.6fermi?

(a) 6fermi

(b) 3.6fermi

(c) 2.1fermi

(d) 2fermi

22.NUCLEAR ENERGY:

The energy obtained from the conversion of nuclear mass is known as nuclear energy.Nuclear energy is obtained from nucleus by either:-
Breaking of heavy nucleus into 2 relatively lighter nuclei or byCombining 2 lighter nuclei to form a heavy nucleus.

There are two forces in the nucleus (a) nuclear force and (b) the coulmb's repulsive force.
The sum of the masses of product nuclei is found to be less than the mass of the reactants. This difference in mass is converted into energy.
Large amount of energy is produced due to chain reactions. There are two types of chain reactions (a) un-controlled chain reaction and (b) controlled chain reaction.

(i) The process of breaking of heavy nucleus into2 relatively lighter nuclei is known as
(a) Nuclear fission (b) Nuclear fusion
(c) Chemical reaction (d) Photo electric effect

(ii) The Stellar energy is due to process of
(a) Nuclear fission
(b) Nuclear fusion
(c) Chemical reaction
(d) Photo electric effect

(iii) The difference between the mass of the constituent nucleons of the nucleus in the free state and the mass of the nucleus is known as
(a) Nuclear mass
(b) atomic mass
(c) mass number
(d) mass defect

(iv) The controlled chain reaction can takes place in
(a) van de graff generator
(b) Transformer
(c) Cyclotron
(d) Nuclear reactor

(v) The principle of atom bomb is
(a) Un-controlled chain reaction
(b) controlled chain reaction
(c) Nuclear fusion
(d) Chemical reaction

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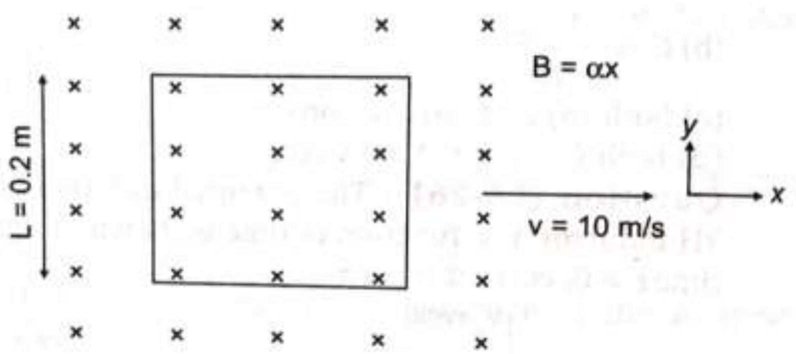
23. According to Faraday's laws of electromagnetic induction, an induced emf appears in a moving conductor due to change in magnetic flux associated with it. An arrangement with a square loop of mass m = 0.1 kg, length L = 0.2 m and resistance R = 80 mΩ lies with its length along the x-axis as shown in the figure. It moves with speed v = 10 m/s in the positive x-direction in a magnetic field which is into the page and has a magnitude that varies with x according to B = α x, where $\alpha = 0.2\ Tm^{-1}$.



i)If loop start moving with the same velocity in x-direction then

(a) Induced emf in the loop will remain the same in magnitude but direction will be opposite
(b) Induced emf in the loop will remain the same both in magnitude and direction
(c) Induced emf in the loop will change in magnitude but direction will be the same
(d) Induced emf in the loop will change both in magnitude and direction

ii)Direction and magnitude of induced current is

(a) 1 A clockwise
(b) 1A anticlockwise
(c) 2 A clockwise
(d) 2A anticlockwise

iii) Net magnetic force on the loop is

(a) 8×10^{-3} N along + x-axis

(b) 8×10^{-3} N along - x-axis
(c) 16×10^{-3} N along +x-axis
(d) 16×10^{-3} N along - x-axis

iv) If loop start moving with the same velocity in +y direction then

(a) induced emf in the loop will be clockwise
(b) induced emf in the loop will be anticlockwise
(c) there will be no induced emf in the loop
(d) data given in the question are insufficient

24. A very small circular loop of area 5×10^{-4} m^2 resistance 2Ω and negligible inductance is initially coplanar and concentric with a much larger fixed circular loop of radius 0.1 m. A constant current of 1 A is passed in the bigger loop is rotated with angular speed ω rad s^{-1}, about the diameter. The magnetic field produced due to bigger loop provides the magnetic flux which is linked with smaller loop. This magnetic flux changes due to the rotation of the bigger loop and hence induced emf and current flows in the smaller loop.

