West Bengal – 2017

Grade 12

Physics

Total time: 3 hours **Total marks: 70**

Instructions to the candidates:

i. You are required to comply with the directions given by the head invigilator at the examination venue.
ii. Your student id card must be visible on your desk during the entire examination.
iii. Marks will be deducted for bad hand writing.

Group A

Section -1

1. Choose the correct alternate: (1x14=14)

(i) Radio wave to fixed amplitude can be produced by

a. using filter b. using rectifier c. using FET D. using oscillator

Answer: D

Explanation: An Oscillator generates a source of repetitive EM Signal across its output terminals without needing any input. The signal generated by the oscillator of constant amplitude.

(ii) For a transistor if β =100 then α will be

a. 0.99 b.1.01 c.100 d.0.01

Answer: A

Explanation: Relation between α and β is α=β/β+1

β=100 ,then according to relation 100/100+1= 0.99

(iii) A radioactive element emit 2 α particles and 3 β particles the values of atomic number (Z) and mass number (A) of the new element will be

a. (A+5), (Z-1) b. (A-5), (Z+1) c. (A-8), (Z-1) d. (A-8), (Z+1)

Answer:

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

a. more energetic electrons will be emitted.

b. less energetic electrons will be emitted.

c. emission of electrons will depend on the intensity of light.

d. electrons will be emitted.

Answer: D

Explanation:- If red light will incident on the surface of metal electrons will emits because red light has highest wavelength as compare to green and yellow, since it has highest wavelength its frequency is least as compare to the these two light and thats why electrons will emits from its surface. Due to lowest frequency it has

largest value of threshold frequency.

(v). A parallel beam of white light falls on one face of a prism the light emerging from the other face suffers.

a. angular deviation b. no dispersion c. dispersion d. no angular

Answer: C

Explanation: When the beam of sunlight falls on the surface of prism it and passes through the prism it disperse into seven different colour and it forms light spectrum, it shows that sunlight is made up of seven different color.

(vi). A luminous object is separated from a screen by a distance D. what is the greatest focal length that a lens should have to focus the image of the object on the screen

a. D/4 b. D/2 c. D d. 4D

Answer: B

Explanation:

(vii). Electromagnetic waves does not carry

a. energy b. charge c. information d. momentum

Answer: B

Explanation: Electromagnetic waves do not carries any charge, it is created by the result of vibration between electric field and magnetic field, these waves are perpendicular to the direction of movement of electromagnetic waves.

(viii). If L and R denote inductance and resistance respectively then

the dimension of L/R is

a. $M^0L^0T^0$ b. $M^0L^0T^1$ c. $M^2L^0T^0$ d.$M^1L^1T^2$

Answer: B

Explanation: $E=1/2LI^2$ this is the relation between L and E so, dimension of L = dimension of energy/dimension of I^2

$= [ML^2T^{-2}]/[A^2] = [ML^2T^{-2}A^{-2}]$

Similarly we know, relation between R and energy is $E = I^2Rt$

So, dimension of R = dimension of E/dimension of i^2t

$= [ML^2T^{-2}][A^2T] = [ML^2T^{-3}A^{-2}]$

dimension of L/R = dimension of L/dimension of R

$= [ML^2T^{-2}A^{-2}][ML^2T^{-3}A^{-2}] = [T]$

Answer: B

(ix).A proton with a speed of 2×10^7 ms enters a magnetic field of flux density 1.5 Wbm^{-2} making an angle of 30 with the field the force acting on the proton is

Answer: B

Explanation: 2.4×10^{12} N

The magnitude of the magnetic force on a charge particle is

$F = |q| v B \sin \theta$

Here q = charge on a proton = 1.602×10^{-19} C

V = 2 x 107 m/s

$\theta = 30°$

B = 1.5 T

Substituting all these values in the expression for F, we get

$F = 1.602 \times 10^{-19}$ C x 2 x 10^7 m/s x 1.5 T sin 30°

$= 2.403 \times 10^{-12}$ N

(x). A straight conductor of length l m carrying a current 1A is bent in form of semi-circle. The magnetic field (in tesla) at the center of the semicircle is

(xi).Mutual inductance of two coils can be increased by

a. decreasing the number of turns on the coils

b. increasing the number of turns on the coils

c. winding the coils on the wooden core

d. none of these

Answer: B

Explanation: M α n1n2, so, with the increase in number of turns mutual inductance increases.

