SAMPLE PAPER TEST 02 FOR BOARD EXAM 2025

SUBJECT: PHYSICS — **MAX. MARKS : 70**

CLASS : XII — **DURATION: 3 HRS**

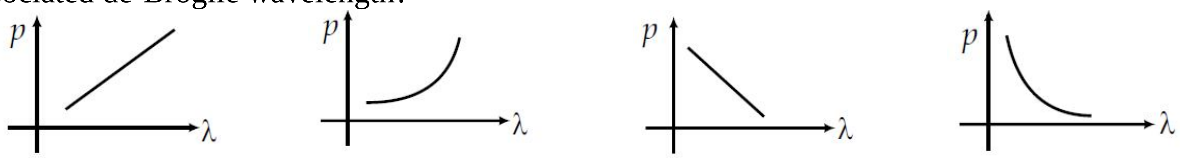
General Instructions:

1. There are 33 questions in all. All questions are compulsory
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. Section A contains sixteen questions, twelve MCQ and four Assertion-Reasoning based questions of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

SECTION – A

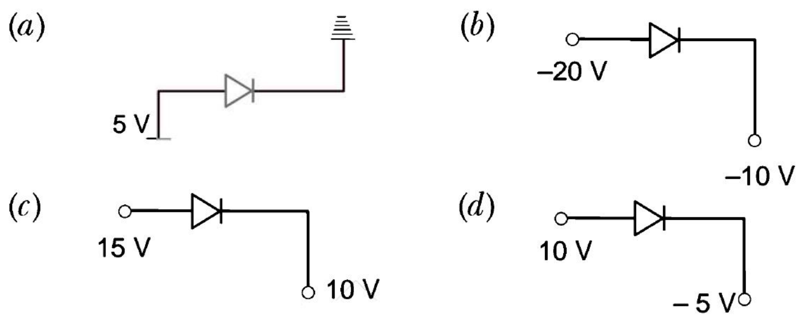
Questions 1 to 16 carry 1 mark each.

1. Which of the following graphs correctly represents the variation of a particle momentum with its associated de-Broglie wavelength?



(a) (b) (c) (d)

2. Which is reverse biased diode?



3. The capacitors, each of 4 μF are to be connected in such a way that the effective capacitance of the combination is 6 μF. This can be achieved by connecting

(a) All three in parallel

(b) All three in series

(c) Two of them connected in series and the combination in parallel to the third.

(d) Two of them connected in parallel and the combination in series to the third.

4. The radius of the nth orbit in Bohr model of hydrogen atom is proportional

(a) n^2 (b) $1/n^2$ (c) n (d) 1/n

5. A point charge is situated at an axial point of a small electric dipole at a large distance from it. The charge experiences a force F. If the distance of the charge is doubled, the force acting on the charge will become

(a) 2F (b) F/2 (c) F/4 (d) F/8.

6. In a dc circuit the direction of current inside the battery and outside the battery respectively are
(a) positive to negative terminal and negative to positive terminal
(b) positive to negative terminal and positive to negative terminal
(c) negative to positive terminal and positive to negative terminal
(d) negative to positive terminal and negative to positive terminal

7. The Young's double-slit experiment is performed with blue and green lights of wavelengths 4360 Å and 5460 Å respectively. If x is the distance of 4th maxima from the central one, then
(a) $(x)_{blue} = (x)_{green}$ (b) $(x)_{blue} > (x)_{green}$ (c) $(x)_{blue} < (x)_{green}$ (d) $\frac{(x)_{blue}}{(x)_{green}} = \frac{5460}{4360}$

8. In a Young's double-slit experiment, the screen is moved away from the plane of the slits. What will be its effect on the following?
(i) Angular separation of the fringes.
(ii) Fringe-width.
(a) Both (i) and (ii) remain constant.
(b) (i) remains constant, but (ii) decreases.
(c) (i) remains constant, but (ii) increases.
(d) Both (i) and (ii) increase.

9. A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Weber/m?. The coil carries a current of 2 A. If the plane of the coil is inclined at an angle of 30^0 with the direction of the field, the torque required to keep the coil in stable equilibrium will be
(a) 0.24 Nm (b) 0.12 Nm (c) 0.15 Nm (d) 0.20 Nm

10. The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is
(a) 64/125 (b) 4/5 (c) 5/4 (d) 1

11. A hydrogen atom makes a transition from n = 5 to n = 1 orbit. The wavelength of photon emitted is λ. The wavelength of photon emitted when it makes a transition from n = 5 to n = 2 orbit is
(a) 8λ/7 (b) 16λ/7 (c) 24λ/7 (d) 32λ/7

12. Which of the following has its permeability less than that of free space?
(a) Copper (b) Aluminium (c) Copper chloride (d) Nickel

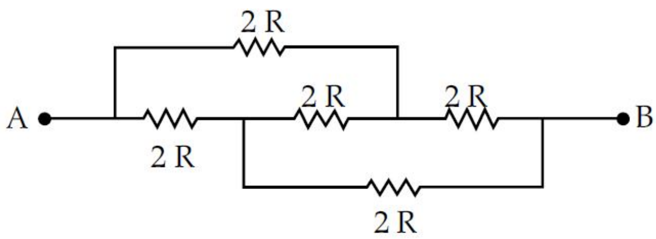
ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).
(b) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).
(c) Assertion (A) is true and Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.

13. Assertion (A): The resistance of an intrinsic semiconductor decreases with increase in its temperature.
Reason (R): The number of conduction electrons as well as hole increase in an intrinsic semiconductor with rise in its temperature.

14. Assertion (A) : Susceptibility is defined as the ratio of intensity of magnetisation *I* to magnetic intensity H.
Reason (R) : Greater the value of susceptibility, smaller the value of intensity of magnetisation *I*.

15. Assertion (A): The equivalent resistance between points A and B in the given network is 2R.
Reason (R): All the resistors are connected in parallel



16. Assertion (A): An electron and a photon possessing same wavelength, will have the same momentum.
Reason (R): Momentum of both particle is same by de Broglie hypothesis.

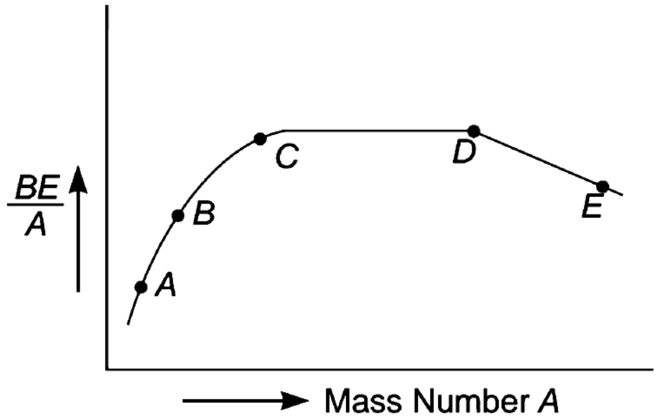
SECTION – B

Questions 17 to 21 carry 2 marks each.

17. (i) How are infrared waves produced? Write their one important use.
(ii) The thin ozone layer on top of the stratosphere is crucial for human survival. Why?

18. The potential difference applied across a given conductor is doubled. How will this affect (i) the mobility of electrons and (ii) the current density in the conductor? Justify your answers. 2

19. The figure shows the plot of binding energy (BE) per nucleon as a function of mass number A. The letters A, B, C, D and E represent the positions of typical nuclei on the curve. Point out, giving reasons, the two processes (in terms of A, B, C, D and E), one of which can occur due to nuclear fission and the other due to nuclear fusion.

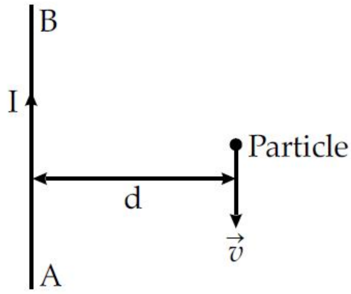


20. How would the stopping potential for a given photosensitive surface change if (i) the frequency of the incident radiation were increased? and (ii) the intensity of incident radiation were decreased? Justify your answer.

21. Write the expression for the Lorentz force on a particle of charge q moving with a velocity $\vec{v}$ in a magnetic field $\vec{B}$. When is the magnitude of this force maximum? Show that no work is done by this force on the particle during its motion from a point $\vec{r_1}$ to point $\vec{r_2}$.

OR

A long straight wire AB carries a current I. A particle (mass m and charge q) moves with a velocity $\vec{v}$, parallel to the wire, at a distance d from it as shown in the figure. Obtain the expression for the force experienced by the particle and mention its directions.



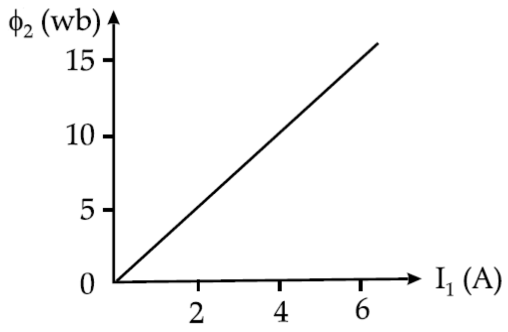
SECTION – C

Questions 22 to 28 carry 3 marks each.