i)According to Faraday's law, magnitude of induced emf depends upon

(a) Initial magnetic flux
(b) Final magnetic flux
(c) Rate of change of magnetic flux
(d) Change in magnetic flux

ii)The total charge induced in a conductor that is moved in a magnetic depends upon

(a) Initial magnetic flux
(b) Final magnetic flux
(c) Rate of change of magnetic flux
(d) Change in magnetic flux

iii)Magnetic field at the centre of bigger loop is

(a) $3\pi \times 10^{-3}$ Wb m^{-2}
(b) $6\pi \times 10^{-3}$ Wb m^{-2}
(c) $\pi \times 10^{-3}$ Wb m^{-2}

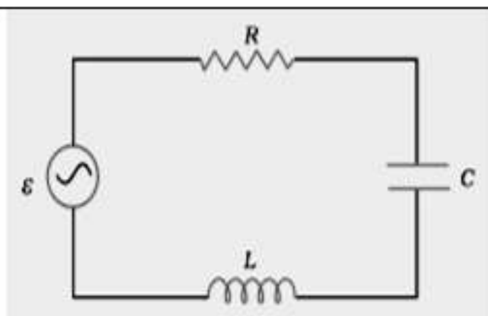
(d) $2\pi \times 10^{-3}$ Wb m^{-2}

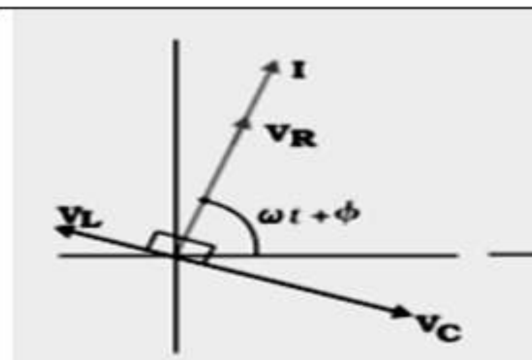
iv)Direction of induced current is given by

(a) Fleming left hand rule
(b) Fleming right hand rule
(c) Right hand thumb rule
(d) Maxwell's cork screw rule

25. From the circuit shown in Figure. We see that the resistor, inductor and capacitor are in series. Therefore, the ac current in each element is the same at any time, having the same amplitude and phase.

Let it be $I = I_m \sin(\omega t + \varphi)$ where φ is the phase difference between the voltage across the source and the current in the circuit. Further, let V_L, V_R, V_C, and V represent the voltage across the inductor, resistor, capacitor and the source, respectively. As we know that V_R is parallel to I, V_C is $\pi/2$ behind I and V_L is $\pi/2$ ahead of I. V_L, V_R, V_C and I are shown in Figure with appropriate phase relations.





i) . Magnitude of applied emf is given by

(a) $\sqrt{{V_R}^2 + (V_L - V_C)^2}$

(b) $\sqrt{{V_R}^2 + (V_L + V_C)^2}$

(c) $\sqrt{V_R + (V_L - V_C)^2}$

(d) $\sqrt{{V_R}^2 + (V_L - V_C)}$

ii). Resonance occur in series LCR when

(a) $R = X_C$
(b) $R = X_L$
(c) $R = X_C + X_L$
(d) $X_L = X_C$

iii). Resonant frequency is given by

(a) $f_r = \frac{1}{\sqrt{2\pi LC}}$
(b) $f_r = \frac{1}{2\pi\sqrt{LC}}$
(c) $f_r = \frac{\pi}{\sqrt{2LC}}$
(d) $f_r = \frac{2}{\sqrt{\pi LC}}$

iv) Impedance of LCR circuit is given by

(a) $\sqrt{R^2 + (X_L - X_C)^2}$
(b) $\sqrt{R + (X_L - X_C)^2}$
(c) $\sqrt{R^2 + {X_L}^2 - {X_C}^2}$
(d) $\sqrt{R^2 + (X_L + X_C)^2}$

26. A transformer is an electrical device which is for changing the ac voltages. It is based on the phenomena of mutual induction. It can be shown that

$$\frac{E_S}{E_P} = \frac{I_P}{I_S} = \frac{N_S}{N_P} = K$$

Where the symbols have their standard meaning. For a step up transformer, K > 1 and for a step down transformer, K < 1.

