PHYSICS

PAPER 1
(THEORY)

Maximum Marks: 70
Time Allotted: Three Hours
Reading Time: Additional Fifteen Minutes

Instructions to Candidates

1. You are allowed **an additional fifteen minutes** for **only** reading the question paper.
2. You must **NOT** start writing during reading time.
3. This question paper has **14 printed pages.**
4. **There are twenty questions in this paper**. Answer ***all*** questions.
5. There are **four** sections in the paper: **A, B, C and D**. **Internal choices** have been provided in **two questions** each in **Sections B, C** and **D**.
6. **Section A** consists of one question having fourteen sub-parts of **one mark** each.
7. While attempting **Multiple Choice Questions** in Section A, you are required to **write only ONE option as the answer.**
8. **Section B** consists of **seven questions** of **two marks** each.
9. **Section C** consists of **nine questions** of **three marks** each.
10. **Section D** consists of **three questions** of **five marks** each.
11. The intended marks for questions are given in brackets [ ].
12. A list of useful constants and relations is given at the end of this paper.
13. A simple scientific calculator without a programmable memory may be used for calculations.

Instruction to Supervising Examiner

1. Kindly read **aloud** the Instructions given above to all the candidates present in the examination hall.

Note: The Specimen Question Paper in the subject provides a realistic format of the Board Examination Question Paper and should be used as a practice tool. The questions for the Board Examination can be set from any part of the syllabus, though the format of the Board Examination Question Paper will remain the same as that of the Specimen Question Paper. The weightage allocated to various topics, as given in the syllabus, will be strictly adhered to.

SECTION A– 14 MARKS

Question 1

(A) In questions (i) to (vii) below, choose the correct alternative (a), (b), (c) or (d) for each of the questions given below:

(i) Two point charges +50nc and -50nc separated a distance of 1mm are kept well inside a large sphere of radius 1m. Electric flux emanating from the sphere is: **[1]**

(Analysis)

(a) 50×10^{-12} Vm

(b) 50×10^{-9} Vm

(c) 50×10^{-6} Vm

(d) Zero

(ii) Three straight, parallel wires are coplanar and perpendicular to the plane of the page. The currents I_1 and I_3 are directed out of the page. If wire 3 experiences no force due to the currents I_1 and I_2, then the current in the wire 2 is: **[1]**

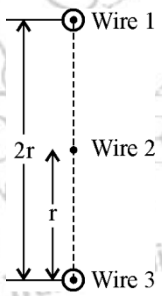


Figure 1

(Analysis)

(a) $I_2 = 2I_1$ and directed into the page

(b) $I_2 = 0.5I_1$ and directed into the page

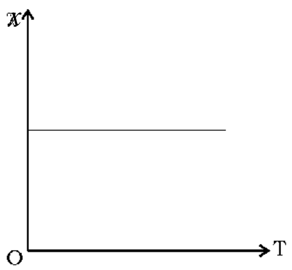
(c) $I_2 = 2I_1$ and directed out of the page

(d) $I_2 = 0.5I_1$ and directed out of the page

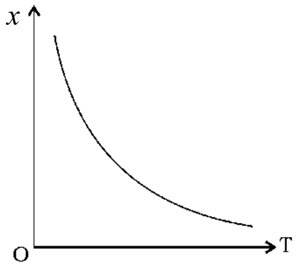
(iii) The variation of magnetic susceptibility (x) with absolute temperature (T) for a **diamagnetic substance** is: **[1]**

(Recall)

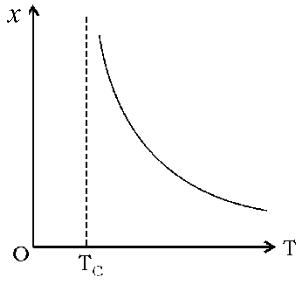
(a)



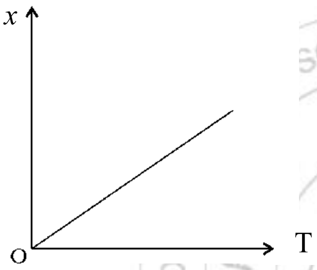
(b)