22. Two coils C_1 and C_2 are placed close to each other. The magnetic flux ϕ_2 linked with the coil C_2 varies with the current I_1 flowing in coil C_1, as shown in the figure. Find

(i) the mutual inductance of the arrangement, and

(ii) the rate of change of current $\left(\frac{dI_1}{dt}\right)$ that will induce an emf of 100 V in coil C_2.



23. A plane wave-front propagating in a medium of refractive index 'μ_1' is incident on a plane surface making an angle of incidence (i). It enters into a medium of refractive index μ_2 ($\mu_2 > \mu_1$). Use Huygen's construction of secondary wavelets to trace the retracted wave-front. Hence, verify Snell's law of refraction.

24. (i) Differentiate between 'distance of closest approach' and 'impact parameter'.

(ii) Determine the distance of closest approach when an alpha particle of kinetic energy 3.95 MeV approaches a nucleus of Z = 79, stops and reverses its directions.

OR

(i) How is the size of a nucleus found experimentally? Write the relation between the radius and mass number of a nucleus.

(ii) Prove that the density of a nucleus is independent of its mass number.

25. A series CR circuit with R = 200 W and C = $(50/\pi)$ μF is connected across an ac source of peak voltage ε_0, = 100 V and frequency n = 50 Hz. Calculate (a) impedance of the circuit (Z), (b) phase angle (ϕ), and (c) voltage across the resistor.

26. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.

27. Depict the orientation of an electric dipole in (a) stable and (b) unstable equilibrium in an external uniform electric field. Write the potential energy of the dipole in each case.

28. State the basic principle behind the working of an ac generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

SECTION – D (Case Study Based Questions)

Questions 29 to 30 carry 4 marks each.

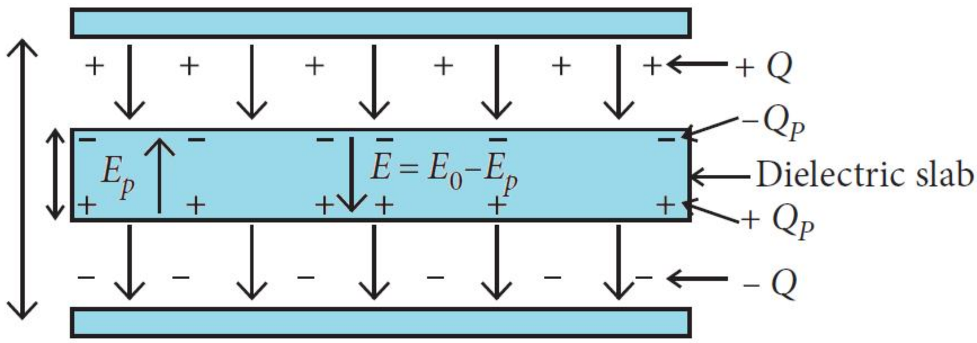
29. Case-Study 1:

Read the following paragraph and answer the questions

Dielectric Slab

A dielectric slab is a substance which does not allow the flow of charges through it but permits them to exert electrostatic forces on one another.

When a dielectric slab is placed between the plates, the field E_0 polarises the dielectric. This induces charge $-Q_p$ on the upper surface and $+Q_p$ on the lower surface of the dielectric. These induced charges set up a field E_p inside the dielectric in the opposite direction of $\vec{E_0}$ as shown.



(i) In a parallel plate capacitor, the capacitance increases from 4μF to 80μF, on introducing a dielectric medium between the plates. What is the dielectric constant of the medium?
(a) 10 (b) 20 (c) 50 (d) 100

(ii) A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the plates is now reduced half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in second case.
(a) 8 pF (b) 10 pF (c) 80 pF (d) 100 pF

(iii) A dielectric introduced between the plates of a parallel plate condenser
(a) decreases the electric field between the plates (b) increases the capacity of the condenser
(c) increases the charge stored in the condenser (d) increases the capacity of the condenser

(iv) A parallel plate capacitor of capacitance 1 pF has separation between the plates is *d*. When the distance of separation becomes 2*d* and wax of dielectric constant *x* is inserted in it the capacitance becomes 2 pF. What is the value of *x*?
(a) 2 (b) 4 (c) 6 (d) 8

OR

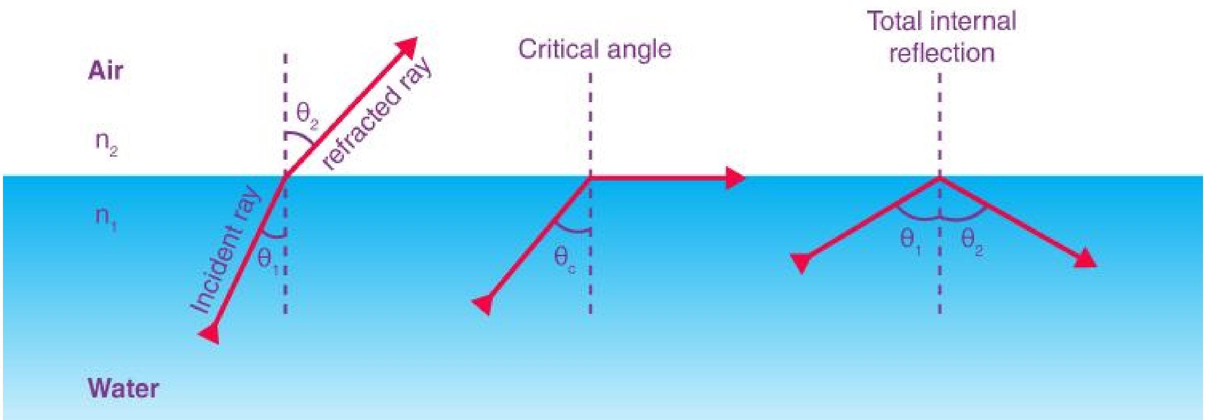
(v) A parallel plate capacitor having area A and separated by distance d is filled by copper plate of thickness b. The new capacity is
(a) $\dfrac{\varepsilon_0 A}{d+\dfrac{b}{2}}$ (b) $\dfrac{\varepsilon_0 A}{2d}$ (c) $\dfrac{\varepsilon_0 A}{d-b}$ (d) $\dfrac{2\varepsilon_0 A}{d+\dfrac{b}{2}}$

30. Case-Study 2:

Read the following paragraph and answer the questions.

Total Internal Refraction

Total internal reflection is the phenomenon of reflection of light into denser medium at the interface of denser medium with a rarer medium. For this phenomenon to occur necessary condition is that light must travel from denser to rarer and angle of incidence in denser medium must be greater than critical angle (C) for the pair of media in contact. Critical angle depends on nature of medium and wavelength of light. We can show that $\mu = \dfrac{1}{\sin C}$.



(i) Critical angle for glass air interface, where m of glass is 3/2, is

(a) 41.8° (b) 60° (c) 30° (d) 15°

(ii) Critical angle for water air interface is 48.6°. What is the refractive index of water?

(a) 1 (b) 3/2 (c) 4/3 (d) 3/4

(iii) Critical angle for air water interface for violet colour is 49°. Its value for red colour would be

(a) 49° (b) 50° (c) 48° (d) cannot say

(iv) Which of the following is not due to total internal reflection?

(a) Working of optical fibre. (b) Difference between apparent and real depth of a pond.

(c) Mirage on hot summer days. (d) Brilliance of diamond.

OR

(v) Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$).

(a) less than θ_2 (b) between θ_1 and θ_2 (c) greater than θ_2 (d) less than θ_1

SECTION – E

Questions 31 to 33 carry 5 marks each.

31. (i) State Huygen's principle. With the help of a diagram, show how a plane wave is reflected from a surface. Hence, verify the law of reflection.

(ii) A concave mirror of focal length 12 cm forms a three times magnified virtual image of an object. Find the distance of the object from the mirror.

OR

(i) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope.

(ii) The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.

32. (i) Explain how free electrons in a metal at constant temperature attain an average velocity under the action of an electric field. Hence obtain an expression for it.

(ii) Consider two conducting wires A and B of the same diameter but made of different materials joined in series across a battery. The number density of electrons in A is 1.5 times that in B. Find the ratio of drift velocity of electrons in wire A to that in wire B.

OR

(i) A cell emf of (E) and internal resistance (r) is connected across a variable load resistance (R). Draw plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load.

(ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r are connected in parallel across a resistor R.

Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.

33. Draw the circuit arrangement for studying V-I characteristics of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Draw the typical V-I characteristics of a silicon diode. Describe briefly the following terms: (i) minority carrier injection in forward biasing and (ii) breakdown voltage in reverse biasing.

OR

Name two important processes involved in the formation of a p-n junction diode. With the help of a circuit diagram, explain the working of junction diode as a full wave rectifier. Draw its input and output waveforms. State the characteristic property of a junction diode that makes it suitable for rectification.

