केंद्रीय विद्यालय संगठन क्षेत्रीय कार्यालय रायपुर

Kendriya Vidyalaya Sangathan Regional Office Raipur

Class - XII

Multiple Choice Question Bank [MCQ] Term – II

PHYSICS [042]

Based on Latest CBSE Exam Pattern for the Session 2021-22

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MESSAGE FROM DUPUTY COMMISSIONER

It is a matter of great pleasure for me to publish study material for different subjects of classes X and XII for Raipur Region. Getting acquainted and familiarized with the recent changes in curriculum and assessment process made by CBSE vide Circular No. 51 and 53 issued in the month of July 2021 will help students to prepare themselves better for the examination. Sound and deeper knowledge of the Units and Chapters is must for grasping the concepts, understanding the questions. Study materials help in making suitable and effective notes for quick revision just before the examination.

Due to the unprecedented circumstances of COVID-19 pandemic the students and the teachers are getting very limited opportunity to interact face to face in the classes. In such a situation the supervised and especially prepared value points will help the students to develop their understanding and analytical skills together. The students will be benefitted immensely after going through the question bank and practice papers. The study materials will build a special bond and act as connecting link between the teachers and the students as both can undertake a guided and experiential learning simultaneously. It will help the students develop the habit of exploring and analyzing the ***Creative & Critical Thinking Skills***. The new concepts introduced in the question pattern related to case study, reasoning and ascertain will empower the students to take independent decision on different situational problems. The different study materials are designed in such a manner to help the students in their self-learning pace. It emphasizes the great pedagogical dictum that *'everything can be learnt but nothing can be taught'*. The self-motivated learning as well as supervised classes will together help them achieve the new academic heights.

I would like to extend my sincere gratitude to all the principals and the teachers who have relentlessly striven for completion of the project of preparing study materials for all the subjects. Their enormous contribution in making this project successful is praiseworthy.

Happy learning and best of luck!

Vinod Kumar
(Deputy Commissioner)

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Kendriya Vidyalaya Sangathan Regional Office Raipur

Our Patorn

Vinod Kumar
Deputy Commissioner
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Smt.Biraja Mishra
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Assistant Commissioner
KVS RO Raipur

Shri Bhoop Singh
Principal, Kendriya Vidyalaya Kanker

CONTENT TEAM

NAME OF UNIT	NAME OF PGT PHYSICS
Chapter 8 – Electromagnetic Waves Chapter 9 – Ray Optics and optical Instruments	**Mrs. Amita Singh** **KV Bilaspur**
Chapter 10 – Wave Optics	**Mr. Simanchal Pradhan** **KV No.1 Shift 1 Raipur**
Chapter 11 – Dual Nature of Radiation and Matter	**Mr. Vinod Kumar Verma** **KV No.4 Korba**
Chapter 12 - Atoms Chapter 13 - Nuclei	**Mrs. Runa Choudhary** **KV CISF Bhilai**
Chapter 14 - Semiconductor Electronics	**Mr. Amitab Adhikari** **KV No.1 Shift II Raipur**
Sample Paper 1	**Mr. Vikas Gola** **KV Chirimiri**
Sample Paper 2	**Ms. Kamalpreet Kaur** **KV Dhamtari**
Sample Paper 3	**Mr. Sanjay Chaturvedi** **KV Durg**

Review Committee:

Mrs. Sunita Khirbat
KV BMY Bhilai
Mr. Somen Dasgupta
KV Bilaspur

TERM-II

		NO. OF PERIODS	MARKS
Unit -5	**Electromagnetic Waves** Chapter–8: Electromagnetic Waves	2	17
Unit-6	**Optics** Chapter–9: Ray Optics and Optical Instruments Chapter–10: Wave Optics	18	
Unit-7	Chapter–11: Dual Nature of Radiation and Matter	7	11
Unit-8	**Atoms and Nuclei** Chapter–12: Atoms Chapter–13: Nuclei	11	
Unit-9	**Electronic Devices** Chapter–14: Semiconductor Electronics	7	7

Term-II Syllabus 2021-22 with deleted part
CLASS-XII
SUBJECT-PHYSICS

Unit V: Electromagnetic waves 2 Periods

Chapter–8: Electromagnetic Waves

Electromagnetic waves, their characteristics, their Transverse nature (qualitative ideas only). Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Unit VI: Optics 18 Periods

Chapter–9: Ray Optics and Optical Instruments

Ray Optics: - Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism.

Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Chapter–10: Wave Optics

Wave optics: Wave front and Huygen's principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light, diffraction due to a single slit, width of central maximum.

Chapter 8 Electromagnetic Waves

Basic idea of displacement current,

Chapter 9 Ray Optics and Optical Instruments

Reflection of Light, spherical mirrors, mirror formula, Scattering of light
blue colour of sky and reddish appearance of the sun at sunriseand Sunset.

Chapter–10: Wave Optics

resolving power of microscope and astronomical telescope, polarisation,
plane polarised Light, Brewster's law,
uses of plane polarised light and Polaroids.

Unit VII: Dual Nature of Radiation and Matter 7 Periods **Chapter–11: Dual Nature of Radiation and Matter** Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Experimental study of photoelectric effect Matter waves-wave nature of particles, de-Broglie relation **Unit VIII: Atoms and Nuclei 11Periods** **Chapter–12: Atoms** Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. **Chapter–13: Nuclei** Composition and size of nucleus, Nuclear force Mass-energy relation, mass defect, nuclear fission, nuclear fusion.	**Chapter-11 Dual Nature of radiation and matter** Davisson- Germer experiment **Chapter-13 Nuclei** Radioactivity, alpha, beta and gamma particles/rays and their properties; radioactive decay law, half-life and mean life, Binding energy per nucleon and its variation with mass number
Unit IX: Electronic Devices 7 Periods **Chapter–14: Semiconductor Electronics: Materials, Devices and Simple Circuits** Energy bands in conductors, semiconductors and insulators (qualitative ideas only) Semiconductor diode - I-V Characteristics in forward and reverse bias, diode as a rectifier; Special purpose p-n junction diodes: LED, photodiode, solar cell.	**Chapter-14 Semiconductor Electronics: Materials, Devices and Simple Circuits** Zener diode and their characteristics, Zener diode as a voltage regulator.

PRACTICAL DETAILS

Term II Total Periods: 16 Experiments assigned for Term-II 1. To find the focal length of a convex lens by plotting graphs between u and v or between 1/u and1/v. 2. To find the focal length of a convex mirror, using a convex lens. OR To find the focal length of a concave lens, using a convex lens. 3. To determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation. 4. To determine refractive index of a glass slab using a travelling microscope. 5. To find refractive index of a liquid by using convex lens and plane mirror. 6. To draw the I-V characteristic curve for a p-n junction diode in forward bias and reverse bias. **Activities assigned for Term-II** 1. To identify a diode, an LED, a resistor and a capacitor from a mixed collection of such items.	**Experiments SECTION-B** To find the value of v for different values of u in case of a concave mirror and tofind the focal length.

2. Use of multimeter to see the unidirectional flow of current in case of a diode and an LED and check whether a given electronic component (e.g., diode) is in working order. 3. To study effect of intensity of light (by varying distance of the source) on an LDR. 4. To observe refraction and lateral deviation of a beam of light incident obliquely on a glass slab. 5. To observe polarization of light using two Polaroids. 7. To observe diffraction of light due to a thin slit. To study the nature and size of the image formed by a (i) convex lens, (ii) concave mirror, on a screen by using a candle and a screen (for different distances of the candle from the lens/mirror). 8. To obtain a lens combination with the specified focal length by using two lenses from the given set of lenses	To draw the characteristic curve of a Zener diode and to determine its reverse breaks down voltage.

CBSE ACAD CIRCUAR/51/ DATED July 05, 2021

Term II Examination/ Year-end Examination:

- At the end of the second term, the Board would organize **Term II or Year-end Examination** based on the rationalized syllabus of Term II only (i.e. approximately 50% of the entire syllabus).
- This examination would be held around **March-April 2022** at the examination centres fixed by the Board.
- The paper will be of **2 hours duration** and have questions of different formats (case-based/ situation based, open ended- short answer/ long answer type).
- In case the situation is not conducive for normal descriptive examination **a 90 minute MCQ** based exam will be conducted at the end of the Term II also.
- Marks of the Term II Examination would contribute to the final overall score.

CHAPTER: 8 ELECTROMAGNETIC WAVES

S.No.	Name	Frequency Range (Hz)	Wavelength Range	Production	Uses
1.	Gamma rays	$10^{19} - 10^{23}$	10^{-11} to 10^{-14}m	Emitted by radioactive nuclei, Produced in nuclear reaction	In medicine, to **destroy cancer cells.**
2.	X – rays	10^{16} - 10^{20}	10^{-8} to 10^{-12}m	Generated by bombarding a metal target by high energy electron	Used as diagnostic tool in medicine, to **study crystal structures**
3.	Ultraviolet rays	$10^{15} - 10^{17}$	$(4 \times 10^{-7}$ to $6 \times 10^{-10})$ m	Produced by special lamps & very hot bodies (sun).	For eye surgery, **to kill germs** in water purifiers.
4.	Visible rays	$4 \times 10^{14} - 7 \times 10^{14}$	700 – 400 nm	Jumping of electrons in higher orbits	Provide us information about the world.
5.	Infrared rays (heat waves)	10^{12} - 10^{14}	1mm - 700 nm	Produced by hot bodies and molecules.	Infrared detectors used in earth satellite, used in green house to keep **plants warm**.
6.	Microwaves	10^{10} - 10^{12}	0.1 – 1 mm	Produced by special vacuum tubes (klystrons, gun diode & magnetrons)	**Microwave oven**, for radar system in aircraft navigation.
7.	Radio waves	10 - 10^{9}	> 0.1 m	Produced by accelerated motion of charges in conducting wires.	In **radio & television communication** system, in cellular phones to transmit voice communication.

FORMULA

1. Equation for travelling electromagnetic waves along Z – axis

$$E = E_X(t) = E_0 \sin(kz - \omega t)$$

$$B = B_y(t) = B_0 \sin(kz - \omega t)$$

MULTIPLE CHOICE QUESTIONS

1. In electromagnetic waves the phase difference between electric and magnetic field vectors are

(a) zero (b) $\pi/4$ (c) $\pi/2$ (d) π

2. Which of the following has minimum wavelength?

(a) Blue light (b) γ-rays (c) infrared rays (d) microwave

3. The correct option, if speed of gamma rays, X-rays and microwave are V_g, V_x an V_m respectively will be.

(a) $V_g > V_x > V_m$ (b) $V_g < V_x < V_m$ (c) $V_g > V_x > V_m$ (d) $V_g = V_x = V_m$

4. Electromagnetic waves travelling in a medium having relative permeability $\mu_r = 1.3$ and relative permittivity $E_r = 2.14$. The speed of electromagnetic waves in medium must be

(a) 1.8×10^8 ms^{-1} (b) 1.8×10^4ms^1 (c) 1.8×10^6ms^1 (d) 1.8×10^2 ms^{-1}

5. Which waves are suitable for radar system used in air craft navigation?

(a) Radio waves (b) Microwaves (c) Infrared waves (d) Visible rays

6. Electromagnetic waves in laboratory are produced by

(a) JJ Thomson (b) Biot- Savarts (c) Hertz (d) Marconi

7. Night vision camera uses

(a) X – rays (b) Infrared rays (c) Gamma rays (d) UV rays

8. If the frequency of oscillating particle is n then the frequency of oscillation of its energy is

(a) n (b) 2n (c)n/2 (d) 4n

9. An EMW of v = 3 MHz passes from vacuum into dielectric medium with permittivity $E_r = 4$, then:

(a) Wavelength is doubled and the frequency remains unchanged

(b) Wavelength is doubled and the frequency become half

(c) Wavelength is halved and the frequency remains unchanged

(d) Wavelength and frequency both remain unchanged

10. The electric field associated with an e.m wave in vacuum is given by $\vec{E}$ =40 cos (kz – 6×10^8) $\vec{i}$, where E, Z and t are in volt/m, metre and seconds respectively. The value of wave vector K is

(a) 2 m^{-1} (b) 0.5 m^{-1} (c) 6 m^{-1} (d) 3 m^{-1}

ASSERTION AND REASONING QUESTIONS

A. Both assertion and reason are True, *and* reason is the correct explanation.

B. Both assertion and reason are True, *but* reason is not the correct explanation.

C. Assertion is True, but reason is False.

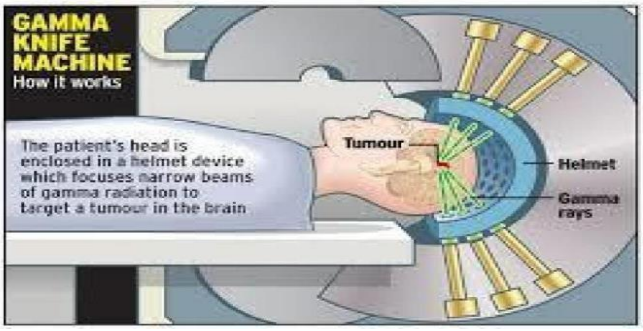
D. Both assertion and reason are False

1. Assertion: electromagnetic waves do not require medium for their propagation.
   Reason: they cannot travel in a medium
2. Assertion: A changing electric field produce magnetic field.
   Reason: a changing magnetic field produced an electric field.
3. Assertion: X-rays travel with the speed of light.
   Reason: X –rays are electromagnetic rays.
4. Assertion: Environmental damages has increased amount of ozone in Atmosphere.
   Reason: increase of ozone increases amount of ultraviolet radiation on the earth.
5. Assertion: Electromagnetic Radiation exerts pressure
   Reason: Electromagnetic wave carry both momentum and energy.

CASE STUDY BASED QUESTIONS

GAMMA RAYS IN TREATMENT OF CANCER

Gamma rays are used in radiotherapy to treat cancer. Theyare used to spot tumors. they kill the living cells and damage malignant tumor.



1. What is the source of gamma rays?
   a) radioactive decay of nucleus
   b) accelerated motion of charges in conducting wire

c) hot bodies and molecule

d) klystron valve

2. How is wavelength of gamma rays

a) low b) high

c) infinite d) zero

3. Choose the one with correct radiation order?

a) alpha>beta>gamma b) beta>alpha>gamma

c) gamma>beta>alpha d) gamma>alpha>beta

4. What is other use of gamma rays?

a) used to change white topaz to blue topaz b) used in aircraft navigation

(c)used in kill microbes d) checking fractures of bone

SHORT ANSWER QUESTIONS EACH QUESTION CARRIES 2 MARKS

1. The oscillating magnetic field in a plane electromagnetic wave is given

by $B_y = 8 \text{ X } 10^{-6} \sin (2 \text{ x } 10^{11} \text{ t} + 300)] \text{ T}$

a. Calculate the wavelength of electromagnetic wave?

b. Write down the expression for the oscillating electric field.

2. EM waves travel in a medium at the speed of $2 \text{ x } 10^{8}$ m/s. The relative permeability of the medium is 1. Find the relative permittivity of that medium.

3. Optical and radio telescopes are built on the ground while X- ray astronomy is possible only from satellites orbiting the Earth. Why?

4. The small ozone layer on top of the stratosphere is crucial for human survival. Why?

5. Identify the following electromagnetic radiation as per the wavelength given below. Write one application of each.

(a) 10^{-12}m (b). 10^{-4}m (c.) 10^{6}m

ANSWERS

MULTIPLE CHOICE QUESTIONS

1.(a) 2.(b) 3.(d) 4.(a) 5.(b) 6.(c) 7.(b) 8.(b) 9.(c) 10.(a)

ASSERTION REASONING QUESTIONS

1) C 2) B 3) A 4) D 5) B

CASE STUDY BASED QUESTIONS

1) a 2) a 3) c 4) a

SHORT ANSWER QUESTIONS EACH QUESTION CARRIES 2 MARKS

1. a. =3m, $E_z = 2400 \sin (2 \times 10^{11} t + 300)]$
2. $v = 2 \times 10^8$ m/s , $\mu_r = 1$, $c = 3 \times 10^8$ m/s

   Speed of EM wave in the medium $v = 1 / \sqrt{\mu\varepsilon}$ or $= c / \sqrt{\mu_r \varepsilon_r}$

   Or $\varepsilon_r = c^2 / v^2 \mu_r = (3 \times 10^8)^2 / (2 \times 10^8)^2 \times 1 = 2.25$

3. The earth's atmosphere is transparent to visible light and radio waves but absorbs X- rays. Satellites orbiting the earth at a height of 36000 km, where atmosphere is very thin and X-rays are not absorbed.
4. Ozone layer absorbs ultraviolet radiation from the sun and prevent these radiations from reaching the earth which causes cancer.
5. Identification: - (a.) gamma rays use- radiotherapy (b.) Infrared rays use – haze photography (c). long radio wave used in radio communication

SELF ASSESMENT

MULTIPLE CHOICE QUESTIONS

1. Radio station WCCO in Minneapolis broadcasts at a frequency of 830 kHz. Wavelength and angular wave number are
   a. 361m, 0.01741m
   b. 381m, 0.0174 rad/m
   c. 391m, 0.0174 rad/m
   d. 371m, 0.0174 rad/m
2. Comparing X-rays and gamma rays
   a. gamma rays have more energy than X –rays
   b. gamma rays have larger wave length then X – rays
   c. gamma rays has more speed then X- rays
   d. gamma rays are less penetrating then X-rays
3. The speed of plain electromagnetic waves is maximum in
   a. glass
   b. vacuum
   c. tourmaline
   d. water

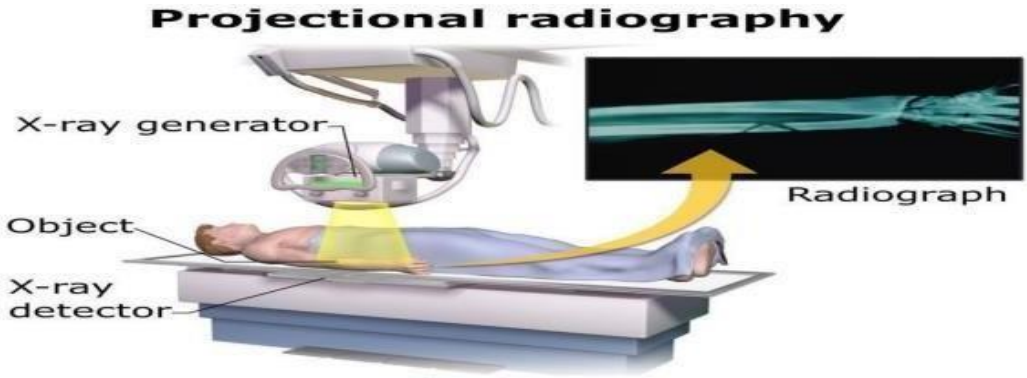
ASSERTION AND REASONING QUESTIONS

A. Both assertion and reason are True, *and* reason is the correct explanation.
B. Both assertion and reason are True, *but* reason is not the correct explanation.
C. Assertion is True, but reason is False.
D. Both assertion and reason are False

1. Assertion: The EM waves of shorter wavelength can travel longer distances on earth's surface than those of longer wavelengths.
   Reason: Shorter the wavelength, the larger is the velocity propagation
2. Assertion: EM waves follow Superposition principle.
   Reason: Differential expression of EM wave is linear.
3. Assertion: Sound wavescannot travel in vacuum, butlight waves can
   Reason: Light is an electromagnetic wave - but soundis a Mechanical wave.
4. Assertion: The Microwaves are better carriersof signals thanradio wave
   Reason: The electromagnetic waves do notrequire anymedium to propagate.
5. Assertion: Transverse waves are not produced in liquids and gases
   Reason: Shorter the wavelength, the larger is the Velocity of propagation.