(c)



(d)



(iv) The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by: **(Understanding)** **[1]**

(a) $\lambda_p \propto \sqrt{\lambda_e}$

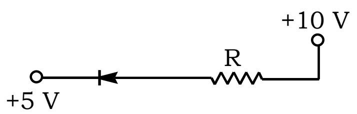
(b) $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$

(c) $\lambda_p \propto \lambda_e^2$

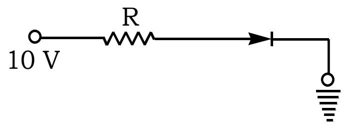
(d) $\lambda_p \propto \lambda_e$

(v) In which of the following figures, is the p-n diode forward biased? **(Recall)** **[1]**

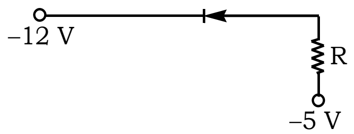
(P)



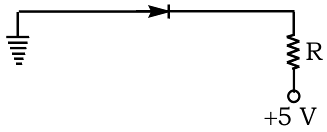
(Q)



(R)



(S)



(a) Only (P), (Q) and (S)

(b) Only (R)

(c) Only (P) and (R)

(d) Only (Q) and (S)

(vi) When a beam of white light is incident on a prism, the prism: **[1]**

(Understanding)

(a) only disperses the incident light.

(b) only deviates the incident light.

(c) deviates as well as disperses incident light.

(d) neither deviates nor disperses incident light.

(vii) Given below are two statements marked, Assertion and Reason. Read the two statements and choose the correct option. **[1]**

Assertion: The focal length of the convex mirror will increase, if the mirror is placed in water.

Reason: The focal length of a convex mirror of radius R is equal to R/2.

(Analysis)

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Assertion is true and Reason is false.

(d) Assertion is false and Reason is true.

(B) Answer the following questions briefly:

(i) Current I flowing through a metallic wire is gradually increased. Show **graphically** how heating power (P) developed in it varies with the current (I). **(Application)** **[1]**

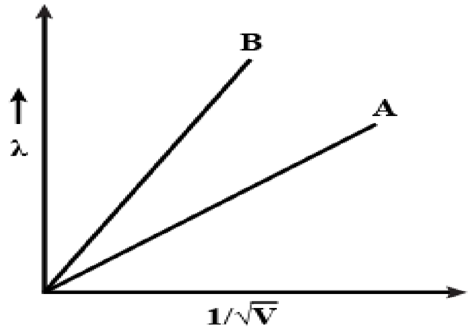
(ii) State one method to minimise **flux loss** in a transformer. **(Recall)** **[1]**

(iii) Why are giant telescopes of reflecting type? Give *any one* scientific reason. **[1]**

(Recall)

(iv) Give *any one* example where a ray of light travelling from one optical medium to another travels undeviated. **(Understanding)** **[1]**

(v) Two charged particles having same charge but different masses, are passed through a potential difference V. When V is varied, de-Broglie wavelength (λ) of the particles varies as shown in graphs below. Which graph is for heavier particles and why? **(Analysis)** **[1]**



(vi) What happens when an electron collides with a positron? **(Recall)** **[1]**

(vii) What is the direction of flow of electrons in a **solar cell**? **(Recall)** **[1]**

SECTION B – 14 MARKS

Question 2 **[2]**

(i) Find the capacitance of the following combinations between terminals A and B. Area of each plate is A and separation between nearest two plates is 'd'. **(Analysis)**

(a)

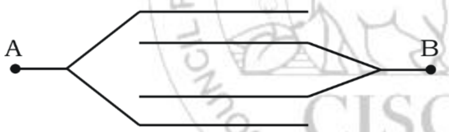


Figure 2

(b)

