MASS PHYSICS

REVISION PACK FOR CBSE BOARD EXAM 2023

Pack Overview

Scoring great marks in cbse exam is not very difficult if you are doing it in systematic way this pack will help you to revise all your syllabus in most efficient way

This pack contains

1. Basic and important theory topics
2. Previous years chapter wise questions from CBSE exams
3. M.C.Qs from each chapter
4. Assertion and reasoning type questions
5. Questions based on case study

Sample papers

This pack is based on latest **sample paper issued by** CBSE to boost your performance in CBSE exam

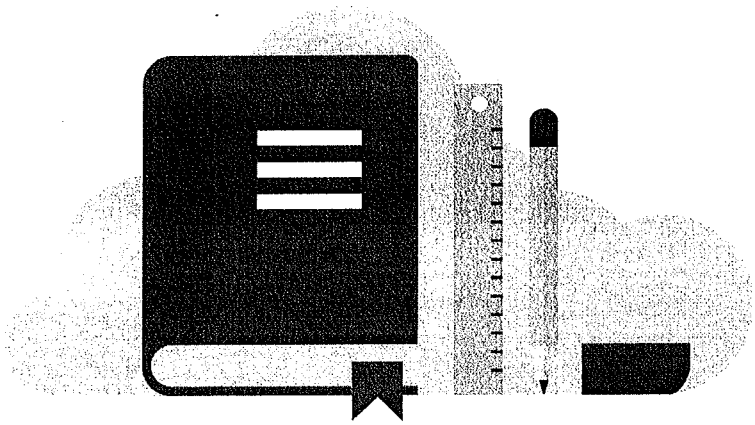
PART 2

SECTION -D : RAY AND WAVE OPTICS + DUAL NATURE

SECTION- E: MODERN PHYSICS EM WAVES, ATOM, NUCLEI & SEMICONDUCTOR

MAY KALI MATA BLESS YOU ALL

Seats are open for focus JEE/NEET Exam batch 2023



Chapter 9 & 10 Revision Notes

[STUDY OF LIGHT]

RAY OPTICS

&

WAVE OPTICS

IMPORTANT TOPICS:

Lets start with Revision of theory & formulas:-

TOPIC (1) Power of lens.

$P = \frac{1}{f}$ S.I unit Diopter

$P = \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ (lens formula)

$P = \frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ Lens maker's formula

$P = \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \cdots$ Combination of lens.

Topic (2):- REFRACTION:-

a) Snell's law $\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = n_{21}$

b) Real & apperant depth. $y = \frac{x}{n} = \frac{\text{real depth}}{\text{refractive index}}$

c) from rarer → denser (Spherical Surface) $\frac{n_1}{-u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$

d) from denser → rarer (Spherical Surface) $\frac{n_2}{-u} + \frac{n_1}{v} = \frac{n_1 - n_2}{R}$

e)* T.I.R (total Internal Reflection)

Conditions:- 1) light from denser → rarer

2) $i > C$

also $\sin C = \frac{1}{n}$.

& $n = \frac{c}{v} \propto \frac{\lambda_a}{\lambda_m}$

or $n \propto \frac{1}{\lambda_m}$.

These conditions are very useful while solving numericals on T.I.R

IMPORTANT TOPICS:

TOPIC ③ PRISM.

a) angle of deviation $\delta = (n-1)A$

b) angular dispersion of prism $= \delta_V - \delta_R$

c) Prism formula $n = \dfrac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin(A/2)}$

d) band of seven color is spectrum V I B G Y O R
(V: min λ, R: max λ)

TOPIC ④ OPTICAL INSTRUMENTS :-

a) Simple Microscope (Single Convex lens)
- $m = 1 + \frac{D}{f}$ (d-adjustment)
- $m = \frac{D}{f}$ (normal-adjustment)

b) Compound Microscope (two coaxial lens)
- $m = \frac{L}{f_o}\left[1 + \frac{D}{f_e}\right]$ (d-adjustment)
- $m = \frac{L}{f_o}\left[\frac{D}{f_e}\right]$ (normal adjustment)

c) Astronomical Telescope (two coaxial lens.)
- $m = \frac{f_o}{-f_e}\left[1 + \frac{f_e}{D}\right)$ (D-adjustment)
- $m = \frac{f_o}{|-f_e|}$ (normal adjustment)

d) Reflecting type telescope (based on mirrors) → $m = \frac{f_o}{|f_e|}$

TOPIC ⑤ :- Refractive Index (Optical density)

$$n = \frac{c}{v} = \frac{\lambda_a}{\lambda_m}$$

($n_{air} = 1.$, $n_{water} = 1.33$, $n_{glass} = 1.5$) learn it ☺

IMPORTANT TOPICS:

WAVE OPTICS :-

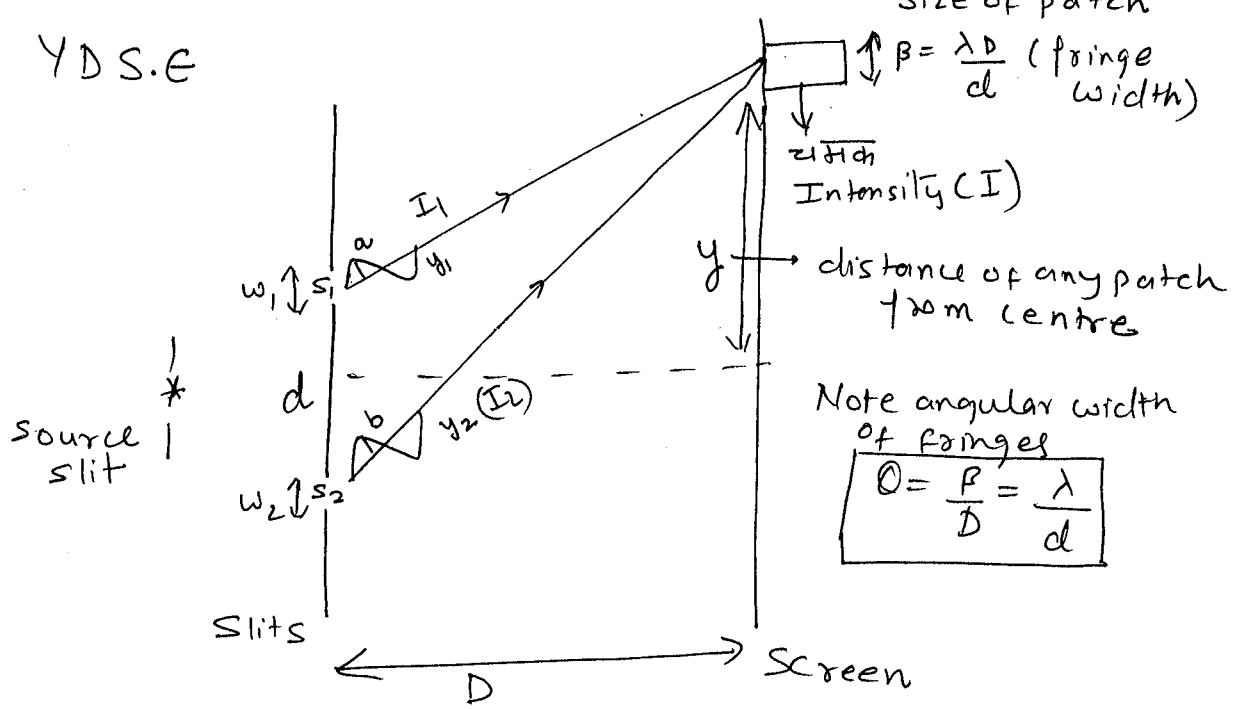
TOPIC ① INTERFENENCE OF LIGHT [Y.D.S.E] (Coherent Sources :-
Call formulas in one table)

a) Intensity $I \propto a^2 + b^2 + 2ab\cos\phi$.

$I \propto A^2$.

(Resultant amplitude) $A = \sqrt{a^2 + b^2 + 2ab\cos\phi}$

b) YDS.E



c) Path diffrence $x = S_2P - S_1P = \frac{dy}{D}$

for Bright Patch $x = n\lambda \rightarrow$ $y = n\lambda\frac{D}{d}$ (distance of any bright)

for dark patch $x = (2n-1)\frac{\lambda}{2} \rightarrow$ $y = (2n-1)\frac{\lambda}{2}\frac{D}{d}$ (distance of any dark)

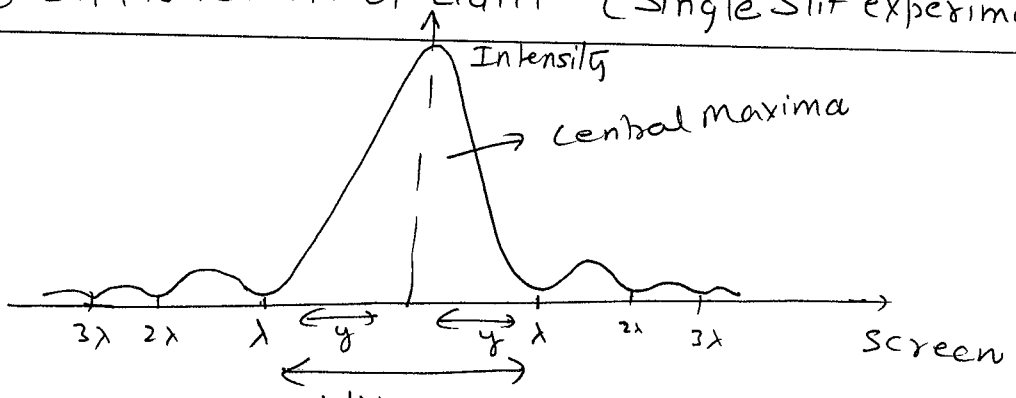
Relation between path difference (x) & Phase difference (ϕ)

$$\phi = \frac{2\pi}{\lambda}x$$

d) Relation of Individual Intensities and amplitudes.

$$\frac{I_1}{I_2} = \frac{a^2}{b^2} = \frac{w_1}{w_2}$$ also $$\frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2}$$

TOPIC ② DIFFRACTION OF LIGHT (Single Slit experiment)



$2y = \frac{2\lambda D}{a}$ a = slit width

Conditions for:—

dark patches $x = a\sin\theta = n\lambda$

bright patches $x = a\sin\theta = (2n+1)\frac{\lambda}{2}$.

Topic ③ Huygens principle & Fresnel distance:—

Huygens principle in 2 points (Postulates)

1) Every point on the primary wavefront act as a fresh new source for secondary disturbance known as wavelets.

2) A continuous plane touching these wavelets tangentialy outwards shows secondary wavefront.

FRESNEL distance [Validity of Ray optics]

$$Z = \frac{a^2}{\lambda}.$$

3 types of wavefront & their properties:—

1) Spherical wavefront 2) Cylindrical wavefront 3) Plane wavefront

Properties:—

a) they are perpendicular to the direction of light

b) they travels with speed of light

c) time taken by each point from primary to secondary wavefront is constant ***

SECTION A 1-MARK QUESTIONS

1. **In a Young's double slit experiment, the path difference at a certain point on the screen between two interfering waves is $\frac{1}{8}$th of the wavelength. The ratio of intensity at this point to that at the centre of a bright fringe is close to**

(i) 0.80

(ii) 0.74

(iii) 0.94

(iv) 0.85

SQP For 2023 Board

2. Two waves having the intensities in the ratio of 9 : 1 produce interference. The ratio of maximum to minimum intensity is

(*a*) 10 : 8 (*b*) 9 : 1 (*c*) 4 : 1 (*d*) 2 : 1

3. In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case [*NCERT Exemplar*]

(*a*) there shall be alternate interference patterns of red and blue.

(*b*) there shall be an interference pattern for red distinct from that for blue.

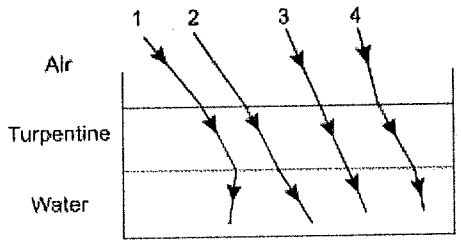
(*c*) there shall be no interference fringes.

(*d*) there shall be an interference pattern for red mixing with one for blue.

4. In Young's double-slit experiment, the distance between the slit sources and the screen is 1 m. If the distance between the slits is 2 mm and the wavelength of light used is 600 nm, the fringe width is

(*a*) 3 mm (*b*) 0.3 mm (*c*) 6 mm (*d*) 0.6 mm

5. The optical density of turpentine is higher than that of water while its mass density is lower. Figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in the figure, the path shown is correct? [*NCERT Exemplar*]



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

6. Why is refractive index in a transparent medium greater than one?
   (*a*) Because the speed of light in vacuum is always less than speed in a transparent medium
   (*b*) Because the speed of light in vacuum is always greater than the speed in a transparent medium
   (*c*) Frequency of wave changes when it crosses medium
   (*d*) None of the above
7. Transmission of light in optical fibre is due to
   (*a*) scattering
   (*b*) diffraction
   (*c*) refraction
   (*d*) multiple total internal reflection

8. Consider the diffraction pattern for a small pinhole. As the size of the hole is increased [*NCERT Exemplar*]

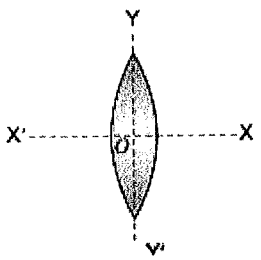
(*a*) the size decreases (*b*) the intensity increases
(*c*) the size increases (*d*) the intensity decreases

9. For light diverging from a point source [*NCERT Exemplar*]
   (*a*) the wavefront is spherical.
   (*b*) the intensity decreases in proportion to the distance squared.
   (*c*) the wavefront is parabolic.
   (*d*) the intensity at the wavefront does not depend on the distance.

