ISC EXAMINATION PAPER - 2024
PHYSICS (THEORY)
Class-12th
(Solved)

Maximum Marks: 70
Time allowed: Three hours

*(Candidates are allowed **additional 15 minutes** for only reading the paper.*
*They must **NOT** start writing during this time.)*
*This paper is divided into four sections - **A, B, C and D.** Answer all questions.*
***Section A** consists of one question having sub-parts of one mark each.*
***Section B** consists of seven questions of two marks each.*
***Section C** consists of nine questions of three marks each, and*
***Section D** consists of three questions of five marks each.*
***Internal choices have been provided in two questions each in Section B, Section C and Section D**.*
The intended marks for questions are given in brackets [].
All working, including rough work, should be done on the same sheet as and adjacent to the rest of the answer.
Answers to sub parts of the same question must be given in one place only. A list of useful physical constants and relations is given at the end of this paper. A simple scientific calculator without a programmable memory may be used for calculations.

SECTION A - 14 MARKS

Question 1

(A) In questions (i) to (vii) given below, choose the correct alternative (a), {b), (c) or (d) for each of the questions.

(i) If potential difference between the two ends of a metallic wire is doubled, drift speed of free electrons in the wire **[1]**

(a) remains same.
(b) becomes double
(c) becomes four times.
(d) becomes half.

(ii) A metre bridge is balanced with a known resistance (R) in the left hand gap and an unknown resistance (S) in the right hand gap. Balance point is found to be at a distance of l cm from the left hand side. When the battery and the galvanometer are interchanged, balance point will **[1]**

(a) shift towards left.
(b) shift towards right.
(c) remain same.
(d) shift towards left or right depending on the values of R and S

(iii) Lorentz force in vector form is **[1]**

(a) $F = B\,q\,v \sin\theta$ **(b)** $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$
(c) $\vec{F} = q\left(\vec{B} \times \vec{v}\right)$ **(d)** $\vec{F} = \vec{v}\left(q \times \vec{B}\right)$

(iv) Assertion: When an electric current is passed through a moving coil galvanometer,its coil gets deflected. **[1]**

Reason: A circular coil produces a uniform magnetic field around itself when an electric current is passed through it.

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
(c) Assertion is true and Reason is false.
(d) Assertion is false and Reason is true.

(v) When a ray of white light is incident obliquely on the first surface of a prism, then **[1]**

(a) red colour is deviated most.
(b) green colour is deviated most.
(c) yellow colour is deviated most.
(d) violet colour is deviated most.

(vi) The de-Broglie wavelength (λ) associated with a moving electron having kinetic energy (E) is given by

(a) $\frac{2h}{\sqrt{2mE}}$ **(b)** $\frac{2\sqrt{2mE}}{h}$
(c) $\frac{h}{\sqrt{2mE}}$ **(d)** $\sqrt{2mhE}$ **[1]**

(vii) The majority charge carriers in a P-type semiconductor are **[1]**

(a) electrons. **(b)** holes.
(c) protons. **(d)** ions.

(B) Answer the following questions briefly. **[1]**

(i) In an electric dipole, what is the locus of a point having zero potential? **[1]**

(ii) Three identical cells each of emf 'e' are connected in parallel to form a battery. What is the emf of the battery? **[1]**

(iii) Three bulbs B_1(230V, 40W), B_2(230V, 60W) and B_3(230V, 100W) are connected in series to a 230V supply. Which bulb glows the brightest? **[1]**

(iv) Explain the meaning of the following statement: Curie temperature for soft iron is 770°C. **[1]**

(v) What type of wavefronts are associated with a point source of light? **[1]**

(vi) What is 'Pair production''? **[1]**

(vii) In semiconductor physics, what is the function of a rectifier? **[1]**

SECTION B - 14 MARKS

Question 2 **[2]**

(i) A hollow sphere of radius R has a point charge q at its centre. Electric flux emanating from the sphere is X. How will the electric flux change, if at all, when

(a) Radius of the sphere is doubled?