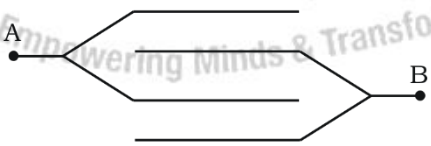
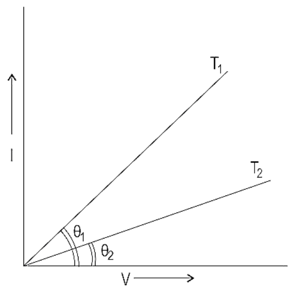


Figure 3

OR

(ii) The current (I)-voltage (V) graphs for a conductor are given at two different temperatures T_1 and T_2. **(Analysis)**



(a) At which temperature T_1 or T_2 is the resistance higher?

(b) Which temperature T_1 or T_2 is higher?

Question 3 **[2]**

Arrangement of an oxygen ion and two hydrogen ions in a water molecule is shown in ***Figure 4*** below.

Calculate electric dipole moment of water molecule. Express your answer in terms of e (charge on hydrogen ion), *l* and θ. **(Application)**

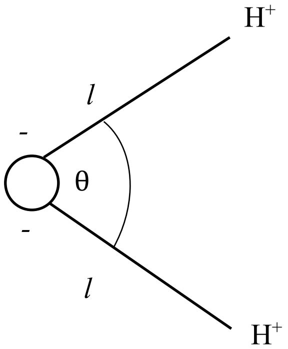


Figure 4

Question 4 **[2]**

(i) Two cells of same *emf* E, but different internal resistance r_1 and r_2 are connected to an external resistance R as shown in ***Figure 5*** given below. The voltmeter V reads zero. Obtain an expression for R in terms of r_1 and r_2. (Assume that the voltmeter V is of infinite resistance). **(Application)**

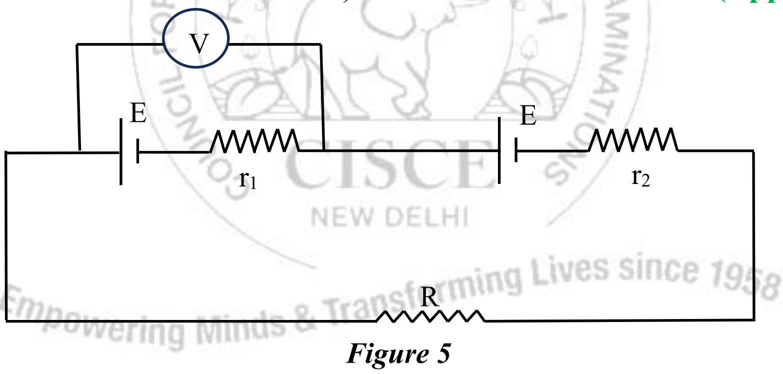


Figure 5

OR

(ii) Ramesh performed an experiment to determine an unknown resistance R using the circuit shown in ***Figure 6*** below. X is a resistance box and PQ is a 100cm potentiometer wire. He closed the key and inserted X = 1Ω, 2Ω ….. and recorded the null point (*l*) corresponding to different values of X.

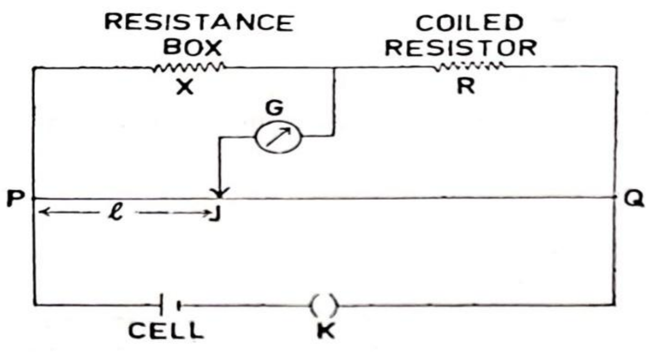


Figure 6 **(Application)**

(a) Identify the principle involved in calculating R.

(b) Write down a relation required to calculate the resistance R in terms of X and (*l*).