10. Focal length of a convex lens of refractive index 1.5 is 2 cm. Focal length of lens, when immersed in a liquid of refractive index of 1.25 will be

(*a*) 10 cm (*b*) 7.5 cm (*c*) 5 cm (*d*) 2.5 cm

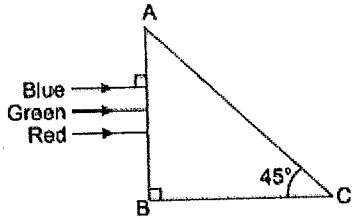
11. An equiconvex lens is cut into two halves along (*i*) XOX' and (*ii*) YOY' as shown in the figure. Let f, f' and f'' be the of the focal lengths of complete lens of each half in case (*i*) and of each half in case (*ii*) respectively. Choose the correct statement from the following :



(*a*) $f' = 2f$ and $f'' = f$ (*b*) $f' = f$ and $f'' = f$

(*c*) $f' = 2f$ and $f'' = 2f$ (*d*) $f' = f$ and $f'' = 2f$

12. A beam of light consisting of red, green and blue colours is incident on a right angled prism. The refractive index of the material of the prism for the above red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively.



The prism will

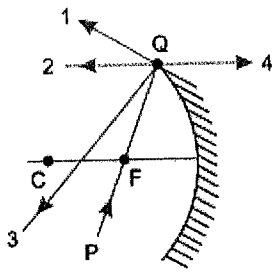
(*a*) not separate the three colours at all

(*b*) separate the red colour part from the green and blue colours

(*c*) separate the blue colour part from the red and green colours

(*d*) separate all the three colours from one another

13. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked 1, 2, 3 and 4 (Fig. given alongside). Which of the four rays correctly shows the direction of reflected ray?



[*NCERT Exemplar*]

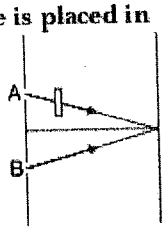
(*a*) 1 (*b*) 2

(*c*) 3 (*d*) 4

14. In a Young's double-slit experiment the fringe width is found to be 0.4 mm. If the whole apparatus is dipped in water of refractive index 4/3, without disturbing the arrangement, the new fringe width will be

(*a*) 0.30 mm (*b*) 0.40 mm (*c*) 0.53 mm (*d*) 0.2 mm

15. In Young's experiment, monochromatic light is used to illuminate the slits *A* and *B*. Interference fringes are observed on a screen placed in front of the slits. Now if a thin glass plate is placed in the path of the beam coming from A, then



(*a*) the fringes will disappear

(*b*) the fringe width will increase

(*c*) the fringe width will decrease

(*d*) there will be no change in the fringe width

ASSERTION- REASONING TYPE QUESTIONS

Two statements are given-one labelled Assertion (A) and the other labelled Reason(R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A

b) Both A and R are true and R is NOT the correct explanation of A

c) A is true but R is false

d) A is false and R is also false

16. **ASSERTION:**
In an interference pattern observed in Young's double slit experiment, if the separation (d) between coherent sources as well as the distance (D) of the screen from the coherent sources both are reduced to 1/3rd, then new fringe width remains the same.
REASON:
Fringe width is proportional to (d/D).

option _____

17. Assertion(A): Light added to light can produce darkness.
Reason (R): When two coherent light waves interfere, there is darkness at position of destructive interference.

option _____

18. Assertion(A): The speed of light in glass depends on colour of light.
Reason (R): The speed of light in glass $v_g = \frac{c}{n_g}$, the refractive index (n_g) of glass is different for different colours.

option _____

SECTION B 2-MARK QUESTIONS

CBSE SQP - 2022.

19. A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging or a diverging lens? Justify your answer.

Ans:-

20. You are given following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope? Give reason.

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

[CBSE Delhi 2009, CBSE (AI) 2017]

Ans. Objective : Lens L_1

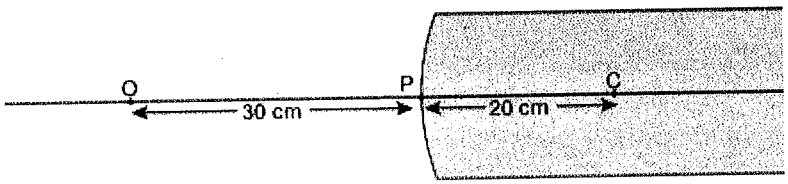
Eyepiece : Lens L_3

Reason: The objective lens should have large aperture (here, 8 cm) and large focal length $\left(f = \frac{1}{\text{Power}}\right)$ while the eyepiece should have small aperture and small focal length.

21. What will be the effect on interference fringes if red light is replaced by blue light? [*CBSE Delhi 2013*]

Ans.

22. A spherical convex surface of radius of curvature 20 cm, made of glass (n = 1.5) is placed in air. Find the position of the image formed, if a point object is placed at 30 cm in front of the convex surface on the principal axis. [*CBSE Sample Paper 2018*]



Ans.

23. A converging and a diverging lens of equal focal lengths are placed co-axially in contact. Find the power and the focal length of the combination. [*CBSE (AI) 2010*]

Ans.

24. A convex lens made of a material of refractive index n_1 is kept in a medium of refractive index n_2. Parallel rays of light are incident on the lens. Complete the path of rays of light emerging from the convex lens if: (*i*) $n_1 > n_2$ (*ii*) $n_1 = n_2$ (*iii*) $n_1 < n_2$. (CBSE DELHI 2012, 2016)

Ans.

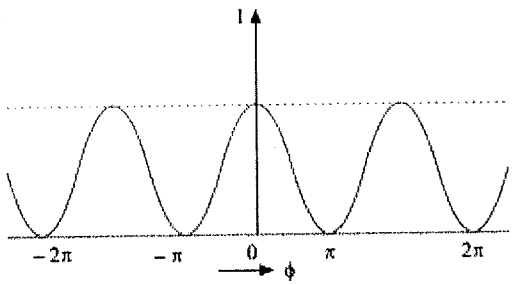
25. An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $4\sqrt{2}/5$.
[*CBSE 2019 (55/1/1)*]

Ans.

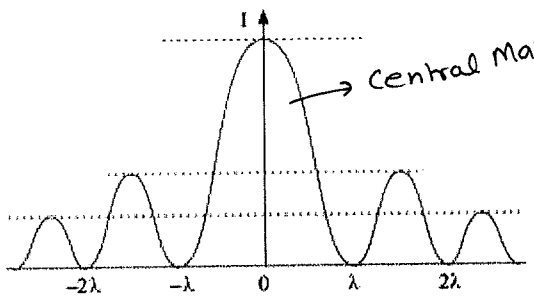
SECTION C 3-MARK QUESTIONS

26. Draw the intensity distribution for (*i*) the fringes produced in interference, and (*ii*) the diffraction bands produced due to single slit. Write two points of difference between the phenomena of interference and diffraction. *[CBSE (F) 2017]*

Ans.



(i) Interference



(ii) Diffraction

Differences between interference and diffraction

Interference	Diffraction
(*a*) It is due to the superposition of two waves coming from two coherent sources.	(*a*) It is due to the superposition of secondary wavelets originating from different parts of the same wavefront.
(*b*) The width of the interference bands is equal.	(*b*) The width of the diffraction bands is not the same.
(*c*) The intensity of all maxima (fringes) is same.	(*c*) The intensity of central maximum is maximum and goes on decreasing rapidly with increase in order of maxima.

Note also Remember Similarities:-

1)

2)

27. (*a*) Why are coherent sources necessary to produce a sustained interference pattern?

(*b*) In Young's double slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is K units. Find out the intensity of light at a point where path difference is $\frac{\lambda}{3}$. [*CBSE Delhi 2012*]

OR

27. What is the shape of the wavefront in each of the following cases: [*CBSE Delhi 2009*]

(*a*) light diverging from a point source.

(*b*) light emerging out of a convex lens when a point source is placed at its focus.

(*c*) the portion of a wavefront of light from a distant star intercepted by the earth.

Ans:-

28. (*i*) What is total internal reflection? Under what conditions does it occur?

(*ii*) Find a relation between critical angle and refractive index.

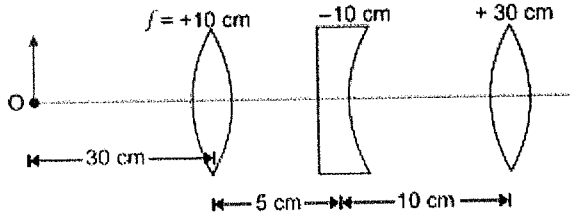
(*iii*) Name one phenomenon which is based on total internal reflection.

[*CBSE (East) 2016, 2019 (55/1/1)*]

Ans.

29. Find the position of the image formed of an object 'O' by the lens combination given in the figure. [*CBSE (F) 2011, 2019 (55/4/1)*]

(NCERT)



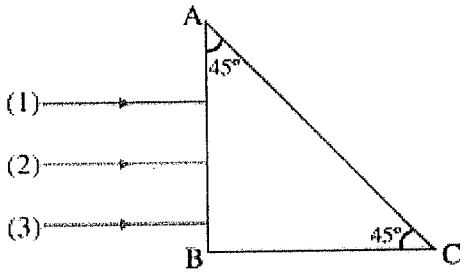
OR

29. A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index 1.6. If it is immersed in a liquid of refractive index 1.3, find its new focal length. [*CBSE (F) 2017*]

Ans:-

30. Three rays (1, 2, 3) of different colours fall normally on one of the sides of an isosceles right angled prism as shown. The refractive index of prism for these rays is 1.39, 1.47 and 1.52 respectively. Find which of these rays get internally reflected and which get only refracted from AC. Trace the paths of rays. Justify your answer with the help of necessary calculations.

[CBSE (F) 2016] *[HOTS]*



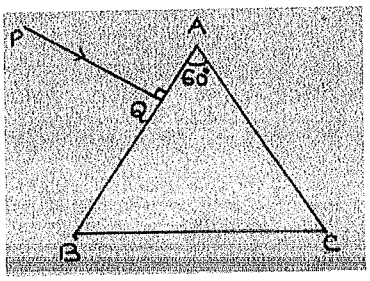
Ans:-

SECTION D 5-MARK QUESTIONS

CBSE SQP For 6th March (2023)

31. a) Draw the graph showing intensity distribution of fringes with phase angle due to diffraction through a single slit. What is the width of the central maximum in comparison to that of a secondary maximum?

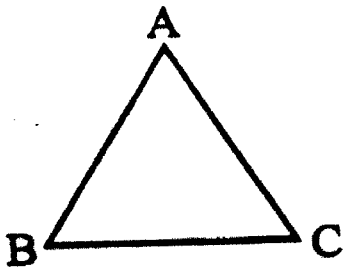
b) A ray PQ is incident normally on the face AB of a triangular prism of refracting angle 60^0 as shown in figure. The prism is made of a transparent material of refractive index $\frac{2}{\sqrt{3}}$. Trace the path of the ray as it passes through the prism. Calculate the angle of emergence and the angle of deviation.



OR

a) Write two points of difference between an interference pattern
and a diffraction pattern.

b) (i) A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of 30°. Calculate the speed of light through the prism.



(ii) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.

32. Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2. Hence, derive lens maker's formula for a double convex lens. State the assumptions made and sign convention used. [*CBSE (F) 2013, (Central) 2016, 2020 (55/2/1)*]

Ans:-

33. (*a*) How is a wavefront defined? Using Huygen's constructions draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media. Hence verify Snell's law of refraction.

When a light wave travels from rarer to denser medium, the speed decreases. Does it imply reduction its energy? Explain. [*CBSE Delhi 2008, 2013, (F) 2011, 2012*]

(*b*) When monochromatic light travels from a rarer to a denser medium, explain the following, giving reasons:

(*i*) Is the frequency of reflected and refracted light same as the frequency of incident light?

(*ii*) Does the decrease in speed imply a reduction in the energy carried by light wave?

[*CBSE Delhi 2013*]

Ans:-

NOTE:- In optical Instruments Compound Microscope & Astronomical telescope are Important for your board exam: '

Practice sheet for their diagrams:-

two types of adjustments for Instruments:—

1) d-adjustment (when the final Image is at least distance of distinct vision i.e 25cm from the eye.)

2) Normal -adjustment (relaxed eye) when final Image is at infinity from the eye.

SECTION E 4-MARK QUESTIONS

How Do You Solve Case Study questions?

There are several steps to writing an answer to a case study assignment:

1. STEP 1: READ THE CASE STUDY AND QUESTIONS CAREFULLY. • ...
2. STEP 2: IDENTIFY THE ISSUES IN THE CASE STUDY. ...
3. STEP 3: LINK THEORY TO PRACTICE. ...
4. STEP 4: PLAN YOUR ANSWER. ...
5. STEP 5: START WRITING YOUR CASE STUDY ANSWER. ...
6. STEP 6: EDIT AND PROOFREAD. ...
7. STEP 7: SUBMIT.

34. **Case Study :**

Read the following paragraph and answer the questions.

A number of optical devices and instruments have been designed and developed such as periscope, binoculars, microscopes and telescopes utilising the reflecting and refracting properties of mirrors, lenses and prisms. Most of them are in common use. Our knowledge about the formation of images by the mirrors and lenses is the basic requirement for understanding the working of these devices.

(i) Why the image formed at infinity is often considered most suitable for viewing. Explain

(ii) In modern microscopes multicomponent lenses are used for both the objective and the eyepiece. Why?

(iii) Write two points of difference between a compound microscope and an astronomical telescope

OR

(iii) Write two distinct advantages of a reflecting type telescope over a refracting type telescope.

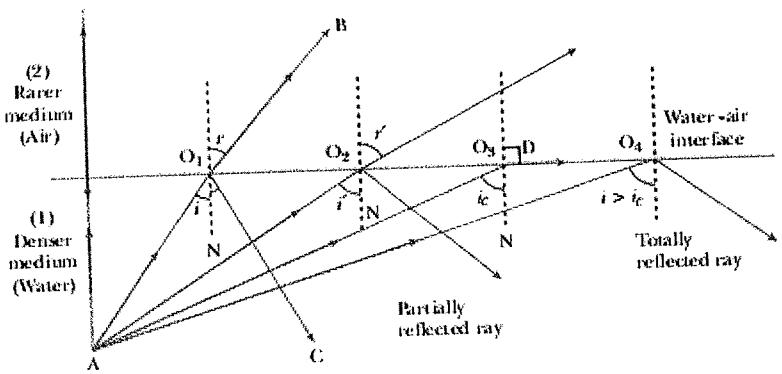
READ THE ABOVE PARAGRAPH AND ANSWER THE QUESTIONS

Ans. 34.

