Roll Number		

SET A

INDIAN SCHOOL MUSCAT
SECOND PRE - BOARD EXAMINATION
PHYSICS (042)

CLASS: XII **TERM- 2** **Time Allotted: 2 hrs.**

21.02.2022 **Max. Marks: 35**

GENERAL INSTRUCTIONS

(i) There are 12 questions in all. All questions are compulsory.
(ii) This question paper has three sections: Section A, Section B and Section C.
(iii) Section A contains three questions of two marks each, Section B contains eight questions of three marks each, Section C contains one case study-based question of five marks.
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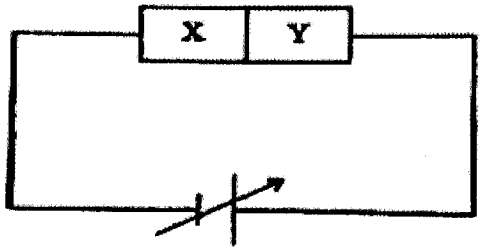
(v) You may use log tables if necessary but use of calculator is not allowed.

SECTION A

1. Two semiconductor materials X and Y shown in given figure are made by doping germanium crystal with Indium and Arsenic respectively. The two are joined end to end and connected to a battery as shown. 2



(i) Will the junction be forward biased or reverse biased?
(ii) Sketch V-I graph for this arrangement.

2. Write two features of photoelectric effect which cannot be explained by wave theory. 2

OR

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.

3. Draw energy band diagrams of an n-type and p-type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy levels with their energies. 2

SECTION B

4. (i) The radius of innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. What is the radius of orbit in the second excited state? 3

(ii) The ground state energy of hydrogen atom is -13.6 eV. What are the kinetic and potential energies of electron in this state?

(iii) Write two important limitations of Rutherford nuclear model of the atom.

5. A student wants to use two p-n junction diodes to convert alternating current into direct current. Draw the labelled circuit diagram she would use and explain how it works. Draw input and output waveforms. 3

6. (i) Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (a) attractive and (b) repulsive. 3

(ii) Two nuclei have mass numbers in the ratio 1:8. What is the ratio of their nuclear radii?

7. Define wavefront. Using Huygen's principle, draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media when light passes from a rarer to a denser medium. Hence verify Snell's law of refraction. 3

8. (i) Draw a ray diagram showing the image formation by a compound microscope when the final image is formed at infinity. 3

(ii) Why both objective and eyepiece of a compound microscope must have short focal length?

OR

(i) Draw a labelled ray diagram of a reflecting type telescope.

(ii) State two advantages of this telescope over a refracting telescope.

9. A beam of monochromatic radiation is incident on a photosensitive surface. Answer the following questions giving reasons: 3

(i) Do the emitted photoelectrons have the same kinetic energy?

(ii) Does the kinetic energy of the emitted electrons depend on the intensity of incident radiation?

(iii) On what factors does the number of emitted photoelectrons depend?

10. Two thin convex lenses L_1 and L_2 of focal lengths f_1 and f_2 respectively, are placed coaxially in contact. An object is placed at a point beyond the focus of lens L_1. Draw a ray diagram to show the image formation and hence derive the expression for the focal length of the combined system. 3

11. (i) Arrange the following electromagnetic radiations in ascending order of their frequencies: 3

Microwave, Radio wave, X-rays, Gamma rays

(ii) The oscillating electric field of an electromagnetic wave is given by
$E_y = 30 \sin [2 \times 10^{11} t + 150 \pi x] \text{ Vm}^{-1}$
Obtain the value of the wavelength of the electromagnetic wave.

(iii) Why are microwaves considered suitable for radar systems used in aircraft navigation?

OR

(a) In a single slit diffraction pattern, how does the angular width of the central maximum vary, when (i) aperture of slit is increased?

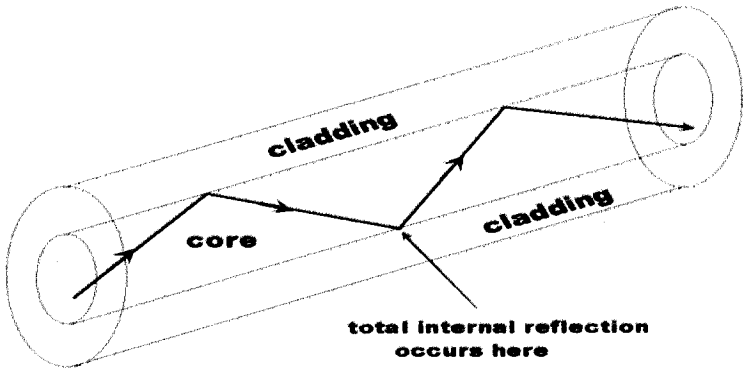
(ii) distance between the slit and the screen is decreased?