CASE STUDY BASED QUESTIONS

X-rays are a form of electromagnetic radiation, similar to visible light. Unlike light, however, x - rays have higher energy and can pass through most objects, including the body. Medical x-rays are used to generate images of tissues and structures inside the body



1. What is the most common method of preparation of X rays ?
   a) magnetron valve
   b) vibration of atoms and molecules
   c) bombardment of metal by high energy electrons
   d) radioactive decay of nucleus
2. Which of the following set of instrument /equipment can detect X- rays
   a) Photocells, photographic film
   b) Thermopiles, bolometer
   c) Photographic film, Geiger tube
   d) Geiger tube, human eye

3. Where do X rays fall on the electromagnetic spectrum?

a) Between UV region and infrared region

b) Between gamma rays and UV region

c) Between infrared and microwaves

d) Between microwaves and radio waves

4. What is the use of rays lying beyond X ray region in electromagnetic spectrum

a) used to kill microbes

b) used to detect heat loss in insulated systems

c) used in standard broadcast radio and television

d) used In oncology, to kill cancerous cells.

TWO MARKS QUESTION

1. Give one uses of each of the following:

a. Microwave b. Infra-red wave c. Ultra violet radiation d. Gamma rays

2. Identify the following electromagnetic radiation as per the wavelength given below. Write one application of each.

a. 1mm b. 10^{-3}nm

3. Arrange the following electromagnetic waves in order of increasing Frequency:

Microwave rays, infrared rays and Ultraviolet rays

4. Name the following constituent radiations of electromagnetic spectrum which-
   (i) are used in satellite communication/in radar and geostationary satellite
   (ii) are used for studying crystal structure of solids
   (iii) are similar to the radiations emitted during decay of radioactive nuclei
   (iv) are used for water purification/ are absorbed from sunlight by ozone layer

5. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2 x 10^{10} Hz and amplitude 48 V .

   (a)) What is the wavelength of thewave?

   (b) What is the amplitude of the oscillatingmagnetic field?

   (c) Show that the average energy density of the Efield equals the average energy density of the B field. [c = 3 x 10^{8} m/s]

CHAPTER 9: RAY OPTICS AND OPTICAL INSTRUMENTS

FORMULA

1. Snell's law: $\frac{\sin i}{\sin r} = {}^{1}n_2 = \frac{n_2}{n_1}$

2 $^{2}n_{1} = \frac{1}{{}^{1}n_2}$

n = ^{c} = $\frac{\text{speed of light in vacuum}}{\text{speed of light in a medium}} = \frac{\lambda_{air}}{\lambda_{medium}}$ v

3. If object is in medium of refractive index n, then n = $\frac{\text{real depth}}{\text{apparent depth}} = \frac{t}{t_{app}}$

4. Apparent shift, $x = t - {}^{t} = t\,(1 - {}^{1})$

$\frac{}{n}$ $\frac{}{n}$

5. Critical angle for total internal reflection: sin C = $\frac{1}{{}^{r}n_{d}} = \frac{1}{n}$

6. Refraction at spherical (convex) surface: For object in rarer medium and real image in denser medium, the formula is $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ where n_2 & n_1 are the refractive indices of denser and rarer media.

7. Lens formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

8. Linear magnification produced by a lens: m = $\frac{I}{O} = \frac{v}{u}$

1 1 a 1 1 1 1

10. Lens maker's formula : $\frac{1}{f} = \frac{}{v} - \frac{}{u} = (\quad {}^{a}n_{g} - 1)\left[\frac{}{R_1} - \frac{}{R_2}\right] = (n - 1)\left[\frac{}{R_1} - \frac{}{R_2}\right]$

11. Power of a lens: P = $\frac{1}{f}$ diopter (f is in metre)

12. Lenses in contact: $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ or $P = P_1 + P_2$

13. Focal length of lens in liquid: $f_l = \frac{n_g - 1}{\frac{n_g}{n_l} - 1} \times f_a$

14. Refraction through a prism: $r_1 + r_2 = A$ and $i + e = A + \delta$ where A is angle of prism and δ is angle of deviation.

15. For minimum deviation, i = e = i and $r_1 + r_2 = r$. Therefore, $\delta_m = 2i - A$

16. Refractive Index of the material of prism: $n = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

17. For a thin prism: $\delta = (n - 1)A$

18. Angular dispersion = $\delta_V - \delta_R$

19. Dispersive power, $\omega = \frac{\delta_V - \delta_R}{\delta_Y} = \frac{n_V - n_R}{n_Y - 1}$

20. Simple microscope: Magnifying power $M = 1 + \frac{D}{f}$ (if final image is at D)

$= \frac{D}{f}$ (if final image is at infinity)

21. Compound microscope:

i) Magnification $M = m_o m_e$

ii) Magnification $M = -\frac{v_o}{u_o}\{1 + \frac{D}{f_e}\} \approx -\frac{L}{f_o}\{1 + \frac{D}{f_e}\}$ (for final image at D)

iii) Magnification $M = -\frac{v_o}{u_o}\{\frac{D}{f_e}\} \approx -\frac{L}{f_o}\{\frac{D}{f_e}\}$ (for final image at infinity)

22. Astronomical Telescope:

I. $M = -f_o/f_e$ and $L = f_o + f_e$ (for final image at infinity)

II. $M = 1 + f_e/D$ and $L = f_o + u_e$ (for final image at D)

MULTIPLE CHOICE QUESTIONS

1. An equiconvex lens of focal length 15 cm is cut into two halves .Find the focal length of each part?

(a) -30cm (b) -20cm

(c) 30cm (d) -15cm

2. How does the focal length of a convex lens changes if mono chromatic red light is used instead of violet light?

(a) Focal length is increased when red light is used
(b) Focal length is decreased when red light is used
(c) Focal length is remained same when red light is used
(d) Not depends on color of light.

3. A glass lens is immersed in water. What will be the effect on the power of lens?

(a) increase (b) decrease

(c) constant (d) not depends

4. How does the magnifying power of a telescope change on increasing the linear diameter of its objective?

(a) Power increases on increases diameter

(b) Power decreases on decreases diameter

(c) Power remains constant on increases diameter

(d) Power doesn’t depends on diameter

5. In a simple microscope, if the final image is located at 20 cm from the eye placed close to the lens, then magnifyingpower is

(a) 25/f (b) 1+25/f (c)f/25 (d)f/25 + 1

6. An object approaches a convergent lens from the left of the lens with a uniform speed 5 m/s and stops at the focus. The image

(a) moves away from the lens with an uniform speed 5 m/s.

(b) moves away from the lens with an uniform acceleration.

(c) moves away from the lens with a non-uniform acceleration.

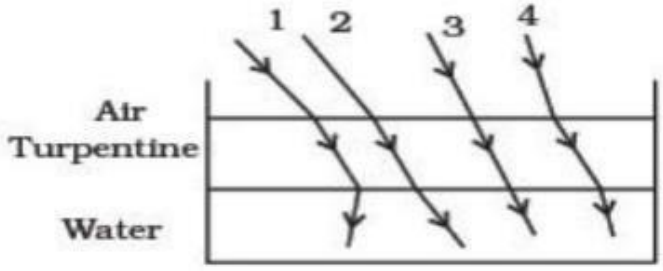
(d) moves towards the lens with a non-uniform acceleration.

7. An astronomical telescope has a large aperture to:

(a) increase span of observation (b) have low dispersion

(c) reduce spherical aberration (d) have high resolution

8. The optical density of turpentine is higher than that of water while its mass density is lower shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in the path shown is correct?



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

9. The basic reason for the extraordinary sparkle of suitably cut diamond is that

(a) It has low refractive index

(b) It has high transparency

(c)It has high refractive index

(d) It is very hard

10. A short pulse of white light incident from air to glass slab at normal incidence. After travelling through the slab the first color to emerge is

(a) violet (b) blue (c) green (d) red

11. Two lenses of focal lengths 20 cm and - 40cm are held in contact. If an object lies at infinity, image formed by the lens combination will be at

(a) infinity (b) 20cm (c) 40cm (d) 60cm

(b)

12. A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen.

(a) half the image will disappear.

(b) incomplete image will be formed.

(c) intensity of image will decrease but complete image is formed.

(d) intensity of image will increase but image is not distinct.

13. In optical fibres, the refractive index of the core is

(a) greater than that of the cladding. (b) equal to that of the cladding.

(c) smaller than that of the cladding. (d) independent of that of cladding.

14. The critical angle for a diamond is 24.4^0. Then the refractive index is

(a) 2.42 (b) 0.413 (c)1 (d) 1.413

15. A Biconcave lens of power P vertically splits into two identical Plano-concave parts. The power of each part will be

(a). 2P (b). P/2 (c). P (d). P/

16. When a ray of light enters a glass slab than,

(a). its frequency and velocity change

(b). only frequency changes

(c). its frequency and wavelength changes

(d). its frequency does not change

17. Which of the following is not due to total internal reflection

(a) Working of optical fibre

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

(c) Mirage on hot summer days

(d) Brilliance of diamond

18. How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light

(a) increase (b) decreases

(c)same (d) none of these

19. The image formed by an objective of a compound microscope is

(a) virtual and diminished

(b) real and diminished

(c) real and enlarged

(d) virtual and enlarged

20. An object is immersed in a fluid, In order that the object becomes invisible, it should
(a) behaves as a perfect reflector
(b) absorb all light falling on it
(c) have refractive index one
(d) have refractive index exactly matching with that of the surrounding fluid

ASSERTION AND REASONING QUESTIONS

Instructions: 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 but 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: The stars twinkle while the planets do not.
Reason: The stars are much bigger in size than the planets.

(2) Assertion: The air bubble shines in water.
Reason: Air bubble in water shines due to refraction of light

(3) Assertion: A double convex lens ($\mu m = 1.5$) has focal length 10 cm. When the lens is immersed in water ($\mu l = 4/3$) its focal length becomes 40 cm.
Reason: $1/f = [(\mu l - \mu m)/\mu m](1/R1 - 1/R2)$

(4) Assertion: The colour of the green flower seen through red glass appears to be dark.
Reason: Red glass transmits only red light.

(5) Assertion: Magnifying glass is formed of shorter focal length.
Reason: It is easier to form lenses of small focal length

(6) Assertion: In compound microscope, the objective lens is taken of small focal length
Reason: This increases the magnifying power of microscope..

(7) Assertion: Within a glass slab, a double convex air bubble is formed. This air bubble behaveslike a converging lens.
Reason: Refractive index of air is more than the refractive index of glass.

(8) Assertion: The focal length of lens does not change when red light is replaced by blue light.
Reason: The focal length of lens does not depends on colour of light used.

(9) Assertion: There is no dispersion of light refracted through a rectangular glass slab.
Reason: Dispersion of light is the phenomenon of splitting of a beam of white light into its

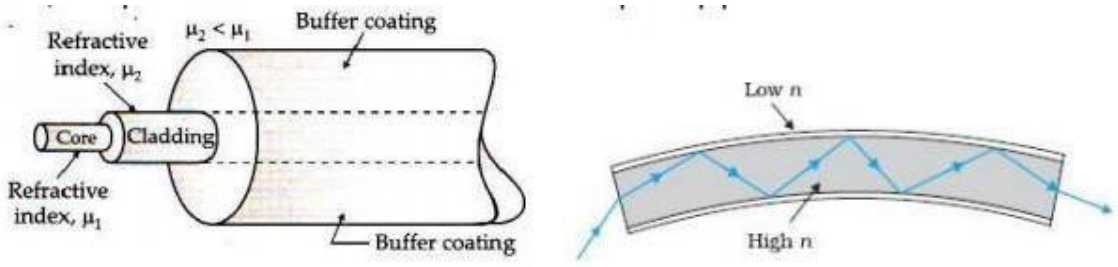
constituent colours.

(10) Assertion: A beam of white light gives a spectrum on passing through a hollow prism.

Reason: Speed of light outside the prism is different from the speed of light inside the prism.

CASE STUDY BASED QUESTIONS

Q1. Optical fibres: Now-a-days optical fibres are extensively used for transmitting audio and video signals through long distances. Optical fibres too make use of the phenomenon of total internal reflection. Optical fibres are fabricated with high quality composite glass/quartz fibres. Each fibre consists of a core and cladding. The refractive index of the material of the core is higher than that of the cladding. When a signal in the form of light is directed at one end of the fibre at a suitable angle, it undergoes repeated total internal reflections alongthe length of the fibre and finally comes out at the other end. Since light undergoes total internal reflection at each stage, there is no appreciable loss in the intensity of the light signal. Optical fibres are fabricated such that light reflected at one side of inner surface strikes the other at an angle larger than the critical angle. Even if the fibre is bent, light can easily travel along its length. Thus, an optical fibre can be used to act as an optical pipe.



i) Which of the following statement is not true.

a) Optical fibres is based on the principle of total internal reflection.

b) The refractive index of the material of the core is less than that of the cladding.

c) an optical fibre can be used to act as an optical pipe.

d) there is no appreciable loss in the intensity of the light signal while propagating through an optical fibre

ii) What is the condition for total internal reflection to occur?

a) angle of incidence must be equal to the critical angle.

b) angle of incidence must be less than the critical angle.

c) angle of incidence must be greater than the critical angle.

d) None of the above.

iii) Which of the following is not an application of total internal reflection?

a) Mirage b) Sparkling of diamond

c) Splitting of white light through a prism. d) Totally reflecting prism.

iv) Optical fibers are used extensively to transmit

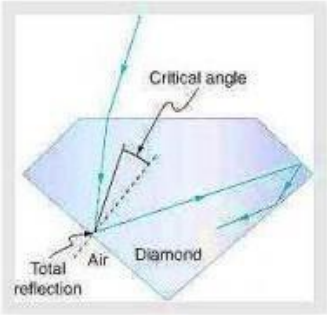
a) Optical Signal b) current

c) Sound waves d) None of the above

Q.2. The total internal reflection of the light is used in polishing diamonds to create a sparking brilliance. By polishing the diamond with specific cuts, it is adjusted the most of the light rays approaching the surface are incident with an angle of incidence more than critical angle. Hence, they suffer multiple reflections and ultimately come out of diamond from the top. This gives the diamond a

Q.3. sparking brilliance

i). At critical angle for a diamond is



a) 1.41 b) Same as glass c) 2.42 d) 1

ii). The basic reason for the extraordinary sparkle of suitably cut diamond is that

a) It has low refractive index

b) It has high transparency

c) It has high refractive index

d) It is very hard

iii). The extraordinary sparkling of diamond

a) Does not depend on its shape

b) Depends on its shape

c) Has no fixed reason

d) None

iv). A diamond is immersed in a liquid with a refractive index greater than water. Then the critical angle for total internal reflection will

a) Increase b) Decrease

c) Depend on the nature of the liquid d) Remains the same

v). OFC cables work on the principle of

a) Dispersion of light

b) Refraction of light

c) Total internal reflection

d) Interference of light

ANSWER

ASSERTION AND REASONING BASED

1. Correct Answer: B Solution : The stars twinkle while the planets do not. It is due to variation in density of atmospheric layer. As the stars are very far and giving light continuously to us. So, the light coming from stars is found to change their intensity continuously. Hence they are seen twinkling. Also stars are much bigger in size than planets but it has nothing to deal with twinkling phenomenon.

2. Correct Answer: C Solution : Shining of air bubble in water is on account of total internal reflection.

3. Correct Answer: A Solution : Focal length of lens immersed in water is four times the focal length of lens in air. It means $f_w = 4f_a = 4 \times 10 = 40$ cm

4. Correct Answer: A Solution : The red glass absorbs the radiations emitted by green flowers; so flower appears black.

5. Correct Answer: C

6. Correct Answer: A.

7. Correct Answer: D Solution: The air bubble would behave as a diverging lens, because refractive index of air is less than refractive index of glass. However, the geometrical shape of the air bubble shall resemble a double convex lens.

8. Correct Answer: D Solution : Focal length of the lens depends upon it's refractive index as $1/f \propto (\mu - 1)$. Since $\mu_b > \mu_r$ so $f_b < f_r$. Therefore, the focal length of a lens decreases when red light is replaced by blue light.

9. Correct Answer: B Solution : After refraction at two parallel faces of a glass slab, a ray of light emerges in a direction parallel to the direction of incidence of white light on the slab. As rays of all colours emerge in the same direction (of incidence of white light), hence there is no dispersion, but only lateral displacement.

10. Correct Answer: D

CASE STUDY BASED QUESTIONS

Q1. i) (b) ii) (c) iii) (c) iv) (a)

Q2 i) (c) ii) (c) iii) (b) iv) (a) v).(c)

(2 marks question)

1. Define the angle of deviation. Write the relation between angle of incidence i, angle of prism A and angle of minimum deviation δ_m for a glass prism.

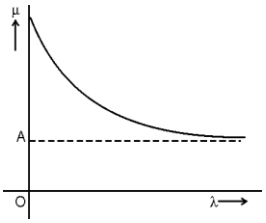
   HINTS. Definition, $2i = A + \delta_m$

2. It is known that the refractive index, , of the material of a prism, depends on the wavelength, of the incident radiation as per the relation

$$\mu = A + \frac{B}{\lambda^2}$$

   where A and B are constants. Plot a graph showing the dependence of μon λ.