(xii) The lengths, radii and specific resistances of two conducting wires are each in the ratio of 1:3. If the resistance of the thinner wire is 10. Then the resistance of the thinner wire is 10 then the resistance of the other wire will be

a. 10 b. 20 c. 10 d.5

(xiii) Two capacitors of a capacitances C1 and C2 are connected in parallel. If a charge q is given to the assembly the charge gets shared the ratio of the charge on the capacitor C1 to the charge C2 is

a. C1/C2

b. C2/C1

c. C1C2

d. 1/C1C2

Answer: B

Explanation:-The two capacitors have same V so for the formula Q=CV you get C1=Q2/C2 so the ratio Q1/Q2=C2/C1.

(xiv) The no of electrons in 2 coloumb of charge is

Answer: C

Section II

2. Answer the following question in one sentence each. **(1x4=4)**

(i) What will be the change in focal length f of a concave mirror when immersed in a liquid of refractive index n?

Solution: Focal length of a spherical mirror depends on the radius of curvature of the mirror, since it is the geographical factor it will remain same in air as well as in water, so the focal length of mirror will remain same in the liquid.

F= R/2 which means focal length is half of length of radius of curvature.

(ii) State one difference between a dynamo and a motor.

Dynamo: Convert mechanical energy into electrical energy

Motor: Convert electrical energy into mechanical energy

(iii) On what physical quantity does the magnetic moment of an electron revolving in an orbit depend?

Solution: Angular momentum is the only physical quantity on which magnetic moment of an electron revolving in an orbit speed.

(iv) Is burlows wheel a motor? Give reason

Electric motor transforms electrical energy into mechanical energy. In wheel of Barlow the metal wheel with a horizontal axis has the edge outcropping in the mercury contained in a tank. An intense magnetic field is generated by a magnet and convert energy into mechanical energy.

Group –B

Answer the following question in very short (Alternative are to be noted) (2 x 5=10)

1. Very high or very low resistance cannot be measured correctly by using the Wheatstone bridge principle. Give reason

Solution: Wheatstone bridge cannot be used for the measurement of very low resistance because wire resistance and lead resistance both are very low and this much low value is taken as the error and if very high resistance is there then very low current will pass and this cannot be measured by the galvanometer.

2. A voltmeter of resistance 300 ohm can be used to measure up to 150 V find the value of shunt to be added to make it an ammeter to measure the flow of 8A current.

Solution:- R=300Ω

V=150V

Let the shunt be ‘r’

I=8 Amphere

To convert into ammeter the resistance should be minimum; using V=IR

150=8*[i/r+1/300]

75/4=[300r/300+r]

75(300+r)=1200r

22500= 1200r-75r

R= 22500/1125=20Ω

OR

Define current sensitivity and voltage sensitivity of a moving coil galvanometer.

