055/1/2

COMMON PRE-BOARD EXAMINATION - 2023

PHYSICS THEORY (042)

MAX.MARKS: 70 **CLASS: XII** **TIME: 3Hours**

General Instructions:

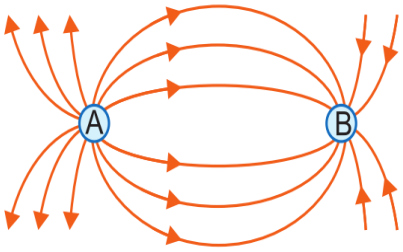
1) There are 35 questions in all. All questions are compulsory
2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5) Use of calculators is not allowed.

SECTION A

1 A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge 1

(a) remains a constant because the electric field is uniform.
(b) increases because the charge moves along the electric field.
(c) decreases because the charge moves along the electric field.
(d) decreases because the charge moves opposite to the electric field.

2 The spatial distribution of the electric field due to two charges (A, B) is shown in figure. Identify the correct statement. 1



(a) A is +ve and B is –ve and |A|>|B|
(b) A is – ve and B is + ve, |A|=|B|
(c) Both are + ve but A>B
(d) Both are – ve but A>B

3 The drift velocity of the free electrons in a conducting wire carrying a current I is v. If in a wire of the same metal, but of double the radius, the current be 2I, the drift velocity of the electrons will be 1

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

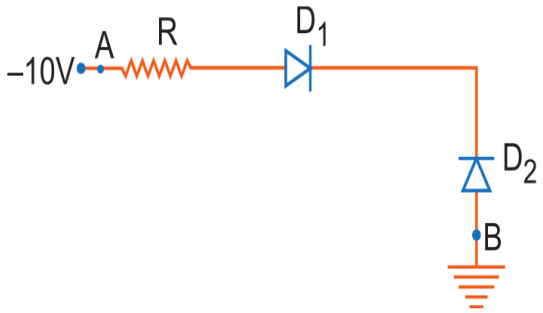
4 A current carrying loop is placed in a uniform magnetic field. The torque acting on it does not depend upon the 1

(a) shape of the loop (b) area of the loop
(c) value of current (d) magnetic field

5 The capacitance of a capacitor becomes 7/6 times its original value if a dielectric slab of thickness t= (2/3)d is introduced in between the plates, where d is the separation between the plates. The dielectric constant of the slab is 1
(a) 14/11 (b) 11/14
(c) 7/11 (d) 11/7

6 The angle of minimum deviation for an equilateral glass prism is 30°. Refractive index of the prism is: 1
(a) 1/√3 (b) √2
(c) 1 (d) √3

7 In given figure, assuming the diodes to be ideal, 1



(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.

8 In Young's double-slit experiment, the distance between the slit sources and the screen is 1 m. If the distance between the slits is 2 mm and the wavelength of light used is 600 nm, the fringe width is 1
(a) 3 mm (b) 0.3 mm
(c) 6 mm (d) 0.6 mm

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

10 Two particles A_1 and A_2 of masses m_1, m_2 (where $m_1 > m_2$) have the same de Broglie wavelength. Then 1
(a) their momenta are the same
(b) their energies are the same
(c) energy of A_1 is less than the energy of A_2
(d) energy of A_1 is more than the energy of A_2

11 The wavelength of the first line of Lyman series in hydrogen is 1216 Å. The wavelength of the second line of the same series will be 1
(a) 912 Å (b) 1026 Å

(c) 3648 Å (d) 6566 Å

12 An electromagnetic wave of frequency 3.0 MHz passes from vacuum into a dielectric medium with relative permittivity $\varepsilon_r = 40$, then 1

(a) wavelength is doubled and frequency remains unchanged
(b) wavelength is doubled and frequency becomes half
(c) wavelength is halved and frequency remains unchanged
(d) wavelength and frequency both remains unchanged

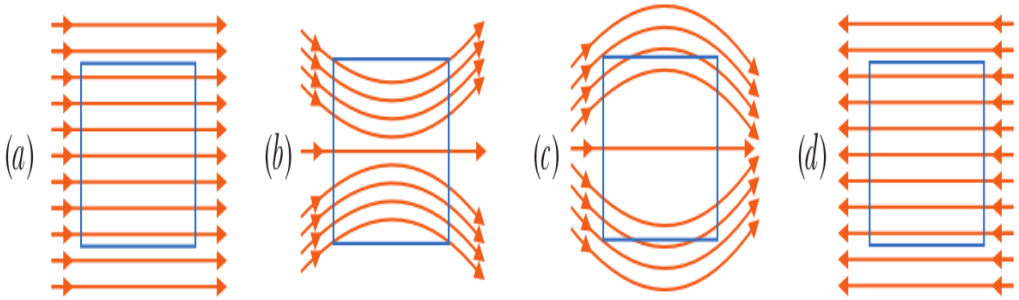
13 When a charged particle moving with velocity v is subjected to a magnetic field of induction B, the force on it is non-zero. This implies that 1