   HINTS.



3. Define the power and write its SI unit. How does power of lens vary when incident red light is replaced by blue light?

   HINTS: Def. and SI unit, Wavelength decreases hence power increases.

4. Two thin lenses of power +6 D and – 2 D are in contact. What is the focal length of the combination?

   HINTS: Net power of lens combination P = P1 + P2 = + 6 D - 2 D = + 4 D
   Focal length, f = 1/P = ¼ m = 25 cm

5. Under what condition does a convex lens of glass having certain refractive index, acts as a plane glass sheet? Justify with mathematical calculation.

   HINTS: When refractive index of lens is equal to refractive index of liquid.

6. You are given following three lenses. Which two lens you will use to make objective and eyepiece of an astronomical telescope and why ?

L2	6D	1cm
L3	10D	1cm
LENS	POWER	APERTURE
L1	3D	8cm

   HINTS: L1 as objective.

L3 as eyepiece , Justification

7. A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens?

HINTS: Since m for lens. < m for surrounding. It behaves like converging lens.

8. A converging lens is kept coaxially in contact with a diverging lens , both the lenses being of equal focal lengths .What is the focal length of the combination?

HINTS. Focal length = infinity

9. State the condition for the phenomenon of total internal reflection to occur.

HINTS. (a) Light travels from denser to rare medium.

(b) Angle of incidence greater then critical angle.

10. Calculate the speed of light in a medium whose critical angle is 30^0

HINT.

$$\because \quad n = \frac{1}{\sin C} = \frac{1}{\sin 30^\circ} \qquad \therefore \; n = 2$$

$$\Rightarrow \quad n = \frac{c}{v} = 2 \qquad \Rightarrow \frac{3\times 10^8}{v} = 2$$

Therefore, speed of light is 1.5 X 10^8m/s

3 MARKS QUESTION

1. For the same value of angle of incidence, the angle of refraction in three media is 15^0, 25^0 and 35^0respectively. In which medium the velocity of light will be minimum?

Ans.

$$\text{As } \mu = \frac{\sin i}{\sin r} = \frac{c}{v} \qquad \text{or } v = \frac{\sin r}{\sin i} \times c$$

For a given angle of incidence $v \propto \sin r$,

$v_A \propto \sin 15^\circ$, $v_B \propto \sin 25^\circ$, $v_C \propto \sin 35^\circ$

But $\sin 15^\circ < \sin 25^\circ < \sin 35^\circ$

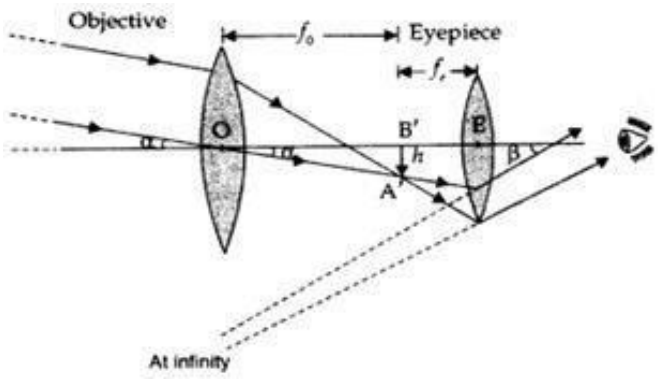
$\therefore \quad v_A < v_B < v_C$

Therefore, Velocity of light is minimum in medium A.

2. Draw a ray diagram of an astronomical telescope in the normal adjustment position. State two drawbacks of this type of telescope.

Ans. (i) Magnifying power m = $-f_0/f_e$. It does not change with increase of aperture of

objective lens, because focal length of a lens has no concern with the aperture of lens.



(ii) Drawbacks:

Lesser resolving power.

The image formed is inverted and faintes.

3. What is the focal length of a combination of a convex lens of focal length 30cm and a concave lens of focal length 20cm ? Is the system a converging or diverginglens? Ignore thickness of the lenses.

Hint: f = -60cm

4. Light from a point source in air falls on a convex spherical glass surface (μ = 1.5,radius of curvature = 20 cm). The distance of light source from the glass surface is 100 cm. At what position is the image formed?

Hint: v= +100cm. (The image is formed at a distance of 100cm from the glass surface in the directin of incident light)

5. Velocity of light in a liquid is 1.5 X 10^8 m/s and in air, it is 3 X 10^8 m/s. If a ray of light passes from liquid into the air, calculate the value of critical angle.

Hint: Critical angle = 30^0

6. Derive the relation between object distance, image distance and focal length, when object is placed at the centre of curvature of a convex lens.

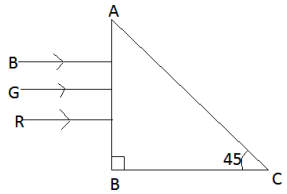
   Hint: Diagram and formula 1/v - 1/u = 1/f

7. (a) Write the necessary conditions for the phenomenon of total internal reflection to occur.

   (b) Write the relation between the refractive index and critical angle for a given pair of optical media.

   Hint: Light travel from denser medium to rare medium. $^a\mu_b = 1/\sin C$

8. Three rays of light, red (R), green (G) and blue (B) are incident on the face AB of a right angled prism as shown in the figure. The refractive indices of the material prism for red, green and blue colours are 1.39, 1.44, and 1.47 respectively. Which one of the three rays will emerge out of the prism? Give reason to support youranswer.



   Hint : Only red ray will emerge out of the prism. ($\mu_R = 1.39 < 1.414$)

9. A beam of light converges at a point P . Now a convex lens is placed in the path of the convergent beam at 15cm from P. At what point does a beam converge if the convex lens has a focal length 10cm?

   Hint : 6cm

9. An illuminated object and a screen are placed 90 cm apart. Determine the focal length and nature of lens required to produce a clear image on the screen, twice the size of the object.

   Hint: f = 20 cm (convex lens)

10. A ray of light passing from air through an equilateral glass prism undergoes minimum deviation. When the angle of incidence is ¾ of angle of prism. Calculate the speed of light in prism.

    Hint : 2.1 x 10^8 m/s

LONG ANSWER QUESTION.

1. (a) Derive the lens maker formula.

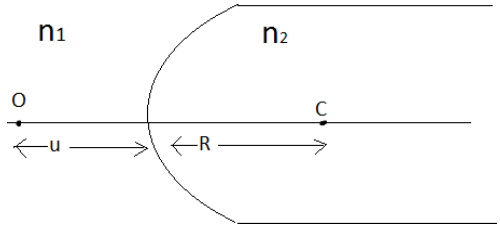
   (b) A convex lens of focal length 20 cm and a concave lens of focal length 15 cm are kept 30 cm apart with their principal axes coincident. When an object is placed 30 cm in front of the convex lens, calculate the position of the final image formed by the combination. Would this result change if the object were placed 30 cm in front of the concave lens? Give reason.

   Hint: v = -30 cm

   The result will not change on interchanging the lenses due to the principle of reversibility of light.

2. (a) A point object 'O' is kept in a medium of refractive index n_1 in front of a convex spherical surface of radius of curvature R which separates the second medium of refractive index n_2 from the first one, as shown in the figure.

   Draw the ray diagram showing the image formation and deduce the relationship between the object distance and the image distance in terms of n_1 , n_2 and R



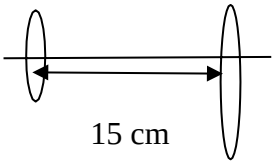
   (b)When the image formed above acts as a virtual object for a concave spherical surface separating the medium n_2 from n_1 ($n_2 > n_1$), draw this ray diagram and write the similar(similar to (a)) relation. Hence obtain the expression for the lens maker's formula.

3. a) Why does a convex lens behave as a diverging lens when immersed in Carbon disulphide (μ=1.6). Justify with calculation.

   b) A ray of light incident on an equilateral glass prism propagates parallel to the base line of the prism inside it. Find the angle of incidence of this ray. Given refractive index of a material of glass prism is $\sqrt{3}$.

4. (a) Draw the ray diagram of astronomical telescope in normal adjustment.

   (b) convex lenses A and B of an astronomical telescope having focal lengths 5cm and 20cm respectively are arranged as shown in the figure.



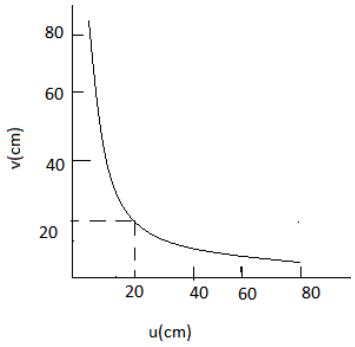
i) Which one of the two lenses you will select to use as the objective lens and why?

ii) What should be the change in the distance between the lenses to have the telescope in its normal adjustment position?

iii) Calculate the magnifying power of the telescope in the normal adjustment position?

5. (a) What is an equivalent lens. Obtain an expression for the effective focal length of two thin lenses placed in contact co-axially with each other.

(b) A lens forms a real image of an object. The distance of the object to the lens is 4 cm and the distance of the image from the lens is v cm. The given graph shows the variation of v with u. (i) What is the nature of the lens? (ii) Using the graph, find the focal length of this lens.



Hint: Lens is convex lens f = + 10 cm

SELF ASSESSMENT

MULTIPLE CHOICE QUESTIONS

1. The length of an astronomical telescope for normal vision will be

(a) $f_0 - f_e$ (b) f_0 / f_e

(c) $f_0 + f_e$ (d) $f_0 \times f_e$

2. A person using a lens as a simple microscope seen as

(a) inverted virtual image

(b) inverted real magnifying image

(c)upright virtual image

(d) upright real magnified image

3. Air bubble in water behaves as

(a) Sometimes concave sometimes convex lens

(b) concave lens

(c) convex lens

(d) always refracting surface

4. The refractive angle of prism is 60^0 and minimum deviation 30^0. The angle of incidence will be

(a) 30^0 (b) 45^0 (c)60^0 (d) 90^0

5. A object is 30 cm in front of converging lens of focal length 10cm. The image is

(a) real and larger than the object

(b) real and the same size than the object

(c)real and smaller than the object

(d) virtual and same size than the object

ASSERTION AND REASONING QUESTIONS

1. Assertion: If objective and eye lenses of a microscope are interchanged then it can work as telescope.

Reason: The objective of telescope has small focal length.

2. Assertion: Although the surfaces of a goggle lens are curved, it does not have any power.

Reason: In case of goggles, both the curved surfaces have equal radii of curvature.

3 Assertion: If the angles of the base of the prism are equal, then in the position of minimum deviation, the refracted ray will pass parallel to the base of prism.

Reason: In the case of minimum deviation, the angle of incidence is equal to the angle of emergence.

4 Assertion: An empty test tube dipped into water in a beaker appears silver, when viewed from a suitable direction.

Reason: Due to refraction of light, the substance in water appears silvery.

5 Assertion: Spherical aberration occur in lenses of larger aperture.

Reason: The two rays, paraxial and marginal rays focus at different points.

SHORT ANSWER QUESTION (2MARKS)

1. An object is placed at the principal focus of a concave lens of focal length f. Where will its image be formed?

2. A prism of angle 60^0 gives a minimum deviation of 30^0 . What is the refractive index of the material of prism?

3. An equi-convex lens has refractive index 1.5. Write its focal length in terms of radius of curvature R.

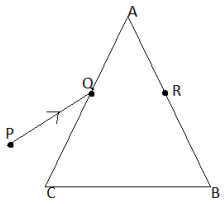
4. Which of the following properties of light: velocity, wavelength and frequency, changes during the phenomenon (i) reflection (ii) refraction

5. Draw a ray diagram of compound microscope. Write the expression for its magnifying power.

SHORT ANSWER QUESTION (3MARKS)

1. A small bulb is placed at the bottom of a tank containing water to depth of 80 cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33 (Consider the bulb to be a point source).

2. A ray PQ incident on the face AC of a prism ABC, as shown in the figure , emerges from the face AB such that AQ = AR .
Draw the ray diagram showing the passage of the ray through the prism. If the angle of



prism is 60^0 and refractive index of the material of the prism is $\sqrt{3}$ determine the values of angle of incidence and angle of deviation.

3. Draw a ray diagram of reflecting type telescope. State two advantage of this type telescope . Write magnifying power formula.

4. Draw a ray diagram of compound microscope when image is formed at least distance of distinct vision . Derive magnifying power formula. How can the magnifying power of a microscope be increased ?

5. Draw ray diagram to show refraction of light through a glass prism. Draw a graph, show the angle of deviation with that of the angle of incidence. For small angle prism, prove that $\delta = A(\mu - 1)$, where the symbols have their usual meanings.

CHAPTER 10: WAVE OPTICS

IMPORTANT FORMULA.

- Resultant intensity at a point $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\theta$
- $R = \sqrt{(a^2 + b^2 + 2ab\cos\theta)}$
- FOR MAXIMA $I_{MAX} = k(a+b)^2$
- FOR MINIMA $I_{MIN} = K(a-b)^2$
- Expression of position of dark fringe is given $x = (2n-1)\frac{\lambda D}{2d}$
- Expression of position of bright fringes is given $X = n\lambda\frac{D}{d}$
- Width of dark and bright fringe $= \lambda\frac{D}{d}$
- Diffraction by single slit for bright fringe $= (2n+1)\frac{\lambda D}{2a}$
- Diffraction by single slit for dark fringe $y = n\frac{\lambda D}{a}$
- Width of centre maxima $= \frac{2\lambda D}{a}$
- Angular width of center maxima in diffraction $= \frac{\lambda}{a}$

MULTIPLE CHOICE QUESTIONS

1. In a thin film experiment, a wedge of air is used between two glass plates. If the wavelength of the incident light in air is 480 nm, how much thicker is the air wedge at the 16th dark fringe than it is at the 6th?

   A. 2400 nm B. 4800 nm C. 240 nm D. 480 nm

2. In a Young's double-slit experiment the center of a bright fringe occurs wherever waves from the slits differ in phase by a multiple of:

   A. π/4 B. π/2 C. 2π D. 3π/4

3. spacing on the screen, the screen-to-slit distance D must be changed to:

   A. D/2 B. D/√2 C. D√2 D. 2D

4. In an experiment to measure the wavelength of light using a double slit, it is found that the fringes are too close together to easily count them. To spread out the fringe pattern, one could:

A. decrease the slit separation B. increase the slit separation

C. increase the width of each slit D. decrease the width of each slit

5. No fringes are seen in a single-slit diffraction pattern if:

A. the screen is far away

B. the wavelength is less than the slit width

C. the wavelength is greater than the slit width

D. the wavelength is less than the distance to the screen

6. When a highly coherent beam of light is directed against a very fine wire, the shadow formed behind it is not just that of a single wire but rather looks like the shadow of several parallel wires. The explanation of this involves:

A. refraction B. diffraction C. reflection D. the Doppler effect

7. Monochromatic light is normally incident on a diffraction grating that is 1 cm wide and has 10, 000 slits. The first order line is deviated at a 30◦ angle. What is the wavelength, in nm, of the incident light?

A. 300 B. 400 C. 500 D. 600

8. Diffraction effects show that light does not travel straight lines. Under what condition the concepts of ray optics are valid. (D =distance of screen from the slit, Z_f = Fresnel distance).

A .$D < Z_f$ B. $D = Z_f$ C.$D > Z_f$ D.$D << Z_f$

9. The ratio of the widths of two slits in Young's double slit experiment is 4 : 1. Evaluate the ratio of intensities at maxima and minima in the interference pattern.

a) 1:1 b) 1:4 c) 3:1 d) 9:1

10. Light takes 10^{-10} second to cross a glass slab. What is the thickness of the glass slab?

(a) 2 cm (b) 3 cm (c) 2.5 cm (d) 3.5 cm

ASSERTION AND REASONING QUESTIONS

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

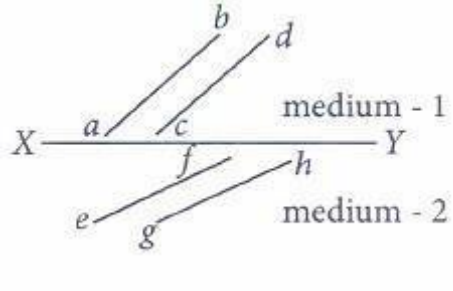
1. **Assertion:** According to Huygen's principle, no backward wave-front is possible.
   Reason: Amplitude of secondary wavelet is proportional to $(1 + \cos\theta)$ where θ is the angle between the ray at the point of consideration and the direction of secondary wavelet.
2. **Assertion:** No interference pattern is detected when two coherent sources are infinitely close to each other.
   Reason: The fringe width is inversely proportional to the distance between the two sources.
3. **Assertion:** It is necessary to have two waves of equal intensity to study interference pattern.
   Reason: There will be an effect on clarity if the waves are of unequal intensity.
4. **Assertion:** White light falls on a double slit with one slit is covered by a green filter. The bright fringes observed are of green colour.
   Reason: The fringes observed are coloured.
5. **Assertion:** In YDSE, if a thin film is introduced in front of the upper slit, then the fringe pattern shifts in the downward direction.
   Reason: In YDSE if the slit widths are unequal, the minima will be completely dark.
6. **Assertion:** In Young's double slit experiment if wavelength of incident monochromatic light is just doubled, number of bright fringe on the screen will increase.
   Reason: Maximum number of bright fringe on the screen is inversely proportional to the wavelength of light used
7. **Assertion:** In YDSE number of bright fringe or dark fringe cannot be unlimited
   Reason: In YDSE path difference between the superposing waves cannot be more than the distance between the slits.
8. **Assertion:** Interference pattern is made by using yellow light instead of red light, the fringes become narrower.
   Reason: In YDSE, fringe width is given by $\beta = \lambda D/d$

9. **Assertion:** Coloured spectrum is seen when we look through a muslin cloth.
Reason: It is due the diffraction of white light on passing through fine slits.

10. **Assertion:** Diffraction takes place for all types of waves mechanical or non-mechanical, transverse or longitudinal.
Reason: Diffraction's effect are perceptible only if wavelength of wave is comparable to dimensions of diffracting device.