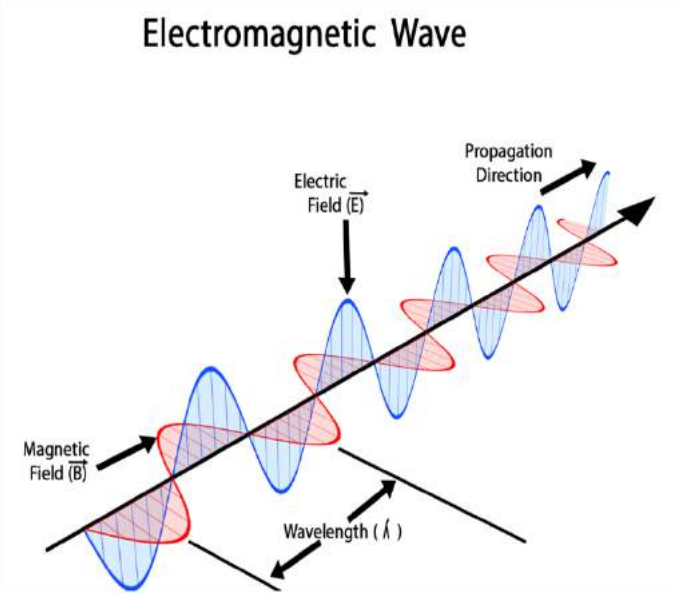
Solution: Current sensitivity is defined as the deflection shown by the galvanometer when unit current is passed through it.

Voltage sensitivity is defined as the deflection show by the galvanometer when unit voltage is applied across the terminals of the circuit.

3. What are the quantities that oscillate in an electromagnetic wave? Show by means of a diagram the relative orientation of the direction

of the electric vector, magnetic vector and propagation of electromagnetic wave.

Solution: An electromagnetic wave consists of two waves that are oscillations of the electric and magnetic fields. An electromagnetic wave travels in a direction that is at right angles to the oscillation direction of both fields.



OR

Why is the ozone layer lying on the upper part of stratosphere helpful for survival of man?

Solution: Ozone layer absorbs the harmful radiation of ultraviolet radiation which causes skin cancer, Actinic keratosis due to which ozone layer is important for life on earth.

4. The voltage supplied across the cathode and anode an x-ray penetrating machine is 50,000V. Determine shortest wavelength of the x ray emitted. Given $h=6.62 \times 10^{-34}$ Js

OR

Write down the β equation decay. Why the detection of neutrons is is difficult?

Solution: The β decay is of two types:

(i) β+ decay: In β+ decay, or "positron emission". The mass number of the radioactive nucleus unchanged but its atomic number decreases by one. A positiron and a few neutrino are emitte from nucleus. The equation is:

$A_ZX \longrightarrow A_{Z-1}X' + e^- + v_e$

(ii) β− decay:- β− decay,the mass number of the radiactive nucleus remain unchanged but its atomic number increses by one. An electron and a few particle antineutrino are emitted from nucleus. The equation is:

$A_ZX \longrightarrow A_{Z+1}X' + e^- + v_e$

5. Define amplitude modulation. The height of a tv tower is 12.5 meter. Find the maximum distance up to which transmitted signal from the tower is available.

Solution: Amplitude Modulation, or AM as it is often called is an electronic communication systems technique wherein the baseband signal is superimposed with the amplitude of the carrier wave

Group – C

Answer the following questions in short (Alternative are to be noted) (3x9=27)

6. Define surface density of electric charge.

Two large conducting spheres carrying charge Q1 and Q2 are brought close to each other. Is the magnitude of the electrostatic force between them exactly given by Q1Q2/4 π ε0 r2. Where r is the distance between their centers.

Solution: Surface charge density (σ) is the quantity of charge per unit area, measured in coulombs per square meter (Cm^{-2}).

The force between two conducting spheres is not exactly given by the expression, Q1Q2/4 π ε_0 r2, because there is no non uniform charge distribution on the spheres.

OR

Define dielectric constant. Two charges $20x10^6$ coulomb placed 2mm apart form an electric dipole. Determine the electric field at a point 10cm away from the center of the dipole on its perpendicular bisector. Given 1/4 π ε_0 r2=$9x10^9$ Nm^2C^{-2}.

Solution: Dielectric constant is defined as the ratio of the permitivity of a substance to the ratio of permitivity of free space. It shows the concentration of electric flux produces by a material.

7.(a) Define dielectric polarisation.

Solution: Polarization is defined as the behaviour shown by the material when external electric field is applied.

(b) Deduce an expression for the potential energy stored in a parallel plate capacitor.