(i)

35. SNELL'S WINDOW:

Total internal reflection is the optical phenomenon in which when the light travels from an optically denser medium to a rarer medium at the interface, it is partly reflected back into the same medium and partly refracted to the second medium. When waves are refracted from the medium of lower propagation speed (*e.g.*, from water to air), the angle of refraction is greater than the angle of incidence. As the angle of incidence approaches a certain limit, called the critical angle, the angle of refraction approaches 90°, at which the refracted ray becomes parallel to the surface. As the angle of incidence increase beyond the critical angle, the condition of refraction can no longer be satisfied, so there is no refracted ray, and partial reflection becomes total.



A similar effect can be observed by opening one's eyes while swimming just below the water surface. If the water is calm, the surface outside the critical angle (measured from the critical) appears mirror-like, reflecting objects below. The region above the water cannot be seen except overhead, where the hemispherical field of view is compressed into a conical field known as Snell's window, whose angular diameter is twice the critical angle.

Snell's window is also called Snell's circle or optical man-hole. It is a phenomenon by which an underwater viewer sees everything above the surface through a cone of light.

READ THE ABOVE PARAGRAPH AND ANSWER ANY FOUR QUESTIONS

(*i*) The phenomenon by which an underwater hemispherical field of view is compressed into a conical field is known as

(*a*) Snell's law (*b*) Snell's window (*c*) mirage (*d*) looming

(*ii*) In Snell's window the angular diameter is

(*a*) equal to critical angle (*b*) twice of the critical angle

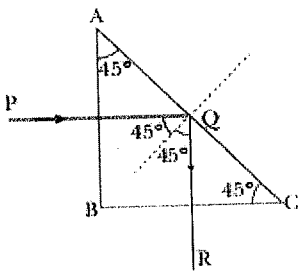
(*c*) half of the incident angle (*d*) twice of the refracted angle

(*iii*) The speed of light in a medium whose critical angle is 30° is

(*a*) 3×10^8 m/s (*b*) 2×10^8 m/s

(*c*) 1.5×10^8 m/s (*d*) 2.5×10^8 m/s

(*iv*) As shown in figure, the ray PQ enters through the side AB, normally and is incident on AC at an angle of 45°. It will be totally reflected along QR, then the refractive index of prism is



(*a*) $\sqrt{2}$ (*b*) $\frac{1}{\sqrt{2}}$

(*c*) $\sqrt{3}$ (*d*) $\frac{2}{\sqrt{3}}$

(*v*) The necessary conditions for total internal reflection is

(*a*) the angle of incidence in denser medium must be smaller than the critical angle for two media

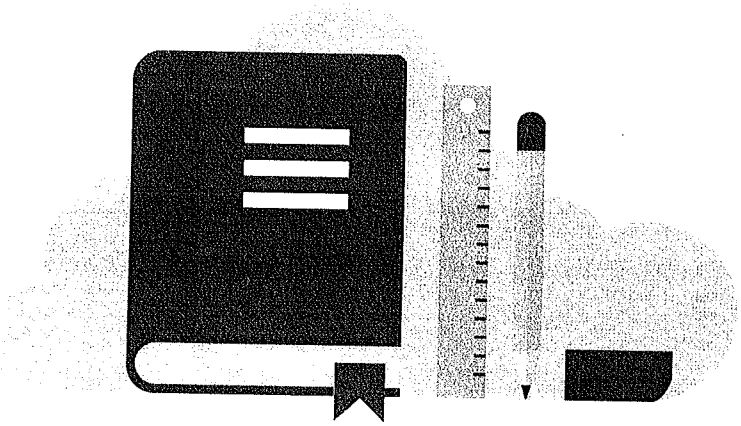
(*b*) the angle of refraction in denser medium must be greater than the critical angle for two media

(*c*) the angle of incidence in denser medium must be greater than the critical angle for two media

(*d*) none of these

ANSWER KEY

(*i*) (*b*) (*ii*) (*b*) (*iii*) (*c*) (*iv*) (*a*) (*v*) (*c*)



Chapter 8 & 11 Revision Notes

ELECTROMAGNETIC WAVES

&

DUAL NATURE

Electromagnetic Spectrum

The electromagnetic waves have a continuous wavelength starting from short gamma rays to long radiowaves. The orderly distribution of wavelength of EM waves is called the electromagnetic spectrum. The complete spectrum is given in the following table:

highest frequency

S. No.	Name	Wavelength Range (m)	Frequency Range (Hz)
i.	Gamma rays	$10^{-13} - 10^{-10}$	$3 \times 10^{21} - 3 \times 10^{18}$
ii.	X-rays	$10^{-10} - 10^{-8}$	$3 \times 10^{18} - 3 \times 10^{16}$
iii.	Ultraviolet rays	$10^{-8} - 4 \times 10^{-7}$	$3 \times 10^{16} - 7.5 \times 10^{14}$
iv.	Visible light	$4 \times 10^{-7} - 7.5 \times 10^{-7}$	$7.5 \times 10^{14} - 4 \times 10^{14}$
v.	Infra red light	$7.5 \times 10^{-7} - 10^{-3}$	$4 \times 10^{14} - 3 \times 10^{11}$
vi.	Microwaves	$10^{-3} - 10^{-1}$	$3 \times 10^{11} - 10^{10}$
vii.	Radio waves	$10^{-1} - 10^{4}$	$10^{10} - 3 \times 10^{4}$

lowest Frequency

Wavelength Range of Visible Spectrum

Visible light has a continuous wavelength starting from 400 nm to 750 nm; for convenience it is divided into 7 colours.

lowest(λ) ← V

I	Indigo	420 nm — 450 nm
B	Blue	450 nm — 500 nm
G	Green	500 nm — 570 nm
Y	Yellow	570 nm — 600 nm
O	Orange	600 nm — 650 nm

highest(λ) → R

R	Red	650 nm — 750 nm

Uses of Electromagnetic Spectrum

(*i*) γ-rays are highly penetrating, they can penetrate thick iron blocks. Due to high energy, they are used to initiate some nuclear reactions. γ-rays are produced in nuclear reactions. In medicine, they are used to destroy cancer cells.

(*ii*) X-rays are used in medical diagnostics to detect fractures in bones, tuberculosis of lungs, presence of stone in gallbladder and kidney. They are used in engineering to check flaws in bridges. In physics X-rays are used to study crystal structure.

(*iii*) Ultraviolet rays provide vitamin *D*. These are harmful for skin and eyes. They are used to sterilise drinking water and surgical instruments. They are used to detect invisible writing, forged documents, finger prints in forensic lab and to preserve food items.

(*iv*) Infrared rays are produced by hot bodies and molecules. These waves are used for long distance photography and for therapeutic purposes.

(*v*) Radiowaves are used for broadcasting programmes to distant places. According to frequency range, they are divided into following groups

(1) Medium frequency band or medium waves 0·3 to 3 MHz

(2) Short waves or short frequency band 3 MHz — 30 MHz

(3) Very high frequency (VHF) band 30 MHz to 300 MHz

(4) Ultrahigh frequency (UHF) band 300 MHz to 3000 MHz

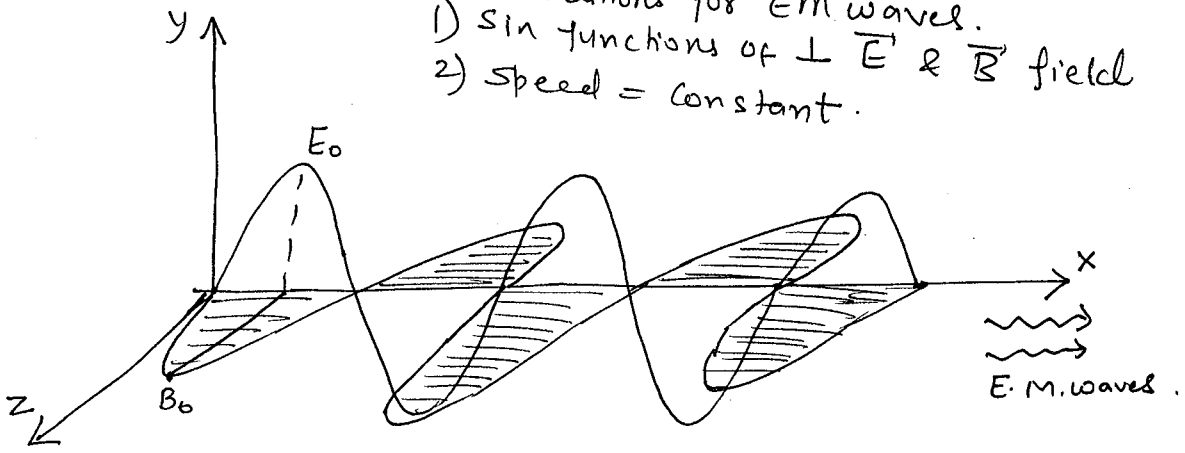
amp

(*vi*) Microwaves are produced by special vacuum tubes, namely; klystrons, magnetrons and gunn diodes. Their frequency range is 3 GHz to 300 GHz.

They are used in RADAR systems for aircraft navigation and microwave used in homes.

IMPORTANT TOPICS:

Conditions for EM waves.
1) sin functions of ⊥ $\vec{E}$ & $\vec{B}$ field
2) Speed = Constant.



equations for Electric field & Magnetic fields:-

$$E_y = E_0 \sin(Kx - \omega t) \text{ N/C}$$

$$B_z = B_0 \sin(Kx - \omega t) \text{ T}$$

also $$\boxed{\frac{E_0}{B_0} = C = \text{Speed of light} = \frac{1}{\sqrt{\mu_0 \epsilon_0}} = n v}$$

Note:- (Electric field, Magnetic field & direction of E.M waves are mutual perpendicular to each other.)

Momentum of wave = $\frac{U}{C} = \frac{\text{energy}}{C}$

SECTION A 1-MARK QUESTIONS

Q. 1. How is the speed of EM-waves in vacuum determined by the electric and magnetic fields? [*CBSE Delhi 2017*]

Ans. Speed of EM waves is determined by the ratio of the peak values of electric field vector and magnetic field vector.

$$c = \frac{E_0}{B_0}$$

Q. 2. Do electromagnetic waves carry energy and momentum? [*CBSE (AI) 2017; 2019, (55/4/1)*]

Ans. Yes, EM waves carry energy E and momentum p. As electromagnetic waves contain both electric and magnetic fields, there is a non-zero energy density associated with it.

3. Arrange the following electromagnetic waves in decreasing order of wavelength:
γ-rays, infrared rays, X-rays and microwaves. [*CBSE (F) 2014*]

Ans. Microwave > Infrared > X-rays > γ-rays

4. Which part of the electromagnetic spectrum is used in operating a RADAR? [*CBSE Delhi 2010; 2019 (55/2/1)*]

Ans. Microwaves with frequency range between 10^{10} to 10^{12} Hz are used in operating a RADAR.

5. Why are microwaves considered suitable for radar systems used in aircraft navigation? [*CBSE Delhi 2016*]

Ans. Microwaves are considered suitable for radar systems used in aircraft navigation due to their short wavelength or high frequency.

6. Which part of the electromagnetic spectrum is absorbed from sunlight by ozone layer? [*CBSE Delhi 2010*]

Ans. Ultraviolet light is absorbed by the ozone layer.

7. Welders wear special goggles or face masks with glass windows to protect their eyes from electromagnetic radiations. Name the radiations and write the range of their frequency. [*CBSE (AI) 2013*]

Ans. Ultraviolet radiations.
Frequency range $10^{15} - 10^{17}$ Hz.
Hint: *Frequency of visible light is of the order of* 10^{14} *Hz.*

8. Name the electromagnetic waves, which (*i*) maintain the Earth's warmth and (*ii*) are used in aircraft navigation. [*CBSE (F) 2012*]

Ans. (*i*) Infrared rays
(*ii*) Microwaves

9. **Which of the following statement is NOT true about the properties of electromagnetic waves?**

(I) These waves do not require any material medium for their propagation

(ii) Both electric and magnetic field vectors attain the maxima and minima at the same time

(iii) The energy in electromagnetic wave is divided equally between electric and magnetic fields

(iv) Both electric and magnetic field vectors are parallel to each other

SQP CBSE (2023) 6th March.

10. Electromagnetic waves with wavelength

(i) λ_1 is suitable for radar systems used in aircraft navigation.

(ii) λ_2 is used to kill germs in water purifiers.

(iii) λ_3 is used to improve visibility in runways during fog and mist conditions.

Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude.

2-Mark
Section – (B)

Ans:-

11. Electromagnetic waves with wavelength

(*i*) λ_1 is used in satellite communication.

(*ii*) λ_2 is used to kill germs in water purifier.

(*iii*) λ_3 is used to detect leakage of oil in underground pipelines.

(*iv*) λ_4 is used to improve visibility in runways during fog and mist conditions.

(*a*) Identify and name the part of electromagnetic spectrum to which these radiations belong.

(*b*) Arrange these wavelengths in ascending order of their magnitude.

(*c*) Write one more application of each. *[NCERT Exemplar]*

Ans. (*a*) $\lambda_1 \rightarrow$ Microwave, $\lambda_2 \rightarrow$ UV For. (2023)

$\lambda_3 \rightarrow$ X-rays, $\lambda_4 \rightarrow$ Infrared

(*b*) $\lambda_3 < \lambda_2 < \lambda_4 < \lambda_1$

(*c*) Microwave – RADAR

UV – LASIK eye surgery

X-ray – Bone fracture identification (bone scanning)

Infrared – Optical communication

12. **Explain briefly how electromagnetic waves are produced by an oscillating charge. How is the frequency of EM waves produced related to that of the oscillating charge?**

[CBSE (F) 2012, 2019 (55/2/3)] 2016, 2015

Ans. An oscillating or accelerated charge is supposed to be source of an electromagnetic wave. An oscillating charge produces an oscillating electric field in space which further produces an oscillating magnetic field which in turn is a source of electric field. These oscillating electric and magnetic field, hence, keep on regenerating each other and an electromagnetic wave is produced

The frequency of EM wave = Frequency of oscillating charge.