(a) angle between is either zero or 180°
(b) angle between is necessarily 90°
(c) angle between can have any value other than 90°
(d) angle between can have any value other than zero and 180°

14 When the current in a coil changes from 8A to 2A in 3×10^{-2} second, the emf induced in the coil is 2 volt. The self-inductance of the coil, in millihenry, is 1

(a) 1 (b) 5
(c) 20 (d) 10

15 A uniform magnetic field exists in space in the plane of paper and is initially directed from left to right. When a bar of soft iron is placed in the field parallel to it, the lines of force passing through it will be represented by 1



16 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. 1

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true and R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Assertion (A): If intensity of incident light is doubled, the kinetic energy of photoelectron is also doubled.

Reason (R): The kinetic energy of photoelectron is directly proportional to intensity of incident light.

17 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. 1

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true and R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

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

18 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. 1

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true and R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

Assertion (A): When the apparatus of Young's double-slit experiment is brought in a liquid from air, the fringe width decrease.
Reason (R): The wavelength of light decreases in the liquid.

SECTION B

19 (a) What type of wave front will emerge from a point source and a distant light source? 2

(b) Make a labelled diagram showing the wave fronts in reflection from:
(i) Plane mirror
(ii) Curved mirror

OR

In Young's double slit experiment, plot a graph showing the variation of fringe width versus the distance of the screen from the plane of the slits keeping other parameters same. What type of information can we obtain from slope of the curve?

20 A point charge is placed at the centre of a closed Gaussian spherical surface of radius r. Electric flux passing through the surface is φ How is the electric flux φ through the surface affected when the following changes are made in turn: 2

(i) The spherical surface is replaced by a cylindrical surface of the same radius.
(ii) The point charge is replaced by an electric dipole.

Justify your answer in each case.

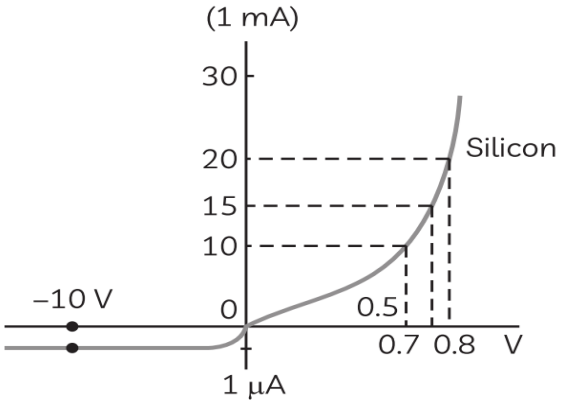
21 How does the 2

(i) pole strength and
(ii) magnetic moment of each part of a bar magnet change if it is cut into two equal pieces transverse to length?

22 (a) Differentiate between the processes of diffusion and drift? 2

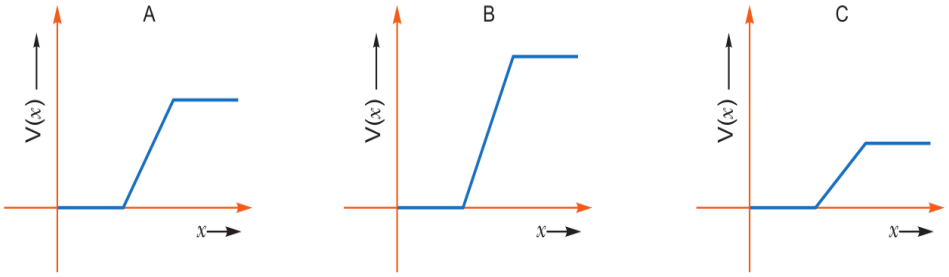
(b) Calculate the resistance of the diode at
(i) I = 15 mA and at
(ii) V = –10 V

with the help of V-I characteristic of a silicon diode given below.

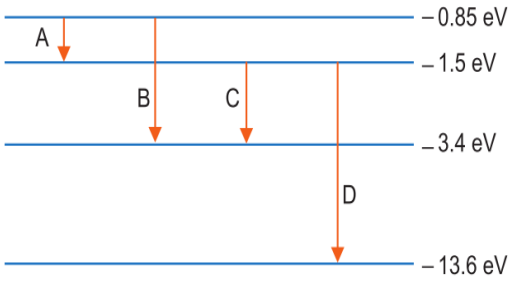


OR

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



23 The energy level diagram of an element is given below. Identify, by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7 nm. 2



24 Name the parts of the electromagnetic spectrum which is 2

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

(ii) Used to treat muscular strain.