Solution: There is a charge +q on one plate and -q on the other.

Potential of capacitor =q/C

Work done in giving additional charge dq to capacitor is

dW= q/Cxdq

total work done in giving a charge Q to the capacitor is q.

Q=Q

W=1/C $Q^2/2$

Energy stored in the capacitor

$U=W=1/2\ Q^2/C$

WE know that Q=CV

$U=1/2\ (CV)^2/C = 1/2\ CV^2$

Now CV=Q

U=1/2 QV

Result $U=1/2\ Q^2/C$

$=1/2\ CV^2$

=1/2 QV

8 (a) what is cyclotron frequency? Is it possible for a cyclotron to accelerate neutron?

Solution: The cyclotron frequency is the frequency of a charged particle moving perpendicular to the direction of a uniform magnetic field B.

The equation for the cyclotron frequency is. $f = q \times B /(2 \times \pi \times m)$

Cyclotrons work on the principle of Lorentz force. A particle can experience a Lorentz force only if it is charged. Neutrons being uncharged are not accelerated by a cyclotron.

(b) Write down the mathematical form of ampere□s circuital law related to magnetic field produced by electric current.

Solution: According to Ampere□s law, magnetic fields are related to the electric current produced in them. The law specifies the magnetic field that is associated with a given current or vice-versa, provided that the electric field doesn□t change with time.

$$\oint \mathbf{H} \cdot \mathbf{dL} = I_{enc}$$

OR

(a) Define electromagnetic unit of flow of current.

Solution: A unit of electrical charge equal to the amount of charge transferred by a current of 1 ampere in 1 second. coulomb.

(b) A wire of length □l□ is bent in the form a circular loop with a number of turns and is suspended in a magnetic field of intensity B. Find the expression for the maximum torque produced on the circular loop when a current □I□ is passed through it.

Solution: We need to find the magnetic moment which is given as,

M=NIA

Where, N= Number of turns.

I= Current in the coil.

A= Area of the coil,which is a circle.

When the wire of length L is bent in the form of the circle, the perimeter of the circle will be L.

So, 2πr=L

⇒r=L2π

So you can find the area now which is,

A=πr2=π×L24π2=L24π

Here N=1

So magnetic moment has a magnitude of,

M=NIL24π

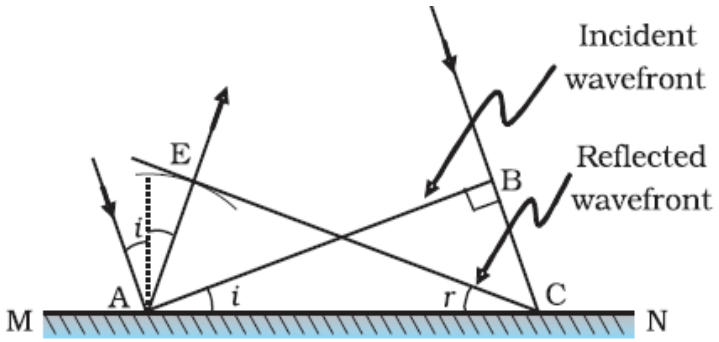
9. A. State one defect of Huygens's wave theory.

Solution: The Huygens principle states that every point on the wave front is the source of wavelets. The wavelets spread out in the forward direction, at the same speed as the source wave. The new wave front is a line tangent to all of the wavelets.

B. Prove the laws of reflection by using Huygens principle.

Solution: Consider a wave front AE incident on the plane reflecting surface XY. No the wave front and the reflecting surface being perpendicular to the plane of paper.

Solution: The ability of an optical instrument to separate or distinguish small or closely adjacent images.



Reflection of a plane wave AB by the reflecting surface MN.
AB and CE represent incident and reflected wavefronts.