13. **Identify the electromagnetic waves whose wavelengths vary as**

(*a*) $10^{-12}\text{m} < \lambda < 10^{-8}$ m (*b*) 10^{-3} m $< \lambda < 10^{-1}$ m

Write one use for each. *[CBSE (AI) 2017]*

Ans. (*a*) X-rays: Used as a diagnostic tool in medicine and as a treatment for certain forms of cancer.

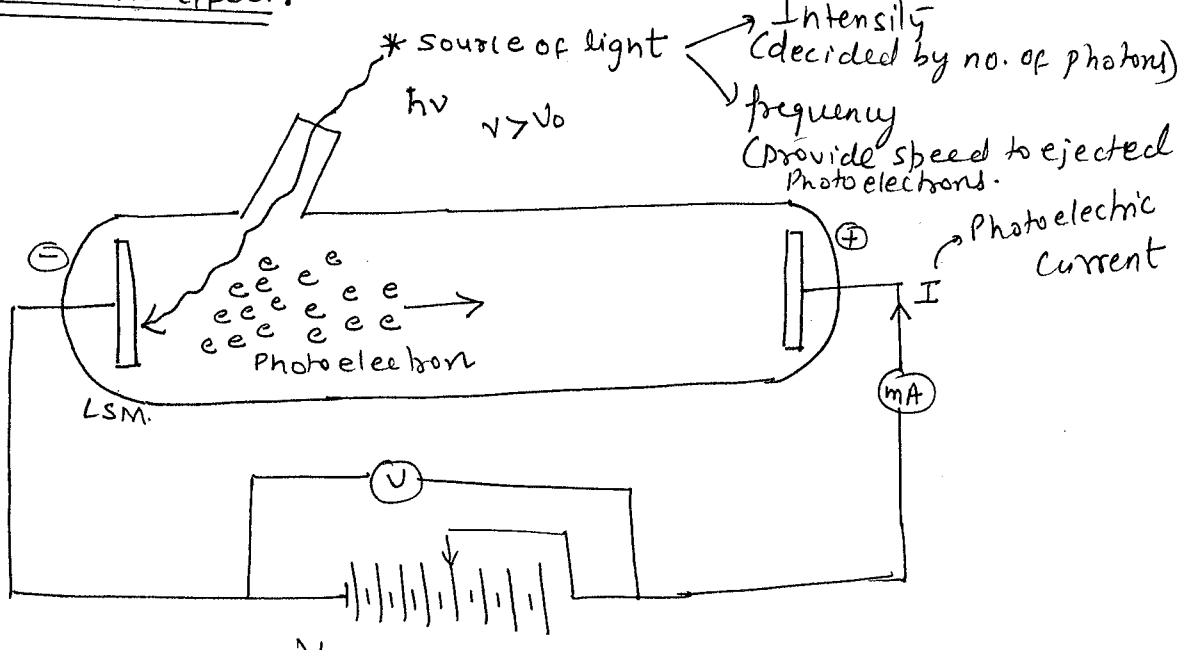
(*b*) Microwaves: Used in radar systems for aircraft navigation.

IMPORTANT TOPICS:

DUAL NATURE

Topic Lets start with Revision of theory & formulas :-

(1) Photoelectric effect:-

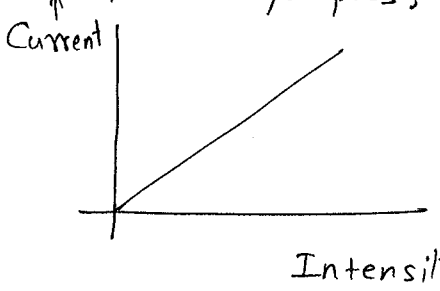


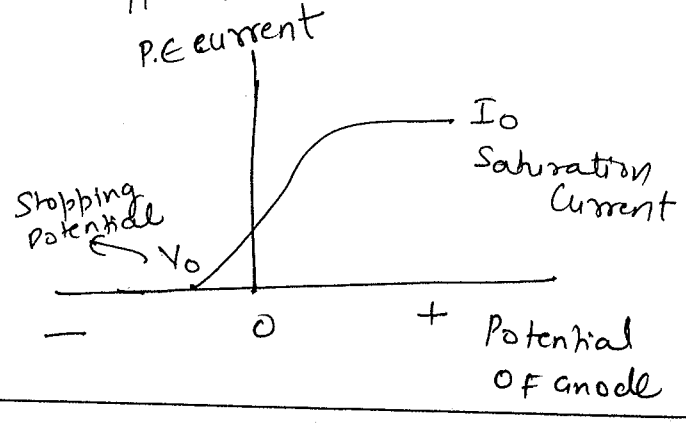
→ light energy converts to electric energy.

→ electrons ejected from light sensitive metal plate when energy more then work function ($\phi_0 = h\nu_0$) is incident on this plate

→ these photoelectron drift toward +ve anode and this results in photoelectric effect

Important graphs:-





TOPIC ② DE BROGLIE - Wavelength :—

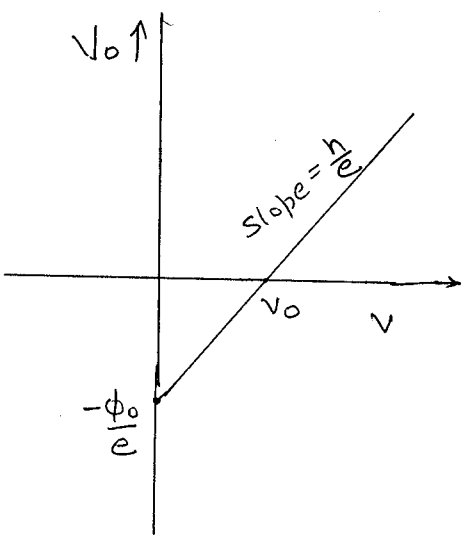
$$\lambda = \frac{h}{m\vartheta} = \frac{h}{p} = \frac{h}{\sqrt{2meV}} = \frac{h}{\sqrt{2mK.E}} = \frac{h}{\sqrt{2m\left(\frac{3}{2}K_BT\right)}} = \frac{1.227}{\sqrt{V}}\ nm$$

Note :- K_B = boltzmann constant
$= 1.38 \times 10^{-23}$
h = Planck's constant
$= 6.6 \times 10^{-34}$.

TOPIC ③ EINSTEIN PHOTOELECTRIC EQUATION :—

total energy = eject photoelectron + provide K.E to it

$$h\nu = \phi_0 + K.E$$
$$h\nu = h\nu_0 + \frac{1}{2}m\vartheta^2$$
$$h\nu - h\nu_0 = \frac{1}{2}m\vartheta^2 = eV_0$$
$$eV_0 = h\nu - h\nu_0$$
$$V_0 = \frac{h\nu}{e} - \frac{h\nu_0}{e}$$
$$V_0 = \frac{h}{e}\nu - \frac{\phi_0}{e}$$



Note ① Intensity effects photoelectric current
② frequency effects stopping potential.

Important :- to Note :—

Wave theory fails to explain photoelectric effect :—

a) there's a certain min. frequency known as threshold frequency below which no electrons will eject out.

b) electrons K.E is independent of Intensity.

SECTION A 1-MARK QUESTIONS

1. **The work function for a metal surface is 4.14 eV. The threshold wavelength for this metal surface is:**

(i) 4125 Å
(ii) 2062.5 Å
(iii) 3000 Å
(iv) 6000 Å

SQP (CBSE-2022)

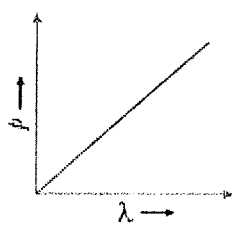
2. If an electron and a photon propagate in the form of waves having same wavelength, it implies that they have same:

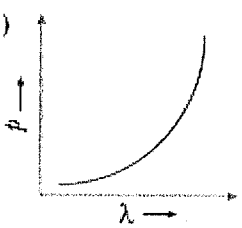
(*a*) speed (*b*) momentum (*c*) energy (*d*) all the above

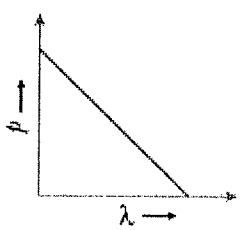
3. A particle of mass 1 mg has the same wavelength as an electron moving with a velocity of 3×10^6 ms $^{-1}$. The velocity of the particle is (mass of electron = 9.1×10^{-31} kg)

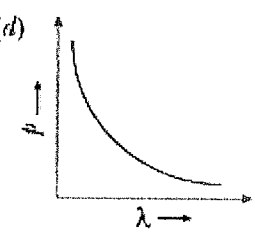
(*a*) 2.7×10^{-18} ms^{-1} (*b*) 9×10^{-2} ms^{-1} (*c*) 3×10^{31} ms^{-1} (*d*) 2.7×10^{-21} ms^{-1}

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

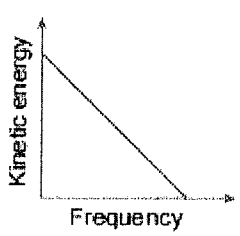
(*a*) 

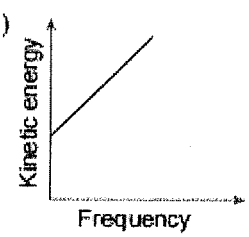
(*b*) 

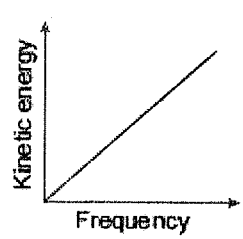
(*c*) 

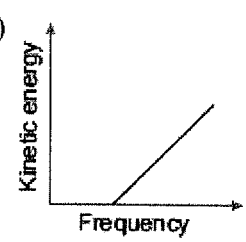
(*d*) 

5. According to Einstein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is

(*a*) 

(*b*) 

(*c*) 

(*d*) 

ASSERTION- REASONING TYPE QUESTIONS

Two statements are given-one labelled Assertion (A) and the other labelled Reason(R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A

b) Both A and R are true and R is NOT the correct explanation of A

c) A is true but R is false

d) A is false and R is also false

6. **Assertion(A)** :

The photoelectrons produced by a monochromatic light beam incident on a metal surface have a spread in their kinetic energies.

Reason(R) :

The energy of electrons emitted from inside the metal surface, is lost in collision with the other atoms in the metal.

option _____

7. Assertion(A): In the process of photoelectric emission, all emitted electrons have the same kinetic energy.

Reason (R): According to Einstein's equation $E_k = h\nu + \phi_0$.

option _____

SECTION B 2-MARK QUESTIONS

1. **If light of wavelength 412·5 nm is incident on each of the metals given below, which ones will show photoelectric emission and why?** *[CBSE 2018]*

Metal	Work Function (eV)
Na	1.92
K	2.15
Ca	3.20
Mo	4.17

Ans:-

Q. 2. **Write three characteristic features in photoelectric effect which cannot be explained on the basis of wave theory of light, but can be explained only using Einstein's equation.** *[CBSE Delhi 2016]*

Ans. The three characteristic features which cannot be explained by wave theory are:

(*i*) Kinetic energy of emitted electrons is found to be independent of the intensity of incident light.

(*ii*) There is no emission of electrons if frequency of incident light is below a certain frequency (threshold frequency).

(*iii*) Photoelectric effect is an instantaneous process.

SECTION C 3-MARK QUESTIONS

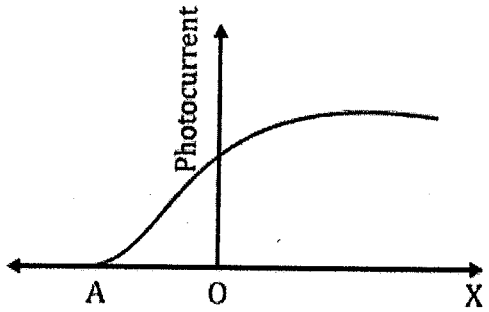
1. Radiation of frequency 10^{15} Hz is incident on three photosensitive surfaces A, B and C. Following observations are recorded:
Surface A: no photoemission occurs
Surface B: photoemission occurs but the photoelectrons have zero kinetic energy.

Surface C: photo emission occurs and photoelectrons have some kinetic energy.
Using Einstein's photo-electric equation, explain the three observations.

OR

The graph shows the variation of photocurrent for a photosensitive metal

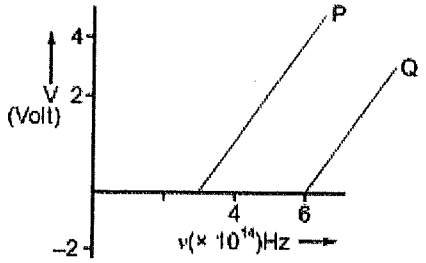
CBSE SQP For 6th March (2023).



(a)What does X and A on the horizontal axis represent?
(b)Draw this graph for three different values of frequencies of incident radiation υ_1, υ_2 and υ_3 ($\upsilon_3 > \upsilon_2 > \upsilon_1$) for the same intensity.
(c) Draw this graph for three different values of intensities of incident radiation I_1, I_2 and I_3 ($I_3 > I_2 > I_1$) having the same frequency.

Ans:-

2. In the study of a photoelectric effect the graph between the stopping potential V and frequency ν of the incident radiation on two different metals P and Q is shown below:



(*i*) Which one of the two metals has higher threshold frequency?

(*ii*) Determine the work function of the metal which has greater value.

(*iii*) Find the maximum kinetic energy of electron emitted by light of frequency 8×10^{14} Hz for this metal.