CASE STUDY BASED QUESTIONS (4 MARKS)

Wavefront is a locus of points which vibratic in same phase. A ray of light is perpendicular to the wavefront. According to Huygens principle, each point of the wavefront is the source of a secondary disturbance and the wavelets connecting from these points spread out in all directions with the speed of wave. The figure shows a surface XY separatingtwo transparent media, medium-I and medium-2. The lines ab and cd represent wavefronts of a light wave travelling in medium-1 and incident on XY. The lines ef and gh represent wavefronts of the light wave in medium-2 after refraction.



(i) Light travels as a

(a) parallel beam in each medium

(b) convergent beam in each medium

(c) divergent beam in each medium

(d) divergent beam in one medium and convergent beam in the other medium

(ii) The phases of the light wave at c, d, e and f are $\emptyset_c, \emptyset_d, \emptyset_e and \emptyset_f$ respectively. It is given that $\emptyset_c \neq \emptyset_f$

((a) $\emptyset_c$can not be equal to $\emptyset_d$

(b) $\emptyset_d$can be equal to $\emptyset_e$

(c) $(\emptyset_d - \emptyset_f)$ is equal to $(\emptyset_c - \emptyset_e)$

(d) $(\emptyset_d - \emptyset_c)$ is not equal to$(\emptyset_f - \emptyset_e)$

(iii) Wave front is the locus of all points, where the particles of the medium vibrate with the same

(a) phase (b) amplitude (c) frequency (d) period

(iv) A point source that emits waves uniformly in all directions, produces wavefronts that are
(a) spherical (b) elliptical (c) cylindrical (d) planar

(v) What are the types of wave fronts?
(a) Spherical (b) Cylindrical (c) Plane (d) All of these

SHORT ANSWER TYPES QUESTIONS (2 MARKS EACH)

1. Maximum intensity in YDSE is I0. Find the intensity at a point on the screen where.
(a) the phase difference between the two interfering beams is $\pi/3$
(b) the path difference between them is $\lambda/4$
2. Two waves of equal frequencies have their amplitudes in the ratio of 3:5 . They are superimposed on each other. Calculate the ratio of maximum and minimum intensities of the resultant wave.
3. Draw a diagram to show the refraction of a plane wave front incident on a convex lens and hence draw the refracted wave front.
4. Why light ways do not diffracted around buildings, while radio waves diffract easily?
5. In double-slit experiment using light of wavelength 600 nm, the angular width of a fringe formed on a distant screen is 0.1º.What is the spacing between the two slits?
6. For what distance is ray optics a good approximation when the aperture is 3 mm wide and the wavelength is 500 nm?
7. The 6563 Å Hα line emitted by hydrogen in a star is found to be red shifted by 15 Å. Estimate the speed with which the star is receding from the Earth.
8. (a) In a single slit diffraction experiment, a slit of width 'd' is illuminated by red light of wavelength 650 nm. For what value of'd' will
(i) the first minimum fall at an angle of diffraction of 30°, and
(ii) the first maximum fall at an angle of diffraction of 30°?
9. In a single slit diffraction experiment, the width of the slit is reduced to half its original width. How would this affect the size and intensity of the central maximum?
10. How does the fringe width of interference fringes change, when the whole apparatus of Young's experiment is kept in a liquid of refractive index 4/3?

SHORT ANSWER TYPES QUESTIONS (3 MARKS EACH)

1. Define the term wave front? Using Huygens's construction draw a figure showing the propagation of a plane wave reflecting at the interface of the two media. Show that the angle of incidence is equalto the angle of reflection.
2. Define the term 'wave front'. Draw the wave front and corresponding rays in the case of a (i) diverging spherical wave (ii) plane wave. Using Huygens's construction of a wave front, explain the refraction of a plane wave front at a plane surface and hence deduce Snell's law.
3. In Young's double-slit experiment a monochromatic light of wavelength λ, is used. The intensity of light at a point on the screen where path difference is λ is estimated as K units. What is the intensity of light at a point where path difference is λ /3?
4. Draw fringe patterns of Interference and Diffractions and write two difference between them.
5. State one feature by which the phenomenon of interference can be distinguished from that of diffraction.

   A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 'a'. If the distance between the slits and the screen is 0.8 m and the distance of 2 nd order maximum from the centre of the screen is. 15 mm, calculate the width of the slit.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. What is interference of light? Write two essential conditions for sustained interference pattern to be produced on the screen. Draw a graph showing the variation of intensity versus the position on the screen in Young's experimentwhen

   (a) both the slits are opened and

   (b) one of the slit is closed. What is the effect on the interference pattern in Young's double slit experiment when: (i) Screen is moved closer to the plane of slits? (ii)Separation between two slits is increased. Explain your answer in each case
2. (a) State Huygens's principle for constructing wave fronts?

   (b) Using Huygens's principle deduce the laws of reflection of light?

   (c) What changes in diffraction pattern of a single slit will you observe. When the monochromatic source of light is replaced by a source of white light?

ANSWER KEY

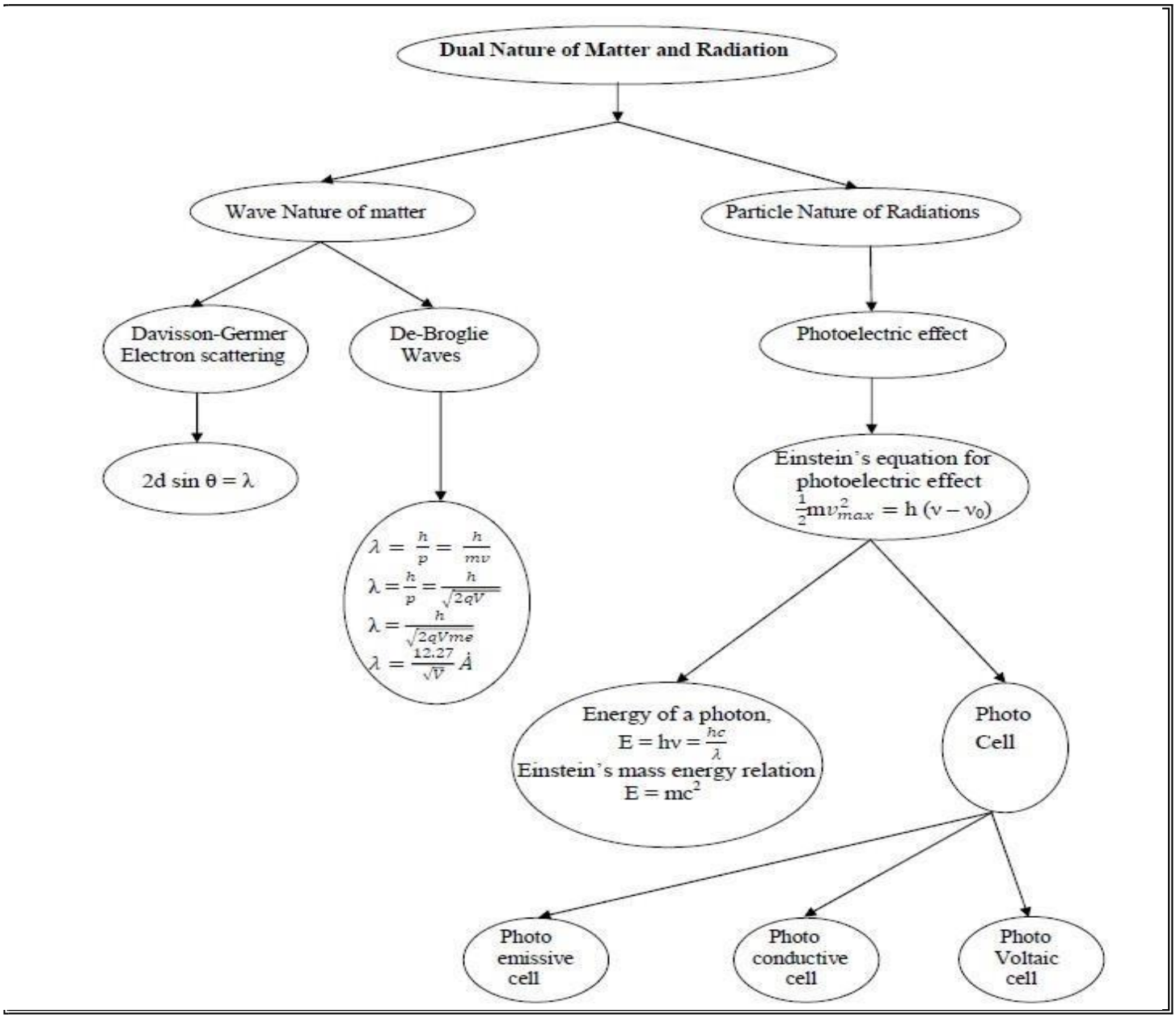
I. MULTIPLE CHOICE QUESTIONS					
QNO.	**Correct answer**	**Marks**	**QNO.**	**Correct answer**	**Marks**
1	A	1	6	B	1
2	C	1	7	C	1
3	D	1	8	B	1
4	A	1	9	D	1
5	C	1	10	B	1

II. ASSERTION AND REASON					
QNO.	**Correct answer**	**Marks**	**QNO.**	**Correct answer**	**Marks**
1	B	1	6	a	1
2	A	1	7	b	1
3	D	1	8	a	1
4	C	1	9	a	1
5	D	1	10	b	1

III. **CASE STUDY BASED QUESTIONS**		
QNO.	Correct answers	Marks
i	a	1
ii	c	1
iii	c	1
iv	a	1
v	c	1

CHAPTER 11: DUAL NATURE OF RADIATION AND MATTER

BRAIN MAP



IMPORTANT FORMULAE

Energy of a photon, $E = h\nu = \frac{hc}{\lambda}$

If λ is in nm and energy of photon is in eV, then $E = \frac{1242eV - nm}{\lambda\ (in\ nm)}$

Work function $w = h\nu_0 = \frac{hc}{\lambda 0}$

Momentum of photon p = $\frac{h}{\lambda}$

Cut-off potential (V_0) then $KE_{max} = eV_0$

$\frac{1}{2} m v^2_{max} = eV_0$

Einstein's equation for photoelectric effect $h\nu = KE_{max} + W_0$

$$V_0 = \frac{h}{e}(\nu - \nu_0)$$

$$V_0 = \frac{h}{e}\left(\frac{c}{\lambda} - \frac{c}{\lambda 0}\right)$$

de-Broglie matter wave equation $\lambda = \frac{h}{p} = \frac{h}{mv}$

$\frac{1}{2}mv^2 = qV$ or $v = \sqrt{\frac{2qV}{m}}$

Momentum $p = mv = \sqrt{2qVm}$

The wave length associated with moving charge is given by $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2qVm}}$

If accelerate charge is electron then $\lambda = \frac{h}{\sqrt{2qVme}}$, where m_e = mass of electron.

$\lambda = \frac{12.2}{\sqrt{V}} A$, For electron beam

Davision- Germer experiment: $2d \sin\theta = \lambda$

MULTIPLE CHOICE QUESTIONS

1. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential, in volt is

   (a) 2 (b)4 (c)6 (d)10

2. A particle of mass M at rest decay in to two particles of masses m_1 and m_2 having non zero velocities. The ratio of the de-Broglie wavelength of the particles λ_1/λ_2 is

   (a) m_1/m_2 (b)m_2/m_1 (c)1.0 (d)$\frac{\sqrt{m2}}{\sqrt{m1}}$

3. Photon of frequency P has a momentum associated with it. If c is the velocity of radiation, then the momentum is

   (a) $\frac{hP}{c}$ (b)$\frac{P}{c}$ (c)hPc (d)$\frac{hP}{c^2}$

4. If the kinetic energy of a free electron doubles its de-Broglie wavelength changes by the factor

(a) 1/2 (b)2 (c)$\frac{1}{\sqrt{2}}$ (d) $\sqrt{2}$

5. De-Broglie wavelength λ associated with neutron is related with absolute temperature T is
   (a) $\lambda \alpha T$
   (b) $\lambda \alpha \frac{1}{T}$
   (c) $\lambda \alpha \frac{1}{\sqrt{T}}$
   (d) $\lambda \alpha \sqrt{T}$
6. In photoelectric effect, electrons are ejected from metals if the incident light has a certain minimum
   (a) Wavelength (b)Frequency (c)Amplitude (d)Angle if incidence
7. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum. Its final velocity will be
   (a) $\sqrt{2eV}$
   (b) $\sqrt{\frac{eV}{m}}$
   (c) $\frac{eV}{2m}$
   (d) $\frac{eV}{m}$
8, If following particles are moving with same velocity then which has maximum de-Broglie wavelength?
   (a) Proton (b)α-particle (c)Neutron (d)β-particle
9. As the intensity of incident light increases
   (a) Photoelectric current increases
   (b) Kinetic energy of emitted photoelectrons increases
   (c) Photoelectric current decreases
   (d) Kinetic energy of emitted photoelectrons decreases
10. Which of these particles (having the same kinetic energy) has the largest de-Broglie wavelength?
   (a) Electron (b)Alpha particle (c)Proton (d)Neutron

ASSERTION AND REASONING QUESTIONS

In the following questions, statement of assertion followed by a statement of reason is given,

Choose the correct answer out of the following choices,

(a) Assertion and reason both are correct statement and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statement but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

11 Assertion: A photon has no rest mass , yet it carries definite momentum.
Reason: Momentum of photon is due to its energy and hence its equivalent mass.

12. Assertion: Mass of moving photon varies inversely as the wavelength.
Reason: Energy of the particle = mass x (speed of light)

13. Assertion: In photoelectron emission, the velocity of electron ejected from near the surface is larger than that coming from interior of metal.
Reason. The velocity of ejected electron will be zero.

14. Assertion: A photocell is called an electric eye.
Reason. When light is incident on some semiconductor, its electrical resistance is reduced .

15. Assertion: The de Broglie equation has significance for any microscopic or sub microscopic particle.
Reason: The de Broglie wavelength is inversely proportional to the mass of the object if velocity is constant.

1 6. Assertion: A particle of mass M at rest decay into particles of masses m1 and m2,having non-zero velocities will have ratio of de-Broglie wavelengths unity.
Reason. Here we cannot apply conservation of linear momentum.

17. Assertion: Photoelectric effect demonstrates the wave nature of light.
Reason. The number of photoelectrons is proportional to the frequency of light.

18. Assertion: When a certain wavelength of light falls on a metal surface it ejects electron.
Reason. Light has wave nature.

19. Assertion: As work function of a material increases by some mechanism, it requires greater energy to excite the electrons from its surface.
Reason. A plot of stopping potential (V2) versus frequency (v) for different materials, has greater slope for metals with greater work functions.

20. Assertion: Light of frequency 1.5 times the threshold frequency is incident on photo sensitive material. If the frequency is halved and intensity is doubled the photo current remains unchanged.
Reason. The photo electric current varies directly with the intensity of light and frequency of light.

CASE STUDY BASED QUESTIONS

21. 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.

1. Packet of energy are called

(a) electron (b) quanta (c) frequency (d) neutron

2. One quantum of radiation is called

(a) meter (b) meson (c) photon (d) quark

3. Energy associated with each photon

(a) hc (b) mc (c) hv (d) hk

4. Which of the following waves can produce photo electric effect

(a). UV radiation (b). Infrared radiation (c). Radio waves (d) .Microwaves

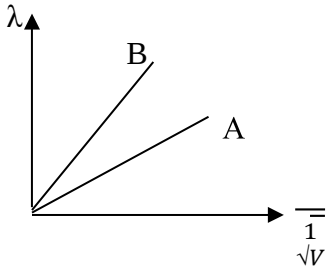
5. Work function of alkali metals is

(a) less than zero (b) just equal to other metals

(c) greater than other metals (d) quite less than other metals

SHORT ANSWER QUESTIONS (2 MARKS)

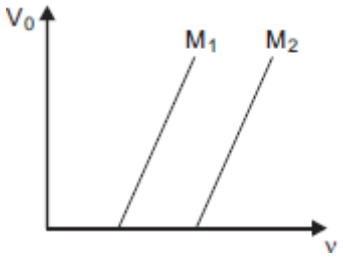
22. The two lines marked A and B in the given figure show a plot of de-Broglie wavelength λ versus $\frac{1}{\sqrt{V}}$, where V is the accelerating potential for two nuclei ${}_{1}^{2}H$ *and* ${}_{1}^{3}H$.(i)What does the slope of the lines represent? (ii) Identify which of the lines corresponded to these nuclei.



23. Draw suitable graphs to show the variation of photoelectric current with collector plate potential for (i) a fixed frequency but different intensities $I_1 > I_2 > I_3$. (ii) a fixed intensity but different frequencies $\nu_1 > \nu_2 > \nu_3$.

24. Figure shows variation of stopping potential (V_o) with the frequency (ν) for two photo sensitive materials M_1 and M_2. (i) Why is the slope same for both lines? (ii) For which material will the

emitted electron have greater kinetic energy for the incident radiation of the same frequency? Justify your answer.



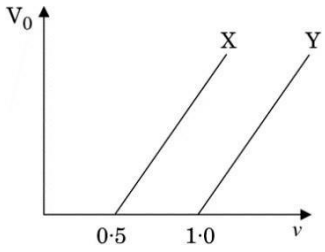
25 An electron is accelerated through a potential difference of 100 V. What is the de-Broglie wavelength associated with it? To which part of the electromagnetic spectrum does this value of wavelength correspond?

26, An α-particle and a proton are accelerated from rest by the same potential. Find the ratio of their de-Broglie wavelengths.

SHORT ANSWER QUESTIONS (3 MARKS)

27. Define the terms cut-off voltage and threshold frequency in relation to the phenomenon of photoelectric effect. Using Einstein's photoelectric equation show how the cut-off voltage and threshold frequency for a given photosensitivematerial can be determine with the help of a suitable graph.

28. The following graph shows the variation of stopping potential V_o with the frequency ν of the incident radiation for two photosensitive metals X and Y (i) Which of the metals has larger threshold wavelength? Give reason. (ii) Explain giving reason which metal gives out electrons having larger kinetic energy. For the same wavelength of the incident radiation. (iii) If the distance between the light source and metal X is halved how will the kinetic energy of electrons emitted from it change? Give reason.



29. Write two characteristic features observed in photoelectric effect which supports the photon pictures of electromagnetic radiation. Draw a graph between the frequency of incident radiation

(ν) and the maximum kinetic energy of the electrons emitted from the surface of a photosensitive material. State clearly how this graph can be used to determine (i) Planck's constant and (ii) work function of the material?