First the wave front touches the reflecting touches the reflecting surface at B and then at the successive points towards C. In accordance with Huygens principle from each point on AC, secondary wavelets start growing with the speed c. During the time the disturbance from A reaches the point c, the secondary wavelet from B must have spread over a hemisphere of radius AB=BC =ct, where t is the time taken by the disturbance to travel from E to C. The tangent plane CD drawn from the point C over this hemisphere of radius ct will be the new refracted wave front. Let angle of

incidence and reflection be I and r respectively. In ABC and AEC we have.

$\angle BAC = \angle CBA$

$AC = AC$

$EC = BA$

So triangle ABC= triangle DCB

$\angle i = \angle r$

Hence the angle of incidence is equal to the angle of reflection. Thus this proves the law of reflections.

OR

(a) Define resolving power of an optical instrument.

Solution: Resolving power is defined as the reverse of the distance between two objects which can be just resolved when viewed through the optical instrument.

10. (a) Under what condition will be object and image always be on the same side of the focus of a concave mirror.

Solution: It is well said that concave mirror usually forms real and inverted image and formed image is on the opposite side of the mirror.

But there is one exception in concave mirror when the image formed is on the same side of the mirror.

In this case image formed is virtual, erect and enlarged in size.

Moreover this image is formed when the object is kept in between pole and principal focus of the mirror.

(b) An image of size 1/n times the object size is formed in a convex mirror. If r is the radius of curvature of the mirror. What would be the object distance?

Solution:- U=-Ve

F=+ve

V=+ve

m=v/u=i/n

u=nv => v=u/n

using mirror lens formula:-

1/v+1/u=1/f

n/u-1/u=1/f

n-1/u=1/f

u=f(n-1).

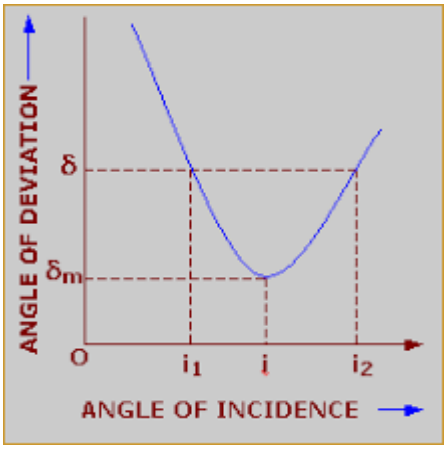
OR

(a) Why is red light used as danger signal?

Solution: Red light is used as the danger signal because it has highest wavelength, due to highest wavelength is scatters less by the air molecules and it is visible from distance.

(b) Explain by using graph the minimum angle deviation of a ray of light passing through a prism

Solution:



From ΔMQR (i-r1) + (e-r2) = δ

(i+e) - (r1+r2) = δ

FROM Δ PQN

r1+r2+ ∠QNR=180

A+ ∠QNR=180

A=r1+r2

i+e-A= δ

At minimum deviation,

i=e, r1=r2 and δ= δm

i=(A+ δm)/2

r=A/2 , μ=sin i /sin r

μ={sin(a+ δ)/2}/sin (A/2)}

11. (a) Production of x ray and emission of electron in photoelectric effect are two opposite phenomenon justify the statement.

Solution:

Photo-electric effect and x-ray production are opposite phenomenon because

In production of x-ray, electrons are accelerated and made to hit a target to get emission of characteristic x-rays. Accelerated electrons produce electromagnetic radiation. But In photo-electric emit, light which is electromagnetic radiation incident on photo-sensitive material and electrons are emitted with kinetic energy.

OR

Explain the characteristic of photoelectric effect on the light of Einstein's equation

Solution:

(i) For a given metal and frequency of incident radiation, the number of photoelectrons ejected per second is directly proportional to the intensity of incident radiation.

(ii) Maximum kinetic energy of the emitted photo electron is independent of the intensity of incident radiations.

(iii) Emission of photoelectrons is instantaneous

In a magnetic field the curvature of the path of a β-particle is greater than of α-particle of the same speed. Explain why.

Solution: Beta Particles (electrons) are much smaller in mass as compared to other particles like proton and Alpha Particles.