(iii) Used as a diagnostic tool in medicine.

Write in brief, how any two of these waves can be produced.

25 A charged particle q is moving in the presence of a magnetic field B which is inclined to an angle 30° with the direction of the motion of the particle. Draw the trajectory followed by the particle in the presence of the field and explain how the particle describes this path. 2

SECTION C

26 (i) What characteristic property of nuclear force explains the constancy of binding energy per nucleon (BE/A) in the range of mass number 'A' lying $30 < A < 170$? 3

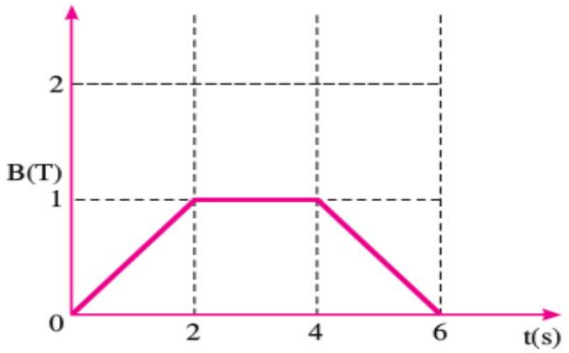
(ii) Obtain the binding energy of a nitrogen nucleus $\left({}^{14}_{7}N\right)$ from the following data in MeV.

$m_H = 1.00783$ u

$m_n = 1.00867$ u

$m_N = 14.00307$ u

27 The magnetic field through a circular loop of wire 12 cm in radius and 8.5 Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time. 3



OR

The currents flowing in the two coils of self-inductance L_1=16 mH and L_2=12mH are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of

(i) Induced voltages

(ii) The currents and

(iii) The energies stored in the two coils at a given instant.

28 A capacitor of unknown capacitance, a resistor of 100 Ω and an inductor of self-inductance $L = (4/\pi^2)$ henry are connected in series to an ac source of 200 V and 50 Hz. Calculate the value of the capacitance and impedance of the circuit when the current is in phase with the voltage. Calculate the power dissipated in the circuit. 3

29 (a) Define the term 'intensity of radiation' in photon picture. 3

(b) Plot a graph showing the variation of photo current vs collector potential for three different intensities $I_1 > I_2 > I_3$, two of which (I_1 and I_2) have the same frequency υ and the third has frequency $\upsilon_1 > \upsilon$.

(c) Explain the nature of the curves on the basis of Einstein's equation.

OR

(i) Draw a graph showing variation of photocurrent with anode potential for a particular intensity of incident radiation. Mark saturation current and stopping potential.

(ii) By how much would be stopping potential for a given photosensitive surface go up if the frequency of the incident radiations were to be increased from 4×10^{15} Hz to 8×10^{15} Hz?

30 A galvanometer of resistance G is converted into a voltmeter to measure up to V volts by connecting a resistance R_1 in series with the coil. If a resistance R_2 is connected in series with it, then it can measure up to V/2 volts. Find the resistance, in terms of R_1 and R_2, required to be connected to convert it into a voltmeter that can read up to 2 V. Also find the resistance G of the galvanometer in terms of R_1 and R_2. 3

SECTION D

31 (i) Distinguish, with the help of a suitable diagram, the difference in the behaviour of a conductor and a dielectric placed in an external electric field. How does polarised dielectric modify the original external field? 5

(ii) A capacitor of capacitance C is charged fully by connecting it to a battery of emf E. It is then disconnected from the battery. If the separation between the plates of the capacitor is now doubled, how will the following change?

(a) Charge stored by the capacitor.

(b) Field strength between the plates.

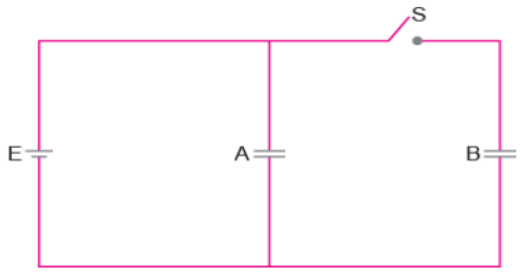
(c) Energy stored by the capacitor.

Justify your answer in each case.

OR

(i) A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

(ii) Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant K. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.



32 An optical instrument uses an objective lens of power 100 D and an eyepiece of power 40 D. The final image is formed at infinity when the tube length of the instrument is kept at 20 cm. 5

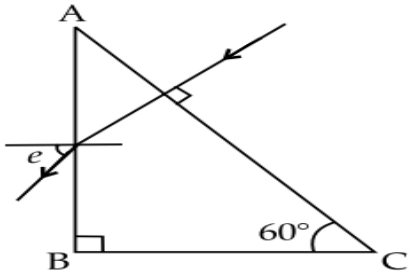
(i) Identify the optical instrument.