Question 5 **[2]**

Two moving coil galvanometers G_1 and G_2 are identical except that they have 50 turns and 20 turns and resistance of 10Ω and 1Ω respectively. Perform necessary calculations to check which one has greater voltage sensitivity.

(Application)

Question 6 **[2]**

Two similar convex lenses are made up of two different materials as shown in ***Figures 7 and 8*** below. Find the number of images formed in the following set ups:

(Application)

(i)

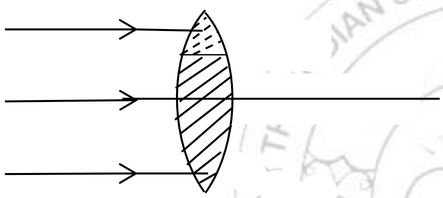


Figure 7

(ii)

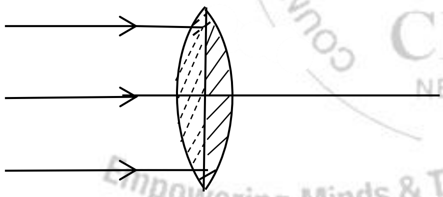


Figure 8

Question 7 **[2]**

Name the electromagnetic wave used in: **(Recall)**

(a) radars

(b) crystallography

Question 8 **[2]**

In the photoelectric effect, the maximum kinetic energy of the emitted photoelectron is ‘a’ and the work function of the metal is W_0. If the frequency of incident radiation is made ‘K’ times, then calculate the change in maximum KE of the ejected electron.

(Application)

SECTION C – 27 MARKS

Question 9 **[3]**

Obtain an expression for electric potential (V) at a point near a point charge 'Q'.

(Recall)

Question 10 **[3]**

(i) Five identical charges $Q = 2\mu C$ are placed equidistant on a semicircle as shown in ***Figure 9***. Another point charge $q = 1\mu C$ is kept at the center of the circle of radius 2cm. Calculate the electrostatic force experienced by the charge q.

(Application)

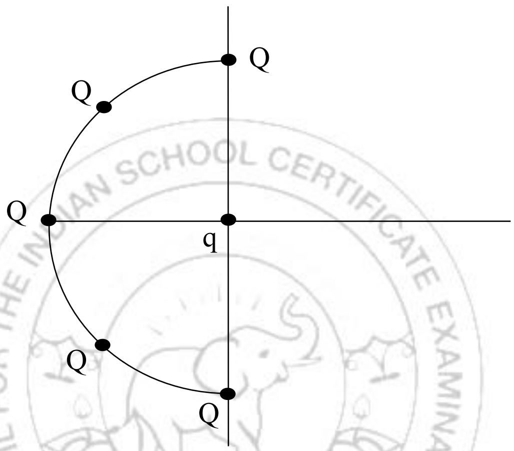


Figure 9

OR

(ii) Using Kirchoff's laws of electrical networks, calculate the current I_3.

(Application)

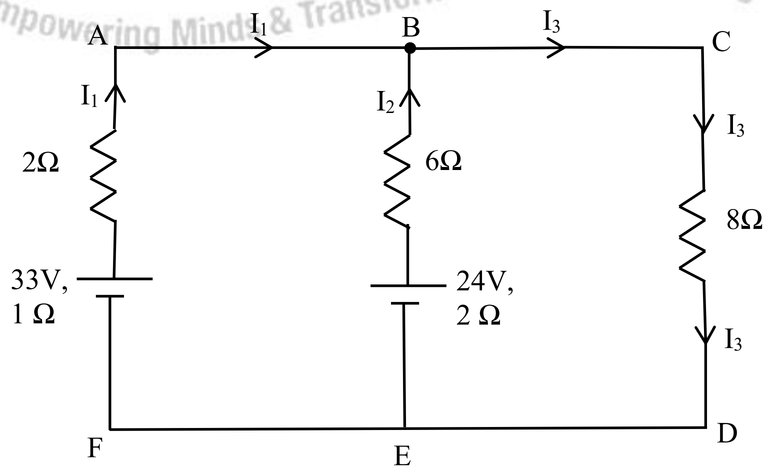


Figure 10

Question 11 **[3]**

Using Ampere circuital law, obtain an expression for magnetic field 'B' at a point at a perpendicular distance 'r' from a long current carrying conductor. **(Recall)**

Question 12 **[3]**

(i) A student records the following data for the magnitudes (B) of the magnetic field at **axial points** at different distances x (See ***Figure 11*** given below) from the centre O of a circular coil of radius a carrying a current I.