R=mv/Bq where R is radius, v is velocity of, B is magnetic field, q is charge

As m is small for a Beta Particle, R is also small as compared to other particles so that why it deflect more.

OR

12. Why is nuclear fusion reactions called a thermonuclear reactions?

Solution: Condition requires for nuclear fusion is extremely high temperature and hence create a large amount of energy due to which it is called thermonuclear reaction.

13. If two inputs of a NAND gate are joined, what type of a gate is formed? Draw V-I characteristic curve for forward and reverse bias in p-n junction diode

Solution: Truth table of NAND gate:-

NAND gate truth table

1	1	0
1	0	1
0	1	1

0 0 | 1

1 denotes high voltage.

0 denotes low voltage.

V-I characteristic in forward biasing

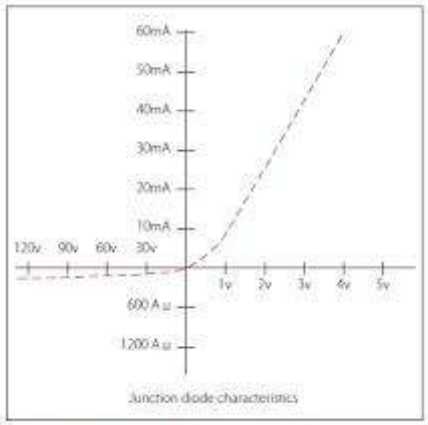


Figure 10-200. Diode biased in both directions.

Important feature of the graph:

Initially the current increases very slowly almost negligible till the voltage across the diode crosses a certain value called threshold

voltage. Before this characteristic voltage the depletion layer plays a dominant role in controlling thr motion of charge carriers

After the cut-in voltage the diode current increases rapidly even for a very small increase in the dipole bias voltage. Here the majority charge carriers feel negligible resistance at the junction.

V-I characteristic in reverse biasing

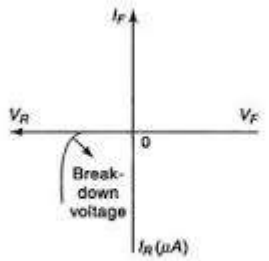


Figure V-I characteristics under reverse bias

When the diode is reverse diode, the reverse bias voltage produces a very small current about remains constant with bias. This small current is called reverse saturation current.

When the reverse voltage across the p-n junction reaches a sufficient high value the reverse currrent suddenly increses to a large value. This voltage at which brekdown of the juncton diode occurs is callled zener breakdown voltage or peak-invere voltage.

14. (a)State one difference between p type n type semiconductor.

Solution:- for making p-type semiconductor 3rd group element of periodic table is used for doping while for making n-type element 5th group elements are added, n-type semiconductor have 5 valance electron while p-type have 3 valance electron.

(b) In a transistor emitter base junction is always forward biased, while the collector base junction is reverse-biased. Why?

Solution:- When the base emitter junction is forward biased and the collector base junction is reversed biased the electrons moves from

n-type region, when the reach each other they combine enabling a current flow across the junction.

GROUP-D

Answer the following question (Alternatives will be noted): (5 x 3=15)

15.(a) Show that equivalent resistance in parallel combination is always less than each of the individual resistance connected in the combination.

Solution:- There are resistances R1, R2□..Rn and equivalent resistance be Rq□.so 1/Rq=1/R1 +1/R2 + □..1/Rn and let the smallest resistance be R1 (suppose)□□□so□..1/Rq > 1/R1

since 1/Rq=1/R1+1/R2□..1/Rn which is always greater than 1/R1

so Rq< R1□□□□hence smaller than the smallest resistance.