SAMPLE PAPER TEST 02 FOR BOARD EXAM 2025

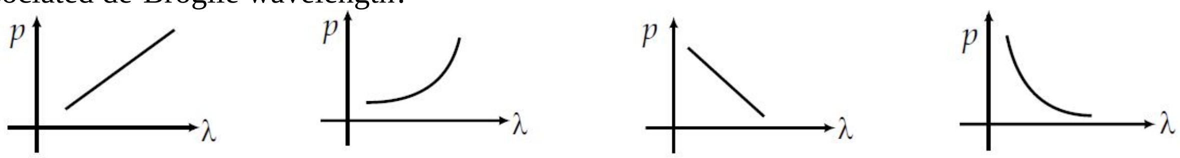
SUBJECT: PHYSICS **(ANSWERS)** **MAX. MARKS : 70**
CLASS : XII **DURATION: 3 HRS**

General Instructions:
1. There are 33 questions in all. All questions are compulsory
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. Section A contains sixteen questions, twelve MCQ and four Assertion-Reasoning based questions of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

SECTION – A

Questions 1 to 16 carry 1 mark each.

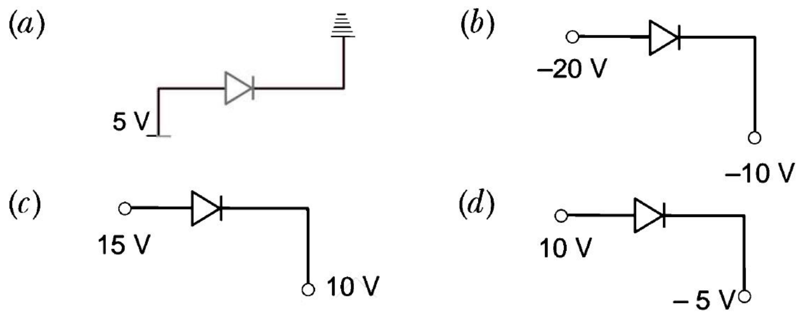
1. Which of the following graphs correctly represents the variation of a particle momentum with its associated de-Broglie wavelength?



(a) (b) (c) (d)

Ans: (d)

2. Which is reverse biased diode?



Ans: (b) Because p-side is more negative as compared to n-side.

3. The capacitors, each of 4 μF are to be connected in such a way that the effective capacitance of the combination is 6 μF. This can be achieved by connecting

(a) All three in parallel
(b) All three in series
(c) Two of them connected in series and the combination in parallel to the third.
(d) Two of them connected in parallel and the combination in series to the third.

Ans: (c) Two of them connected in series and the combination in parallel to the third.

4. The radius of the nth orbit in Bohr model of hydrogen atom is proportional

(a) n^2 (b) $1/n^2$ (c) n (d) 1/n

Ans: (a) n^2

5. A point charge is situated at an axial point of a small electric dipole at a large distance from it. The charge experiences a force F. If the distance of the charge is doubled, the force acting on the charge will become

(a) 2F (b) F/2 (c) F/4 (d) F/8.

Ans: (d) F/8

6. In a dc circuit the direction of current inside the battery and outside the battery respectively are

(a) positive to negative terminal and negative to positive terminal

(b) positive to negative terminal and positive to negative terminal

(c) negative to positive terminal and positive to negative terminal

(d) negative to positive terminal and negative to positive terminal

Ans: (c) negative to positive terminal and positive to negative terminal

Inside the battery ions (i.e. electron) move from positive to negative plates of electrodes. So, current flows from negative terminal to positive terminal. But outside the battery current flows from positive terminal to negative terminal.

7. The Young's double-slit experiment is performed with blue and green lights of wavelengths 4360 Å and 5460 Å respectively. If x is the distance of 4th maxima from the central one, then

(a) $(x)_{blue} = (x)_{green}$ (b) $(x)_{blue} > (x)_{green}$ (c) $(x)_{blue} < (x)_{green}$ (d) $\frac{(x)_{blue}}{(x)_{green}} = \frac{5460}{4360}$

Ans: (c) $(x)_{blue} < (x)_{green}$

As $\chi_n = \frac{n\lambda D}{d}$ (nth of bright fringes)

$\chi_n \propto \lambda \Rightarrow \lambda_{blue} < \lambda_{green} \Rightarrow \chi_{blue} < \chi_{green}$

8. In a Young's double-slit experiment, the screen is moved away from the plane of the slits. What will be its effect on the following?

(i) Angular separation of the fringes.

(ii) Fringe-width.

(a) Both (i) and (ii) remain constant. (b) (i) remains constant, but (ii) decreases.

(c) (i) remains constant, but (ii) increases. (d) Both (i) and (ii) increase.

Ans: (c) (i) remains constant, but (ii) increases.

9. A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Weber/m?. The coil carries a current of 2 A. If the plane of the coil is inclined at an angle of 30^0 with the direction of the field, the torque required to keep the coil in stable equilibrium will be

(a) 0.24 Nm (b) 0.12 Nm (c) 0.15 Nm (d) 0.20 Nm

Ans: (d) 0.20 Nm

10. The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is

(a) 64/125 (b) 4/5 (c) 5/4 (d) 1

Ans: (d) 1

11. A hydrogen atom makes a transition from n = 5 to n = 1 orbit. The wavelength of photon emitted is λ. The wavelength of photon emitted when it makes a transition from n = 5 to n = 2 orbit is

(a) 8λ/7 (b) 16λ/7 (c) 24λ/7 (d) 32λ/7

Ans: (d) 32λ/7

12. Which of the following has its permeability less than that of free space?

(a) Copper (b) Aluminium (c) Copper chloride (d) Nickel

Ans: (a) Copper

ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

(a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).

(b) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is also false.

13. Assertion (A): The resistance of an intrinsic semiconductor decreases with increase in its temperature.

Reason (R): The number of conduction electrons as well as hole increase in an intrinsic semiconductor with rise in its temperature.

Ans: (a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).

In semiconductors, as temperature increases, thermally generated electron and hole pair increases and the resistance decreases.

Hence, assertion and reason both are correct and the reason explains the assertion.

14. Assertion (A) : Susceptibility is defined as the ratio of intensity of magnetisation *I* to magnetic intensity H.

Reason (R) : Greater the value of susceptibility, smaller the value of intensity of magnetisation *I*.

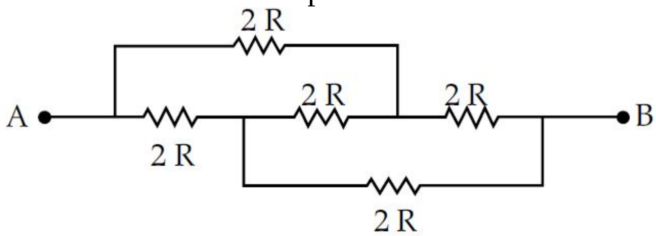
Ans: (c) A is true but R is false.

From the relation, $\chi_m = \dfrac{I}{H} \Rightarrow \chi_m \propto I$

Thus, it is option that greater the value of supportability of a material greater will be the value of interesting of magnetisation.

15. Assertion (A): The equivalent resistance between points A and B in the given network is 2R.

Reason (R): All the resistors are connected in parallel



Ans: (c) Assertion (A) is true and Reason (R) is false.

The given resistance network represents in the bridge balance condition, so the equivalent resistance between A and B will be 2R, Hence assertion (A) is correct but Reason (R) is false because all resistances are not in parallel.

16. Assertion (A): An electron and a photon possessing same wavelength, will have the same momentum.

Reason (R): Momentum of both particle is same by de Broglie hypothesis.

Ans: (a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).

SECTION – B

Questions 17 to 21 carry 2 marks each.

17. (i) How are infrared waves produced? Write their one important use.

(ii) The thin ozone layer on top of the stratosphere is crucial for human survival. Why?

Ans: (i) Infrared waves are produced by hot bodies and molecules.

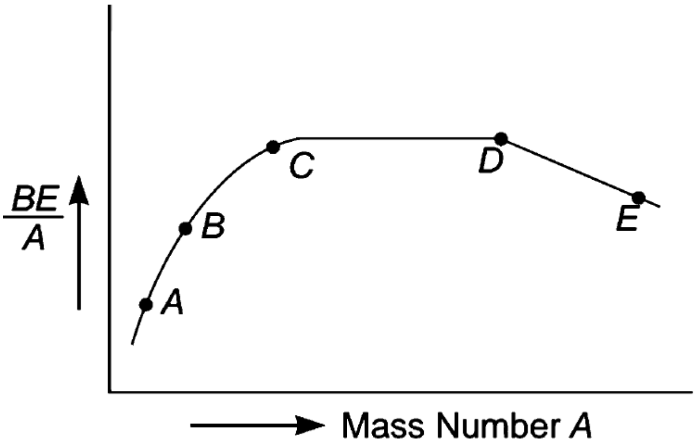
Important use:

(a) To treat muscular strains

(b) To reveal the secret writings on the ancient walls
(c) For producing dehydrated fruits
(d) Solar heater
(e) Solar cooker
(ii) Ozone layer protects us from harmful UV rays.