(b) Charge q is replaced by an electric dipole?

OR

(ii) In case of an infinite line charge, how does intensity of electric field at a point change, if at all, when

(a) Charge on it is doubled?

(b) Distance of the point is halved?

Question 3 **[2]**

(i) What is meant by the statement "Relative permittivity of water is 81"?

(ii) Can a body be given a charge of 2.2×10^{-19}C ? Give a reason for your answer.

Question 4 **[2]**

(i) What type of transformer is used in a mobile phone charger?

(ii) Why is the core of a transformer made of soft iron and not of steel?

Question 5 **[2]**

(i) Name the electromagnetic radiation whose frequency is 10^{11} Hz.

(ii) What is the speed of radio waves in vacuum?

Question 6 **[2]**

Draw a labelled graph showing the variation in intensity of diffracted light with diffracting angle in a single slit Fraunhofer diffraction experiment.

Question 7 **[2]**

(i) Figure 1 below is the Energy level diagram for Hydrogen atom. Study the transitions shown and answer the following questions.

(a) State the type of spectrum obtained.

(b) Name the series of spectrum obtained.

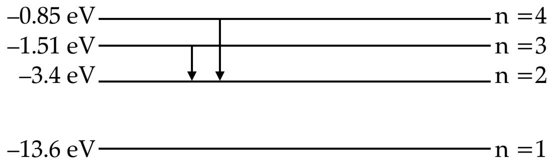


Figure - 1

OR

(ii) In a nuclear reactor, state the use of the following:

(a) Graphite rods

(b) Cadmium rods

Question 8 **[2]**

With reference to a semiconductor diode define the following terms:

(i) depletion region

(ii) potential barrier

SECTION C - 27 MARKS

Question 9 **[3]**

Obtain an expression for equivalent capacitance C when three capacitors C_1, C_2 and C_3 are connected in series.

Question 10 **[3]**

(i) Figure 2 below shows two batteries E_1 and E_2 having emfs of 18V and 10V and internal resistances of 1Ω and 2Ω respectively. W_1, W_2 and W_3 are uniform metallic wires AC, FD and BE having resistance of 8Ω, 6Ω and 10Ω respectively. B and E are midpoints of the wires W_1 and W_2. Using Kirchhoffs laws of electrical circuits, calculate the current flowing in the wire W_3.

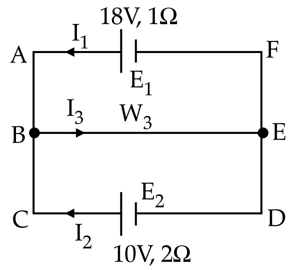


Figure - 2

OR

(ii) Figure 3 below shows a potentiometer circuit in which the driver cell D has an emf of 6 V and internal resistance of 2Ω. The potentiometer wire AB is 10m long and has a resistance of 28Ω. The series resistance R_s is of 20Ω.

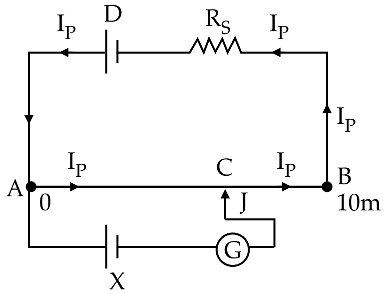


Figure - 3

Calculate:

(a) The current I_p flowing in the potentiometer wire AB when the jockey (J) does not touch the wire AB.

(b) emf of the cell X if the balancing length AC is 4·5m.

Question 11 **[3]**

Using Biot-Savart law, show that magnetic flux density 'B', at the centre of a current carrying circular coil of radius R is given by:

$$B=\frac{\mu_0 I}{2R}$$

where the terms have their usual meaning.

Question 12 **[3]**

Figure 4 below shows an infinitely long metallic wire YY' which is carrying a current I'. P is a point at a perpendicular distance r from it.