A power transmission line feeds input power at 2200 V to a step down transformer to get the output power at220 V with its primary windings having 3000 turns

i)In step up transformer

(a) $N_S = N_P^2$
(b) $N_P = N_S^2$
(c) $N_P = N_S$
(d) $N_S > N_P$

ii)In step down transformer

(a) $N_S = N_P^2$
(b) $N_P = N_S^2$
(c) $N_p > N_S$
(d) $N_S = N_P$

iii)Transformation ratio of step down transformer

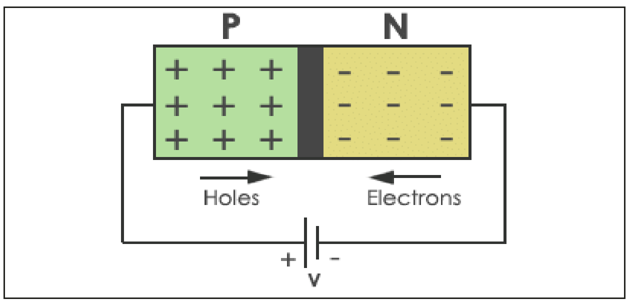
(a) 100
(b) 200
(c) 1/10
(d) 1/100

iv)Number of turns in secondary coil is

(a) 300
(b) 3000
(c) 3
(d) 1/300\

27.

A single piece of a semiconductor material with one portion doped with pentavalent impurity and other portion doped with trivalent impurity behaves as a pn junction diode. The region around the pn junction having no mobile charge carriers. The thickness of this region is about 10^{-7}m. Across the pn junction the potential difference is due to negative immobile ions on p-side and positive immobile ions on n-side. This potential difference is about 0.7V for silicon and 0.38V for germanium crystal at room temperature. The action pn junction diode can be explained under forward and reverse bias of diode.



i).An intrinsic semiconductor doped with pentavalent impurity forms.

(a) P-type extrinsic semi-conductor.

(b) N-type extrinsic semi-conductor.

(c) Silicon crystal

(d) Germanium crystal.

ii). In the above fig. The action of PN junction diode is

(a) Reverse bias

(b) Forward bias

(c) Zero bias

(d) Both reverse and forward bias

iii). The region around the pn junction having no mobile charge carriers.

(a) Depletion region.

(b) Forbidden energy gap

(c) Fermi level

(d) Donor level

iv). The electric field across the region around the PN junction having no mobile charge carriers.

(a) 7×10^{6} V/m

(b) 7×10^{-7}V/m

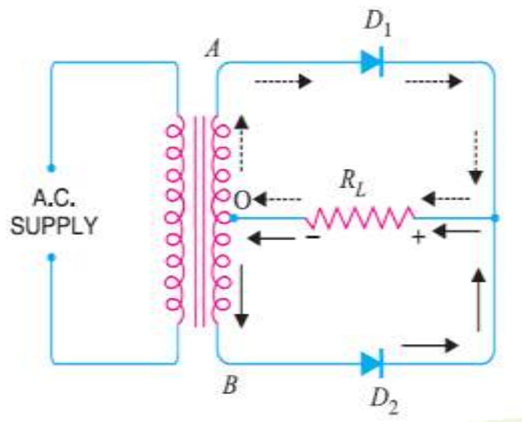
(c) 0.7 V/m

(d) 7×10^{-6}V/m

28.

Junction diode can be used as a rectifier. A rectifier is of two types,

(i) Half wave rectifier and (ii) full wave rectifier. In full wave rectifier, output is continuous. So its efficiency is more than that of the half wave rectifier.



i) Rectification is the process of:

(a) Converting low resistance to high resistance.

(b) Converting high resistance to low resistance.

(c) Converting a.c. into d.c.

(d) Converting d.c. into a.c.

(ii) A rectifier works under the principle of:

(a) Electromagnetic induction

(b) Ohm's law

(c) Junction diode conducts in the forward bias and does not Conduct in the reverse bias.

(d) Junction diode does not conduct in the forward bias and Conducts in the reverse bias.

(iii) Expression for output voltage in rectifier.

(a) $V_{a.c.} = I_{d.c.} \times R_L$

(b) $V_{d.c.} = I_{d.c.} \times R_L$

(c) $I_{d.c.} = V_{d.c.} \times R_L$

(d) $I_{a.c.} = V_{d.c.} \times R_L$

(iv) Type of transformer used in the rectifier:

(a) Step-up transformer

(b) Step-down transformer

(c) Both step-up and step-down transformer

(d) None of the above