18. The potential difference applied across a given conductor is doubled. How will this affect (i) the mobility of electrons and (ii) the current density in the conductor? Justify your answers. 2
Ans: (i) Mobility ∝ 1/Potential difference
So, if potential difference is doubled, mobility will be halved.
(ii) Current density ∝ Potential difference
So, if potential difference is doubled, current density will also be double.

19. The figure shows the plot of binding energy (BE) per nucleon as a function of mass number A. The letters A, B, C, D and E represent the positions of typical nuclei on the curve. Point out, giving reasons, the two processes (in terms of A, B, C, D and E), one of which can occur due to nuclear fission and the other due to nuclear fusion.



Ans: The nuclei A and B undergo nuclear fusion as their binding energy per nucleon is small and they are less stable so they fuse with other nuclei to become stable. The nuclei at E undergo nuclear fission as its binding energy per nucleon is less it splits into two or more lighter nuclei and becomes stable.

20. How would the stopping potential for a given photosensitive surface change if (i) the frequency of the incident radiation were increased? and (ii) the intensity of incident radiation were decreased? Justify your answer.
Ans: (i) From Einstein's photoelectric equation,
$h\nu = \phi_0 + KE$
$KE = eV_s$, where V_S is the stopping potential.
Stopping potential depends on the frequency of the incident radiation. If frequency increases KE increases (Since, ϕ_0 remains constant). Hence, stopping potential increases.
(ii) There is no intensity term in Einstein's equation. Hence, stopping potential is independent of intensity of incident radiation.

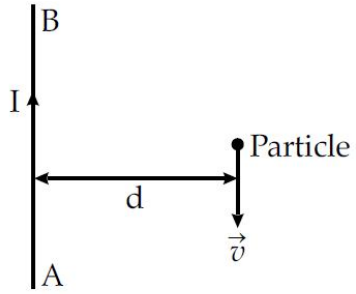
21. Write the expression for the Lorentz force on a particle of charge q moving with a velocity $\vec{v}$ in a magnetic field $\vec{B}$. When is the magnitude of this force maximum? Show that no work is done by this force on the particle during its motion from a point $\vec{r}_1$ to point $\vec{r}_2$.
Ans: Expression for Lorentz force: $\vec{F} = q(\vec{v} \times \vec{B})$

The force is maximum when the angle between $\vec{v}$ and $\vec{B}$ is 90^0.

Here, $\vec{F}$ is perpendicular to $\vec{v}$. So, no work is done by this force on the particle during its motion

OR

A long straight wire AB carries a current I. A particle (mass m and charge q) moves with a velocity $\vec{v}$, parallel to the wire, at a distance d from it as shown in the figure. Obtain the expression for the force experienced by the particle and mention its directions.



Ans: Magnetic field produced by the current carrying from a point $\vec{r_1}$ to point $\vec{r_2}$ wire,

The direction of field is ⊗

Force acting on the particle = $q(\vec{v}\times\vec{B})$

Here, θ = 90°

So, Force = $qvB = \frac{qv\mu_0 I}{2\pi I} = \frac{\mu_0}{2\pi}\frac{qv}{d}$

Its direction is towards right. Repulsive.

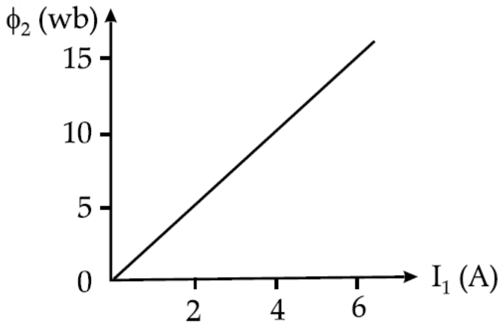
SECTION – C

Questions 22 to 28 carry 3 marks each.

22. Two coils C_1 and C_2 are placed close to each other. The magnetic flux ϕ_2 linked with the coil C_2 varies with the current I_1 flowing in coil C_1, as shown in the figure. Find

(i) the mutual inductance of the arrangement, and

(ii) the rate of change of current $\left(\frac{dI_1}{dt}\right)$ that will induce an emf of 100 V in coil C_2.



Ans: (i) Since, $N_2\phi_2 = MI_1$

From graph, ϕ_2 = 10Wb corresponding to I_1 = 4A

and ϕ_2 = 10Wb

∴ $N_2 \times 10 = M \times 4$

Considering $N_2 = 1$

M = 10/4 = 2.5H

(ii) Again, $N_2\phi_2 = MI_1$

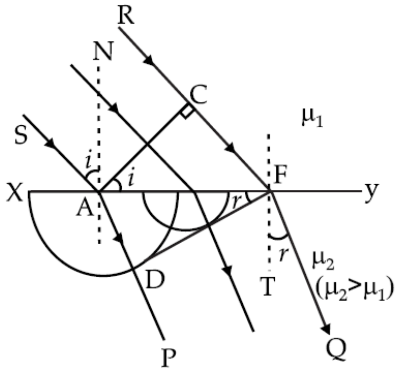
$$\frac{d}{dt}(N_2\phi_2) = \frac{d}{dt}(MI_1) \Rightarrow N_2\frac{d\phi_2}{dt} = M\frac{dI_1}{dt}$$

$\Rightarrow \varepsilon = M\dfrac{dI_1}{dt}$

$\Rightarrow 100 = 2.5\dfrac{dI_1}{dt} \Rightarrow \dfrac{dI_1}{dt} = 40A/s$

23. A plane wave-front propagating in a medium of refractive index 'μ_1' is incident on a plane surface making an angle of incidence (i). It enters into a medium of refractive index μ_2 ($\mu_2 > \mu_1$). Use Huygen's construction of secondary wavelets to trace the retracted wave-front. Hence, verify Snell's law of refraction.

Ans: A plane wavefront AC is incident on the plane of separation XY of two media of refractive indices μ_1 and μ_2 ($\mu_2 > \mu_1$) making an angle i. This is known as angle of incidence.



When the wavefront touches the point A, the point becomes a source of secondary wavelets. Thus, when the whole waveform passes through the XY plane, each point of AF becomes the source of secondary wavelets.

When point C of the wavefront in medium 1 traverses CF distance by that time (t) the wavelet from point A traverses AD distance. If v_1 and v_2 are the speeds of light in medium 1 and 2 respectively, then AD = v_2t and CF = v_1t.

Refracted wavefront DF which is obtained by drawing a tangent to the arc having radius v_2t and centre A. The angle made by the tangent with the plane XY is r. This is known as angle of refraction.

The perpendiculars drawn on wavefront AC are the incident rays. The perpendiculars drawn on wavefront DF are the refracted rays.

AN and TF are the perpendiculars drawn on XY, the plane of separation of the two media.

$\angle CAF = \angle i = 90° - \angle NAC = 90° - (90° - \angle SAN)$

$\therefore \angle SAN = \angle i$

Similarly, $\angle QFT = \angle r$

In ΔACF, $\sin i = \dfrac{CF}{AF} = \dfrac{v_1t}{AF}$

In ΔADF, $\sin r = \dfrac{AD}{AF} = \dfrac{v_2t}{AF}$

$\therefore \dfrac{\sin i}{\sin r} = \dfrac{v_1t}{v_2t} = \dfrac{v_1}{v_2} = {}_1\mu_2$

This is Snell's law

24. (i) Differentiate between 'distance of closest approach' and 'impact parameter'.

(ii) Determine the distance of closest approach when an alpha particle of kinetic energy 3.95 MeV approaches a nucleus of Z = 79, stops and reverses its directions.

Ans: Distance of closest approach: Distance of closest approach is the distance of a charged particle from the centre of the nucleus where the total kinetic energy of the charged particle gets converted into potential energy.

$$r = \frac{Ze^2}{4\pi\varepsilon_0\left(\frac{1}{2}mv^2\right)}$$

Impact Parameter: Impact parameter is the perpendicular distance between the path of projected charged particles and centre of the nucleus.

$$b = \frac{Ze^2 \cot(\theta/2)}{4\pi\varepsilon_0\left(\frac{1}{2}mv^2\right)}$$

(ii)

$$\text{Distance of closest approach} = r = \frac{Qq}{4\pi\varepsilon_0 E}$$

$$Q = 79e = 79 \times 1.6 \times 10^{-19}\text{C}$$
$$q = 2e = 2 \times 1.6 \times 10^{-19}\text{C}$$
$$E = 3.95\text{ MeV}$$
$$= 3.95 \times 10^6 \times 1.6 \times 10^{-19}\text{ J}$$

$$\therefore r = (9 \times 10^9)\frac{(79\times1.6\times10^{-19})\times(2\times1.6\times10^{-19})}{3.95\times10^6\times1.6\times10^{-19}}$$

$$= 576 \times 10^{-16}\text{ m}$$
$$= 5.76 \times 10^{-14}\text{ m}$$

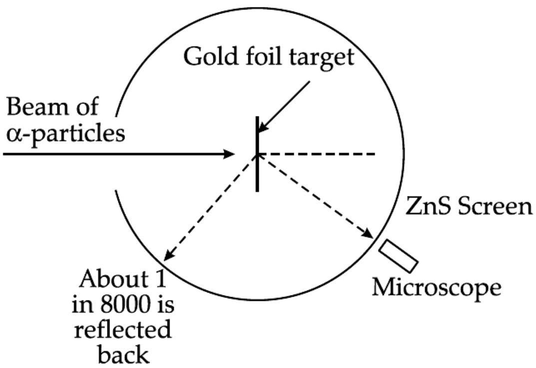
OR

(i) How is the size of a nucleus found experimentally? Write the relation between the radius and mass number of a nucleus.