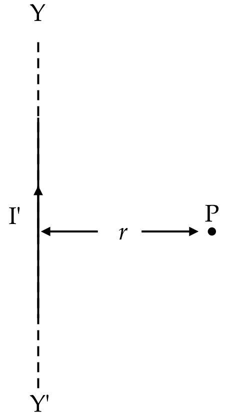


Figure - 4

(i) What is the direction of magnetic flux density B of the magnetic field at the point P?

(ii) What is the magnitude of magnetic flux density B of the magnetic field at the point P?

(iii) Another metallic wire MN having length l and carrying a current I is now kept at the point P. If the two wires are in vacuum and parallel to each other, how much force acts on the wire MN due to the current I′ flowing in the wire YY′?

Question 13 **[3]**

(i) Using Huygen's wave theory, show that (for refraction of light):

$$\frac{\sin i}{\sin r} = \text{Constant}$$

where terms have their usual meaning. You must draw a neat and labelled diagram.

OR

(ii) In Young's double slit experiment, show that:

$$\beta = \frac{\lambda D}{d}$$

where the terms have their usual meaning.

Question 14 **[3]**

Figure 5 below shows a ray of monochromatic light LM incident on the first surface AB of a regular (equilateral) glass prism ABC. The emergent ray grazes the adjacent surface AC. Calculate the angle of incidence. (Refractive Index of glass = 1.5)

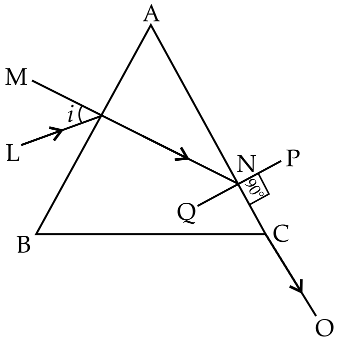


Figure - 5

Question 15 **[3]**

A student is performing an experiment to determine focal length of a convex lens by using lens formula i.e., by no parallax method. The examiner gives some instructions to the student. The student responds to each instruction as per her understanding of the experiment.

State whether the student's response is correct or incorrect . Give a reason for your answer.

(i) **EXAMINER:** Image formed by the lens is magnified. Reduce the size of the image STUDENT moves the lens towards the object pin.

(ii) **EXAMINER:** Plot a graph of (I/v) against (I/u).

STUDENT takes(I/v) on Y-axis and(I/u) on X-axis.

(iii) **EXAMINER:** Write the relation between the optical power (P) and the focal length (f) of the convex lens.

STUDENT writes $P = 2f$.

Question 16 **[3]**

(i) In an experiment on photo electric effect , how does stopping potential change, if at all, when intensity of incident monochromatic UV radiation is increased?

(ii) Ultraviolet light is incident on metals P,Q and R, having work functions 8eV, 2eV and 4eV respectively.

(a) Which metal has lowest threshold frequency for photoelectric effect?

(b) For which metal is the value of E_{max} minimum?

(Note:E_{max} is maximum kinetic energy of the emitted photoelectrons.)

Question 17 **[3]**

(i) What is meant by forward biasing of a semiconductor diode?

(ii) Draw a labelled characteristic curve (I-V graph) for a semiconductor diode during forward bias.

SECTION D - 15 MARKS

Question 18 **[5]**

(i) **(a)** A 220V, 50Hz ac source is connected to a coil having coefficient of self-inductance of 1 H and a resistance of 400Ω. Calculate:

(1) the reactance of the coil.

(2) the impedance of the coil.

(3) the current flowing through the coil.

(b) Draw a labelled graph showing variation of impedance (Z) of a series LCR circuit Vs frequency (f) of the ac supply. Mark the resonant frequency as f_0.

OR

(ii) **(a)** When current flowing through a solenoid decreases from 5A to 0 in 20 milliseconds, an emf of 500V is induced in it.

(1) What is this phenomenon called?

(2) Calculate coefficient of self-inductance of the solenoid.

(b) **(1)** RMS value of an alternating current flowing in a circuit is 5A. Calculate its peak value.

(2) State any one difference between a direct current (dc) and an alternating current (ac).