(b) How is the diffraction pattern different from the interference pattern obtained in Young's double slit experiment? (Any two differences)

SECTION C

12. CASE STUDY: OPTICAL FIBRES 5

Optical fibre is extremely thin and long strand of very fine quality glass or quartz coated with a thin layer of material of refractive index less than refractive index of the strand. The coating or surrounding layer of optical strand is known as cladding. The sleeve containing a bundle of optical fibres is called light pipe. The light travels the entire length of the fibre and arrives at the other end of the fibre without any loss in its intensity even if the fibre is rounded or curved.



(i) A ray of light will undergo total internal reflection inside the optical fibre, if it

(a) goes from rarer medium to denser medium

(b) is incident at an angle less than the critical angle

(c) strikes the interface normally

(d) is incident at an angle greater than the critical angle

(ii) Which of the following is based on the phenomenon of total internal reflection of light?

(a) Sparkling of diamond

(b) Optical fibre communication

(c) Instrument used by doctors for endoscopy

(d) All of these

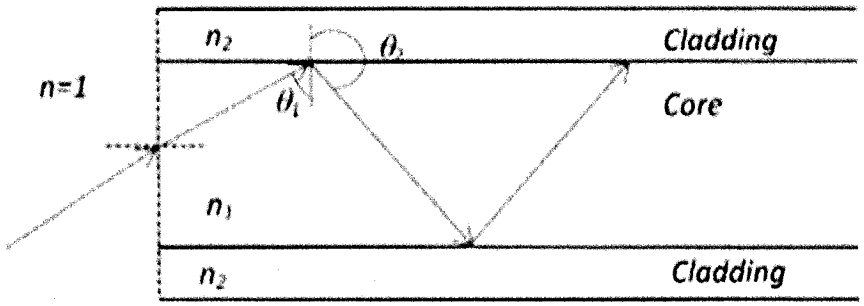
(iii) If in core, angle of incidence is equal to critical angle, then angle of refraction will be

(a) 0°
(b) 45°
(c) 90°
(d) 180°

(iv) If the value of critical angle is 30° for total internal reflection from given optical fibre, then speed of light in that fibre is (given speed of light in vacuum = 3×10^8 m s^{-1})

(a) 3×10^8 m s^{-1}
(b) 1.5×10^8 m s^{-1}
(c) 6×10^8 m s^{-1}
(d) 4.5×10^8 m s^{-1}

(v) In an optical fibre (shown), correct relation for refractive indices of core and cladding is



(a) $n_1 = n_2$
(b) $n_1 > n_2$
(c) $n_1 < n_2$
(d) $n_1 + n_2 = 2$

End of the Question Paper

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SET B

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(v) You may use log tables if necessary but use of calculator is not allowed.

SECTION A

1. Name the optoelectronic device used for detecting optical signals and mention the biasing in which it is operated. Draw its I-V characteristics. 2

2. Write two features of photoelectric effect which cannot be explained by wave theory. 2

OR

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.

3. (i) Name the two important processes that occurs during the formation of a p-n junction. 2

(ii) Define the term barrier potential.

SECTION B

4. (i) Draw a ray diagram of an astronomical telescope for the final image formed at least distance of distinct vision. 3

(ii) The objective of a telescope is of larger focal length and of larger aperture (as compared to eye piece). Why?

OR

(i) Draw a labelled ray diagram of a reflecting type telescope.

(ii) Give two reasons to explain why a reflecting telescope is preferred over a refracting telescope.

5. (i) Describe the working principle of a solar cell. Explain three basic processes involved in the generation of emf. 3

(ii) Why are Silicon and GaAs preferred materials for solar cells?

6. A beam of monochromatic radiation is incident on a photosensitive surface. Answer the following questions giving reasons: 3

(i) Do the emitted photoelectrons have the same kinetic energy?

(ii) Does the kinetic energy of the emitted electrons depend on the intensity of incident radiation?

(iii) On what factors does the number of emitted photoelectrons depend?

7. Draw a ray diagram for image formation of a point object by a thin double convex lens having radii of curvature R_1 and R_2. Hence, derive Len's maker's formula for a double convex lens. 3

8. (i) What is the ratio of radii of orbits corresponding to the first excited state and ground state in a hydrogen atom? 3

(ii) State Bohr's frequency condition.

(iii) An α- particle of kinetic energy 'K' is bombarded on a thin gold foil. The distance of closest approach is 'r'. what will be the distance of closest approach for an α- particle of double the kinetic energy?

9. (i) Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (a) attractive and (b) repulsive. 3

(ii) What is the nuclear radius of ^{125}**Fe**, if that of ^{27}**Al** is 3.6 Fermi?

10. Define wavefront. Using Huygen's principle, draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media when light passes from a rarer to a denser medium. Hence verify Snell's law of refraction. 3

11. (i)Identify the part of the electromagnetic spectrum which is: 3

(a) Suitable for radar system used in aircraft navigation

(b) Produced during radioactive decay of a nucleus

(ii)The oscillating magnetic field in a plane electromagnetic wave is given by

$$B_z = 8\times10^{-6} \sin [2 \times 10^{11} t + 300 \pi x] \text{ T}$$

Obtain the value of the wavelength of the electromagnetic wave.