(ii) Prove that the density of a nucleus is independent of its mass number.

Ans: (b) (i) Experimental determination of size of nucleus:

Size of nucleus was determined experimentally by Rutherford by his alpha particle scattering experiment.



In the experiment, a gold foil of thickness 2.1×10^{-7} was bombarded by energetic α-particles generated from $_{83}Bi^{214}$ source.

Scattered α-particles were observed on a ZnS screen with the help of a microscope.

It was observed that most of the α-particles passed through the gold foil undeviated.

About 14% α-particles were scattered by an angle more than 10.

1 out of 8000 α-particles was scattered by an angle more than 90^0.

Very few α-particles was scattered by an angle 180^0.

From these observations Rutherford calculated the impact parameter and distance of closest approach and concluded that the size of nucleus lies between 10^{-15}m and 10^{-14} m.

Relation between radius and mass number:

$$r = R_0 A^{1/3} \text{ (where } R_0 = 1.25\text{fm)}$$

(ii) Density of nucleus is independent of mass number:

$$\rho = \frac{M}{V} \Rightarrow \rho = \frac{mA}{\frac{4}{3}\pi r^3}$$

$$\Rightarrow \rho = \frac{mA}{\frac{4}{3}\pi R_0{}^3 A}$$ [$\because$ $r = R_0A^{1/3}$ (where R_0 = 1.25fm)]

$$\Rightarrow \rho = \frac{m}{\frac{4}{3}\pi R_0{}^3}$$

Hence, the density of a nucleus is independent of its mass number

25. A series CR circuit with R = 200 W and C = (50/π) μF is connected across an ac source of peak voltage ε_0, = 100 V and frequency n = 50 Hz. Calculate (a) impedance of the circuit (Z), (b) phase angle (ϕ), and (c) voltage across the resistor.

Ans:

(a) Given, R = 200 Ω, C = $\frac{50}{\pi}\mu F$

Impedance: $Z = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2} \Rightarrow Z = \sqrt{(200)^2 + \left(\frac{1}{2\pi \times 50 \times \frac{50}{\pi} \times 10^{-6}}\right)^2}$

$$\Rightarrow Z = \sqrt{(200)^2 + (200)^2} \Rightarrow Z = 200\sqrt{2}$$

(b) Phase angle: $\theta = \tan^{-1}\frac{1}{\omega CR} \Rightarrow \theta = \tan^{-1}\left(\frac{1}{2\pi \times 50 \times \frac{50}{\pi} \times 10^{-6} \times 200}\right)$

$$\Rightarrow \theta = \tan^{-1}1 \Rightarrow \theta = 45^0$$

(c) Voltage across resistor: $I_{RMS} = \frac{\varepsilon_{RMS}}{Z} \Rightarrow I_{RMS} = \frac{\frac{\varepsilon_0}{\sqrt{2}}}{Z} \Rightarrow I_{RMS} = \frac{\frac{100}{\sqrt{2}}}{200\sqrt{2}}$

$$\Rightarrow I_{RMS} = \frac{1}{4}A \Rightarrow V_R = I_{RMS} \times R$$

$$\Rightarrow V_R = \frac{1}{4} \times 200 \Rightarrow V_R = 50V$$

26. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.

Ans: Current density: Current density is the current per unit area of cross-section of a conductor.

J = I/A

Relaxation time: Relaxation time is the time interval between two successive collisions of electrons in a conductor.

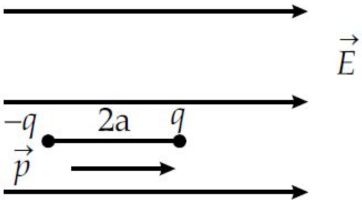
Expression for resistivity: $v_d = \frac{eE}{m}\tau \Rightarrow v_d = \frac{eV}{ml}\tau \quad \left[\because E = \frac{V}{l}\right]$

$\Rightarrow V = \frac{v_d ml}{e\tau} \Rightarrow IR = \frac{v_d ml}{e\tau}$ (since from Ohm's law, V = IR)

$$\Rightarrow \frac{\rho l}{A} = \frac{v_d ml}{e\tau I} \quad \left[\because R = \frac{\rho l}{A}\right] \Rightarrow \rho = \frac{v_d mA}{e\tau I} \Rightarrow \rho = \frac{v_d mA}{e\tau(neAv_d)} \quad [\because I = neAv_d] \Rightarrow \rho = \frac{m}{ne^2\tau}$$

27. Depict the orientation of an electric dipole in (a) stable and (b) unstable equilibrium in an external uniform electric field. Write the potential energy of the dipole in each case.

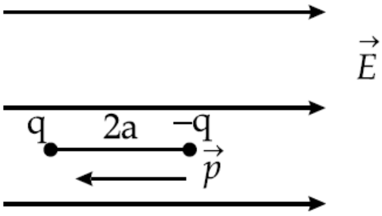
Ans: (a) Stable equilibrium: When angle between $\vec{p}$ and $\vec{E}$ is 0º.



Potential energy of dipole = –pEcosθ

In this case θ = 0º, so Potential energy = –pE

(b) Unstable equilibrium: When angle between $\vec{p}$ and $\vec{E}$ is 180º.



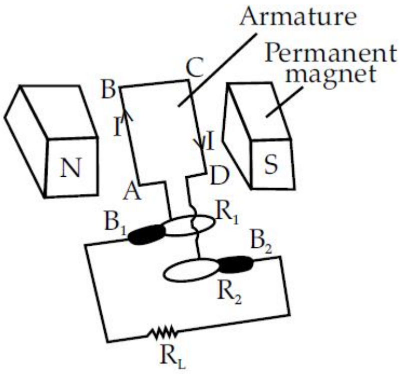
Potential energy of dipole = – pEcosθ

In this case θ = 180º, so Potential energy = pE

28. State the basic principle behind the working of an ac generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

Ans: Basic principle of working of AC generator:

Basic principle of working of AC generator is electromagnetic induction. A copper coil known a armature is rotated in a strong magnetic field and emf is induced in the coil according to the Faraday's laws of electromagnetic induction and the direction of induced emf is determined by Fleming's right hand rule.



Working of ac generator:

Main components of ac generator are:

(i) Armature, (ii) Field magnet, (iii) slip ring (iv) Brush

Armature (ABCD) is a copper coil wound on a soft iron core. The armature is rotated by a turbine.

The armature is placed in between poles of a strong permanent magnet (NS) known as field magnet.

Two ends of armature coil are connected to the slip rings(R_1 and R_2). Carbon brushes (B_1 and B_2) kept just in firm contact with the rings. External circuit is connected with the brushes.

When armature rotates in the magnetic field induced emf is generated which is supplied to the external circuit through the brushes.

Expression of instantaneous emf induced:

If the armature has N number of turns, then magnetic flux through the coil is

$\phi = N(\vec{B}.\vec{A}) = NBA\cos\theta$

If ω is the angular velocity, then emf induced

$$\varepsilon = -\frac{d\phi}{dt} = NBA\omega \sin \omega t$$

∴ $\varepsilon = \varepsilon_0 \sin\omega t$ (where $NBA\omega = \varepsilon_0$)

SECTION – D (Case Study Based Questions)

Questions 29 to 30 carry 4 marks each.

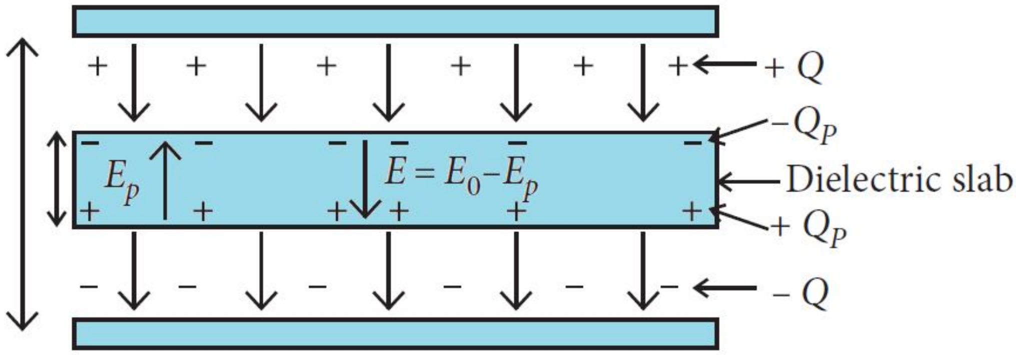
29. Case-Study 1:

Read the following paragraph and answer the questions

Dielectric Slab

A dielectric slab is a substance which does not allow the flow of charges through it but permits them to exert electrostatic forces on one another.