Verify (for any two) that these observations are in good agreement with the expected theoretical **values** of B. **(Application)**

X	$x = 0$	$x = a$	$x = 2a$	$x = 3a$
B	B_0	$\frac{B_0}{2\sqrt{2}}$	$\frac{B_0}{5\sqrt{5}}$	$\frac{B_0}{10\sqrt{10}}$

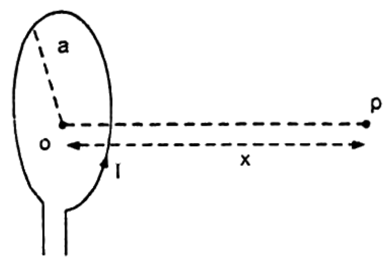


Figure 11

OR

(ii) An electron moving along positive X axis with a velocity of 8×10^7 ms^{-1} enters a region having uniform magnetic field $B = 1{\cdot}3 \times 10^{-3}$ T along positive Y axis. **(Application)**

(a) Explain why the electron describes a circular path.

(b) Calculate the radius of the circular path described by the electron.

Question 13 **[3]**

Study the diagram shown in ***Figure 12*** given below.

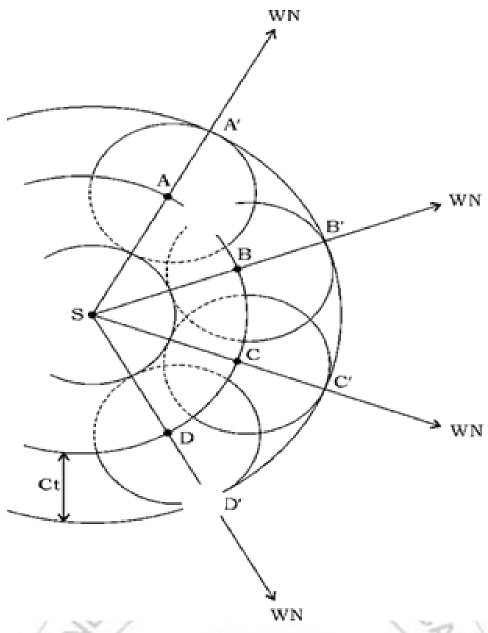


Figure 12

Identify the following in ***Figure 12.*** **(Understanding)**

(i) A primary wavefront

(ii) A secondary wavefront

(iii) A wave normal

Question 14 **[3]**

In Young's double slit experiment, show that fringe width ω (fringe separation) is given by

$$\omega = \frac{\lambda D}{d}$$

where the terms have their usual meaning. **(Recall)**

Question 15 **[3]**

With reference to the lens maker's formula, answer the following questions: **(Understanding)**

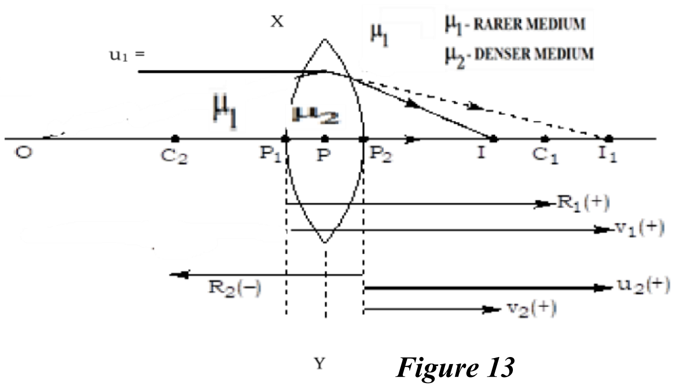


Figure 13

(i) Apply the formula (expression) of refraction at a single spherical surface to:

(a) refraction at first spherical surface.