(ii) Draw the ray diagram representing the image formation.

(iii) Calculate the angular magnification produced by the instrument.

OR

(i) Calculate the angle of emergence (e) of the ray of light incident normally on the face AC of a glass prism ABC of refractive index √3. How will the angle of emergence change qualitatively, if the ray of light emerges from the prism into a liquid of refractive index 1.3 instead of air?



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

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

33 (i) State Kirchhoff's laws for electrical network. 5

(ii) Two cells of emf 1.5 V and 2 V and internal resistance 1Ω and 2Ω respectively are connected in parallel to pass a current in the same direction through an external resistance of 5Ω.

(a) Draw the circuit diagram.

(b) Using Kirchhoff's laws, calculate the current through each branch of the circuit and potential difference across 5Ω resistor.

OR

(i) Write the mathematical relation for the resistivity of a material in terms of relaxation time, number density, mass and charge of charge carriers in it.

(ii) Plot a graph showing the variation of resistivity with temperature for a metallic conductor.

(iii) Explain the variation of conductivity with temperature for

(a) a metallic conductor

(b) ionic conductors and

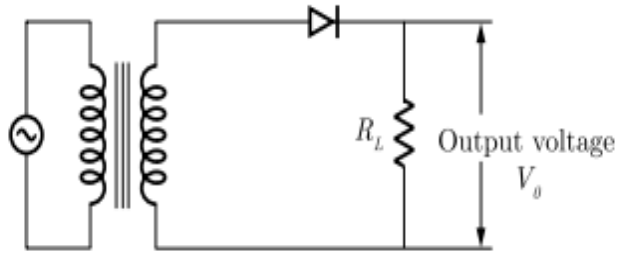
(c) semiconductors.

SECTION E

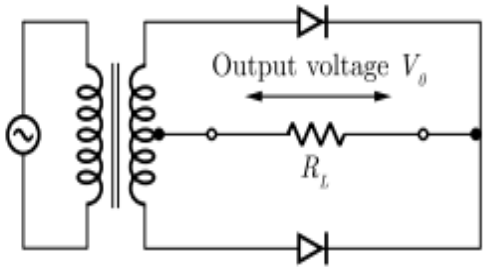
34 **Case Study :** 4

Read the following paragraph and answer the questions.

Rectifier is a device which is used for converting alternating current or voltage into direct current or voltage. Its working is based on the fact that the resistance of p-n junction becomes low when forward biased and becomes high when reverse biased. A half-wave rectifier uses only a single diode while a full wave rectifier uses two diodes as shown in figures (a) and (b):



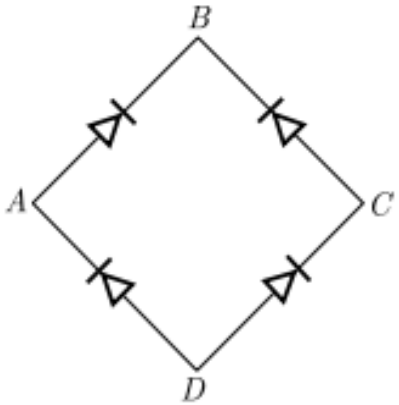
(a) Half wave rectifier



(b) Full wave rectifier

(i) If the rms value of sinusoidal input to a full wave rectifier is $V_0/\sqrt{2}$. What is the rms value of the rectifier's output?

(ii) In the diagram, the alternating input is across the terminals A and C. What is the output across B and D?



(iii) What is the use of rectifier in AM radio?

OR

What is the efficiency of a full wave rectifier?

35 **Case Study:** 4

Read the following paragraph and answer the questions.

The lens maker's formula relates the focal length of a lens to the refractive index of the lens material and the radii of curvature of its two surfaces. This formula is called so because it is used by manufacturers to design lenses of required focal length from a glass of given refractive index. If the object is placed at infinity, the image will be formed at focus for both double convex lens and double concave lens. Therefore, lens maker's formula is,

$$\frac{1}{f} = \frac{\mu_2 - \mu_1}{\mu_1}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

When lens is placed in air, $\mu_1 = 1$ and $\mu_2 = \mu$.

The lens maker's formula takes the form,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(i) The radius of curvature of each face of biconcave lens with refractive index 1.5 is 30 cm. Calculate the focal length of the lens in air.

(ii) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. If focal length is 12 cm, then what is the refractive index of glass?

(iii) Why does an under-water swimmer cannot see very clearly even in absolutely clear water?

OR

An object is immersed in a fluid then that what should be the condition so the object becomes invisible?