Question 19 **[5]**

(i) **(a)** On the basis of Bohr's theory, derive an expression for the radius of the n^{th} orbit of an electron of hydrogen atom.

(b) Calculate the energy released in the following nuclear fusion reaction:

$${}^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + \text{energy}$$

Mass of ${}^{2}_{1}H$ = 2.014102u

Mass of ${}^{4}_{2}He$ =4.002604u

OR

(ii) **(a)** Calculate mass defect and binding energy of ${}^{20}_{10}Ne$ nucleus, given

Mass of ${}^{20}_{10}Ne$ = 19.992397u,

Mass of ${}^{1}_{1}H$ = 1.007825u,

Mass of ${}^{1}_{0}n$ = 1.008665u.

(b) State the Bohr's postulate of angular momentum of an electron.

(c) **(1)** What is the velocity of an electron in the 3rd orbit of hydrogen atom if its velocity in the 1st orbit v_0?

(2) Radius of the 1st orbit of hydrogen atom is r_0. What will be the radius of the 4th orbit?

Question 20 **[5]**

Read the passage given below and answer the questions that follow.

There are two types of option instruments: Microscopes and Telescopes.

Microscopes are used to magnify very tiny objects whereas telescopes are used to study distant objects. Both of them deploy convex lenses. In his telescope, Newton used a large parabolic mirror to collect light from the stars and reduce aberrations.

(i) Rohit observed the launch of Chandrayan 3 with the help of an optical instrument. Name the instrument used by him.

(ii) State any one advantage of a reflecting telescope over a refracting telescope.

(iii) Which instrument is used to study the structure of a virus?

(iv) What is the ability of an optical instrument to form enlarged images called?

(v) What is the difference between a compound microscope and an astronomical telescope (refracting type), as far as their lenses are connected?

Useful Constants & Relations:

1.	Charge of a proton	e	1.6×10^{-19}C
2.	Speed of light in vacuum	c	3×10^{8}ms^{-1}
3.		$1u$ = 931 MeV	

■■

ANSWERS

1. (A)

(i) Option (b) is correct.

Explanation: $V_{\text{new}} = 2V_{\text{old}}$

Drift velocity $v_d = \frac{eE\tau}{m} = \frac{eV\tau}{ml}$

Now, $v'_d = \frac{2eV\tau}{ml} = 2\,v_d$.

(ii) Option (c) is correct.

Explanation: If galvanometer and battery are interchanged at balance point in a metre bridge, then the balance point remain the same.

(iii) Option (b) is correct.

Explanation: Lorentz force in vector is given by $\vec{F} = q(\vec{v} \times \vec{B})$.

(iv) Option (c) is correct.

Explanation: When an electric current is passed through a moving coil galvanometer, its coil gets deflected as when a current carrying coil is placed in a uniform magnetic field, it gets deflected because of torque acting on it. A non-uniform magnetic field is produced around the circular coil when an electric current is passed through it.

(v) Option (d) is correct.

Explanation: When a ray of white light is incident obliquely on the first surface of a prism then the violet color is deviated the most as violet color has less wavelength owing to which its corresponding refractive index for the prism is the most. As deviation and refractive index are directly proportional to each other. Hence, violet color deviates the most.

(vi) Option (c) is correct.

Explanation: According to de-Broglie's relation $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$

(vii) Option (b) is correct.

Explanation: Holes are majority carriers in a *p*-type semiconductor.

(B) (i) Locus of a point having zero potential is a vertical straight line which is the perpendicular bisector (equatorial-line) of an electric dipole.

(ii) The total emf of the parallel combination will be the same as that of the individual emf of the cells.

(iii) Power rating is inversely proportional to the resistance of the bulb *i.e.,* $P = \frac{V^2}{R}$. As the bulbs are connected in series, hence power consumed will be $P = I^2R$. Since the B_1 has less power rating then its resistance will be more in comparison to the other bulbs. Therefore, it will consume more power causing it to glow more.