30. An electron and a photon each have a wavelength 10^{-9} m. Find (i) Their momenta (ii) The energy of the photon and (iii) The kinetic energy of electron.

31. Draw a plot showing the variation of photoelectric current with collector plate potential for two different frequencies $\nu_2 > \nu_1$ of incident radiation having the same intensity. In which case will the stopping potential be higher? Justify your answer.

HINTS

(MULTIPLE CHOICE QUESTIONS)

1. (b) $Vo = \frac{kmax}{e} = \frac{4eV}{e} = 4\ V$
2. (c) By law of conservation of linear momentum $p_1 + p_2 = 0$

   $Ip_1I = Ip_2I$

   $\frac{\lambda 1}{\lambda 2} = \frac{p1}{p2} = 1$
3. (a) $p = \frac{hP}{c}$
4. (c)

   $\lambda = \frac{h}{\sqrt{2mK}}$,

   $\lambda' = \frac{h}{\sqrt{2m2K}} = \frac{\lambda}{\sqrt{2}}$
5. (c) $K = \frac{3kT}{2}$, $\lambda = \frac{h}{\sqrt{2mK}}$

   $\lambda \alpha \frac{1}{\sqrt{T}}$
6. (b)
7. (a) $\frac{1}{2}mv^2 = eV$
8. (d) $\lambda = \frac{h}{mv}$, β- particle is the lightest
9. (a)
10. (a) Electron have least mass

ASSERTION REASONING QUESTIONS

11. (a) ,12, (a), 13. (c), 14. (c), 15. (a), 16. (a), 17. (d), 18. (b), 19. (c), 20. (d)

CASE BASED QUESTIONS

21. 1.(b), 2. (c), 3. (c), 4. (a), 5. (d)

SHORT ANSWER QUESTIONS (2 MARKS)

22. $\lambda = \frac{h}{\quad}$

$\sqrt{2mqV}$

(a) The slope of line represents $\frac{h}{\sqrt{2mq}}$

(b) The lighter mass i.e. ${}^{2}_{1}H$ is represents by line of greater slope.

23. Two graphs

24. (a) Slope of stopping potential with frequency of incident radiation gives the value of plank's constant

(b) The intercept of graph on stopping potential gives the value of stopping potential which is higher for M_2.

25. $\lambda = \frac{12.27}{\sqrt{V}} A$, $\lambda = 1.227$ The wavelength belong to the X- Ray part of electromagnetic radiation.

26. $\lambda = \frac{h}{\sqrt{2mqV}}$, $\frac{\lambda_\alpha}{\lambda_p} = \frac{1}{2\sqrt{2}}$

SHORT ANSWER QUESTION (3 MARKS)

27. Definition of Cut off voltage and Threshold frequency

Einstein's equation $Vo = \frac{h}{e}(P - Po)$ and graph

28. $\lambda = \frac{c}{v}$, (a) $\lambda_x > \lambda$, (b) KE_{max} for metal X is greater than Y, (c) No effect.

29. Correct answer and graph.

30. (i) $= \frac{h}{p}$, P = 6.63x10^{-25} m (ii) $E = \frac{hc}{\lambda} = 1243$ eV (iii) $E = \frac{p^2}{2m} = 1.52$ eV.

31. Graph and correct answer, It is clear that for higher frequency cut off potential is higher.

SELF ASSESMENT
MULTIPLE CHOICE QUESTIONS

1. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential, in volt is
   (a) 2
   (b) 4
   (c) 6
   (d) 10
2. De-Broglie wavelength λ associated with neutron is related with absolute temperature T is
   (a) $\lambda \alpha T$
   (b) $\lambda \alpha \frac{1}{T}$
   (c) $\lambda \alpha \frac{1}{\sqrt{T}}$
   (d) $\lambda \alpha \sqrt{T}$

3. In photoelectric effect, electrons are ejected from metals if the incident light has a certain minimum
   (a) Wavelength
   (b) Frequency
   (c) Amplitude
   (d) Angle if incidence

ASSERTION REASONING QUESTIONS

Directions: In each of the following questions, a statement of Assertion (A) is given followed by a corresponding statement of Reason (R) just below it. Of the statements, mark the correct answer as:

(A)If both assertion and reason are true and reason is the correct explanation of assertion

(B)If both assertion and reason are true but reason is not the correct explanation of assertion

(C)If assertion is true and reason is false

(D)If both assertion and reason are false

4. Assertion. The de-Broglie wavelength of a neutron when its kinetic energy is k is λ. Its wavelength is 2 λ when its kinetic energy is 4k.

   Reason. The de - Broglie wavelength λ is proportional to square root of the kinetic energy.

5. Assertion. The de – Broglie wavelength of a molecule varies inversely as the square root of temperature.

   Reason. The root mean square velocity of the molecule depends on the temperature.

Case Study Based Question

6. According to de-Broglie a moving material particle sometimes acts as a wave and sometimes as a particle or a wave is associated with moving material particle which controls the particle in every respect. The wave associated with moving material particle is called matter wave or de-Broglie wave whose wavelength called de-Broglie wavelength, is given by $\lambda = h/mv$

   (i).The dual nature of light is exhibited by

   (a) diffraction and photo electric effect
   (b) photoelectric effect
   (c) refraction and interference
   (d)diffraction and reflection.

   (ii). If the momentum of a particle is doubled, then its de-Broglie wavelength will

   (a)remain unchanged
   (b)become four times
   (c) become two times
   (d)become half

(iii). If an electron and proton are propagating in the form of waves having the same λ , it implies that they have the same

(a) energy (b) momentum

(c) velocity (d) angular momentum

(iv). Velocity of a body of mass m, having de-Broglie wavelength λ , is given by relation

(a) $v = \lambda h/m$ (b) $v = \lambda m/h$

(c) $v = \lambda/hm$ (d) $v = h/\lambda m$

(v). Moving with the same velocity, which of the following has the longest de Broglie wavelength?

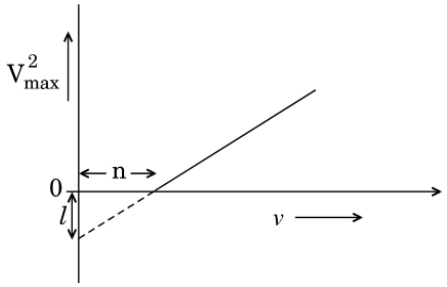
(a) β -particle (b) α -particle

(c) proton (d) neutron.

2 Marks Questions

7. Draw suitable graphs to show the variation of photoelectric current with collector plate potential for (i) a fixed frequency but different intensities $I_1 > I_2 > I_3$. (ii) a fixed intensity but different frequencies $\nu_1 > \nu_2 > \nu_3$.

8. A plot of V_{ma}^2 is found to vary with frequency v as shown in the figure. Use Einstein's photoelectric equation to find the expressions for (i) Planck's constant and (ii) work function of the given photosensitive material, in terms of the parameters l, n and mass m of the electron.

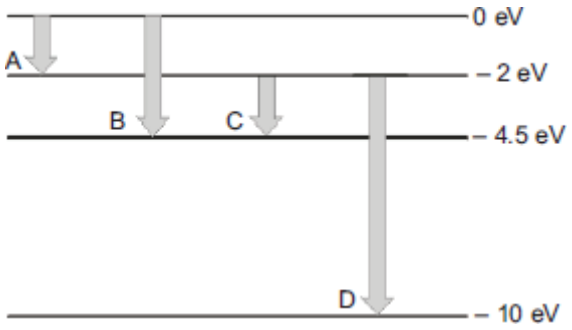


9. Define the terms cut-off voltage and threshold frequency in relation to the phenomenon of photoelectric effect. Using Einstein's photoelectric equation show how the cut-off voltage and threshold frequency for a given photosensitive material can be determine with the help of a suitable graph.

10. Draw a plot showing the variation of photoelectric current with collector plate potential for two different frequencies $\nu_2 > \nu_1$ of incident radiation having the same intensity. In which case will the stopping potential be higher? Justify your answer.

CHAPTER 12: ATOMS AND CHAPTER 13: NUCLEI

1. The de - Broglie wavelength associated with electron orbiting in the ground state of hydrogen atom is
   (a) 0.33 nm (b)0.66 nm (c)0.13 nm (d)0.54 nm
2. The speed of electron orbiting in the first excited state of hydrogen atom is
   (a) 1.06×10^5 m/s (b)2.1×10^6 m/s
   (c) 1.09×10^6 m /s (d)2.21×10^5m/s
3. The wavelength of the radiation emitted when the electron in thehydrogen atom jumps from n = α to n =1 is
   (a) 109 A^o (b)912 A^o (c)4000 A^o (d)6990 A^o
4. The radii of two nuclei with mass number 1 and 27 respectively are in the ratio of
   (a)3: 1 (b)2: 1 (c) 1: 3 (d) 2:1
5. If an electron makes a transition from energy level -1.15 eV to -3.4 e V in a hydrogen atom, the wavelength of the spectral line emitted will be
   (a) 6.75×10^{-7}m (b)$6.5\ 7 \times 10^{-7}$m
   (c) 6.66×10^{-7}m (d)$7.6\ 5 \times 10^{-7}$m
6. The energy level of a hypothetical atom is shown below. Which of the following transistion will result in the emission of photon of wavelength 275nm?



   (a) A (b)B (c)C (d)D
7. The ground state of energy of hydrogen atom is -13.6 eV. What is the kinetic energy of electron in the second excited state?
   (a) 3.02 eV (b)3.34 eV (c)1.15 eV (d) 0.25 eV
8. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4 then the number of spectral lines in the emission spectra will be
   (a)3 (b) 5 (c) 6 (d) 2

9. Fusion reaction takes place at high temperature because
   (a) nuclei break up at high temperature
   (b) atoms get ionised at high temperature
   (c) kinetic energy is high enough to overcome the coulomb repulsion between the nuclei
   (d) molecules break up at high temperature

. 10. What is the ionisation potential of hydrogen atom?

(a) 3.4V (b) 13.6V (c). 0 V (d).26.2V

ASSERTION AND REASONING QUESTIONS

Instructions: In each problem statement of assertion (A)is given and the corresponding statement of reason(R) is given just below it. one of the statements mark the correct answer as:

(A) if both A and R are true and R is the correct explanation of A.

(B) if both A and R are true but R is not the correct explanation of A.

(C) if A is true but R is false.

(D) if both A and R are false.

(E)if A is false and R is true.

1. **Assertion**: It is not possible to use ^{35}Cl as the fuel for fusion energy .
   Reason: The binding energy of ^{35}Cl is too small.
2. **Assertion**: Density of all the nuclei is same.
   Reason: The radius of nucleus is directly proportional to the cube root of the mass number.
3. **Assertion**: Isobars are the elements having same mass number but different atomic number.
   Reason: Neutrons and protons are present inside nucleus.
4. **Assertion**: According to the classical theory the proposed part of an electron in a Rutherford atom model will beparabolic.
   Reason: According to electromagnetic theory an accelerated particle continuously emits radiation.
5. **Assertion**: Electrons in an atom are held due to coulomb forces.
   Reason: The atom is stable only because the centripetal force due to the Coulomb's law is balanced by the centrifugal force.

CASE STUDY BASED QUESTIONS

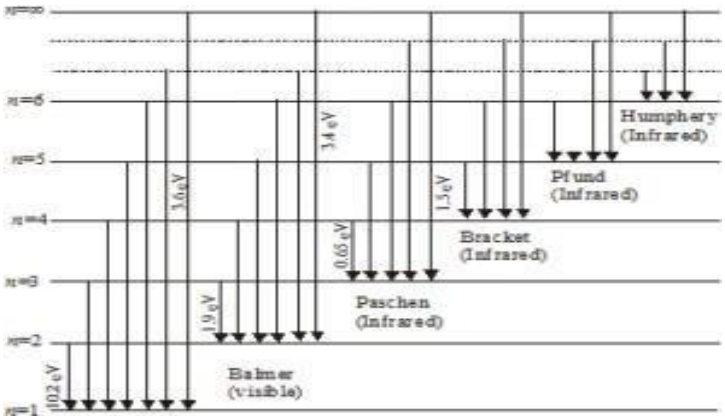
(I) BOHR'S MODEL

According to the third postulates of Bohr's model, when an atom makes a transition from the higher energy state with quantum number n_i to the lower energy state with quantum number

n_f ($n_f < n_i$) , the difference of the energy is carried away by the photon of frequency such that

$$h\nu_{if} = E_{ni} - E_{nf}$$

Since both n_i and n_f are integers, this immediately shows that in transitions between the different atomic levels, light is radiated in various discrete frequencies. For hydrogen atom spectrum, the Balmer formula corresponds to $n_f = 2$ and $n_i = 3, 4, 5$ etc. This result of the Bohr's model suggested the presence of other series spectra for hydrogen atom - those corresponding to the transitions resulting from $n_f = 1$ and $n_i = 2, 3$ etc ; and $n_f = 3$ and $n_i = 4, 5$ etc. and so on. Such series were identified in the course of spectroscopic investigations and are known as Lyman, Balmer, Paschen, Brackett and Pfund-series. The electronic transitions corresponding to this series are shown in the figure.



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 the lower energy state to make a transition to the higher than the state, the process is called absorption. Thus, a photon with a continuous range of frequencies pass through a rarefied gas and then analysed with a spectrometer, a series of the spectral absorption lines appears in a continuous spectrum. The dark lines indicate the frequency that has been observed by the atoms of the gas.

This explanation of the hydrogen atom spectrum provided by the Bohr's model was a brilliant achievement which greatly stimulated progress towards the modern Quantum theory.

(i) The total energy of an electron in an atom in an orbit is - 3.4 eV. Its kinetic and potential energies are respectively

(a) 3.4 eV , 3.4 eV
(b) -3.4 eV ,-3.4 eV
(c) -3.4 eV ,-6.8 eV
(d) 3.4 eV ,-6.8 eV

(ii). 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) 0.5×10^7
(b) $0.2\ 5 \times 10^7$
(c) 2.5×10^7
(d) 0.025×10^4

(iii). The ratio of wavelength of last line of Balmer series and the last line of Lyman series
(a) 0.5
(b) 2
(c) 1
(d) 4

(iv). The wavelength of Balmer series lies in
(a) ultraviolet region
(b) infrared region
(c) far infra-red region
(d) visible region

(v). In the empirical formula for the observed wavelength (λ) for hydrogen is
$1/\lambda = R\,(1/4^2 - 1/n^2)$
where n is integral values higher than 4 then it represents ---------- series.
(a) Balmer series
(b) Brackett series
(c) Pfund series
(d) Lyman series

SHORT ANSWER QUESTION(2 MARKS EACH)

1. Given the value of ground state energy of hydrogen atom as - 13.6 eV .Find out its kinetic energy and potential energy in the ground and second excited state.
2. A beam of alpha particles of velocity 2.1×10^7 m/s is scattered by a gold foil (Z = 79). Find the distance of closest approach of the Alpha particle to the gold nucleus. The value of the charge /mass of Alpha particle is 4.8×10^7 C kg^{-1}.
3. A 12.5 eV electron beam is used to excite a gaseous hydrogen atom at room temperature. Determine the wavelength and the corresponding series of the lines emitted.
4. Show mathematically how Bohr's postulate of quantization of orbital angular momentum in hydrogen atom is explained by the de - Broglie's hypothesis.
5. Use Bohr's model of hydrogen atom to calculate the speed of electron in the first excited state.

SHORT ANSWER QUESTION(03 MARKS EACH)

1. Use Bohr's postulates to derive the expression for the potential and the kinetic energy of the electron moving in the nth orbit of the hydrogen atom. How is the total energy of the electron expressed in terms of its kinetic and potential energy?
2. The wavelength of second line of Balmer series in the hydrogen spectrum is 4861 A^o. Calculate the wavelength of the first line.

3. The energy of an electron in an excited hydrogen atom is -3.4 eV. Calculate the angular momentum of the electron according to the Bohr's theory.

4. (a). Define neutron multiplication factor and critical size for a fissionable material.
(b) If 200 MeV energy is released in the fission of a single nucleus of $^{238}_{92}U$, how many fission must occur to produce a power of 1KW?

5. (a)Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their separation. Mark the regions where the nuclear force is (a) attractive and (b) repulsive.
(b) State two characteristic property of nuclear force.

LONG ANSWER QUESTIION (05 MARKS EACH)

1. (a) Calculate the velocity of electron in the Bohr's first orbit of hydrogen atom. How many times does the electron go in the first Orbit in one second?
(b) Obtain formula for the frequency of radiation emitted when a hydrogen atom de-excites from level n to level (n-1) .For large n , show that this frequency equals to the classical frequency of revolution of the electron in the orbit.

2. (a) State the postulates of Bohr's model of hydrogen atom.
(b) Show that the radius of the orbit in hydrogen atom varies as n^2 , where n is the principal quantum number of the atom.

SOLUTION

MULTIPLE CHOICE QUESTION (01 MARK each)

QUESTION NO.	OPTION	QUESTION NO.	OPTION
1	b. 0.66 nm	**6**	b. B
2	c. 1.09 x 10^6 m /s	**7**	c.1.15 e V
3	b. 912 A^o	**8**	c. 6
4	c. 1: 3	**9**	c. kinetic energy is high enough to overcome the coulomb repulsion between the nuclei
5	b. 6.57 x 10^{-7}m	**10**	a.1/16

ASSERTION AND REASONING QUESTIONS(01 MARK each)

QUESTION NO.	OPTION
1	C
2	A
3	B
4	E
5	C

CASE – BASED MCQs

QUESTION NO.	OPTION
1	d. 3.4 e V , -6.8 e V
2	b. 0.2 5 x 10^{7} m^{-1}
3	d. 4
4	d. Visible region
5	b. Brackett series

02 MARKS QUESTIONS ANSWER

1. E_n=-13.6 eV

(i) Kinetic energy at the ground state = **13.6 eV**

Potential energy at the ground state = -2(13.6) eV = **-27.2 eV**

(ii) Kinetic energy at second excited state = = **-3.4 eV**

Potential energy = -2 (3.4) eV =**-6.8 Ev**

2. At the distance of closest approach

Electrostatic potential energy = initial kinetic energy of Alpha particle.

K Ze.2e/r_o= 1/2 (mv^2)

r_o= 2KZe.2e/v^2m= **$2.5x10^{-14}$m**

3. (i) **$E_n \alpha 1/n^2$**

(ii) The energy level are **-13.6 eV , -3.4 eV , -1.5 eV**

Therefore 12.5 eV electron beam can excite the electron upto n = 3 level only.

