PRE-BOARD EXAMINATION TERM II (2021-22)
CLASS XII
PHYSICS THEORY-TERM II

TIME-2HRS M. MARKS-40

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

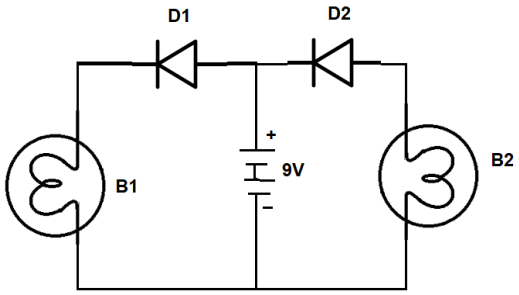
1 In a pure semiconductor crystal of Germanium, if Bismuth is added then what type of extrinsic semiconductor is obtained? Draw the energy band diagram of the extrinsic semiconductor so formed. 2

2 A proton and an α-particle have the same de-Broglie wavelength. Determine the ratio of their accelerating potentials. 2

OR

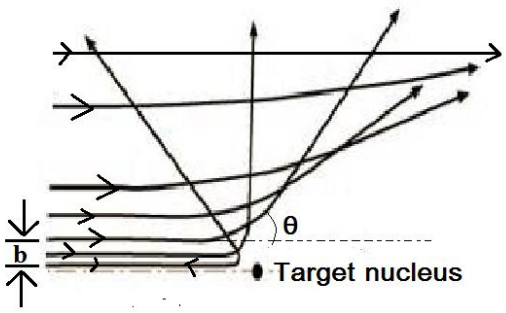
Draw suitable graph to show the variation of photoelectric current with collector plate potential for a fixed frequency but different intensities I1 > I2 > I3 of radiation.

3 In the given circuit diagram, which bulb out of B1 and B2 will glow and why? 2



SECTION B

4 The trajectories, traced by different α-particles in Geiger-Marsden experiment were observed. 3
(a) What names are given to 'b' and 'θ' shown here?
(b) What can we say about the values of 'b' for (i) $\theta=0^0$ and (ii) $\theta = \pi$ radian?



5 Explain with a proper diagram how an ac signal can be converted into dc (pulsating) signal with output frequency as double than the input frequency using p-n junction diode. Give its input and output waveforms. 3

6 Calculate the energy release in MeV in the deuterium-tritium fusion reaction: 3

$^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n + Q$

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

Given, 1u = 931.5 MeV/c^2.

7 Plot a graph to show the variation of the angle of deviation as a function of angle of incidence for light rays passing through a prism. Write the relation for the refractive index of the prism in terms of the angle of minimum deviation and the angle of the prism. 3

OR

Sketch the graphical variation of the interference pattern in Young's double - slit experiment.

8 Answer following questions (on the basis of data given in the following table and your understanding of the related studied concepts.: - 3

In a school laboratory, following lenses are available: -

Serial no. of lens	1	2	3	4	5	6	7	8	9	10	11
Focal length of lens f (cm)	50	100	100	20	10	5	3	25	5	2	2
Aperture of lens A (cm)	10	10	20	5	2	1	2	5	5	1	1.5

All these lenses are converging lenses.

(i)Which lens would you select as objective to design a compound microscope?

(ii) Which lens would you choose as objective to prepare an astronomical telescope?

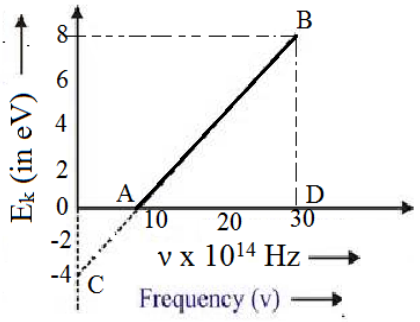
(iii) Aperture for objective for astronomical telescope is chosen carefully so as: -

a to gather less light.