(iv) The statement "Curie temperature for soft iron is 770°C" means that at temperatures below 770°C, soft iron exhibits ferromagnetic properties, while above this temperature, it loses its magnetism.

(v) Spherical wavefronts.

(vi) Pair production is the process where a high-energy photon spontaneously converts into a particle-antiparticle pair, such as an electron and a positron.

(vii) Rectifier is used to convert AC (Alternating Current) into DC (Direct Current).

2. (i) (a) The electric flux does not change if the radius of the sphere is doubled.

(b) The electric flux will become zero if q is replaced by an electric dipole as the net charge inside the Gaussian surface will become zero.

OR

(ii) For an infinite line charge, intensity of electric field is given as,

$$E = \frac{2k\lambda}{r}$$

(a) If the charge is doubled then the λ is also doubled, hence E will become double.

(b) If the distance of the point is halved then the electric field will become double.

3. (i) The statement "relative permittivity of water is 81" indicates that water has a dielectric constant 81 times greater than that of a vacuum, affecting its electrical behavior in electric fields.

(ii) $Q = ne$

$Q = 2.2 \times 10^{-19}$ C

2.2×10^{-19} C $= n \times 1.6 \times 10^{-19}$ C

$n = 1.375$

By calculation, it may be possible, but because of the quantization of charge, electrons can never be transfered in terms of fraction. Hence, 2.2×10^{-19} charge can not be given to the body.

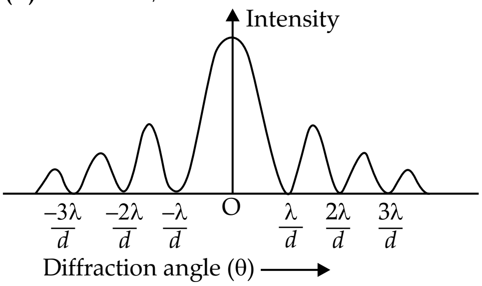
4. (i) Step down transformer or switched-mode power supply (SMPS) transformer.

(ii) The core of a transformer is made of soft iron instead of steel due to soft iron's higher permeability, lower hysteresis losses, and reduced eddy current losses, enhancing transformer efficiency.

5. (i) Radiowaves.

(ii) 3×10^8 m/s.

6.



7. (i) (a) Line spectrum or discrete spectrum.

The Balmer spectrum consists of the visible spectral lines emitted by hydrogen atoms when electrons transition to the second energy level, characterized by the Balmer series formula.

(b) Balmer series.

OR

(ii) (a) In a nuclear reactor, graphite rods control the rate of fission reactions by moderating neutron speed.

(b) Cadmium rods absorb excess neutrons to regulate reactor power output.

8. In a semiconductor diode,

(i) The depletion region is a space where mobile charge carriers are depleted, creating an electric field, while

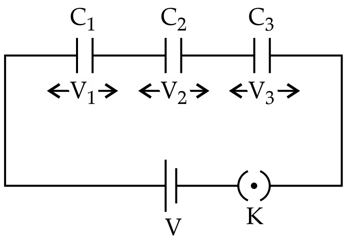
(ii) The potential barrier is the energy barrier formed at the junction due to the migration of charge carriers, restricting current flow.

9. Let the three capacitors connected in series be C_1, C_2 and C_3 and supply voltage be V.

$$V_1 = \frac{q}{C_1}$$

$$V_2 = \frac{q}{C_2}$$

$$V_3 = \frac{q}{C_3}$$



Now $V = V_1 + V_2 + V_3$ ... (i)

If equivalent capacitance of combination of capacitors is C then

$$V = \frac{q}{C} \quad \text{...(ii)}$$

By equations (i) and (ii)

$$\frac{q}{C_1} + \frac{q}{C_2} + \frac{q}{C_3} = \frac{q}{C}$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

10. (i) Resistance of the AB and BC portion of W_1 metallic wire is 4 ohm.

Resistance of the FE and ED portion of W_2 metallic wire is 3 ohm.