[*CBSE Delhi 2017*]

Ans:-

3. A proton and an α-particle have the same de-Broglie wavelength. Determine the ratio of (*i*) their accelerating potentials (*ii*) their speeds. *[CBSE Delhi 2015; 2019 (55/4/1)]*

Ans:-

OR

4. A proton and an alpha particle are accelerated through the same potential. Which one of the two has (*i*) greater value of de Broglie wavelength associated with it and (*ii*) less kinetic energy? Give reasons to justify your answer. *[CBSE North 2016, Delhi 2014]*

Ans:-

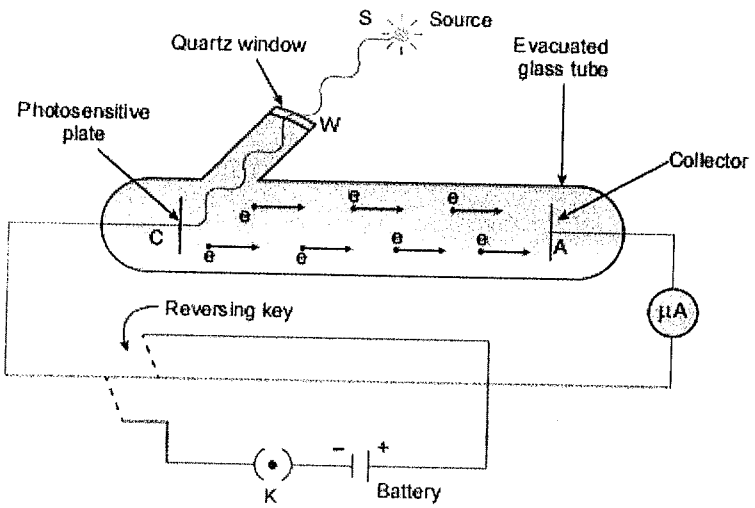
SECTION D 5-MARK QUESTIONS

Q. 1. Describe an experimental arrangement to study photoelectric effect. Explain the effect of (*i*) intensity of light on photoelectric current, (*ii*) potential on photoelectric current and (*iii*) frequency of incident radiation on stopping potential.

Ans. Experimental study of Photoelectric Effect: The apparatus consist of an evacuated glass or quartz tube which encloses a photosensitive plate *C* (called emitter) and a metal plate *A* (called collector).

A transparent window *W* is sealed on the glass tube which can be covered with a filter for a light of particular radiation. This will allow the light of particular wavelength to pass through it.

The plate *A* can be given a desired positive or negative potential with respect to plate *C*, using the arrangement as shown in figure.



SECTION E 4-MARK QUESTIONS

How Do You Solve Case Study questions?

There are several steps to writing an answer to a case study assignment:

1. STEP 1: READ THE CASE STUDY AND QUESTIONS CAREFULLY. • ...
2. STEP 2: IDENTIFY THE ISSUES IN THE CASE STUDY. ...
3. STEP 3: LINK THEORY TO PRACTICE. ...

CASE BASED QUESTIONS
DUAL NATURE OF RADIATION AND MATTER

1. The photoelectric emission is possible only if the incident light is in the form of packets of energy, each having a definite value, more than the work function of the metal. This shows that light is not of wave nature but of particle nature. It is due to this reason that photoelectric emission was accounted by quantum theory of light.

Q1. Packet of energy are called
(a)electron
(b)quanta
(c)frequency
(d)neutron

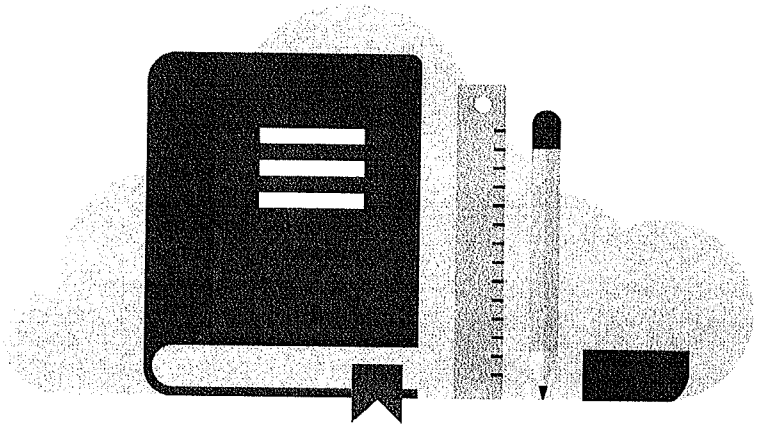
Q2. One quantum of radiation is called
(a)meter
(b)meson
(c) photon
(d)quark

Q3. Energy associated with each photon
(a)hc
(b)mc
(c)hv
(d)hk

Q4. Which of the following waves can produce photo electric effect
(a). UV radiation
(b). Infrared radiation
(c). Radio waves
(d) .Microwaves

Q5. Work function of alkali metals is
(a)less than zero
(b)just equal to other metals
(c) greater than other metals
(d) quite less than other metals

Answer
Q1.(b) Q2.(c) Q3.(c) Q4.(a) Q5.(d)



Chapter 12 & 13 Revision Notes

ATOM

&

NUCLEI

IMPORTANT TOPICS:

Lets start with Revision of theory & Important formula's.

CH-12. (NCERT) ATOM.

TOPIC (1)

BOHR'S THEORY:-

TOPICS 1: Bohr's Ist postulate $\frac{mv^2}{r} = \frac{Ze^2}{4\pi\epsilon_0 r^2}$

2. Bohr's IInd Postulate $mvr = \frac{nh}{2\pi}$

3. Bohr's IIIrd Postulate $h\nu = E_2 - E_1$

4. Size of H-atom. $r = \frac{n^2h^2\epsilon_0}{Ze^2m\pi}$
($r = 0.53\,A^\circ$ for $n=1$, $Z=1$)

5. Velocity of electron in H-atom. $v = \frac{Ze^2}{2h\epsilon_0 n}$
($v = 2.2\times10^6$ for $n=1$; $Z=1$)

6. Frequency of electron in H-atom. $\nu = \frac{Z^2e^4m}{4\epsilon_0^2 n^3 h^3}$
$\nu = 1.3\times10^{15}\,Hz$
(for $n=1$; $Z=1$)

7. Total energy associated with H-atom.

$$K.E = \frac{Ze^2}{8\pi\epsilon_0 r} \qquad P.E = -\frac{Ze^2}{4\pi\epsilon_0 r}$$

$$T.E = K.E + P.E = -\frac{Ze^2}{8\pi\epsilon_0 r}$$

$\therefore$ $\boxed{|T.E| = K.E \quad \& \quad P.E = 2\,T.E}$

also: $\boxed{T.E = -\frac{Z^2e^4m}{8h^2\epsilon_0^2 n^2} = -\frac{13.6\,Z^2}{n^2}\ eV.}$

IMPORTANT TOPICS:

TOPIC 2. SPECTRAL SERIES OF H-ATOM.

a) Rydberg / Balmer formula

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{n_f^2} - \frac{1}{n_i^2}\right]$$

R = Rydberg Constant
$= 1.097 \times 10^7\ m^{-1}$.

If electron jumps to $n_f = 1$ (Lymen series) - UV Rays.
If electron jumps to $n_f = 2$ (Balmer series) → Visible Light
If electron jumps to $n_f = 3$ (Paschen series) → IR Rays
If electron jumps to $n_f = 4$ (Brackett series) — IR Rays

ATOMIC HISTORY.

Dalton's atomic theory
↓
Thomson's Model of Atom.
↓
Rutherford Nuclear Model (Geiger & Marsden) → $r = \frac{2Ze^2}{4\pi\epsilon_0(K)}$ (Closest distance of least approach)
→ $b = \frac{2e^2 \cot(\theta/2)}{4\pi\epsilon_0 K}$ (Impact Parameter)
↓
Bohr's Model of Hydrogen
↓
Quantum Mechanics.

Important topics in NUCLEI :—

(1) Nuclear size & density

$$R = R_0 A^{1/3}$$

Nuclear density $\sim 10^{17}$ kg/m^3

R_0 = imperical constant = 1.01×10^{-15} m
A = mass no.

(2) B.E (Binding energy) & mass defect.

$$\Delta m = [Z m_p + (A-Z) m_N - M_N]$$

$$B.E = [Z m_p + (A-Z) m_N - M_N] \times 931.5 \text{ meV}.$$

(3) Energy associated with Nuclear Reaction:-

let us consider any reaction

$$X + Y = W + Z + Q_{Energy}.$$

$$Q_{energy} = [\text{mass of reactants} - \text{mass of products}] \times 931.5 \text{ MeV}.$$

$$= [m_X + m_Y - m_W - m_Z] \times 931.5 \text{ MeV}.$$

Provided that mass are given in (amu)

Note 1amu mass gives = 931.5 MeV of energy

(4) NUCLEAR FISSION & FUSSION:

$${}^1_0n + {}^{235}_{92}U \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^1_0n + E$$

$${}^2_1H + {}^2_1H \longrightarrow {}^4_2He + E$$

(5) ISOTOPES → eg. ${}^{235}_{92}U$ & ${}^{238}_{92}U$ → same atomic No.

ISOBARS → eg. ${}^3_1H$ & ${}^3_2He$ → same mass No.

ISOTONES → eg. ${}^{37}_{17}Cl$ & ${}^{39}_{19}K$ → Same no. of Neutrons

SECTION A 1-MARK QUESTIONS

1. The size of the atom is proportional to
(a) A (b) $A^{1/3}$ (c) $A^{2/3}$ (d) $A^{-1/3}$

2. To explain his theory, Bohr used
(a) conservation of linear momentum (b) quantisation of angular momentum
(c) conservation of quantum (d) none of these

3. When an electron in an atom goes from a lower to a higher orbit, its
(a) kinetic energy (KE) increases, potential energy (PE) decreases
(b) KE increases, PE increases
(c) KE decreases, PE increases
(d) KE decreases, PE decreases

4. According to Bohr's theory, the energy of radiation in the transition from the third excited state to the first excited state for a hydrogen atom is
(a) 0.85 eV (b) 13.6 eV (c) 2.55 eV (d) 3.4 eV

5. Given the value of Rydberg constant is 10^7 m^{-1}, the wave number of the last line of the Balmer series in hydrogen spectrum will be
(a) 0.25×10^7 m^{-1} (b) 2.5×10^7 m^{-1} (c) 0.025×10^4 m^{-1} (d) 0.5×10^7 m^{-1}

6. Taking the Bohr radius as $a_0 = 53$ pm, the radius of Li^{++} ion in its ground state, on the basis of Bohr's model, will be about [*NCERT Exemplar*]
(a) 53 pm (b) 27 pm (c) 18 pm (d) 13 pm

7. When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge Ze, its distance of closest approach from the nucleus depends on m as
(a) $\frac{1}{m^2}$ (b) m (c) $\frac{1}{m}$ (d) $\frac{1}{\sqrt{m}}$

8. **The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. The radius of the n =3 orbit is**

(i) 1.01×10^{-10}m

(ii) 1.59×10^{-10}m

(iii) 2.12×10^{-10}m

(iv) 4.77×10^{-10}m

For CBSE 2023 March- 6th exam.

9. **Which of the following statements about nuclear forces is not true?**

(i) The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few femtometres.
(ii) The nuclear force is much weaker than the Coulomb force.
(iii) The force is attractive for distances larger than 0.8 fm and repulsive if they are separated by distances less than 0.8 fm.
(iv) The nuclear force between neutron-neutron, proton-neutron and proton-proton is approximately the same.

(SQP CBSE 2022)

10. If radius of the $^{27}_{13}$Al nucleus is taken to be R_{Al}, then the radius of $^{125}_{53}$Te nucleus is nearly

(a) $\frac{3}{5}R_{Al}$ (b) $\left(\frac{13}{53}\right)^{1/3}R_{Al}$ (c) $\left(\frac{53}{13}\right)^{1/3}R_{Al}$ (d) $\frac{5}{3}R_{Al}$

ASSERTION- REASONING TYPE QUESTIONS

Two statements are given-one labelled Assertion (A) and the other labelled Reason(R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A

b) Both A and R are true and R is NOT the correct explanation of A

c) A is true but R is false

d) A is false and R is also false

11. Assertion(A): Paschen series lies in the infrared region.
Reason (R): Paschen series corresponds to the wavelength given by $\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$, where $n = 4, 5, 6, ..., \infty$.

option _____

12. Assertion(A): Energy is released in nuclear fission.
Reason (R): Total binding energy of fission fragments is larger than the total binding energy of the parent nucleus.

option _____

13. Assertion(A): Large angle of scattering of α-particles led to the discovery of atomic nucleus.
Reason (R): Entire positive charge of atom is concentrated in the central core.

option _____

SECTION B 2-MARK QUESTIONS

14. What is the nuclear radius of ^{125}Fe ,if that of ^{27}Al is 3.6 fermi?.

OR

The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 $\mathbf{A^0}$. Calculate the short wavelength limit for the Balmer series of the hydrogen spectrum.

(CBSE SQP - 2022)

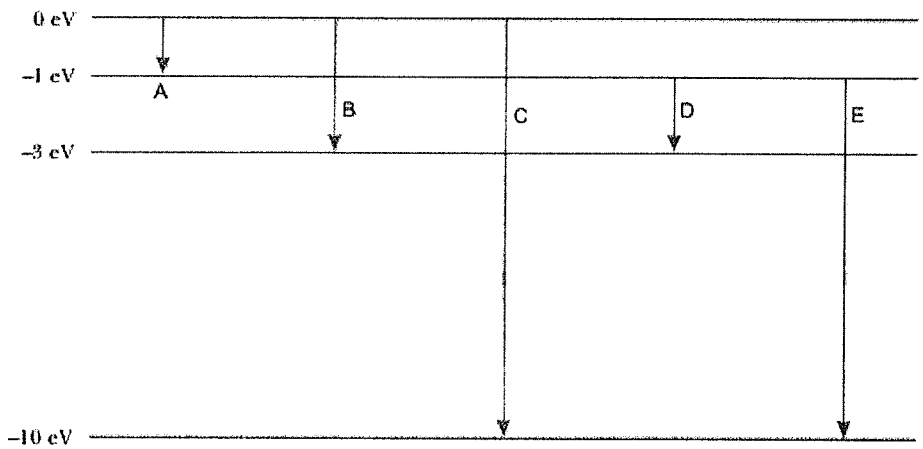
Ans.

15. **When is H_α line in the emission spectrum of hydrogen atom obtained? Calculate the frequency of the photon emitted during this transition.** *[CBSE North 2016]*

Ans. The line with the longest wavelength of the Balmer series is called H_α.