When a dielectric slab is placed between the plates, the field E_0 polarises the dielectric. This induces charge $-Q_p$ on the upper surface and $+Q_p$ on the lower surface of the dielectric. These induced charges set up a field E_p inside the dielectric in the opposite direction of $\vec{E_0}$ as shown.



(i) In a parallel plate capacitor, the capacitance increases from 4μF to 80μF, on introducing a dielectric medium between the plates. What is the dielectric constant of the medium?
(a) 10 (b) 20 (c) 50 (d) 100

(ii) A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the plates is now reduced half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in second case.
(a) 8 pF (b) 10 pF (c) 80 pF (d) 100 pF

(iii) A dielectric introduced between the plates of a parallel plate condenser
(a) decreases the electric field between the plates (b) increases the capacity of the condenser
(c) increases the charge stored in the condenser (d) increases the capacity of the condenser

(iv) A parallel plate capacitor of capacitance 1 pF has separation between the plates is d. When the distance of separation becomes $2d$ and wax of dielectric constant x is inserted in it the capacitance becomes 2 pF. What is the value of x?
(a) 2 (b) 4 (c) 6 (d) 8

OR

(v) A parallel plate capacitor having area A and separated by distance d is filled by copper plate of thickness b. The new capacity is

(a) $\dfrac{\varepsilon_0 A}{d+\dfrac{b}{2}}$ (b) $\dfrac{\varepsilon_0 A}{2d}$ (c) $\dfrac{\varepsilon_0 A}{d-b}$ (d) $\dfrac{2\varepsilon_0 A}{d+\dfrac{b}{2}}$

Ans. (i) (b) 20

$$k = \frac{\text{Capacitance with dielectric}}{\text{Capacitance without dielectric}} = \frac{80\ \mu F}{4\ \mu F} = 20$$

(ii) (c) 80 pF

(iii) (d) increases the capacity of the condenser

If a dielectric medium of dielectric constant K is filled completely between the plates then capacitance increases by K times.

(iv) (b) 4

$$C = \frac{\varepsilon_0 A}{d} = 1\ \text{pF} \quad ...(i)$$

$$C' = \frac{x\varepsilon_0 A}{(2d)} = 2\ \text{pF} \quad ...(ii)$$

Divide (ii) by (i), $x/2 = 2/1 \Rightarrow x = 4$

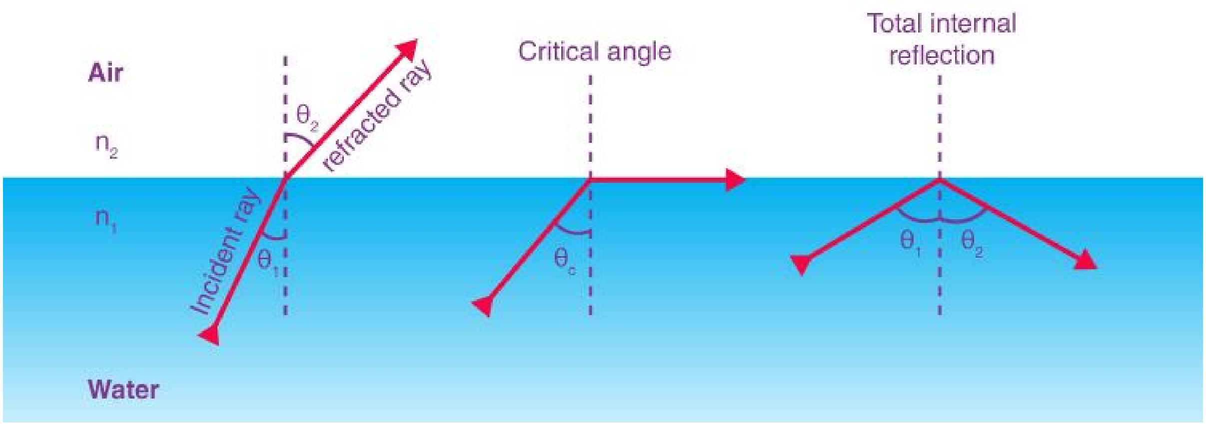
(v) (c) $\dfrac{\varepsilon_0 A}{d-b}$

30. Case-Study 2:

Read the following paragraph and answer the questions.

Total Internal Refraction

Total internal reflection is the phenomenon of reflection of light into denser medium at the interface of denser medium with a rarer medium. For this phenomenon to occur necessary condition is that light must travel from denser to rarer and angle of incidence in denser medium must be greater than critical angle (C) for the pair of media in contact. Critical angle depends on nature of medium and wavelength of light. We can show that $\mu = \dfrac{1}{\sin C}$.



(i) Critical angle for glass air interface, where m of glass is 3/2, is

(a) 41.8° (b) 60° (c) 30° (d) 15°

(ii) Critical angle for water air interface is 48.6°. What is the refractive index of water?

(a) 1 (b) 3/2 (c) 4/3 (d) 3/4

(iii) Critical angle for air water interface for violet colour is 49°. Its value for red colour would be

(a) 49° (b) 50° (c) 48° (d) cannot say

(iv) Which of the following is not due to total internal reflection?

(a) Working of optical fibre.
(b) Difference between apparent and real depth of a pond.
(c) Mirage on hot summer days.
(d) Brilliance of diamond.

OR

(v) Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$).
(a) less than θ_2 (b) between θ_1 and θ_2 (c) greater than θ_2 (d) less than θ_1

Ans. (i) (a) 41.8°

$$\mu = \frac{1}{\sin C} \sin C = \frac{1}{\mu} = \frac{2}{3} = 0.6667 \Rightarrow C = \sin^{-1}(0.6667) = 41.8^0$$

(ii) (c) 4/3

$$\mu = \frac{1}{\sin C} = \frac{1}{\sin 48.6^0} = \frac{1}{0.75} = \frac{4}{3}$$

(iii) (c) 48°

$$\mu = \frac{1}{\sin C} \Rightarrow \sin C = \frac{1}{\mu}$$

As $\mu_v > \mu_r \therefore C_v < C_r$

(iv) (b) Difference between apparent and real depth of a pond.

OR

(v) (c) greater than θ_2

$${}^w\mu_g < {}^a\mu_w < {}^a\mu_g \Rightarrow \theta > \theta_2 > \theta_1$$

SECTION – E

Questions 31 to 33 carry 5 marks each.

31. (i) State Huygen's principle. With the help of a diagram, show how a plane wave is reflected from a surface. Hence, verify the law of reflection.
(ii) A concave mirror of focal length 12 cm forms a three times magnified virtual image of an object. Find the distance of the object from the mirror.

Ans: (i) Huygens' principle:
Eachpoint on primary wavefront act as a source of secondary wavelets sending out disturbances in all directions in the similar manner as the original source of light does.

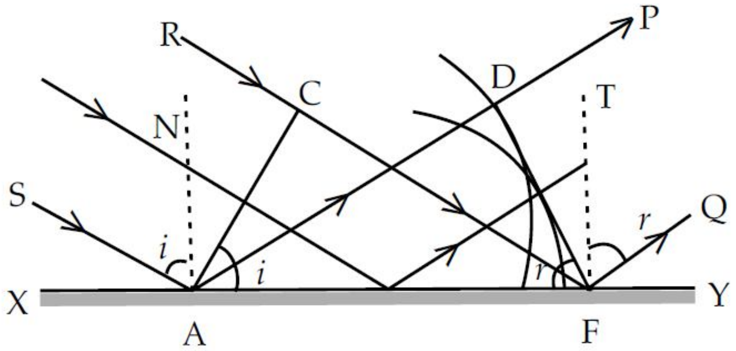
Verification of laws of reflection:

A plane wavefront AC is incident on a plane reflector XY making an angle i. This is known as angle of incidence.

Each and every point of the wavefront when touches the reflector becomes a source of secondary wavelets.

When the wavefront touches the point A, the point becomes a source of secondary wavelets. Thus, when the whole waveform touches the XY plane, each point of AF becomes the source of secondary wavelets. When point C of the wavefront in medium 1 traverses CF distance by that time (t) the wavelet from point A traverse AD distance. If v_1 is the speeds of light in medium then AD = v_1t and CF = v_1t.

Reflected wavefront DF which is obtained by drawing a tangent to the arc having radius v_1t and centre A. The angle made by the tangent with the plane XY is r. This is known as angle of refraction.