Voltage from $E_1 = V_1 = E_1 - I_1 = 18 - I_1$

Voltage from $E_2 = V_2 = E_2 - 2I_2 = 10 - 2I_2$

Using junction rule at B,

$I_1 + I_2 = I_3$

From mesh AFEBA,

$E_1 - 4I_1 - 10I_3 - 3I_1 = 0$

$18 - 8I_1 - 10I_3 = 0.$ (Using $I_1 = I_3 - I_2$)

$18 - 18I_3 + 8I_2 = 0$ ...(i)

From mesh CBEDC,

$E_2 - 4I_2 - 10I_3 - 3I_3 = 0$

$10 - 6I_2 - 13I_3 = 0$ ...(ii)

Using (i) and (ii)

$188 = 212 I_3$

$I_3 = 0.89$ A

OR

(ii) (a) Apply Kirchhoff's voltage law, $6 - 28I_p - 20I_p - 2I_p = 0$

$6 - 50I_p = 0$

$$I_p = \frac{6}{50}\text{A} = 0.12 \text{ A}$$

(b) $l_{AC} = 4.5$ m

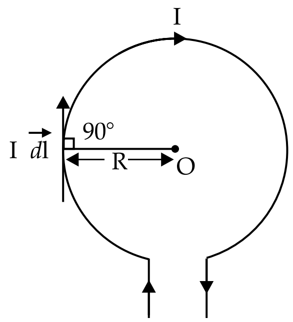
$R_{AC} = 2.8 \times 4.5 = 12.6\ \Omega$

$R_{AC} \times I_p = V_x$

$V_x = 12.6 \times 0.12 = 1.51$ V

11. Consider a circular loop of radius R with O as its centre.

Let I be the current flowing through the circular loop.



Using Biot Savart Law,

$$B = \int_0^{2\pi R} \frac{\mu_0 I}{4\pi R^2} . dl \sin 90^0$$

$$B = \frac{\mu_0 I}{4\pi R^2} \int_0^{2\pi R} dl$$

$$B = \frac{\mu_0 I}{4\pi R^2} \times 2\pi R$$

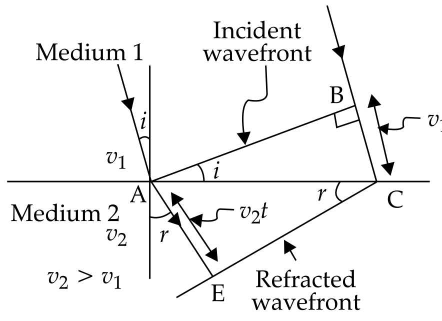
$$B = \frac{\mu_0 I}{2R}$$

12. (i) Perpendicular inward to the plane of the paper

(ii) $B = \dfrac{\mu_0 I'}{2\pi r}$

(iii) $F = |B| = \left|\dfrac{\mu_0 I'}{2\pi r}\right|$

13. (i)



The figure drawn here shown the refrected wave front corresponding to the given incident wave front. It is seen that

$$\sin i = \frac{BC}{AC} = \frac{v_1 t}{AC}$$

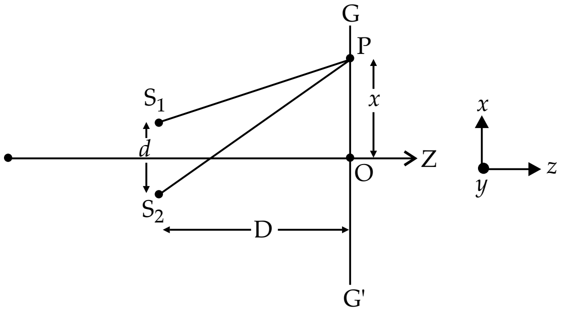
$\sin r = \frac{AE}{AC} = \frac{v_2 t}{AC}$

$\therefore \frac{\sin i}{\sin r} = \frac{v_1}{v_2} = n_{21}$

This is Snell's law of refraction.