(iii) Energy values , of the emitted photons, of the three possible lines are

3 →1 : (-1.5 + 13.6) eV = 12.1 eV

2→1: (- 3.4 +13.6)eV = 10.2 eV

$3 \rightarrow 2$: (- 1.5 + 3.4) eV = 1.9 eV

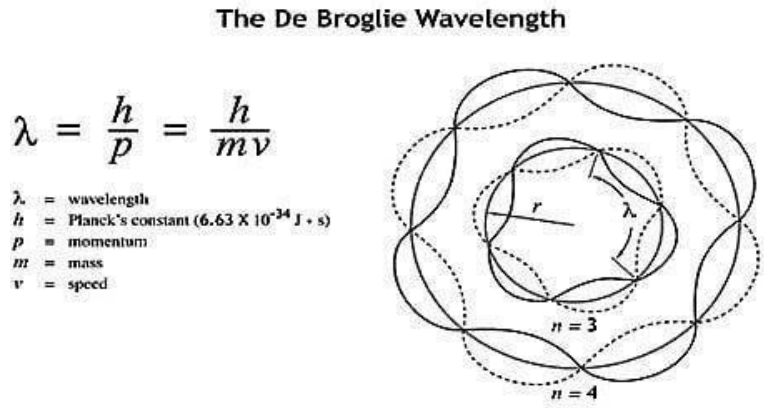
The corresponding wavelengths are are**102nm , 122 nm and 653 nm**

4. According to de- Broglie hypothesis

$\lambda = h/mv$

According to de de- Broglie condition for stationary orbit, the stationary orbits are those which contains complete de - Broglie wavelength

$2\pi r = n\lambda$



$2\pi r = nh/mv$

$mvr = nh/2\pi$

5 $v_n = 2\pi Ke^2/ nh$, n=2 ,

$V_n = 1.09x10^6 m/s$

03 MARKS QUESTIONS ANSWER

1: According to Bohr's postulate, in an hydrogen atom, a single electron revolves around the nucleus of charge + e. For an electron moving with a uniform speed in a circular orbit on given radius, the centripetal force is provided by the Coulomb force of attraction between the electron and the nucleus. $mv^2/r = Ze^2/4\pi€_o r^2$

$mv^2 = Ze^2/4\pi€_o r$

Kinetic Energy = K.E = $1/2(Ze^2/4\pi€_o r)$

Potential Energy = P.E = $Ze(-e)/ 4\pi€_o r$

Total Energy = E= K.E + P.E = $1/2(Ze^2/4\pi€_o r) + Ze(-e)/ 4\pi€_o r$

$= -1/2(Ze^2/4\pi€_o r)$

E= - K.E and E= P.E/2

K.E = -E P.E = - 2 K.E

2: $1/\lambda_1 = R(1/2^2 - 1/3^2) = (5/36)R$

$1/\lambda_2 = R(1/2^2 - 1/4^2) = (3/16)R$

$\lambda_1 / \lambda_2 = 27/20$

$\lambda_1 = (27/20)\text{x}4861 =$ **6562 A°**

3: $E_n = -13.6/n^2$, Given $E_n = -3.4$ Ev , $-3.4 = -13.6/n^2$

$N^2 = 4$, $n=2$

Angular momentum ,$mvr = nh/2\pi =$ **$2.1\text{x}10^{-34}$ Js**

4: (a) The neutron **multiplication factor** of fissionable mass is defined as the ratio of the number of neutrons present in the beginning of a particular generation to the number of neutrons present in the beginning of the previous generation .Multiplication factor k gives a measure of the growth rate of the neutron in a fissionable mass.

Critical size : The size of the fissionable material for which the multiplication factor k=1 , is called the critical size and the corresponding mass is called the Critical Mass

(b) Let the number of fissions per second be n.

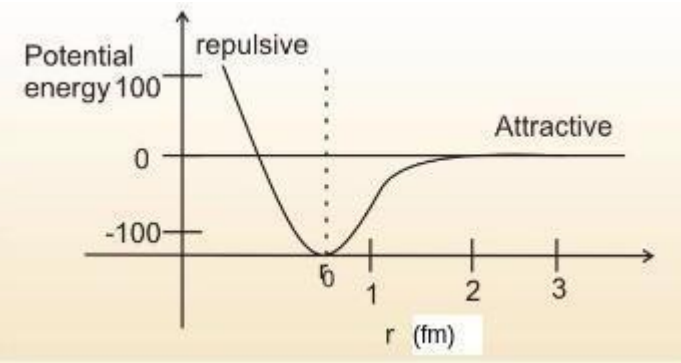
Energy released per second = nx200MeV = nx200X $1.6\text{X}10^{-19}$ J

Energy required per second = 1000J

nx200X $1.6\text{X}10^{-19}$ J = 1000

n = $3.125\text{x}10^{13}$

5 (a)



(b) Properties of nuclear force:

1. Nuclear forces are the strongest attractive force known in nature.
2. They ate short range force.

<u>05 MARKS QUESTIONS ANSWER</u>

1: (a) The velocity of electrons in Bohr's nth orbit is $v = 2\pi ke^2 / nh$

The velocity of electrons in Bohr's (n = 1) orbit is v = **$2.186\text{x}10^6$ m/s.**

Frequency of revolution of electron = $f = 1/T = v/2\pi r =$ **6.57×10^{15} m/s**

(a) From Bohr's theory, the frequency $f = 2\pi^2 mk^2 Z^2 e^4/h^3 (1/n_1^2 - 1/n^2)$

Given $n_1 = n-1$, $n_2 = n$ $f = 2\pi^2 mk^2 Z^2 e^4/h^3 (1/(n-1)^2 - 1/n^2)$

$f = 2\pi^2 mk^2 Z^2 e^4 (2n-1)/h^3 (n-1)^2 n^2$

For large value of n , $2n-1 = 2n$, $n-1=n$ and for hydrogen atom $Z=1$

$f = (2\pi^2 mk^2 e^4)/h^3 (2n/n^4) == 4\pi^2 mk^2 e^4/n^3 h^3$

Velocity of electron in nth orbit = $nh/2\pi mr$

Radius of nth orbit = $n^2 h^2/4\pi mke^2$

The orbital frequency of electron in the nth orbit $v/2\pi r = 4\pi^2 mk^2 e^4/n^3 h^3$

Hence for large value of n , the classical frequency of revolution of electron in the nth orbit is same as that obtained from Bohr's theory.

2: (a) Bohr gave following three postulates for hydrogen atom:

1. An electron revolves round the nucleus in certain specified circular orbits in which it does not radiate energy. The centripetal force required for uniform circular motion in stationary orbit is provided by electrostatic force of attraction. Thus,

$mv_n^2 / r_n = 1/ 4\pi\epsilon (e^2/r^2)_n$

(b) For orbit to be stationary (or non-radiating), the angular momentum of the electron must be an integer multiple of h where it is the Planck's constant. Thus,

$L_n = mv_n r_n = nh/2\pi$

3. Whenever an electron shifts from one of its specified non-radiating orbit to another orbit, it emits/ absorbs a photon whose energy is equal to the energy difference between the initial and final states .Thus, **$E_f - E_i = hc/\lambda$**

(c) We know that when an electron revolves in a stable orbit, the centripetal force is provide electrostatic force of attraction acting on it due to a proton present in the nucleus .

$mv_n^2 / r_n = 1/ 4\pi\epsilon_o (e^2/r^2)_n$

$v_n^2 = e^2/4\pi\epsilon_o mr_n$ ……(1)

and from Bohr's quantization condition , $mv_n r_n = nh/2\pi$ or $v_n = nh/2\pi mr_n$….(2)

Squaring (2) and equating it with (i) , we get

$(nh/2\pi mr_n)^2 = e^2/4\pi\epsilon_o mr_n$ or $r = \epsilon_o h^2 n^2/ \pi me^2$.

In stable orbit of hydrogen atom n = 1 then the Bohr's radius is $\mathbf{r_o = €_o h^2 / \pi m e^2}$.

PRACTICE PAPER

SECTION A MCQ (01 MARK each)

1. The Bohr's model is applicable to which kind of atoms
   (a) Having one electron only
   (b) Having two electrons
   (c) Having eight electrons
   (d) Having more than eight electrons
2. The minimum energy the required to knock electrons completely out of the atom is called as
   (a) Kinetic energy
   (b) Potential energy
   (c) Ionization energy
   (d) Excitation energy

ASSERTION AND REASONING QUESTIONS

Instructions :

In each problem statement of assertion (A)is given and the corresponding statement of reason© is given just below it . one of the statement mark the correct answer as :

(A) if both A and R are true and R is the correct explanation of A.
(B) if both A and R are true but R is not the correct explanation of A.
(C) if A is true but R is false.
(D) if both A and R are false .
(E)if A is false and R is true.

3. **Assertion**: Bohr's orbit are the region where the electron may be found with large probability.
   Reason: The orbital picture in both model of the hydrogen Atom was inconsistent with the uncertainty principle.
4. **Assertion**: Nuclear density is almost same for all nuclei.
   Reason: The radius R of a nucleus depends only on the mass number A as $r \alpha A^{1/3}$

CASE STUDY BASED QUESTION

NUCLEAR FORCE

Neutrons and protons are identical particle in the sense that their masses are nearly the same and the force, called nuclear force, does into distinguish them. Nuclear force is the strongest force. Stability of nucleus is determined by the neutron Proton ratio or mass defect or packing fraction. Shape of nucleus is calculated by quadrupole moment and the spin of nucleus depends on even or odd mass number. Volume of nucleus depends on the massnumber. Whole mass of the atom(nearly 99%)is centred at the nucleus.

5. The correct statement about the nuclear force is are

(a) Charge independent
(b) Short range force
(c) Non conservative force
(d) all of these

6. The range of nuclear force is the order of
(a) 2×10^{-10} m
(b) 1.5×10^{-20} m
(c) 1.2×10^{-4} m
(d) 1.4×10^{-15} m

7. A force between two protons is same as the force between proton and neutron. The nature of the force is
(a) electrical force
(b) weak nuclear force
(c) gravitational force
(d) strong nuclear force

8. All the nucleons in an atom are held by
(a) Nuclear forces
(b) Vander Waal's forces
(c) Tensor forces
(d) Coulomb forces

02 MARKS QUESTIONS

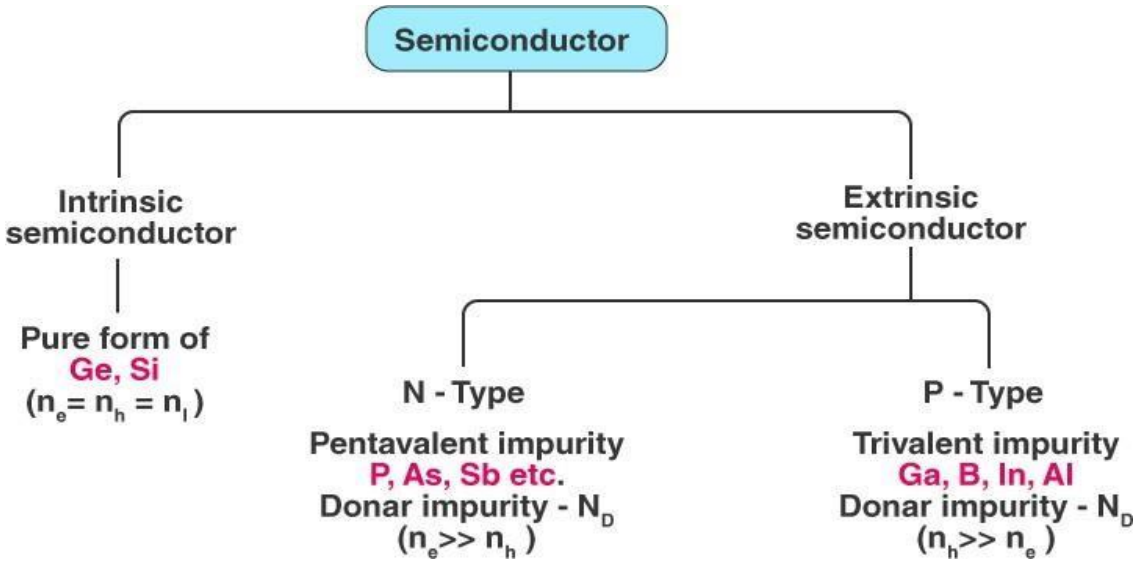
9. A nucleus with mass number A is equal to 240 and B.E/ A = 7.6 Ev breaks into two fragments each of A=120 with B.E/A = 8.5 Ev. Calculate the released energy.

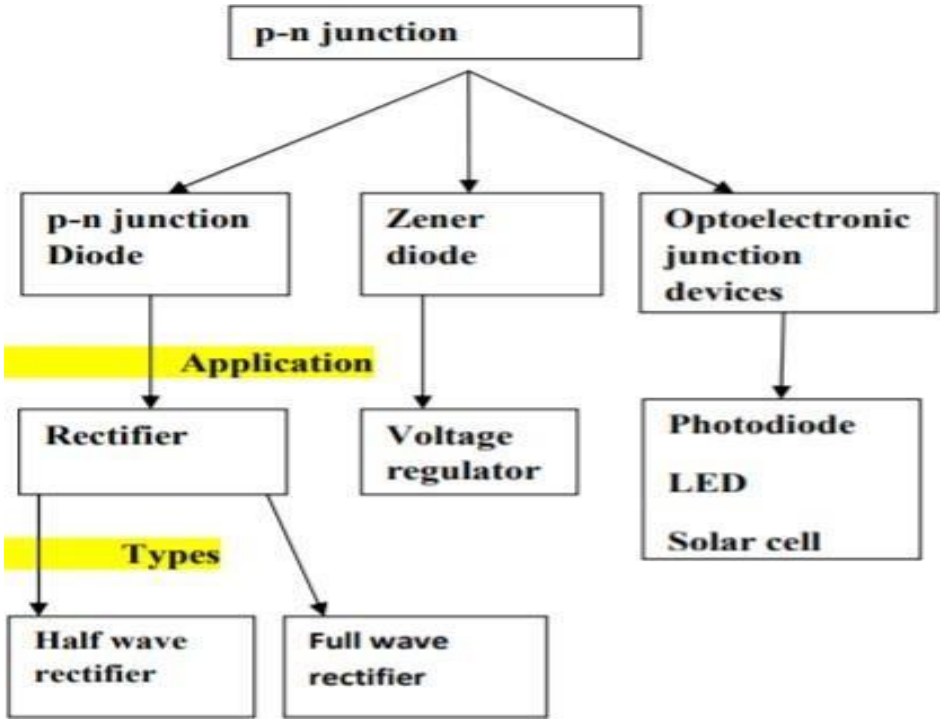
03 MARKS QUESTIONS

10. The value of ground the value of ground state energy of hydrogen atom is -13.6 electron volt
(a) Find the energy required to remove an electron from ground state to the first excited state of the atom.
(b) Determine (i)the kinetic energy, and (ii) the orbital radius in the first excited state of the atom.

CHAPTER14: SEMICONDUCTOR ELECTRONICS

MIND MAP





MULTIPLE CHOICE QUESTIONS

(ONE MARK EACH)

1. Carbon, Silicon and Germanium atoms have four valence electrons each. Their valence and conduction bands are separated by energy band gaps represented by $(Eg)_C$, $(Eg)_{Si}$ and $(Eg)_{Ge}$ respectively. Which one of the following relationship is true in their case?

   (a) $(Eg)_C > (Eg)_{Si}$ (b) $(Eg)_C < (Eg)_{Si}$ (c) $(Eg)_C = (Eg)_{Si}$ (d) $(Eg)_C < (Eg)_{Ge}$

2. A semiconductor device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. The device may be a/an

   (a) intrinsic semiconductor (b) p-type semiconductor

   (c) n-type semiconductor (d) p-n junction diode

3. Which of the following statements is incorrect for the depletion region of a diode?

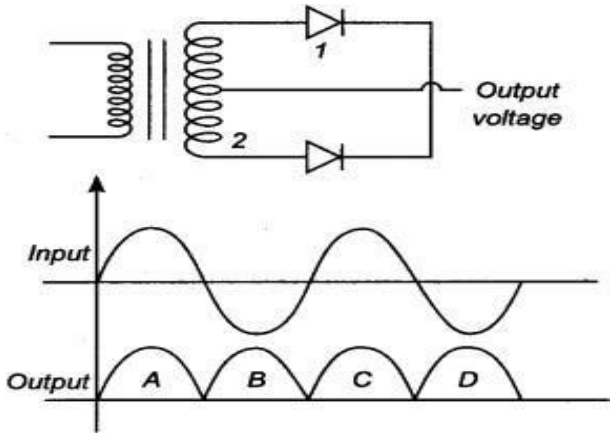
   (a) There the mobile charges exist.

   (b) Equal number of holes and electrons exist, making the region neutral.

   (c) Recombination of holes and electrons has taken place.

   (d) None of these

4. A full-wave rectifier circuit along with the input and output voltages is shown in the figure The contribution to output voltage from diode 2 is



   (a) A, C (b) B, D (c) B, C (d) A, D

5. The cause of the potential barrier in a p-n junction diode is

   (a) depletion of positive charges near the junction

   (b) concentration of positive charges near the junction

(c) depletion of negative charges near the junction

(d) concentration of positive and negative charges near the junction

6. The rms value of a half wave rectifier current is 10A.Its value for full wave rectification would be:

(a).14.14A (b).10A (c).7.07A (d).5A

7. The average value of output direct current in a full wave rectifier is

(a) I₀/π (b) I₀/2

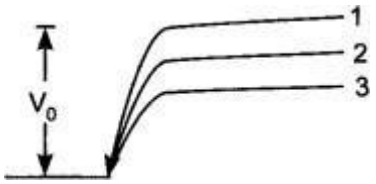
(c) π I₀/2 (d) 2 I₀/π

8. An LED is constructed from a pn junction based on a certain Ga-As-P semiconducting material whose energy gap is 1.9 Ev. What is the wave length of the emitted light? (approximately):

(a).620 Angstrom (b).6520 Angstrom

(c).5200 nm (d).6500 nm

9. No battery is cdnnected across the junction. In the given figure V_0 is the potential barrier across a p-n junction,(Represented by 2) when



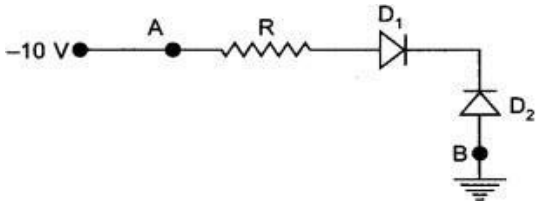
(a) 1 and 3 both correspond to forward bias of junction.