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$

16. **The energy levels of an atom are given below in the diagram.**



Which of the transitions belong to Lyman and Balmer series? Calculate the ratio of the shortest wavelengths of the Lyman and the Balmer series of the spectra.

[CBSE Chennai 2015, CBSE 2019 (55/2/3)]

Ans. Transition C and E belong to Lyman series.

Reason: In Lyman series, the electron jumps to lowest energy level from any higher energy levels.

Transition B and D belong to Balmer series.

Reason: The electron jumps from any higher energy level to the level just above the ground energy level.

The wavelength associated with the transition is given by

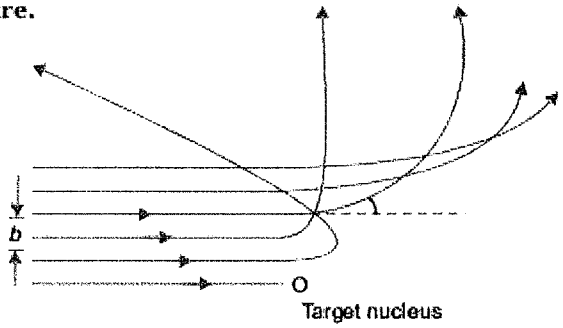
$$\lambda = \frac{hc}{\Delta E}$$

Ratio of the shortest wavelength

$$\lambda_L : \lambda_B = \frac{hc}{\Delta E_L} : \frac{hc}{\Delta E_B}$$

$$= \frac{1}{0-(-10)} : \frac{1}{0-(-3)} = 3:10$$

17. **The trajectories, traced by different α-particles, in Geiger-Marsden experiment were observed as shown in the figure.**



(*a*) **What names are given to the symbols '*b*' and 'θ' shown here?**

(*b*) **What can we say about the values of *b* for (*i*) θ = 0° (*ii*) θ = π radians?** [*HOTS*]

Ans:-

18. **Find out the wavelength of the electron orbiting in the ground state of hydrogen atom.** [*CBSE Delhi 2017*]

Ans. Radius of ground state of hydrogen atom, $r = 0.53\ \text{Å} = 0.53 \times 10^{-10}\ \text{m}$

According to de Broglie relation, $2\pi r = n\lambda$

For ground state, $n = 1$

$$2 \times 3.14 \times 0.53 \times 10^{-10} = 1 \times \lambda$$

$$\therefore \quad \lambda = 3.32 \times 10^{-10}\ \text{m}$$

$$= \mathbf{3.32\ Å}$$

19. State three properties of nuclear forces. [*CBSE Allahabad 2015*]

Ans. Properties of nuclear forces

(1) Nuclear forces are the strongest attractive forces.

(2) Nuclear forces are short ranged upto 10^{-15} m.

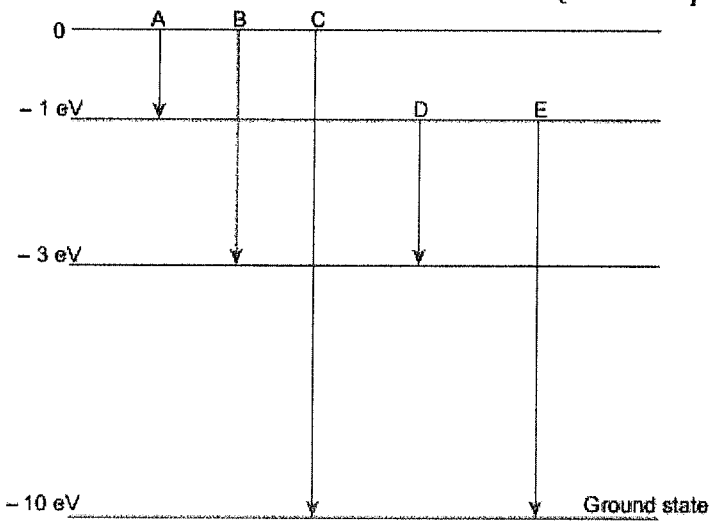
(3) Nuclear forces are charge independent.

20. Two nuclei have mass numbers in the ratio 1 : 8. What is the ratio of their nuclear radii? [*CBSE (AI) 2009*]

Ans:-

SECTION C 3-MARK QUESTIONS

21. The energy levels of an atom of element X are shown in the diagram. Which one of the level transitions will result in the emission of photons of wavelength 620 nm? Support your answer with mathematical calculations. *[CBSE Sample Question Paper 2018]*



Ans:-

$$E = \frac{hc}{\lambda}$$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{620 \times 10^{-9}}$$

$$= 3.2 \times 10^{-19} \text{ J}$$

$$= \frac{3.2 \times 10^{-19}}{1.6 \times 10^{-19}} = 2 \text{ eV}$$

This corresponds to the transition 'D'. Hence level transition D will result in emission of wavelength 620 nm.

22. Determine the distance of closest approach when an alpha particle of kinetic energy 4.5 MeV strikes a nucleus of $Z = 80$, stops and reverses its direction. *[CBSE Ajmer 2015]*

Ans:-

23. In a typical nuclear reaction, *e.g.*,

$${}_1^2H + {}_1^2H \longrightarrow {}_2^3He + n + 3.27\ MeV,$$

although number of nucleons is conserved, yet energy is released. How? Explain.

[CBSE Delhi 2013]

Ans:-

24. Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (*i*) attractive, (*ii*) repulsive.

Write two important conclusions which you can draw regarding the nature of the nuclear forces.

[CBSE 2019 (55/5/2/1)]

Ans:-

SECTION D 5-MARK QUESTIONS

25. Draw a schematic arrangement of Geiger-Marsden experiment for studying α-particle scattering by a thin foil of gold. Describe briefly, by drawing trajectories of the scattered α-particles. How this study can be used to estimate the size of the nucleus? *[CBSE Delhi 2010]*

Ans:-

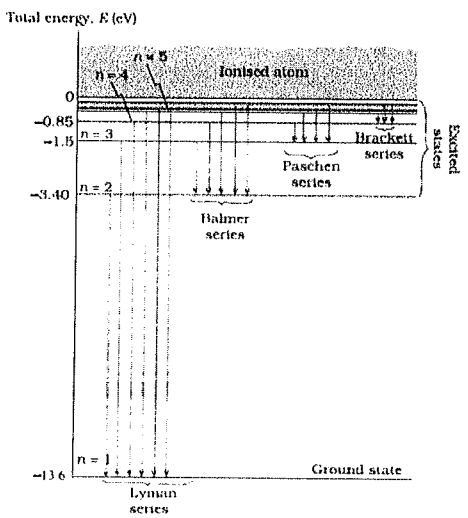
SECTION E 4-MARK QUESTIONS

How Do You Solve Case Study questions?

There are several steps to writing an answer to a case study assignment:

1. STEP 1: READ THE CASE STUDY AND QUESTIONS CAREFULLY. • ...
2. STEP 2: IDENTIFY THE ISSUES IN THE CASE STUDY. ...
3. STEP 3: LINK THEORY TO PRACTICE. ...

Q. 26. ⟶ THE LINE SPECTRA OF THE HYDROGEN ATOM



According to the third postulate of Bohr's model, when an atom makes a transition from the higher energy state with quantum number *ni* to the lower energy state with quantum number *nf* (*nf* < *ni*), the difference of energy is carried away by a photon of frequency *v* such that *hv* = *Eni* – *Enf*. Since both *nf* and *ni* are integers, this immediately shows that in transitions between different atomic levels, light is radiated in various discrete frequencies. For hydrogen spectrum, the Balmer formula corresponds to *nf* = 2 and *ni* = 3, 4, 5 etc. The results of the Bohr's model suggested the presence of other series spectra for hydrogen atom–those corresponding to transitions resulting from *nf* = 1 and *ni* = 2, 3, etc; *nf* = 3 and *ni* = 4, 5, etc. and so on. Such series were identified in the course of spectroscopic investigations and are known as the Lyman, Balmer, Paschen, Brackett, and Pfund series. The electronic transitions corresponding to these series are shown in Fig. The various lines in the atomic spectra are produced when electrons jump from higher energy state to a lower energy state and photons are emitted. These spectral lines are called emission lines. But when an atom absorbs a photon that has precisely the same energy needed by the electron in a lower energy state to make transitions to a higher energy state, the process is called absorption. Thus if photons with a continuous range of frequencies pass through a rarefied gas and then are analysed with a spectrometer, a series of dark spectral absorption lines appear in the continuous spectrum. The dark lines indicate the frequencies that have been absorbed by the atoms of the gas. The explanation of the hydrogen atom spectrum provided by Bohr's model was a brilliant achievement, which greatly stimulated progress towards the modern quantum theory.

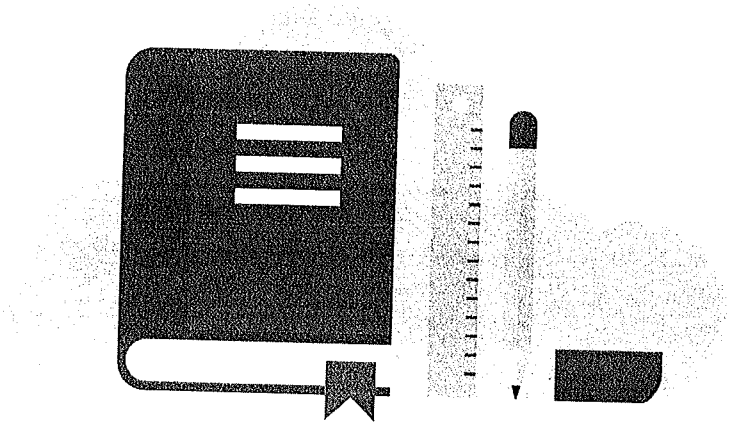
Q1. The series of spectrum when electron jumps from n = 5 to n = 3 is
a) Lymen
b) Balmer
c) Paschen
d) Bracket

Q2. Balmer series is obtained when electron transits from
a) n = 1,2,3, ... to n = 5
b) n = 3,4,5 ... to n = 2
c) n = 1,2,3, ... to n = 4
d) n = 1,2,3, ... to n = 6

Q3. From Fig. shown predict which series has waves of maximum frequency
a) Lymen
b) Balmer
c) Paschen
d) Bracket

Q4. What is the maximum energy of photon in emission spectrum of hydrogen atom
a) 13.6 eV
b) 1.36 eV
c) 1.5 eV
d) 1eV

Answer : Q1 – c; Q2 – b; Q3 – a; Q4 – a



Chapter 14 Revision Notes

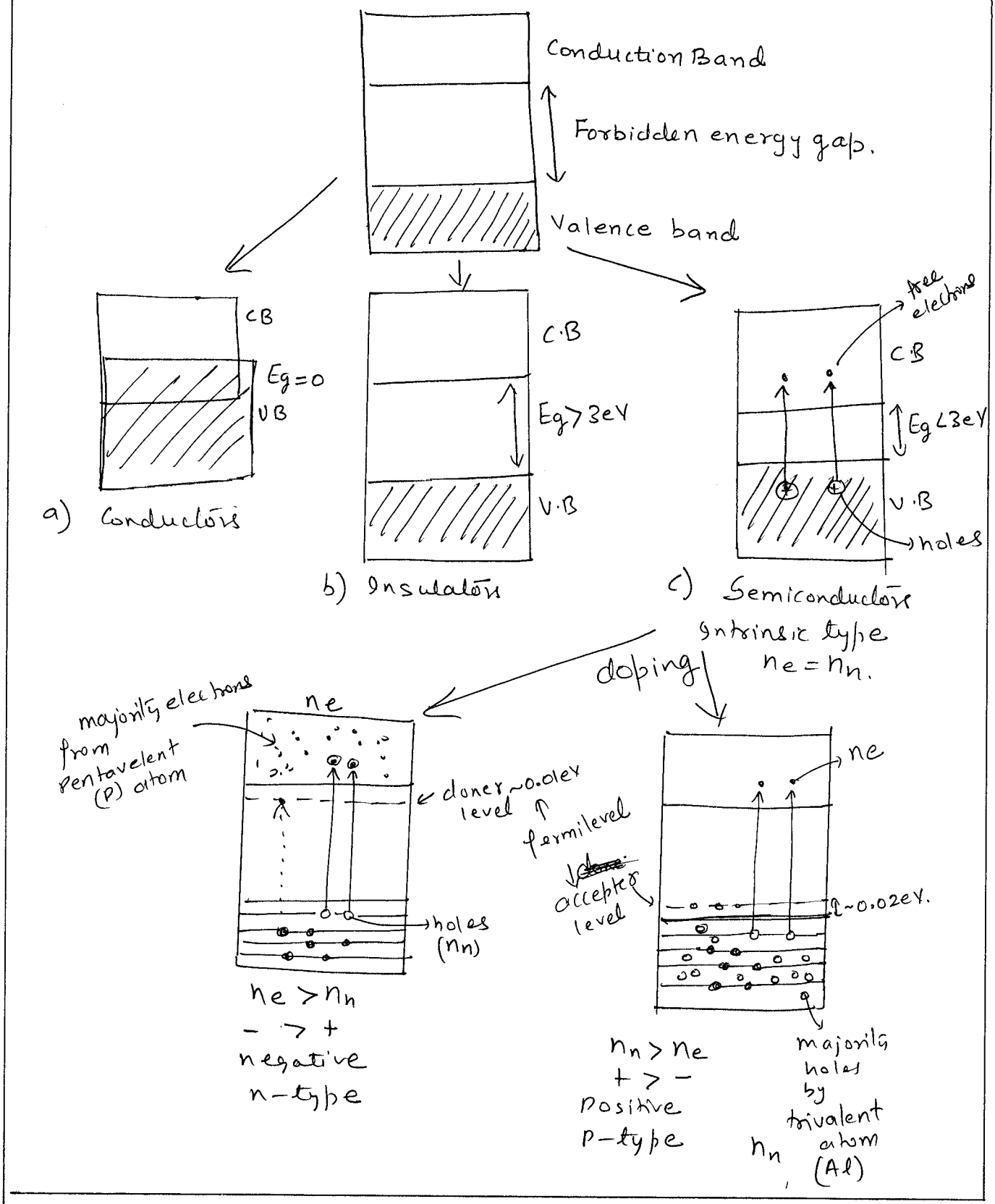
SEMICONDUCTOR

P-N JUNCTION DIODE

Topic.