OR

(ii) Young's double slit Experiment:



At "P", which is at x distance from O path difference

$(S_2P\text{-}S_1P) = \frac{xd}{D}$

Condition for P to be a bright spot:

$\frac{xd}{D} = 0, \lambda, 2\lambda \ldots\ldots\ldots\ldots n\lambda$

$x_{n^{th}\text{bright}} = \frac{nD}{d}\lambda$

Where , n is number of bright fringes after central fringe.

Condition for P to be a dark spot:

$\frac{xd}{D} = 0, \frac{3\lambda}{2} \ldots\ldots\ldots\ldots (2n+1)\frac{\lambda}{2}$

$x_{n^{th}dark} = \frac{(2n+1)D}{2d}\lambda$

Here, n is the number of dark fringes after central fringe.

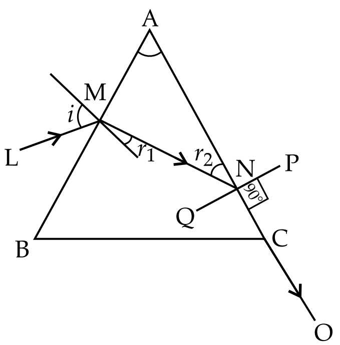
Width of the bright fringe $(\beta_B) = x_{nB} - x_{(n-1)B} = \frac{D\lambda}{d}$

Width of the dark fringe $(\beta_D) = x_{nD} - x_{(n-1)D} = \frac{D\lambda}{d}$

Width of the central fringe $(\beta_C) = \frac{D\lambda}{d}$

Hence, $\beta_B = \beta_D = \beta_C$

14.



Emergent angle $(e) = 90°$

Refractive index of glass = 1.5

Angle of prism $A = 60°$

Using Snell's law at N,

$\frac{\sin r_2}{\sin e} = \frac{1}{1.5}$

$\sin r_2 = \frac{2}{3}$

$r_2 = \sin^{-1}(0.67) = 42°$

Using Snell's law at M,

$\frac{\sin i}{\sin r_1} = 1.5$

$r_1 = A - r_2 = 60° - r_2$

$\frac{\sin i}{\sin(A - r_2)} = 1.5$

$\sin i = \sin(A - r_2) \times 1.5$

$\sin i = \sin(60° - r_2) \times 1.5 = 1.5 \times 0.309$

$i = \sin^{-1}(0.4635) = 27.61°$

15. (i) The student's response is incorrect. As we go near to the convex lens the image size increases.

(ii) The student's response is correct. As $\frac{1}{v}$ vs $\frac{1}{u}$ graph is asked to make; here $\frac{1}{u}$ is independent variable and $\frac{1}{v}$ is dependent variable.

(iii) The student's response is incorrect. As $P = \frac{1}{f}$.

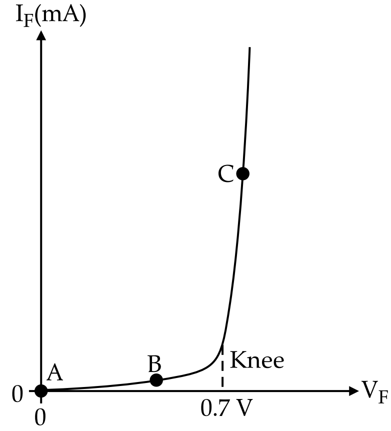
16. (i) The stopping potential does not change when the intensity of incident radiation increases.

(ii) (a) Metal Q

(b) Metal P

17. (i) Forward biasing of a semiconductor diode refers to applying a voltage in a direction that allows current to flow easily across the diode junction, reducing the potential barrier.