(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.

10. In figure given, assuming the diodes to be ideal



(a) D_1 is forward biased and D_2 is reverse 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.

ASSERTION-REASONING QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark thecorrect choice as:

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of assertion.

(c) If assertion is true but reason is false.

(d) If both assertion and reason are false..

(1) **Assertion:** If there is some gap between the conductionbandandthevalenceband, electrons inthe valencebandallremain boundand no free electrons are available in the conductionband. Thenthe material is an insulator.

Reason: Resistance of insulators is very low.

(2) **Assertion:** If the temperature of a semiconductor is increased then it's resistance decreases.

Reason: The energy gap between conduction band and valence band is very small.

(3) **Assertion:** An N-type semiconductor has a large number of electrons but still it is electrically neutral.

Reason: An N-type semiconductor is obtained by doping an intrinsic semiconductor with a pentavalent impurity.

(4) **Assertion:** Semiconductors do not obey's Ohm'slaw.

Reason: Current cannot be determined by the rate of flow of charge carriers.

(5) **Assertion:** The energygapbetweenthevalenceband andconduction band is greater in silicon than ingermanium.

Reason: Thermal energy produces fewer minoritycarriers in silicon than in germanium.

CASE STUDY BASED QUESTIONS

Read the Case Study given below and answer the questions thatfollow:

Consider a thin p-type silicon (p-Si) semiconductor wafer. By adding precisely a small quantity of pentavalent impurity, part of the p-Si wafer can be converted into n-Si. There are several processes by which a semiconductor can be formed. The wafer now contains p-region and n- region and a metallurgical junction between p-, and n- region. Two important processes occur during the formation of a p-n junction: diffusion and drift. We know that in an n-type semiconductor, the concentration of electrons (number of electrons per unit volume) is more compared to the concentration of holes. Similarly, in a p-type semiconductor, the concentration of holes is more than the concentration of electrons. During the formation of p-n junction, and due to the concentration gradient across p-, and n- sides, holes diffuse from p- side to n-side (p → n) and electrons diffuse from n-side to p-side (n → p). This motion of chargecarries gives rise to diffusion current across the junction.

I. How can a p-type semiconductor be converted into n- type semiconductor?

a) adding pentavalent impurity

b) adding trivalent impurity

c) not possible

d) heavy doping

II. Which of the following is true about n type semiconductor?

a) concentration of electrons is less than that of holes.

b) concentration of electrons is more than that of holes.

c)concentration of electrons equal to that of holes.

d)None of these

III. Which of the following is true about p type semiconductor?

a) concentration of electrons is less than that of holes.

b)concentration of electrons is more than that of holes.

c)concentration of electrons equal to that of holes.

d)None of these

IV. Which of the following is the reason about diffusion current?

a) diffusion of holes from p to n

b)diffusion of electronss from n to p

c) both (a) and (b)

d) None of these

V. What are the processes that occur during formation of a p-n junction?

a) drift

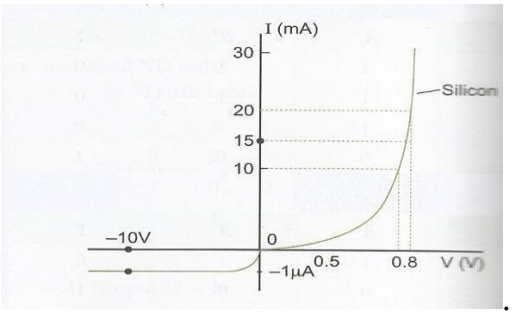
b) diffusion

c) both (a) and (b)

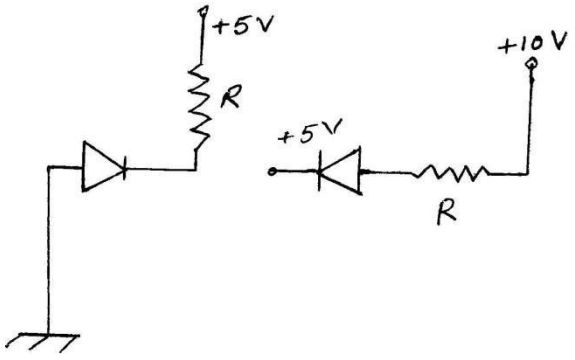
d)None of these

SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. The V-I characteristics of a silicon diode is shown in the figure. Calculate the resistance of the diode at (i) I = 10 mA and V = -10 V



2. In the following diagrams, write which of the diodes are forward biased and which are reverse biased?



3.

3. A p-n photo diode is fabricated from a semiconductor with a band gap 2.8eV. Can it detect a wavelength of 6000nm?

4. An intrinsic semiconductor has $5x10^{28}$ atoms per metre^2 with $n_i = 1.5 \times 10^6$ m^3, If it is doped with pentavalent impurity of concentration 1 ppm, calculate the number of electrons holes in the sample.

5. Three photo diodes D_1, D_2, D_3 are made of semiconductors having bas gaps of 2.5eV,2eV and 3eV respectively. Which one will be able to detect the light of wavelength $6000A^0$?

SHORT ANSWER TYPE QUESTIONS(3 MARKS)

1. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half wave rectifier.
2. A semiconductor has equal electron and hole concentration of $4.2 \times 10^8 m^{-3}$. On doping with a certain impurity, electron concentration increases to $6 \times 10^{12} m^{-3}$.
   (i) Identify the new semiconductor obtained after doping .(ii) calculate the new hole concentration .
3. Define the terms potential barrier and depletion region for a p – n junction diode. State how the thickness of depletion region will change when the p – n junction diode is (i) forward biased (ii) reverse biased.
4. On the basis of energy band diagrams distinguish between metals, insulators and semiconductors.
5. (i) Explain briefly the process of emission of light by an LED.
   (ii) Which semiconductors are preferred to make LED and why?
   (iii) Give two advantages of using LEDs over conventional in candescent lamps.

LONG ANSWER TYPE QUESTIONS(5 MARKS)

1. (a) Explain (i) forward biasing, (ii) reverse biasing of a P-N junction diode with the help of a diagram.
   (b) Draw V- I characteristics of a p-n junction diode.
   (c)Answer the following questions giving reasons:
   (i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage?
   (ii) Why does the reverse current show a sudden increase at the critical voltage?
   (iii) Name any semiconductor device which operates under the reverse bias in the breakdown region.
2. (a)Explain the formation of depletion layer and potential barrier in a pn junction.
   (b)With the help of a labeled diagram, explain the working of full wave rectifier. Draw the input and output waveforms.

ANSWER/HINT:
MULTIPLE CHOICE QUESTIONS-

1. (a) $(Eg)_C > (Eg)_{Si}$ reason-Due to strong electronegativity of carbon.

2. (d) p-n junction diode

3. (a) There the mobile charges exist

4. (b) Explaination: In the positive half cycle of input ac signal diode D_1 is forward biased and D_2 is reverse biased so in the output voltage signal, A and C are due to D_1. In negative half cycle of input ac signal, D2 conducts, hence output signals B and D are due to D_2

5. (d) concentration of positive and negative charges near the junction

6. (a) 14.14A (Hint : $I_{rms}=I_0/2$.Thus $I_0=2I_{rms}=20A$.Hence $I_{rms=}I_0/2=20\sqrt{2}=14.14$ A)

7. (d) The average value of output direct current in a full wave rectifier = average value of current over a cycle = $2I_0/\pi$

8. (b) 6520 angstrom ($\lambda = hc/Eg = 12.4$ keV A/ 1.9 eV = 6520 A where $Eg = hc/\lambda$).

9. (b) Height of potential barrier is decreases when p-n junction is forward bias.

10. (b) Explanation:

10 V is the lower voltage in the circuit. Now p side of the p-n junction diode D_1 is connected to

lower voltage and n- side of D_1 to higher voltage , thus D_1, is reverse biased. In D_2 p-side of p-n

junction diode is at higher potential and n-side is at lower potential, therefore D_2 is forward biased. Hence current flows through junction from B to A.

ASSERTION-REASON BASED QUESTIONS-

1(c), 2(a), 3(b), 4(d), 5(b)

CASE BASED QUESTIONS-

I. Ans : a, II. Ans:b, III. Ans :a, IV.Ans. c, V.Ans: c

SHORT ANSWER TYPE QUESTIONS(2 MARKS)

1. (i) $R = \Delta V/\Delta I = (0.8- 0.7)/ (20-10)x\ 10^{-3} = 10\ \Omega$

   (ii) $R= V/I= 10/10^{-6} = 10^{7}\Omega$

2. (a)Reverse biased(b) Forward biased

3. Wavelength of incident photon,λ

   $= 6000nm = 6x\ 10^{-6}m$

   energy of incident photon $E = hc/\lambda = 0.207eV$

   as $E < E_g$ p-n junction can not detect the radiation.

4. $n_h = n_i^2/ n_e = 4.5 \times 10^{9}m^{-3}$

5. $E = hc /\lambda = (6.6 \times 10^{-34}) \times (3 \times 10^{8}) / (6x10^{-7}) \times 1.6 \times 10^{-19}) = 2.06eV$

   Incident radiation can be detected by a photo diode if energy of incident radiation photon is greater than the band gap. This is true for D_2 ,therefore only D_2 will detect these radiation.

SHORT ANSWER TYPE QUESTIONS (3 MARKS)-

2. (i) since electron concentration increases, so the majority charge carriers in the doped semiconductor are electrons hence new semiconductor is n-type .

   (ii) $n_h = n_i^2/ n_e = 2.94 \times 10^{4}m^{-3}$

PRACTICE QUESTION

1. For a junction diode the ratio of forward current (If) and reverse current (Ir) is

   [e = electronic charge,

   V = voltage applied across junction,

   k = Boltzmann constant,

   T = temperature in kelvin]

   (a) $e^{-V/kT}$ (b) $e^{V/kT}$

   (c) $(e^{-eV/kT} + 1)$ (d) $(e^{eV/kT} - 1)$

2. In a semiconductor diode, the barrier potential offers opposition to

(a) holes in P-region only (b) free electrons in N-region only

(c) majority carriers in both regions (d) majority as well as minority carriers in both regions

3. In forward biasing of the p–n junction

(a) the positive terminal of the battery is connected to p–side and the depletion region becomes thick

(b) the positive terminal of the battery is connected to n–side and the depletion region becomes thin

(c) the positive terminal of the battery is connected to n–side and the depletion region becomes thick

(d) the positive terminal of the battery is connected to p–side and the depletion region becomes thin

4. The forbidden energy band gap in conductors, semiconductors and insulators are EG_1,EG_2 and EG_3 respectively. The relation among them is

(a) $EG_1 = EG_2 = EG_3$ (b) $EG_1 < EG_2 < EG_3$

(c) $EG_1 > EG_2 > EG_3$ (d) $EG_1 < EG_2 > EG_3$

5. The average value of output direct current in a half wave rectifier is

(a) I₀/π (b) I₀/2

(c) π I₀/2 (d) 2 I₀/π

6. Describe briefly using the necessary circuit diagram, the three basic processes which takes place to generate the emf in a solar cell when light falls on it. Draw the I-V characteristics of a solar cell.

7. A full wave rectifier has two diodes, the internal resistance of each diode may be assumed constant at 25 Ω . The transformer rms secondary voltage from centre tap to each end of the secondary is 50V and the load resistance is 975 Ω . Find the (i) mean load current(ii) rms value of load current.

8. Read the Case Study given below and answer the following questions:

A Photodiode is again a special purpose p-n junction diode fabricated with a transparent window to allow light to fall on the diode. It is operated under reverse bias. When the photodiode is illuminated with light (photons) with energy (hv) greater than the energy gap (E) of the

semiconductor, then electron- hole pairs are generated due to the absorption of photons. The diode is fabricated such that the generation of e-h pairs takes place in or near the depletion region of the diode. Due to electric field of the junction, electrons and holes are separated before they recombine. The direction of the electric field is such that electrons reach n-side and holes reach p-side. Electrons are collected on n-side and holes are collected on p-side giving rise to an emf. When an external load is connected, current flows. The magnitude of the photocurrent depends on the intensity of incident light.

I. Photo Diode is

a) forward biased b) reverse biased

c) Not biased d) None of these

II. Which of the following is true about photodiode?

a) E > hv b) E = hv

c) E < hv d) None of these

III. Magnitude of photocurrent depends on

a) Intensity of light b) Biasing

c) Potential d) None of these

IV. Electrons and holes are separated before they recombine by:

a) Diffusion current b) Drift current

c) Electric field d) Electric potential

V. Direction of electric field is such that

a) electrons reach n- side b) holes reach p- side

c) Both (a) and (b) d) holes reach n side

9. (i) Explain briefly the process of emission of light by an LED.

(ii) Which semiconductors are preferred to make LED and why?

(iii) Give two advantages of using LEDs over conventional in candescent lamps.

10. (i) With the help of circuit diagrams distinguish between forward biasing and reverse biasing of a *pn* junction diode.

(ii) Draw *V-I* characteristics of a *p-n* junction diode in (a) forward bias, (b) reverse bias.

(iii) Describe briefly the following terms: (a) “minority carrier injection” in forward bias, (b) “breakdown voltage” in reverse bias.

KENDRIYA VIDYALAYA SANGATHAN RAIPUR REGION
SAMPLE QUESTION PAPER-1
TERM-II
CLASS XII
BLUE PRINT

S.N	UNIT	VSA(1)	SA(2)	SA(3)	Case study (4)	LA(5)	TOTAL MARKS
1.	• Electro Magnetic Waves & • Optics	3(1)	1(2)	1(3)	1(4)	1(5)	17
2.	• Dual nature of radiation and matter • Atom & • Nuclei	1(1) 1(1) 1(1)	1(2)	1(3) 1(3)			11
3.	• Electronic Devices		1(2)			1(5)	7
	TOTAL	6(1)	3(2)	3(3)	1(4)	2(5)	35

QUESTION PAPER

Max. Marks : 35 **Time Allowed: 2 hours**

General Instructions:

(i) All questions are compulsory. There are 15 questions in all in the question paper.

(ii) The question paper have five sections: **Section A, Section B, Section C, Section D and Section E.**

(iii) **Section A** contain six very short answer questions each of 1 mark.

(iv) **Section B** has one Source based/Case based question of 4 marks each.

(v) Section C contains three short answer questions of 2 marks each. **Section D** contains three short answer questions of 3 marks each and **Section E** contains two long answer questions of 5 marks each.

(vi) There is no overall choice in the question paper. However, internal choice has been provided in some questions. You have to attempt only one of the choices in such questions.

SECTION A

Q1. When light travels from a rarer to a denser medium, the speed decreases. Does this decrease in speed imply a decrease in the energy carried by the light wave? Justify your answer.

OR

Monochromatic light of wavelength 589 nm is incident from air on a water surface. What are the wavelength and speed of refracted light? Refractive index of water is 1.33.

Q2. A proton and an electron have same kinetic energy. Which one has greater de-Broglie wavelength and why?

OR

State Bohr's quantization condition for defining stationary orbits.

Q3. What is the ratio of radii of the orbits corresponding to first excited state and ground state in a hydrogen atom?

Q4. Write any two characteristic properties of nuclear force.

Q5. A converging lens is kept co-axially in contact with a diverging lens – both the lenses being of equal focal lengths. What is the focal length and power of the combination?

OR

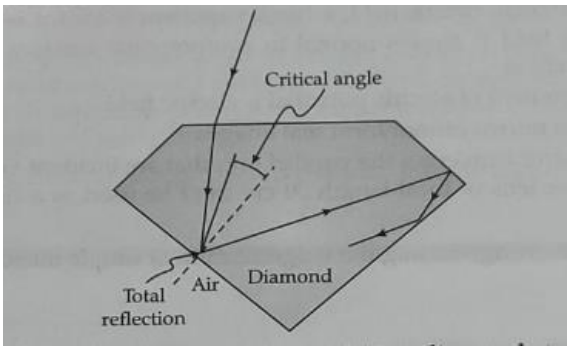
A ray of monochromatic light passes from medium (1) to medium (2). If the angle of incidence in medium (1) is Θ and the corresponding angle of refraction in medium (2) is $\Theta/2$, which of the two media is optically denser? Give reason.

Q6. Two convex lenses of same focal length but of aperture A1 and A2 (A2 < A1), are used as the objective lenses in two astronomical telescopes having identical eyepieces. Which telescope will you prefer and why?

SECTION B

Q7. **Case Study based questions (Do any 4 out of 5) :**

Sparking Brilliance of Diamond:



The total internal reflection of the light is used in polishing diamonds to create a sparking brilliance. By polishing the diamond with specific cuts, it is adjusted the most of the light rays approaching the surface are incident with an angle of incidence more than critical angle. Hence, they suffer multiple reflections and ultimately come out of diamond from the top. This gives the diamond a sparking brilliance.

(i). Light cannot easily escape a diamond without multiple internal reflections. This is because:

(a) Its critical angle with reference to air is too large

(b) Its critical angle with reference to air is too small

(c) The diamond is transparent

(d) Rays always enter at angle greater than critical angle

(ii). The critical angle for a diamond is 24.4°. Then its refractive index is

(a) 2.42 (b) 0.413 (c) 1 (d) 1.413

(iii). The basic reason for the extraordinary sparkle of suitably cut diamond is that

(a) It has low refractive index (b) It has high transparency

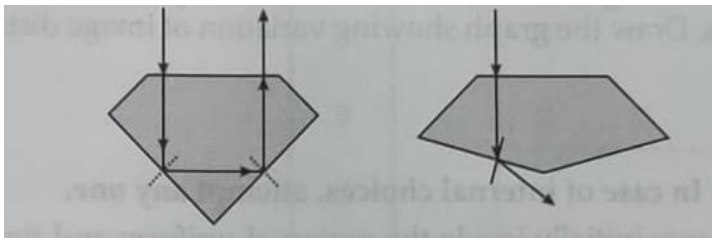
(c) It has high refractive index (d) It is very hard

(iv). A diamond is immersed in a liquid with a refractive index greater than water. Then the critical angle for total internal reflection will

(a) will depend on the nature of the liquid (b) decrease

(c) remains the same (d) increase

(v). The following diagram shows same diamond cut in two different shapes.