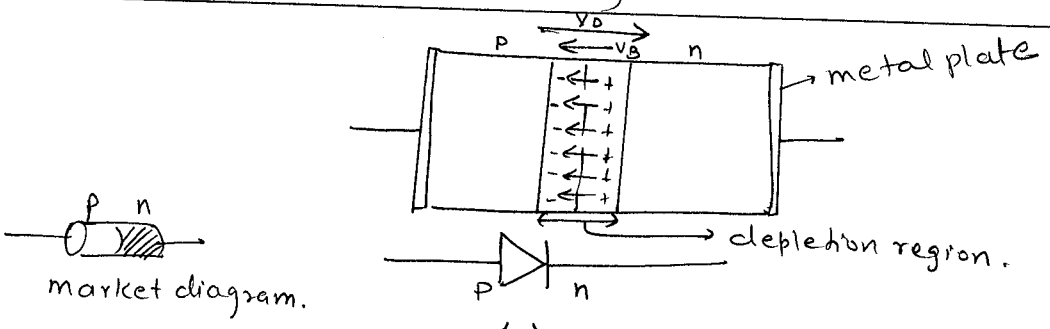
IMPORTANT TOPICS

① Energy band Diagram:-

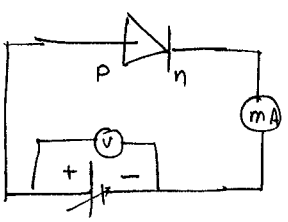


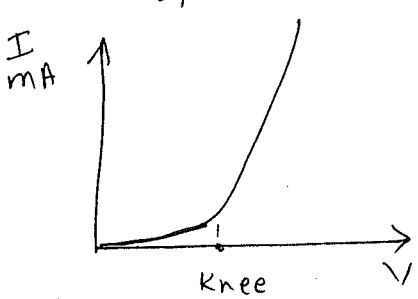
IMPORTANT TOPICS

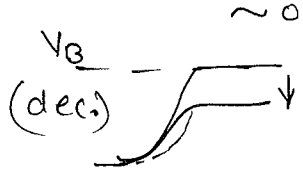
TOPIC (2) DIODE (p-n junction)



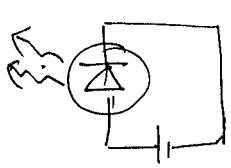
Forward biasing (p-with heigher Potential)





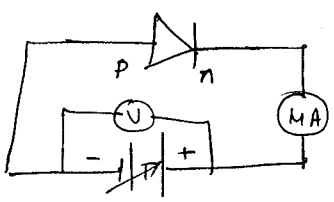


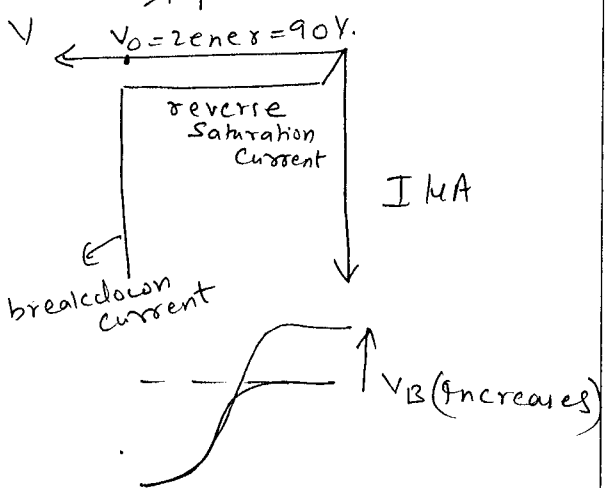
application:-
L.E.D.



Electric → Light

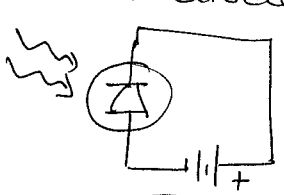
Reverse biasing (p-with lower Potential)





Common application
Rectifier
↓
A.C → D.C

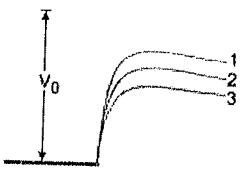
application
Photodiode



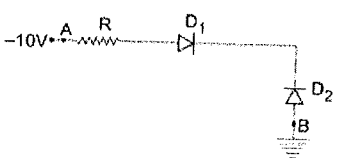
Light → electric

SECTION -A ONE MARK QUESTIONS

1. The usual semiconductors are:
   (*a*) germanium and silicon (*b*) germanium and copper
   (*c*) silicon and glass (*d*) glass and carbon
2. The energy gap between the valence and conduction bands of a substance is 6 eV. The substance is a:
   (*a*) conductor (*b*) semiconductor
   (*c*) insulator (*d*) superconductor
3. In a *n*-type semiconductor, which of the following statements is true?
   (*a*) Electrons are majority carriers and trivalent atoms are the dopants.
   (*b*) Electrons are minority carriers and pentavalent atoms are dopants.
   (*c*) Holes are minority carriers and pentavalent atoms are dopants.
   (*d*) Holes are majority carriers and trivalent atoms are dopants.
4. The conductivity of a semiconductor increases with increase in temperature because [*NCERT Exemplar*]
   (*a*) number density of free current carriers increases.
   (*b*) relaxation time increases.
   (*c*) both number density of carriers and relaxation time increase.
   (*d*) number density of current carriers increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density.
5. In given figure, V_0 is the potential barrier across a *p-n* junction, when no battery is connected across the junction [*NCERT Exemplar*]
   (*a*) 1 and 3 both correspond to forward bias of junction
   (*b*) 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junction
   (*c*) 1 corresponds to forward bias and 3 corresponds to reverse bias of junction.
   (*d*) 3 and 1 both correspond to reverse bias of junction.



6. In given figure, assuming the diodes to be ideal, [*NCERT Exemplar*]
   (*a*) D_1 is forward biased and D_2 is reverse biased and hence currentflows from A to B.
   (*b*) D_2 is forward biased and D_1 is reverse biased and hence no current flows from B to A and vice versa.
   (*c*) D_1 and D_2 are both forward biased and hence current flows from A to B.
   (*d*) D_1 and D_2 are both reverse biased and hence no current flows from A to B and vice versa.



7. In a good conductor, the energy gap between the valence and conduction bands is
   (*a*) 1 eV (*b*) 6 eV (*c*) infinite (*d*) zero
8. Electrical conduction in a semiconductor occurs due to
   (*a*) electrons only (*b*) holes only
   (*c*) electrons and holes both (*d*) neither electrons nor holes.
9. If n_e and n_h are the number of electrons and holes in pure germanium, then
   (*a*) $n_e > n_h$ (*b*) $n_e < n_h$ (*c*) $n_e = n_h$ (*d*) n_e = finite and $n_h = 0$
10. When an electric field is applied across a semiconductor [*NCERT Exemplar*]
    (*a*) electrons move from lower energy level to higher energy level in the conduction band.
    (*b*) electrons move from higher energy level to lower energy level in the conduction band.
    (*c*) holes in the valence band move from higher energy level to lower energy level.
    (*d*) holes in the valence band move from lower energy level to higher energy level.

ASSERTION REASON QUESTIONS

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A

b) Both A and R are true and R is NOT the correct explanation of A

c) A is true but R is false

d) A is false and R is also false

1. **ASSERTION(A):**
The electrical conductivity of a semiconductor increases on doping.
REASON:
Doping always increases the number of electrons in the semiconductor.

OPTION _____

2. Assertion(A): The electrical conductivity of *n*-type semiconductor is higher than that of *p*-type semiconductor at a given temperature and voltage applied.
Reason (R): The mobility of electron is higher than that of hole.

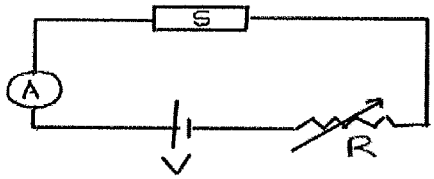
OPTION _____

3. Assertion(A): A *p-n* junction with reverse bias can be used as a photo-diode to measure light intensity.
Reason (R): In a reverse bias condition, the current is small but it is more sensitive to change in incident light intensity.

option _____

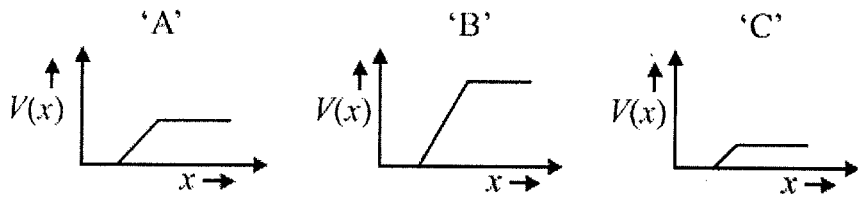
SECTION -B TWO MARK QUESTIONS

1. The figure shows a piece of pure semiconductor S in series with a variable resistor R and a source of constant voltage V. Should the value of R be increased or decreased to keep the reading of the ammeter constant, when semiconductor S is heated? Justify your answer



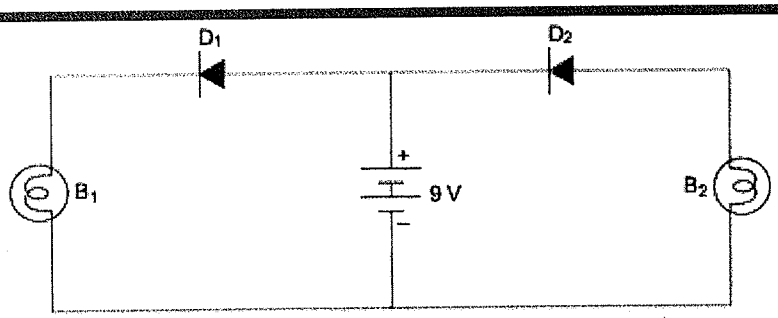
OR

The graph of potential barrier versus width of depletion region for an unbiased diode is shown in graph A. In comparison to A ,graphs B and C are obtained after biasing the diode in different ways .Identify the type of biasing in B and C and justify your answer.



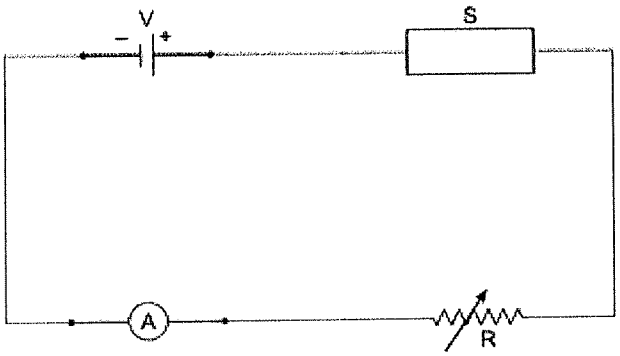
Ans:-

2. In the following diagram, which bulb out of B_1 and B_2 will glow and why? [*CBSE (AI) 2017*]



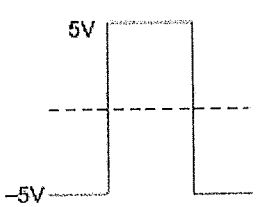
Ans. Bulb B_1 will glow as diode D_1 is forward biased.

3. In the following diagram 'S' is a semiconductor. Would you increase or decrease the value of R to keep the reading of the ammeter A constant when S is heated? Give reason for your answer. [*CBSE (AI) 2017*]

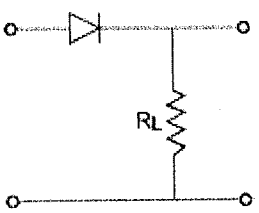


Ans. The value of R would be increased. On heating, the resistance of semiconductor (S) decreases.

4. Draw the output signal in a p-n junction diode when a square input signal of 10 V as shown in the figure is applied across it. [*CBSE 2019 (55/5/1)*]



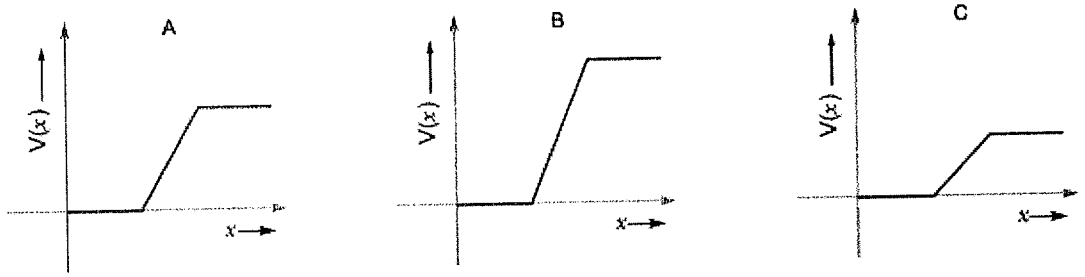
Ans:-



5. Name the optoelectronic device used for detecting optical signals and mention the biasing in which it is operated. Draw its I-V characteristics. [*CBSE Sample Paper 2018*]

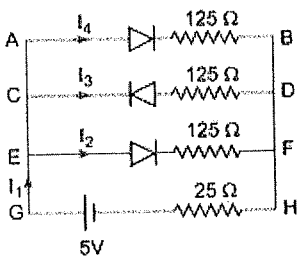
Ans.