(ii) I-V Characteristic for a diode during forward bias:



18. (i) (a) $V_{rms} = 220$ V, $f = 50$ Hz, $L = 1$H, $R = 400$ ohm

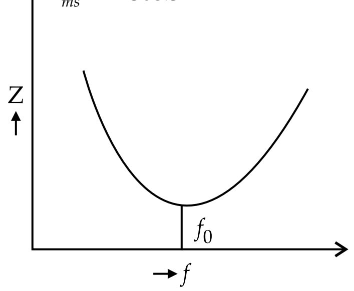
(1) reactance, $X_L = \omega L = 2\pi f L = 314$ ohm

(2) impedance,

$$Z = \sqrt{X_L^2 + R^2} = \sqrt{314^2 + 400^2} = 508.52\text{ohm}$$

(3) $\frac{V_{rms}}{I_{ms} Z} = \frac{220}{508.52} = 0.433\text{A}$

(b)



OR

(ii) (a) (1) Electromagnetic induction

(2) $$\frac{\varepsilon}{\frac{\Delta I}{\Delta t}} = L$$

$$L = \frac{500 \times 20 \times 10^{-3}}{5} = 2\text{H}$$

(b) (1) $I_{peak} = \sqrt{2} \times 5\text{A}$.

(2) In DC circuits, voltage and current remain relatively constant over time (aside from minor fluctuations or changes). In AC circuits, both voltage and current vary sinusoidally with time.

19. (i) (a) The necessary centripetal force for the rotation of electron is supplied by the electrostatic force between the electron and nucleus.

$$\frac{mv^2}{r} = \left(\frac{1}{4\pi\varepsilon_0}\right)\left(\frac{e^2}{r^2}\right) \qquad \text{[Putting Z = 1]}$$

Or, $$mv^2 = \frac{e^2}{4\pi\varepsilon_0 r} \qquad \text{....(i)}$$

From Bohr's theory,

$$mvr = \frac{nh}{2\pi}$$

$\therefore$ $$v = \frac{nh}{2\pi mr}$$

Putting in equation (i)

$$m\left(\frac{nh}{2\pi mr}\right)^2 = \frac{e^2}{4\pi\varepsilon_0 r}$$

Or, $$r = \frac{\varepsilon_0 n^2 h^2}{\pi m e^2}$$

In general, $$r_n = \frac{\varepsilon_0 n^2 h^2}{\pi m e^2}$$

$\therefore r \propto n^2$

(b) ${}_1^2\text{H} + {}_1^2\text{H} \rightarrow {}_2^4 He + Energy$

$$Q = \left[2m\left({}_1^2 H\right) - m\left({}_2^4 He\right)\right]c^2$$

$Q = (2 \times 2.014102 - 4.002604)c^2$

$Q = (4.028204 - 4.002604)c^2$

$Q = 0.0256 \times 931.5$ MeV

$Q = 23.85$ MeV

OR

(ii) (a) Mass Defect for ${}_{10}^{20}Ne$:

$$\Delta m = \left[10m\left({}_1^1 H\right) + 10m\left({}_0^1 n\right)\right] - m_{10}^{20}Ne$$

$= (10 \times 1.007825\text{u} + 10 \times 1.008665\text{u}) - 19.992397\text{u}$

$= 10.07825\text{u} + 10.08665\text{u} - 19.992397\text{ u}$

$= (20.1649 - 19.992397)\text{u}$

$= 0.172503\text{u}$

(b) Binding Energy $E_b = \Delta mc^2$

$= 0.172503 \times 931.5$ MeV

$= 160.7$ MeV

Postulate–II: The electrons can revolve only in certain selected orbits in which angular momentum of electrons is equal to the integral multiple of $\frac{h}{2\pi}$, where h is Planck's constant. These orbits are known as stationary or permissible orbits. The electrons do not radiate energy while revolving in these orbits.

(c) (1) $v_n = \frac{v_0}{n}$

$$v_3 = \frac{v_0}{3}$$

(2) $r_n = r_0 n^2$

$r_4 = 16 r_0$

20. (i) Astronomical Telescope.

(ii) Mirrors used in reflecting telescopes do not cause chromatic aberration while lenses used in refracting telescopes cause chromatic aberration.

(iii) Compound Microscope.

(iv) Magnifying Power.

(v) Compound microscope uses a short focal length objective lens to view small objects. The objective lens creates a large, real image of a nearby object.

Astronomical telescope uses a long focal length objective lens to view large objects, such as planets. The objective lens creates a small, real image of a distant object.