The brilliance of diamond in the second diamond will be:

(a) less than the first (b) greater than first

(c) same as first (d) will depend on the intensity of light

SECTION C

Q8. Draw a sketch of a plane electromagnetic wave propagating along the z-direction. Depict clearly the direction of electric and magnetic fields varying sinusoidally with z.

Q9. Find the energy equivalent of one atomic mass unit, first in Joules and then in MeV. Using this, express the mass defect of ${}_8O^{16}$ u in MeV/c^2 given $\Delta M = 0.13691$ u

Q10. Describe briefly, with the help of a diagram, the role of the two important processes involved in the formation of a p-n junction.

OR

Draw the energy bands of p-type and n-type semiconductors.

SECTION D

Q11. (i) Draw a neat labelled ray diagram of a compound microscope. (2)

(ii) How does focal length of a lens change when red light incident on it is replaced by violet light? Give reason for your answer. (1)

OR

(i) Draw a schematic diagram of a reflecting telescope (Cassegrain). Write two important advantages that the reflecting telescope has over a refracting type. (2)

(ii) Plot a graph between angle of incidence and angle of deviation for a triangular prism. (1)

Q12. Draw a graph between the frequency of incident radiation (v) and the maximum kinetic energy of the electrons emitted from the surface of two photosensitive materials A & B. State clearly how this graph can be used to determine (*i*) Planck's constant and (*ii*) work function of the material. (1,2)

Q13. Using Bohr's postulates, obtain the expression for total energy of the electron in stationary state of hydrogen atom and also Draw the energy level diagram for hydrogen atom. (2,1)

SECTION E

Q14. (i) Explain briefly with the help of a circuit diagram how V-I characteristics of a p-n junction diode are obtained in: (i) forward bias & (ii) reverse bias. (3)

(ii) Draw a circuit diagram showing the biasing of an LED. State the factor which controls:

(a) wavelength of light. (b) intensity of light emitted by the diode. (2)

OR

(i) Discuss working principle of full wave rectifier with circuit diagram. Draw its input & output wave forms. (3)

(ii) Why is a photo diode operated in reverse bias mode? Draw its I-V characteristics for different intensities of illumination. (2)

Q15. (i) With the help of ray diagram derive an expression for the linear width and angular width of the central maxima due diffraction of light at a single slit. (3)

(ii) Draw a graph showing the variation of intensity with phase difference or path difference in a single slit experiment. (1)

(iii) What happens to the width of the central maxima if the whole apparatus is immersed in water and why? (1)

OR

(i) Write two essential conditions for sustained interference pattern to be produced on the screen. Two slits in Young's double slit experiment are illuminated by two different sodium lamps emitting light of the same wavelength. Why is no interference pattern observed? (2)

(ii) Write the conditions for constructive and destructive interference & Draw a graph showing the variation of intensity versus the position on the screen in Young's double slit experiment. (2)

(iii) If s is the size of the source and S its distance from the plane of the two slits, what should be the criterion for the interference fringes to be seen? (1)

SAMPLE QUESTION PAPER-2
TERM II
CLASS XII
BLUE PRINT

NAME OF CHAPTERS	VSA (1MARK)	CBS (4MARKS)	SA-I (2 MARKS)	SA-II (3MARKS)	LA (5 MARKS)	TOTAL
CH-8 ELECTROMAGNETIC WAVES	1					17
CH-9 RAY OPTICS AND OPTICAL INSTRUMENTS	2		1(or)	2		
CH-10 WAVE OPTICS	1		1		1	
CH-11 DUAL NATURE OF RADIATION AND MATTER	1		1	1		11
CH-12 ATOMS				1(or)	1(or)	
CH-13 NUCLEI					1	
CH-14 SEMICONDUCTOR	1	1	1			7

QUESTION PAPER

Time allowed:2 hours **Max.Marks:35**

General Instructions:

(i) All questions are compulsory. There are 15 questions in all in the question paper.

(ii) The question paper have five sections: **Section A, Section B, Section C, Section D and Section E.**

(iii) **Section A** contain six very short answer questions each of 1 mark.

(iv) **Section B** has one Source based/Case based question of 4 marks each.

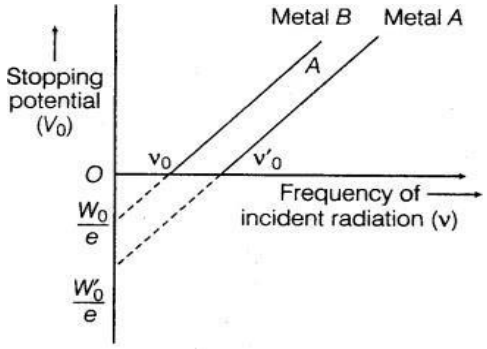
(v) Section C contains three short answer questions of 2 marks each. **Section D** contains three short answer questions of 3 marks each and **Section E** contains two long answer questions of 5 marks each.

(vi) There is no overall choice in the question paper. However, internal choice has been provided in some questions. You have to attempt only one of the choices in such questions.

SECTION A

Note: very short answer questions of 1 mark each.

Q.1. The graph shows the variation of stopping potential with frequency of incident radiation for two photosensitive metals A and B. Which one of the two has higher value of work-function? Justify your answer.



OR

Write the expression for the de Broglie wavelength associated with a charged particle having charge 'q' and mass 'm', when it is accelerated by a potential V.

Q.2. You are given following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope?

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

Q.3. Draw a diagram to show refraction of a plane wave front incident in a convex lens and hence draw the refracted wave front.

Q.4. What happens to the width of depletion layer of a p-n junction when it is

(i) forward biased?

(ii) reverse biased?

Or

What is the most common use of photo diode?

Q.5. Name the electromagnetic waves which

(i) maintain the earth's warmth and

(ii) are used in aircraft navigation.

Q.6. For the same value of angle of incidence, the angles of refraction in three media A, B and C are 15°, 25° and 35° respectively. In which medium would the velocity of light be minimum?

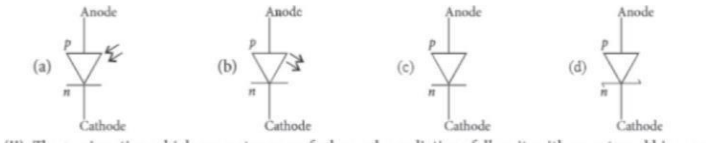
SECTION B

NOTE: CASE STUDY BASED QUESTIONS OF 4 MARKS EACH

Q.7. Read the following and answer any four questions from (i) to (v):

Solar cell is a p-n junction diode which converts solar energy into electrical energy. It is basically a solar energy converter. The upper layer of solar cells is of p-type semiconductor and very thin so that the incident light photons may easily reach the p-n junction. On the top face of p-layer, the metal finger electrodes are prepared in order to have enough spacing between the fingers for the lights to reach the p-n junction through p-layer.

(i) The schematic symbol of solar cells is



(ii) The p-n junction which generates an emf when solar radiations fall an it, with no external bias applied, is a (a) light emitting diode (b) photo diode (c) solar cell (d) none of these

(iii) For satellites the source of energy is (a) solar cell (b) fuel cell (c) Edison cell (d) none of these

(iv) Which of the following material is used in solar cells? (a) Barium (b) Silicon (c) Silver (d) Selenium

(v) The efficiency of a solar cell may be in the range (a) 2 to 5% (b) 10 to 15% (c) 30 to 40% (d) 70 to 80%

SECTION C

Note: short answer questions of 2 marks each

Q.8. Draw a labelled diagram of a full -wave rectifier circuit. State its working principle. Show the input-output wave forms.

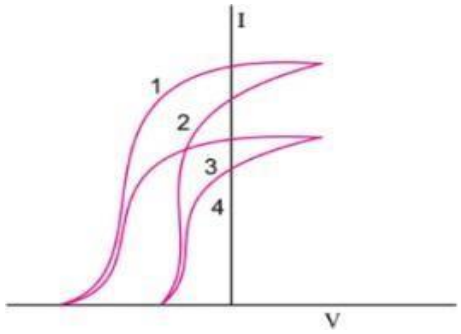
Q.9 State one feature by which the phenomenon of interference can be distinguish from that of diffraction.

A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 'a'. if the distance between the slits and screen is 0.8m and the distance of 2nd order maximum from the centre of screen is 1.5mm, calculate the width of the slit.

Or

Draw a schematic ray diagram of reflecting telescope showing how rays coming from distant objects are received at the eye-piece. Write its two important advantages over refracting telescope.

Q.10. The given graph shows the variation of photo electric current (I) with the applied voltage (V) for two different materials and for two different intensities of the incident radiations. Identify and explain using Einstein's photoelectric equation for the pair of curves that correspond to (i) different materials but same intensity of incident radiation (ii) different intensities but same materials.



SECTION D

Note: short answer questions of 3 marks each.

Q.11.(a) A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has

(a) greater value of de-Broglie wavelength associated with it, and

(b) less momentum?

Give reasons to justify your answer

Or

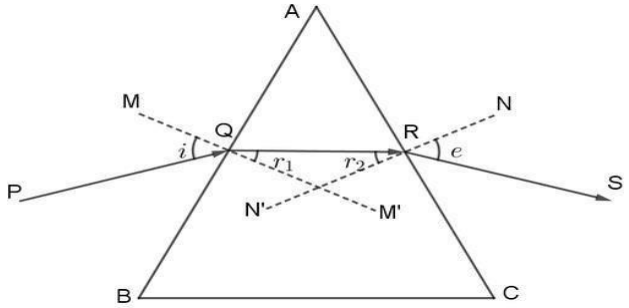
The ground state energy of hydrogen atom is -13.6 eV.

(i) What is the potential energy of an electron in the 3rd excited state?

(ii) If the electron jumps to the ground state from the 3rd excited state, calculate the wavelength of the photon emitted.

Q.12. Figure shows a ray of light passing through a prism. If the refracted ray QR is parallel to the base BC, show that (i) $r_1=r_2=A/2$

(ii) angle of minimum deviation $D_m=2i-A$



Q.13. A convex lens made up of glass of refractive index 1.5 is dipped, in turn,

(i) a medium of refractive index 1.6,

(ii) a medium of refractive index 1.3.

(a) Will it behave as a converging or a diverging lens in the two cases?

(b) How will its focal length change in the two media?

Q.14. (a) State Huygen's principle. Using this principle draw a diagram to show how a plane wave front incident at the interface of the two media gets refracted when it propagates from a rarer to a denser medium. Hence verify Snell's law of refraction.

(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?

OR

In young's double slit experiment, deduce the condition for (a) constructive and destructive interference at a point on the screen. Draw a graph showing variation of intensity in the interference pattern against position 'x' on the screen.

Q.15.(a) How is the size of a nucleus experimentally determined? Write the relation between the radius and mass number of the nucleus. Show that the density of nucleus is independent of its mass number.

(b)Distinguish between nuclear fission and fusion. Show how in both these processes energy is released.

Calculate the energy release in MeV in the deuterium-tritium fusion reaction :

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + n$$

Using the data :

$m(^{2}_{1}H) = 2.014102$ u $m(^{3}_{1}H) = 3.016049\ u$

$m(^{4}_{2}He) = 4.002603$ u $m_n = 1.008665$ u

$1u = 931.5\ MeV/c^2$

OR

(a) Write two important limitations of Rutherford model which could not explain the observed features of atomic spectra. How were these explained in Bohr's model of hydrogen atom?

Use the Rydberg formula to calculate the wavelength of the H_α line.

$R=1.1x10^{-7}m^{-1}$

(b) Using Bohr's postulates, obtain the expression for the radius of the n^{th} orbit in hydrogen atom.

SAMPLE QUESTION PAPER-3
TERM II
CLASS XII
BLUE PRINT

S.NO.	KENDRIYA VIDYALAYA SANGATHAN							
	TERM-2 / SAMPLE PAPER 2021-22/ BLUE PRINT							
	UNIT	VSA	SA	SA	CASE STUDY	LA	MARKS	
		1 MARK	2 MARKS	3 MARKS	4 MARKS	5 MARKS	TOTAL MARKS	
1	ELECTRO MAGNETIC WAVES	1					1	17
2	RAY OPTICS AND OPTICAL INSTRUMENTS	2	1	2			10	
3	WAVE OPTICS	1				1	6	
4	DUAL NATURE OF MATTER AND RADIATION	1	1	1			6	12
5	ATOMS & NUCLEI					1	5	
6	SEMICONDUCTOR ELECTRONICS	1	1		1		7	7
		6	3	3	1	2	35	

KENDRIYA VIDYALAYA SANGATHAN RAIPUR REGION

Class: XII

Session: 2021-2022

Subject: Physics Sample Question Paper (Theory)

Maximum Marks: 35 Marks Time Allowed: 2 hours

General Instructions:

(i) All questions are compulsory. There are 15 questions in all in the question paper.

(ii) The question paper have five sections: **Section A, Section B, Section C, Section D and Section E.**

(iii) **Section A** contain six very short answer questions each of 1 mark.

(iv) **Section B** has one Source based/Case based question of 4 marks each.

(v) Section C contains three short answer questions of 2 marks each. **Section D** contains three short answer questions of 3 marks each and **Section E** contains two long answer questions of 5 marks each.

(vi) There is no overall choice in the question paper. However, internal choice has been provided in some questions. You have to attempt only one of the choices in such questions.

SECTION A (EACH QUESTION CARRIES 1 MARK)

1. Define intensity of radiation on the basis of photon picture of light.
2. How does the power of a convex lens vary if the incident red light is replaced by violet light.
3. . What type of wave front will emerge from a
   (i) point source
   (ii) distant light source?
4. What happens to the width of depletion layer of a p-n junction when it is
   (i) forward biased?
   (ii) reverse biased?
5. A plane electromagnetic wave travels in vacuum along z-direction. What are the directions of electric and magnetic field vectors?
6. Refractive index of diamond with respect to glass is 1.6 and the absolute refractive index of glass is 1.5. Find out the absolute refractive index of diamonds.

SECTION B (EACH QUESTION CARRIES 4 MARKS)

7. A pure semiconductor germanium or silicon, free of every impurity is called intrinsic semiconductor. At room temperature, a pure semiconductor has very small number of current carriers (electrons and holes) .Hence its conductivity is low. When the impurity atoms of valance five or three are doped in a pure semiconductor, we get respectively n-type or p- type extrinsic semiconductor. In case of doped semiconductor n_e $n_h = n_i^2$. Where ne and n_h are the number density of electron and hole charge carriers in a pure semiconductor. The conductivity of extrinsic semiconductor is much higher than that of intrinsic semiconductor. Answer the following questions:

(i). Which of the following statements is not true?
   a. The resistance of intrinsic semiconductor decreases with increase of temperature.
   b. Doping pure Si with trivalent impurities gives p- type semiconductors.
   c. The majority charges in n- type semiconductors are holes.
   d. A p-n junction can act as semiconductor diode.

(ii) The impurity atoms with which pure Si should be doped to make a p- type semiconductor in.
   a. Phosphorus
   b. Boron
   c. Arsenic
   d. Antimony

(iii). Holes are majority charge carriers in
   a. Intrinsic semiconductors.
   b. Ionic Solids
   c. p- type semiconductors
   d. Metals

(iv). At absolute zero, Si acts as

a. Non- metal
b. Metal
c. Insulator
d. None of these

SECTION C (EACH QUESTION CARRIES 2MARKS)

8. State the reason, why GaAs is most commonly used in making of a solar cell.
9. Draw a ray diagram for the formation of image by a compound microscope. Write the expression for total magnification when the image is formed at infinity.

OR

A convex lens of focal length 25 cm is placed coaxially in contact with a concave lens of focal length 20 cm. Determine the power of the combination. Will the system be converging or diverging in nature?

10. Write the expression for the de-Broglie wavelength associated with a charged particle having charge q and mass m, when it is accelerated by a potential.

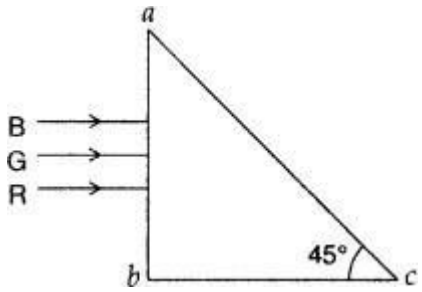
SECTION D (EACH QUESTION CARRIES 3 MARK)

11. The mass of a particle moving with velocity 5 x 10^6 m/s has de-Broglie wavelength associated with it to be 0.135 nm. Calculate its mass.
(ii) In which region of the electromagnetic spectrum does this wavelength lie?

OR

The ground state energy of hydrogen atom is -13.6 eV. If an electron makes a transition from an energy level -1.51 eV to -3.4 eV, calculate the wavelength of the spectral line emitted and name the series of hydrogen spectrum to which it belongs.

12. A ray of light passing through an equilateral triangular glass prism from air undergoes minimum deviation when angle of incidence is 3/4th of the angle of prism. Calculate the speed of light in the prism.
13. Three light rays red (R), green (G) and blue (B) are incident on a right B angled prism ‘abc’ Q at face ‘ab’. The R refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Out of the three which colour ray will emerge out of face ‘ac’? Justify your answer. Trace the path of these rays after passing through face ‘ab’.



SECTION E (EACH QUESTION CARRIES 5 MARKS)

14. (a)Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression for the fringe width.
(b) In Young's double slit experiment, the two slits 0.12 mm apart are illuminated by monochromatic light of wavelength 420 nm. The screen is 1.0 m away from the slits.
(c) Find the distance of the second
(i) bright fringe,
(ii) dark fringe from the central maximum.
(d How will the fringe pattern change if the screen is moved away from the slits?

OR

(a) Write the conditions under which light sources can be said to be coherent.
(b) Use Huygens' principle to show how a plane wavefront propagates from a denser to rarer medium. Hence verify Snell's law of refraction.

15. **(a)** Derive lens maker's formula for biconvex lens.
(b) 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? Give reason.

16. (a) Using Bohr's second postulate of quantization of orbital angular momentum show that the circumference of the electron in the n^{th} orbital state in hydrogen atom is n times the de-Broglie wavelength associated with it.
(b) The electron in hydrogen atom is initially in the third excited state. What is the maximum number of spectral lines which can be emitted when it finally moves to the ground state?