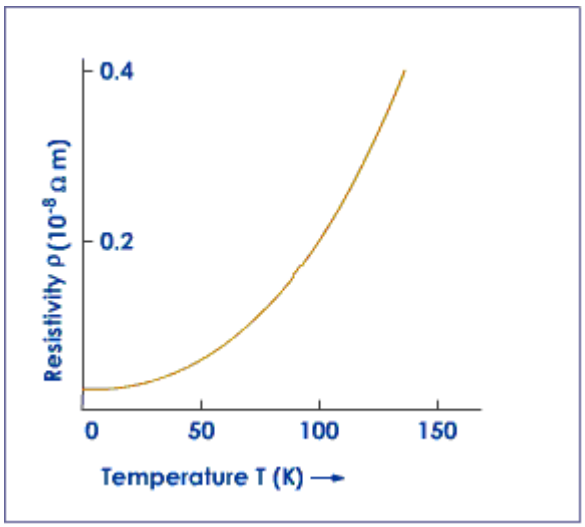
(b) How can be sensitivity of a potentiometer be increased?

Solution: Sensitivity of potentiometer can be increased by increasing the length of potentiometer and reducing the current in the circuit.

OR

Draw a graph representing the change in specific resistance with temperature.

Solution:

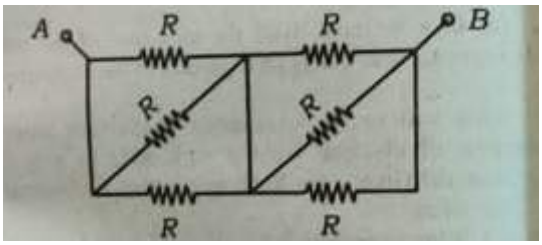


Relation between specific resistance and temperature $\rho_t = \rho_0 [1 + \alpha (T - T_0)$.

As the temperature increase resistivity will increase and vice-versa.

Find the equivalent resistance between two ends A and B of the following circuit.

Solution:-



3 x 1/R=1/Req

Req=R/3

Now, they will be in

R/3+R/3=2R/3

(c) Define lost volt. State the factors on which the internal resistance of cell depends.

Solution: Potential energy which is lost during the transfer of current from one point to the point in the circuit is called lost current.

Factors which affects this are internal resistance of cell, distance between the electrodes of cell and conductivity of the electrodes.

16. (a) Define Wattless current.

Solution: when the average power consumed in such circuit corresponds to Zero. Such current is also called as wattles Current.

(b) Show that Len'z law obeys the law of conservation of energy.

Solution: Lenz's Law states whenever induce a current in a wire via a changing magnetic field, the current flows through the wire in such a direction so that its magnetic field opposes the change that produced the current.

So, moving a wire in which current flows through magnetic field the mechanical energy of moving wire is converts into electrical energy due to which energy is conserved and Lenz law follow conservation law.

Show that in a.c circuit the average power dissipated per cycle in a pure conductor is zero.

Solution: Formula of average power supplied by a source over a complete

$P=VI \cos \theta$

$\cos \theta$ is the power factor.

For pure inductive circuit

The phase difference between the voltage and current is $\pi/2$

Due to which $P=VI \cos \pi/2$

$\cos \pi/2 =0$, $P=0$

And average power dissipates is zero.

OR

Compare between inductive resistance and capacitive resistance

Solution: Inductive resistance is to cause the current to lag the voltage. Where as capacitive reactance is to cause the current to lead the voltage.

State the factors on which the peak value of alternating current depends

Solution: The pick value depends on impedance of the circuit. The more the AC waveform departs in smoothness from a square wave, the higher will be the likely peak value of the AC voltage. Obviously the highest peak voltage will be the case where the entire voltage exists for only a very short time interval in each voltage half-cycle.

17. (a) With diagram, state the reason for short sightedness and mention its remedies

Solution: Short sight occurs because the light coming from the object fall and make focus in front of retina. It happens because eyeball is too long or cornea is too curved.

Remedies: (i) Prescription lenses: By wearing corrective lenses which increase the curvature of cornea and helps in focusing the light on the retina.

(ii) Refractive surgery: This can be treated by the surgery in which shape of cornea is reshaped which result into the formation of image on the retina.