SAMPLE QUESTION PAPER

BLUE PRINT

Time : 2 Hours **Max. Marks :** 35

S. No.		Chapter	Section-A (2 marks)	Section-B (3 marks)	Section-C (5 marks)	Total
8.	Unit-V	Electromagnetic Waves	–	1(3)	–	6(17)
9.	Unit-VI	Ray Optics and Optical Instruments	1(2)	2(6)	–	
10.		Wave Optics	–	2(6)#	–	
11.	Unit-VII	Dual Nature of Radiation and Matter	1(2)#	1(3)	–	4(11)
12.	Unit-VIII	Atoms	–	2(6)	–	
13.		Nuclei	–	–	–	
14.	Unit-IX	Semiconductor Electronics : Materials, Devices and Simple Circuits	1(2)#	–	1(5)	2(7)
		Total Questions	**3(6)**	**8(24)**	**1(5)**	**12(35)**

*It is a choice based questions.
#Out of the two or more questions only one question is choice based.

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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.*

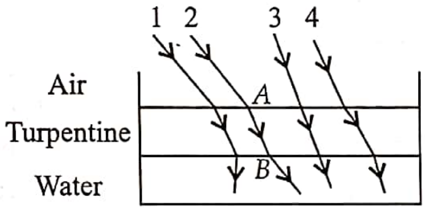
(iv) *There is no overall choice. However, an internal choice has been provided in one question of two marks and two questions of three marks. You have to attempt only one of the choices in such questions.*

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

SECTION - A

1. An electron of mass m and a photon have same energy E. Find the ratio of de-Broglie wavelengths associated with them.

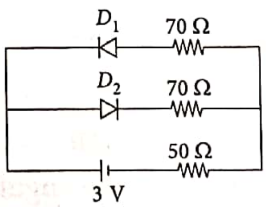
2. The optical density of turpentine is higher than that of water while its mass density is lower. Figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in figure, the path shown is correct?



3. Explain the term 'depletion layer' and 'potential barrier' in a p-n junction diode. How are the (i) width of depletion layer, and (ii) value of potential barrier affected when the p-n junction is forward biased?

OR

The circuit shown in the diagram contains two diodes, each with a forward resistance of 30 Ω and infinite reverse resistance. If the battery is of 3 V, then what will be the voltage drop across 50 Ω resistance?

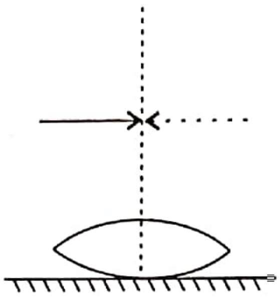


SECTION - B

4. 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.

5. An electromagnetic wave of frequency $\upsilon = 3.0$ MHz passes from vacuum into a dielectric medium with relative permittivity $\varepsilon = 4.0$. Then what will be the wavelength and frequency?

6. A symmetric biconvex lens of radius of curvature R and made of glass of refractive index 1.5, is placed on a layer of liquid placed on top of a plane mirror as shown in the figure. An optical needle with its tip on the principal axis of the lens is moved along the axis until its real, inverted image coincides with the needle itself. The distance of the needle from the lens is measured to be x. On removing the liquid layer and repeating the experiment, the distance is found to be y. Obtain the expression for the refractive index of the liquid in terms of x and y.



7. Write three characteristic features in photoelectric effect which cannot be explained on the basis of wave theory of light, but can be explained only using Einstein's equation.

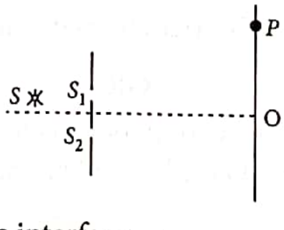
OR

When the light of frequency $2\upsilon_0$ (where υ_0 is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is v_1. When the frequency of the incident radiation is increased to $5\upsilon_0$, the maximum velocity of electrons emitted from the same plate is v_2. Find the ratio of v_1 to v_2?

8. (a) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.
   (b) The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece.

9. In a Geiger-Marsden experiment, calculate the distance of closest approach to the nucleus of $Z = 80$, when an α-particle of 8 MeV energy impinges on it before it comes momentarily to rest and reverses its direction. How will the distance of closest approach be affected when the kinetic energy of the α-particle is doubled?

10. The figure shows a modified Young's double slit experimental set-up. Here $SS_2 - SS_1 = \lambda/4$.



   (a) Write the condition for constructive interference.
   (b) Obtain an expression for the fringe width.

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?

11. Monochromatic light of wavelength 5000 Å is used in YDSE, with slit width, $d = 1$ mm, distance between screen slits $D = 1$ m, If intensities at the two slits are $I_1 = 4I_0$ and $I_2 = I_0$, Find :
   (i) fringe width b;

(ii) distance of 5^{th} minimum from the central maxima on the screen;

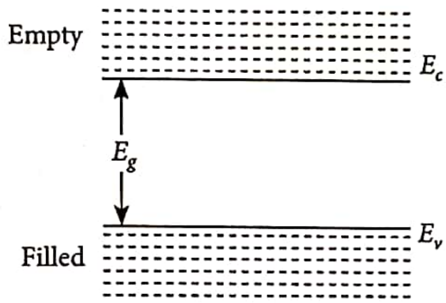
(iii) intensity at $y = \frac{1}{3}$ mm;

(iv) distance of the 1000^{th} maxima.

SECTION - C

12. CASE STUDY : ENERGY BAND GAP

From Bohr's atomic model, we know that the electrons have well defined energy levels in an isolated atom. But due to interatomic interactions in a crystal, the electrons of the outer shells are forced to have energies different from those in isolated atoms. Each energy level splits into a number of energy levels forming a continuous band. The gap between top of valence band and bottom of the conduction band in which no allowed energy levels for electrons can exist is called energy gap.



(i) In an insulator, energy band gap is

(a) $E_g = 0$ (b) $E_g < 3$ eV (c) $E_g > 3$ eV (d) none of the above.

(ii) In a semiconductor, separation between conduction and valence band is of the order of

(a) 0 eV (b) 1 eV (c) 10 eV (d) 50 eV

(iii) Based on the band theory of conductors, insulators and semiconductors, the forbidden gap is smallest in

(a) conductors (b) insulators (c) semiconductors (d) all of these.

(iv) Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statements is most appropriate ?

(a) The number of free electrons for conduction is significant only in Si and Ge but small in C.
(b) The number of free conduction electrons is significant in C but small in Si and Ge.
(c) The number of free conduction electrons is negligibly small in all the three.
(d) The number of free electrons for conduction is significant in all the three.

(v) Solids having highest energy level partially filled with electrons are

(a) semiconductor (b) conductor (c) insulator (d) none of these.