The perpendiculars drawn on wavefront AC are the incident rays. The perpendiculars drawn on wavefront DF are the reflected rays.
AN and TF are the perpendiculars drawn on XY, the plane reflector.
$\angle CAF = \angle i = 90° - \angle NAC = 90° - (90° - \angle SAN)$
$\therefore \angle SAN = \angle i$
Similarly, $\angle QFT = \angle r$
In ΔACF and ΔAFD
$\angle ACF = \angle ADF = 90°$
CF = AD
AF is the common side
So, the triangles are congruent.
$\angle CAF = \angle AFD$
$\therefore \angle i = \angle r$
This is law of reflection.

(ii) Magnification, $m = -\frac{v}{u} \Rightarrow 3 = -\frac{v}{u} \Rightarrow v = -3u$

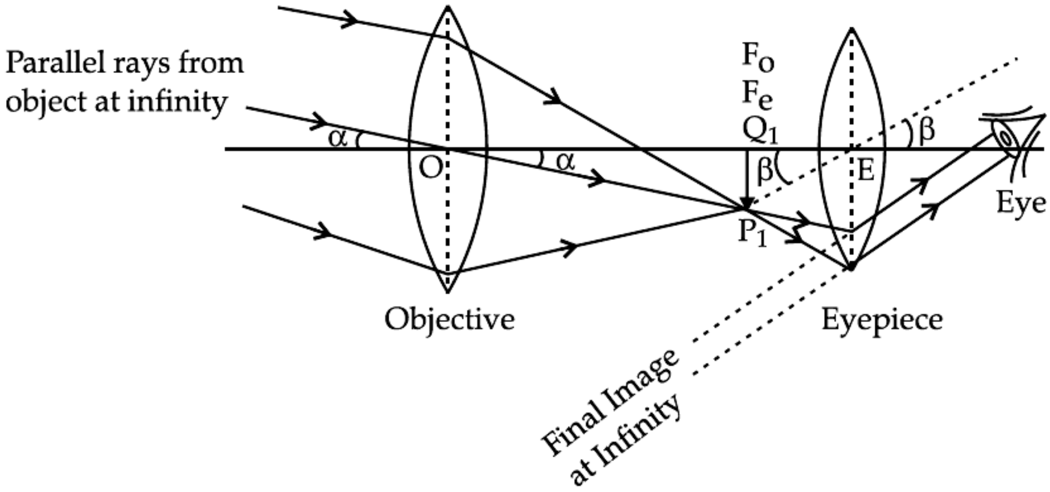
Applying mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-3u} + \frac{1}{u} = \frac{1}{-12} \Rightarrow \frac{-1+3}{3u} = \frac{1}{-12}$

$\Rightarrow \frac{2}{3u} = \frac{1}{-12} \Rightarrow u = \frac{-24}{3} = -8$

$\therefore u = -8$ cm

OR

(i) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope.
(ii) The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.
Ans: (i) **Refracting telescope in normal adjustment**:



In an refracting telescope there are two lenses – objective (O) and Eyepiece (E).
The two lenses are so placed during focussing that the foci of the lenses meet at a point.

Objective is directed towards the object at infinity.
Parallel rays coming from the object meet at the focus of the objective and forms an inverted, real image P_1Q_1 in front of eyepiece. This point is the focus of eyepiece too.
This acts as the object of the eyepiece. An (inverted with respect to P_1Q_1, erect with respect to original object), highly magnified, real image is formed at infinity.

Magnification = m = $\frac{\text{Angle subtended at eye by the final image}}{\text{Angle subtended at eye by the object}}$

$$\Rightarrow m = \frac{\text{Angle subtended at eyepiece by the final image}}{\text{Angle subtended at objective by the object}}$$

$$\Rightarrow m = \frac{\beta}{\alpha} \Rightarrow m = \frac{\angle Q_1EP_1}{\angle Q_1OP_1} \Rightarrow m = \frac{\tan\angle Q_1EP_1}{\tan\angle Q_1OP_1}$$

[α and β being very small, tanα = α and tanβ = β]

$$\Rightarrow m = \frac{\frac{Q_1P_1}{Q_1E}}{\frac{Q_1P_1}{Q_1O}} = \frac{Q_1O}{Q_1E} = \frac{f_o}{f_e}$$

Limitations of refracting telescope over reflecting type telescope :
(a) Refracting telescope suffers from chromatic aberration as it uses large sized lenses.
(b) The requirement of big lenses tend to be very heavy and therefore, difficult to make.
(ii) Given, f_0 = 1 cm
f_e = 2.5 cm
m = 300

Since, $m = \frac{L \times D}{f_0 \times f_e} \Rightarrow 300 = \frac{L \times 25}{1 \times 2.5} \Rightarrow L = 30cm$

32. (i) Explain how free electrons in a metal at constant temperature attain an average velocity under the action of an electric field. Hence obtain an expression for it.
(ii) Consider two conducting wires A and B of the same diameter but made of different materials joined in series across a battery. The number density of electrons in A is 1.5 times that in B. Find the ratio of drift velocity of electrons in wire A to that in wire B.
Ans: (a) (i) In absence of any electric field, the free electrons in metals move haphazardly in all possible directions and hence, develop no net flow of current. When an electric field is applied, a force acts on the electrons and the electrons now tend to move in the direction of the force.
When electron collides with lattice, its velocity becomes instantaneously zero and then again it starts moving in a specific direction due to the applied electric field.

If the average time between two collisions (relaxation time) is τ, then $l = \frac{1}{2}a\tau^2$

Where l = average drift distance
a = acceleration = Ee/m
E = electric field intensity
e = charge of electron
m = mass of electron

$$\therefore l = \frac{1}{2}\frac{Ee}{m}\tau^2$$

Drift velocity = $\frac{l}{\tau} = v_d = \frac{1}{2}\frac{Ee}{m}\tau$

$\frac{e\tau}{2m}$ = K, a constant, which depends on the nature of the material and the temperature.
∴ vd = K × E

Thus, free electrons in a metal at constant temperature under the action of an electric field attain a constant average velocity.
(b) Since, the wires are joined in series current flowing through then will be same.
Let the current in both A and B be I.
Diameter being same, there areas of cross section are also same. Let it be A.
So, in wire A, I = $n_A eAv_{dA}$
In wire B, I = $n_B eAv_{dB}$
Taking the ratio, we get

$$1 = \frac{n_A}{n_B} \times \frac{v_{dA}}{v_{dB}} \Rightarrow 1 = 1.5 \times \frac{v_{dA}}{v_{dB}}$$

$$\therefore \frac{v_{dA}}{v_{dB}} = \frac{1}{1.5} = 2:3$$

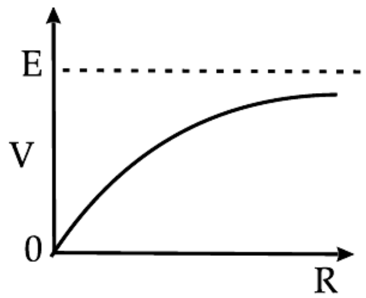
OR

(i) A cell emf of (E) and internal resistance (r) is connected across a variable load resistance (R). Draw plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load.
(ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r are connected in parallel across a resistor R.
Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.
Ans: (i) Terminal voltage vs. load resistance graph: V = E – ir

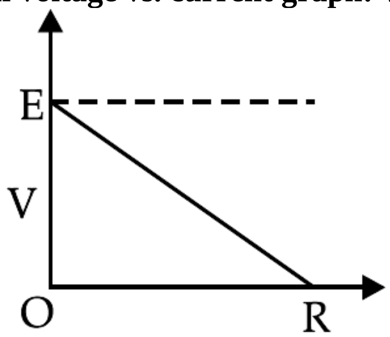
And $i = \frac{E}{R+r}$

$$\therefore V = E - \frac{E}{R+r} \Rightarrow V = E\frac{1-r}{r+R}$$

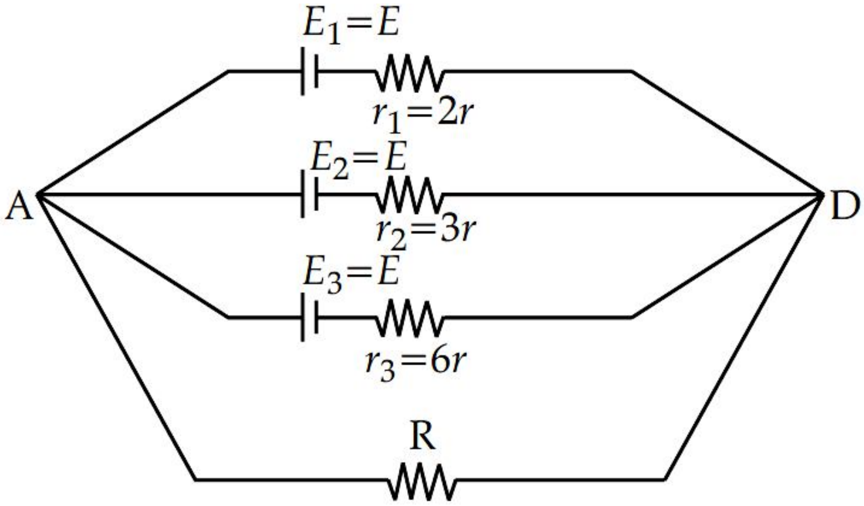
$$\therefore V = \frac{ER}{R+r}$$



Terminal voltage vs. current graph: $V = E - ir$



(ii) Three cells combination diagram is given below,



Current through cells (*i*) = $\frac{E_{eq}}{r_{eq}} = \frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3}$