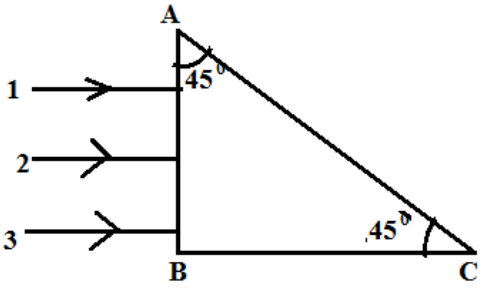
b to gather more light

c Neither a nor b is correct.

9 The graph between the frequency (ν) of the incident light and maximum kinetic energy (E_k) of emitted photoelectrons is shown. Find the values of (i) threshold frequency, and (ii) work function from the graph. 3



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



11 Identify the part of electromagnetic spectrum which is – 3

(i) Suitable for radar system used in aircraft navigation.

(ii) Produced by bombarding a metal target by high speed electrons.

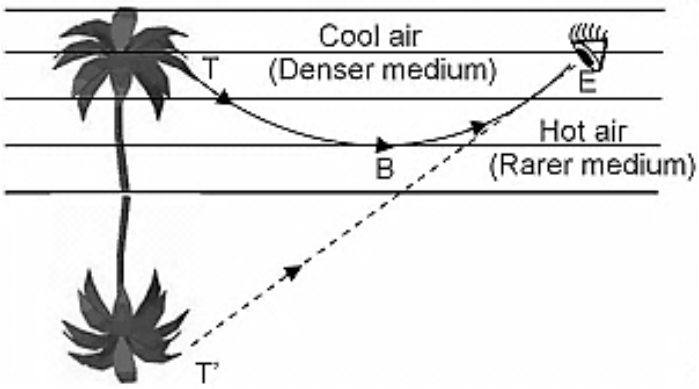
(iii) Used as a diagnostic tool in medicine.

OR

Light from a point source in air falls on a convex spherical glass surface of refractive index 1.5 and radius of curvature 20 cm. the distance of light source from glass surface is 100 cm. At what position is the image formed?

SECTION-C

12 CASE STUDY: MIRAGE IN DESERTS 5



To a distant observer, the light appears to be coming from somewhere below the ground. The observer naturally assumes that light is being reflected from the ground, say, by a pool of water near the tall object.

Such inverted images of distant tall objects cause an optical illusion to the observer. This phenomenon is called mirage. This type of mirage is especially common in hot deserts.
Based on the above facts, answer the following questions:

a) Which of the following phenomena is prominently involved in the formation of mirage in deserts?

(i) Refraction, Total internal Reflection

(ii) Dispersion and Refraction

(iii) Dispersion and scattering of light

(iv) Total internal Reflection and diffraction.

b) A diver at a depth 12 m inside water (having refractive index = 4/3 w.r.t. air) sees the sky in a cone of semi- vertical angle-

(i) $\sin^{-1} 4/3$

(ii) $\tan^{-1} 4/3$

(iii) $\sin^{-1} 3/4$

(iv) 90^0.

c) In an optical fibre, if n_1 and n_2 are the refractive indices of the core and cladding respectively, then which among the following would be a correct equation?

(i) $n_1 < n_2$
(ii) $n_1 = n_2$
(iii) $n_1 << n_2$
(iv) $n_1 > n_2$

d) A diamond is immersed in such a liquid which has its refractive index with respect to air as greater than the refractive index of water with respect to air. Then the critical angle of diamond-liquid interface as compared to critical angle of diamond -water interface will-

(i) depend on the nature of the liquid only
(ii) decrease
(iii) remain the same
(iv) increase.

e) The following figure shows a cross-section of a 'light pipe' made of a glass fiber of refractive index 1.68. The outer covering of the pipe is made of a material of refractive index 1.44.

What is the range of the angles of the incident rays with the axis of the pipe for the following phenomena to occur?

(i) $0 < i < 90°$
(ii) $0 < i < 60°$
(iii) $0 < i < 45°$
(iv) $0 < i < 30°$