(iii) Write any two important properties of electromagnetic waves.

OR

(iv) Draw the intensity distribution for (a) fringes produced in interference, and (b) the diffraction bands produced due to single slit.

(v) Write two points of difference between the phenomena of interference and diffraction.

SECTION C

12. CASE STUDY: OPTICAL FIBRES 5

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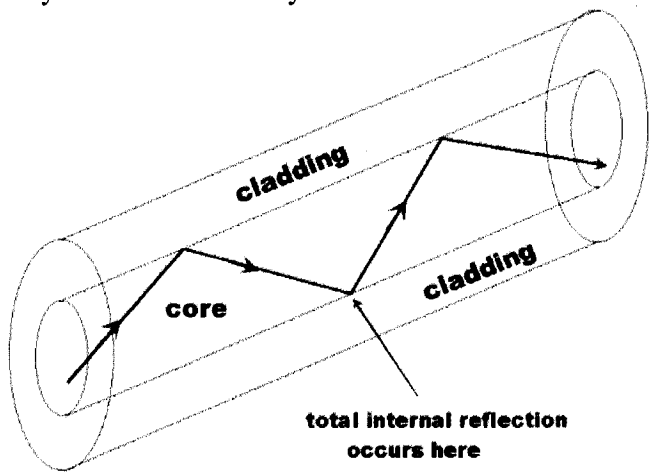

(i) If the value of critical angle is 30° for total internal reflection from given optical fibre, then speed of light in that fibre is (given speed of light in vacuum = 3×10^8 m s^{-1})

(a) 3×10^8 m s^{-1}

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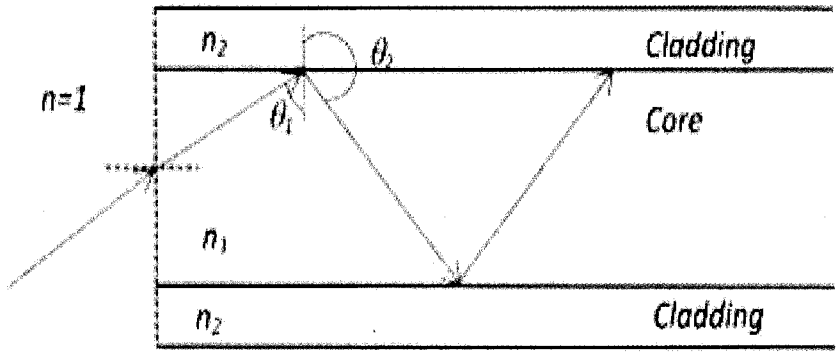

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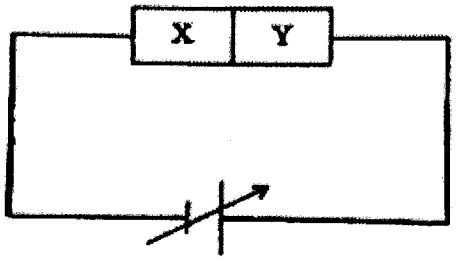

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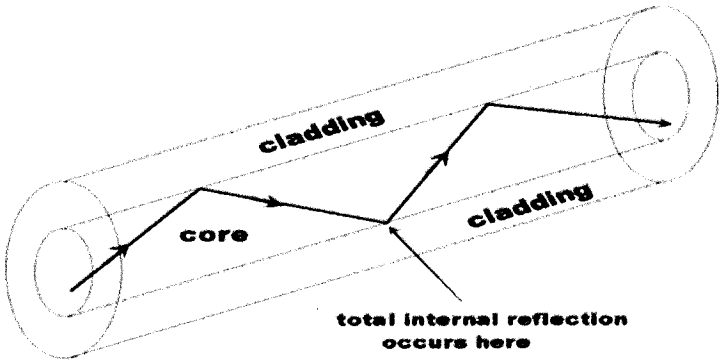

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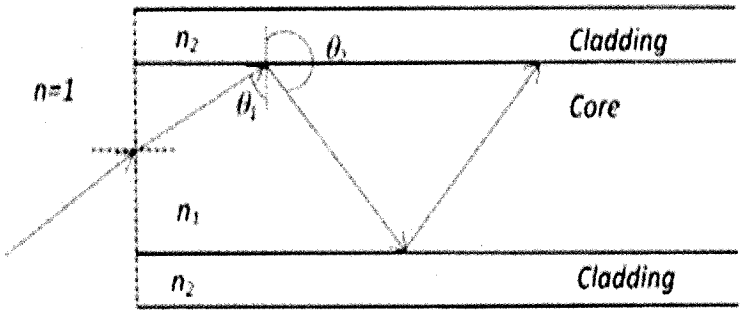

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