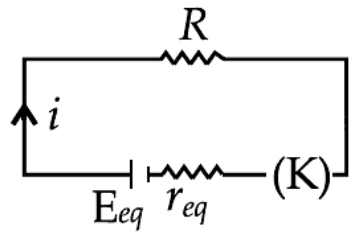
And $\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}$

$\Rightarrow \frac{1}{r_{eq}} = \frac{1}{2r} + \frac{1}{3r} + \frac{1}{6r} = \frac{3+2+1}{6r} = \frac{6}{6r} = \frac{1}{r}$

∴ Equivalent resistance of internal resistance $r_{eq} = r$

Putting in equation (i), $i = \frac{E_{eq}}{r} = \frac{E}{2r} + \frac{E}{3r} + \frac{E}{6r} = \frac{3E+2E+E}{6r} = \frac{6E}{6r} = \frac{E}{r}$

So, the equivalent circuit is,



(i) Current flowing through the circuit = $i = \frac{E}{R+r}$

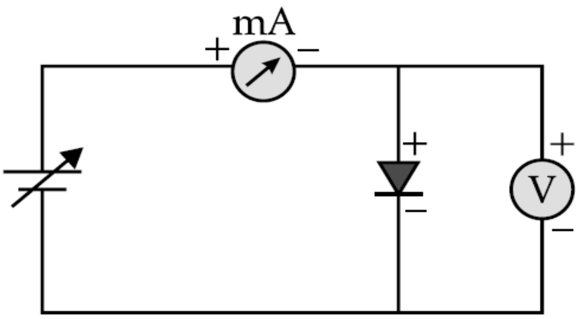
(ii) Terminal potential difference, $V = iR$

$\Rightarrow V = \left(\frac{E}{R+r}\right)R \Rightarrow V = \frac{ER}{R+r}$

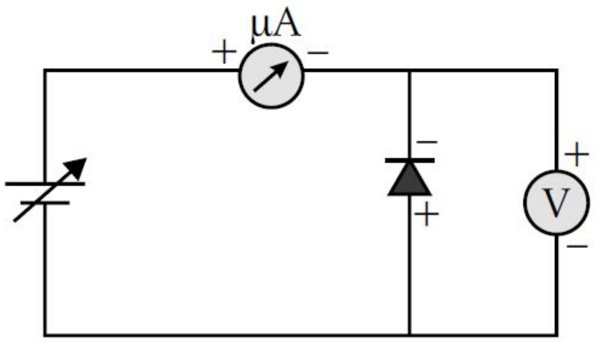
33. Draw the circuit arrangement for studying V-I characteristics of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Draw the typical V-I characteristics of a silicon diode. Describe briefly the following terms: (i) minority carrier injection in forward biasing and (ii) breakdown voltage in reverse biasing.

Ans: Circuit diagram to study the V-I Characteristics of p-n junction diode in

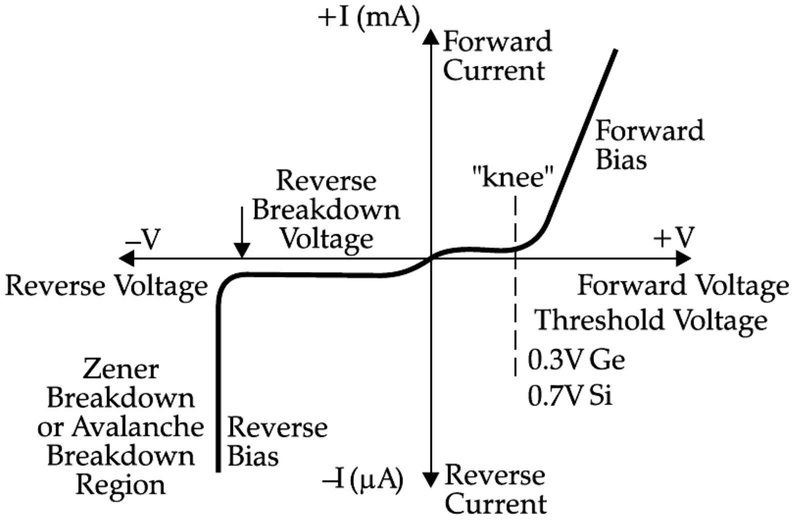
(i) Forward biasing:



(ii) Reverse biasing:



V–I Characteristics of Diode



(i) Minority carrier injection in forward bias: In forward biased p-n junction, electrons from n-region diffuse into p-region where they are minority carriers. Holes are injected from p-side to n-side where they are minority carriers. This process is known as 'minority carrier injection'.

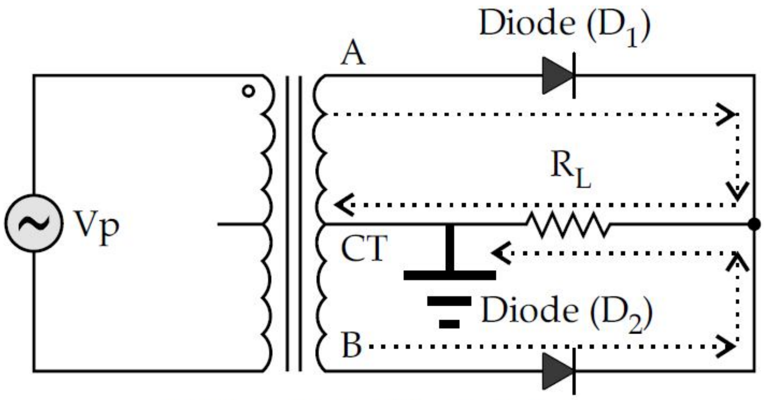
(ii) Breakdown voltage in reverse bias: In reverse biased p-n junction, only minority carriers can cross the junction. Hence, a very small amount of current flows in reverse direction which is known as reverse saturation current. If the reverse voltage is increased to a very large value, a large reverse current flows through the diode due to zener diode breakdown. The voltage at which this happens is known as breakdown voltage.

OR

Name two important processes involved in the formation of a p-n junction diode. With the help of a circuit diagram, explain the working of junction diode as a full wave rectifier. Draw its input and output waveforms. State the characteristic property of a junction diode that makes it suitable for rectification.

Ans: Two processes involved in formation of p-n junction: (i) Diffusion (ii) Drift

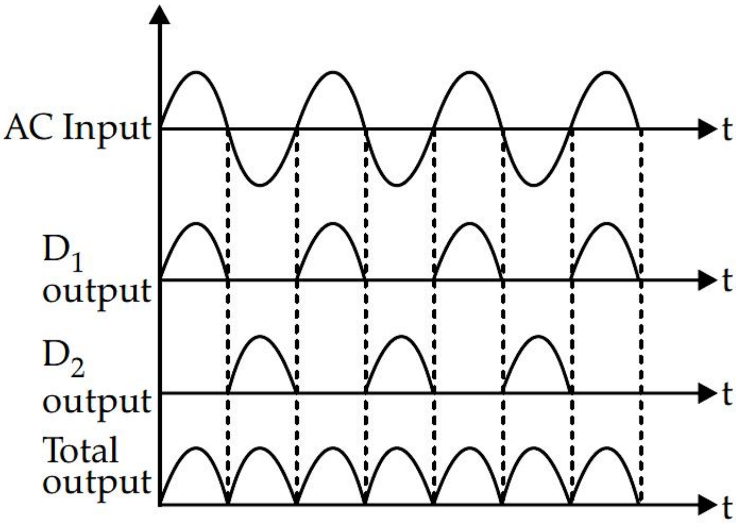
Full wave rectifier:



Centre-tapped transformer

A centre-tapped transformer and two p-n junction diodes are used for a full weave rectifier. Input of the transformer is connected to the ac supply. In secondary there are three terminals – A, B and CT. For positive half cycle, A is positive, B is negative. For the negative half cycle, A is negative, B is positive. CT is always at zero potential. It is always grounded.
Anode of one diode (D_1) is connected to A and anode of other diode (D_2) is connected to B.
Cathodes of both the diodes are joined together and ultimately connected to CT through a load resistance (R_L).
When positive half cycle appears, A is at positive and B is at negative potential. So, diode D_1 is forward biased and hence, it conducts.
When negative half cycle appears, B is at positive and A is at negative potential. So, diode D_2 is forward biased and hence, it conducts.
The process repeats.
For both the half cycles current flowing through the load resistance is unidirectional. Hence, a DC voltage appears across it.
Thus, a full wave rectifier works.

Input and output wave forms:



Characteristic property of junction diode that makes it suitable for rectification:
An ideal p-n junction diode exhibits zero resistance when forward biased and infinite resistance when reversed biased.