6. The graph of potential barrier versus width of depletion region for an unbiased diode is shown in *A*. In comparison to *A*, graphs *B* and *C* are obtained after biasing the diode in different ways. Identify the type of biasing in *B* and *C* and justify your answer. [*CBSE Sample Paper 2016*]



Ans:-

Q. 7. If each diode in figure has a forward bias resistance of 25 Ω and infinite resistance in reverse bias, what will be the values of current I_1, I_2, I_3 and I_4? [*HOTS*] [*NCERT Exemplar*]



Ans. I_3 is zero as the diode in that branch is reverse biased. Resistance in the branch *AB* and *EF* are each (125 + 25) Ω = 150 Ω

As *AB* and *EF* are identical parallel branches, their effective resistance is $\frac{150}{2} = 75\ \Omega$

$\therefore$ Net resistance in the circuit = (75 + 25) Ω = 100 Ω

$\therefore$ Current $I_1 = \frac{5}{100} = \mathbf{0.05\ A}$

As resistances of *AB* and *EF* are equal, and $I_1 = I_2 + I_3 + I_4$, $I_3 = 0$

$\therefore$ $I_2 = I_4 = \frac{0.05}{2} = \mathbf{0.025\ A}$

SECTION -C THREE MARK QUESTIONS

1. A semiconductor has equal electron and hole concentration of 2×10^{8} / m^3. On doping with a certain impurity, the hole concentration increases to 4×10^{10} / m^3.
   (*i*) What type of semiconductor is obtained on doping?
   (*ii*) Calculate the new electron and hole concentration of the semiconductor.
   (*iii*) How does the energy gap vary with doping?

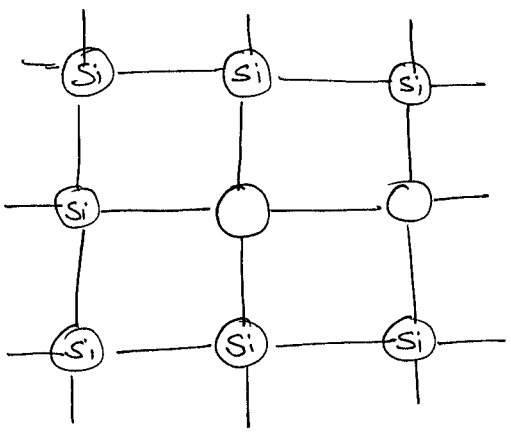
Ans.

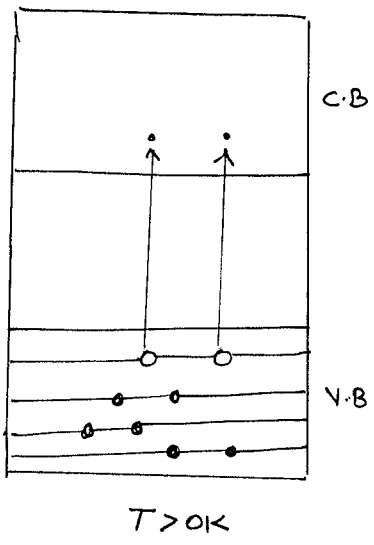
2. How is a light emitting diode fabricated? Briefly state its working. Write any two important advantages of LEDs over the conventional incandescent low power lamps.
[*CBSE Bhubaneshwar 2015, CBSE 2019*]

Ans.

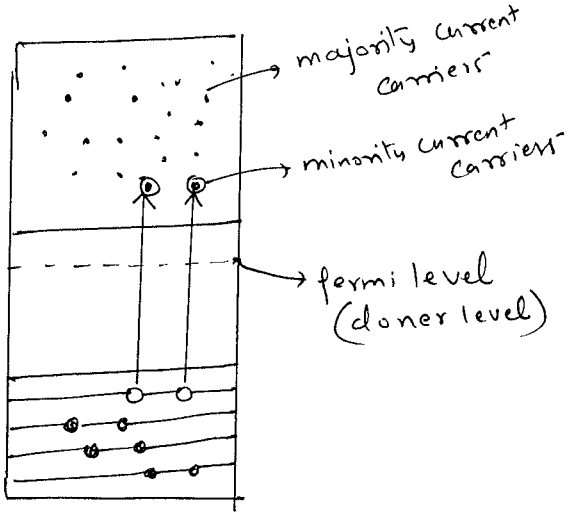
Q. 3. What is doping? How n-type semiconductor is obtained from Intrinsic type semiconductor Draw its energy band diagram also explain the effect of temperature on electrical conductivity of n-type semiconductor?

Ans;-





Effect of temperature



Q.4*:- [No. of elements like Diode, Resistor, Inductor etc in a circuit]

SECTION -D FIVE MARK QUESTIONS

Q. 1. Draw the circuit diagram of a full wave rectifier and explain its working. Also, give the input and output waveforms. *[CBSE Delhi 2019]*

OR

Draw a circuit diagram of a full wave rectifier. Explain the working principle. Draw the input/ output waveforms indicating clearly the functions of the two diodes used. *[CBSE (AI) 2011]*

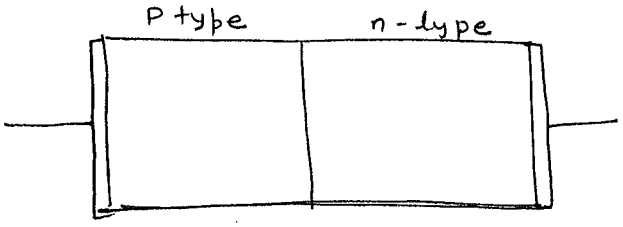
Ans:-

Q.2. (*a*) State briefly the processes involved in the formation of *p-n* junction explaining clearly how the depletion region is formed.

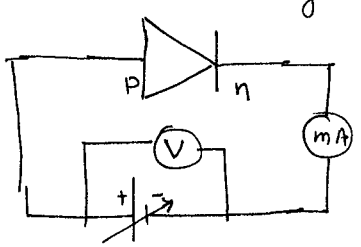
(*b*) Using the necessary circuit diagrams, show how the V–I characteristics of a *p-n* junction are obtained in (*i*) Forward biasing (*ii*) Reverse biasing

How are these characteristics made use of in rectification? [*CBSE Delhi 2014*]

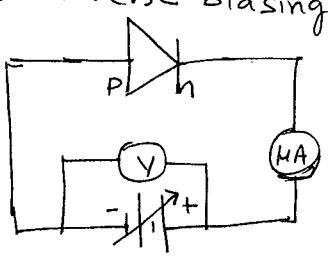
Ans:-



(i) Forward biasing



(ii) Reverse biasing.



Q.3. What are energy bands? Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.

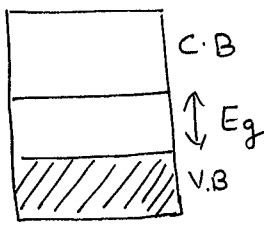
[CBSE (AI) 2014, North 2016]

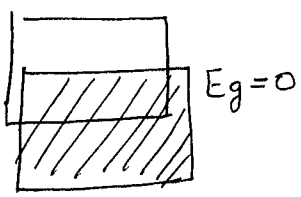
OR

Draw the necessary energy band diagrams to distinguish between conductors, semiconductors and insulators. How does the change in temperature affect the behaviour of these materials? Explain briefly.

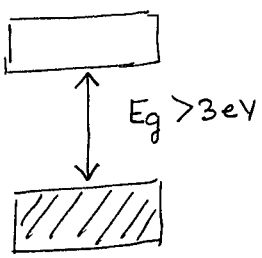
[CBSE Patna 2015]

Ans:-

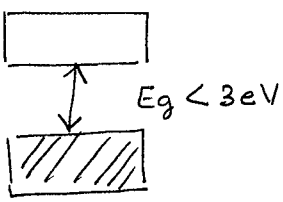




a) Conductors



b) Insulators



c) Semiconductors

EFFECT OF TEMPERATURE ON SEMICONDUCTORS:-/Insulators.

$$T \propto \frac{1}{R}$$

EFFECT OF TEMPERATURE ON CONDUCTORS.

$$T \propto R$$

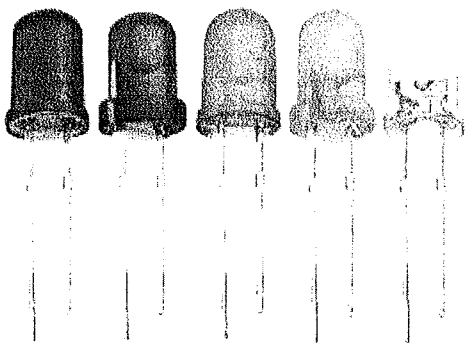
SECTION -E FOUR MARK QUESTIONS

CASE STUDY

Important Question (1) **Case study: Light emitting diode.** From CBSE Sample paper (For 2023 exam.)

Read the following paragraph and answer the questions

LED is a heavily doped P-N junction which under forward bias emits spontaneous radiation. When it is forward biased, due to recombination of holes and electrons at the junction, energy is released in the form of photons. In the case of Si and Ge diode, the energy released in recombination lies in the infrared region. LEDs that can emit red, yellow, orange, green and blue light are commercially available. The semiconductor used for fabrication of visible LEDs must at least have a band gap of 1.8 eV. The compound semiconductor Gallium Arsenide – Phosphide is used for making LEDs of different colours.

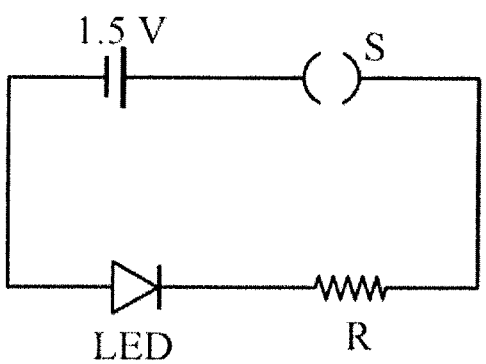


LEDs of different kinds

(i). Why are LEDs made of compound semiconductor and not of elemental semiconductors?

(ii) What should be the order of bandgap of an LED, if it is required to emit light in the visible range?

(iii) A student connects the blue coloured LED as shown in the figure. The LED did not glow when switch S is closed. Explain why ?



OR

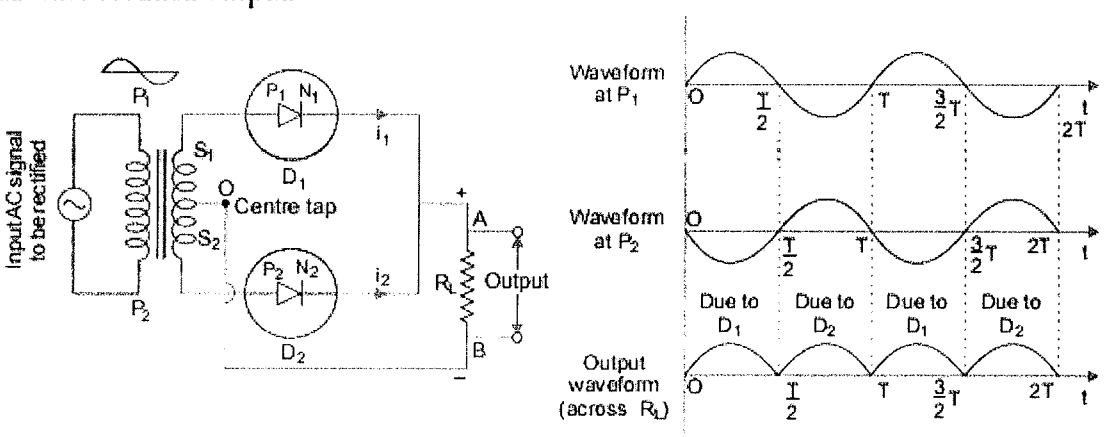
(iii) Draw V-I characteristic of a p-n junction diode in

(i) forward bias and (ii) reverse bias

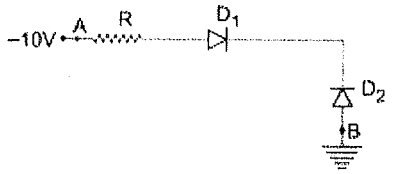
Ans:-

Q. 2. DIODE AS A RECTIFIER:

A rectifier is an electrical device that converts alternating current (ac), which periodically reverses direction, to direct current (dc), which flows in only one direction. The reverse operation is performed by the inverter. The process is known as rectification. From V-I characteristics of a junction diode we see that it allows current to pass only when it is forward biased. So, if an alternating voltage is applied across a diode the current flows only in that part of the cycle when the diode is forward biased. This property of diode is used to rectify alternating voltage and the circuit used for this purpose is said to be rectifier. If an alternating voltage is applied across a diode in series with a load, a pulsating voltage will appear across the load only during half cycles of the ac input during which diode is forward biased; such type of rectifier circuit is said to be half-wave rectifier. The circuit using two diodes gives output rectified voltage corresponding to both the positive as well as negative half cycle. Hence, it is known as full-wave rectifier. For a full-wave rectifier the secondary of the transformer is provided with a centre tapping and so it is called centre-tap transformer. The voltage rectified by each diode is only half the total secondary voltage. Each diode rectifies only for half the cycle, but the two do so for alternate cycles. Thus, the output between their common terminals and the centre-tap of the transformer becomes a full-wave rectified output.



(*i*) In figure shown, assuming the diodes to be ideal, which of the following statements is true?



(*a*) D_1 is forward biased and D_2 is reversed biased and hence current flows from *A* to *B*.

(*b*) D_2 is forward biased and D_1 is reverse biased and hence no current flows from *B* to *A* and vice-versa.

(*c*) D_1 and D_2 are both forward biased and hence current flows from *A* to *B*.

(*d*) D_1 and D_2 are both reverse biased and hence no current flows from *A* to *B* and vice-versa.

(*ii*) To reduce the ripples in a rectifier circuit with capacitor filter

(*a*) R_L should be increased

(*b*) capacitors with high capacitance should be used

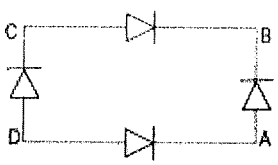
(*c*) input frequency should be increased

(*d*) all of the above

(*iii*) In a full-wave rectifier circuit operating from 50 Hz main frequency, the fundamental frequency in the ripple would be

(*a*) 25 Hz (*b*) 50 Hz (*c*) 75 Hz (*d*) 100 Hz

(*iv*) In figure shown, the input is across the terminals *A* and *C* and the output is across *B* and *D* then the output is



(*a*) same as the input (*b*) full wave rectified

(*c*) half wave rectified (*d*) zero

ANSWER KEY

(*i*) (*b*) (*ii*) (*d*) (*iii*) (*d*) (*iv*) (*b*)

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PART-2

SECTION D : OPTICS [NCERT CH-9,10 & CH-11]

SECTION E: MODERN PHYSICS [NCERT CH-8,12,13 & CH-14]

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