(b) refraction at second spherical surface.

(ii) Combine these two expressions / equations to obtain an expression for focal length of the lens.

Question 16 **[3]**

(i) A student studies details of a microorganism with the help of an instrument. Name the instrument used by him. **(Recall)**

(ii) Draw a labelled ray diagram of an image formed by this instrument, assuming **(Recall)**

(a) a small upright object.

(b) image lies at least distance of distinct vision.

Question 17 **[3]**

In a hydrogen atom, an electron jumps from the first excited state to the ground state, and a photon is emitted. This photon is incident on a metal surface having a work function of 2eV. Calculate the stopping potential of the electron emitted from the metal surface. **(Analysis)**

SECTION D – 15 MARKS

Question 18 **[5]**

(i) (a) Define the co-efficient of self-inductance. **(Recall)**

(b) (1) Consider an A.C. source of frequency $\left(\frac{200}{\pi}\right)$ Hz applied across a coil. For each value of V- I in the tabulation, evaluate Inductive reactance and Self – Inductance of the coil. **(Analysis)**

S.No.	V(volt)	I(A)	Inductive Reactance	Self - Inductance
1	3.0	0.5		
2	6.0	1.0		
3	9.0	1.5		

(2) If a D.C. source be connected to the same coil, what would be the value of inductive reactance? **(Analysis)**

OR

(ii) Three students, X, Y and Z performed an experiment for studying the variation of A.C. with frequency in a **series LCR circuit** and obtained the graphs as shown below. They all used an AC source of the same emf and inductance of the same value.

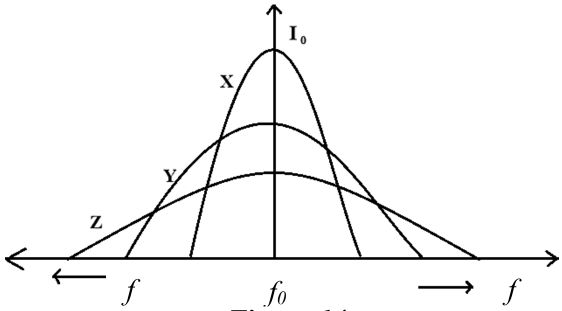


Figure 14

(a) Who used minimum resistance? **(Analysis)**

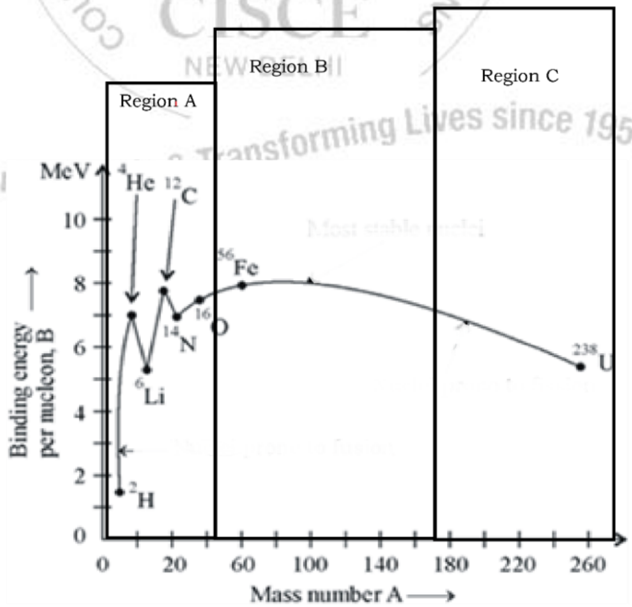
(b) In which case will the quality Q factor be **maximum**? **(Analysis)**

(c) What did the students conclude about the nature of impedance at resonant frequency (f_0)? **(Analysis)**

(d) An ideal capacitor is connected across 220V, 50Hz, and 220V, 100Hz supplies. Find the ratio of current flowing through it in the two cases. **(Application)**

Question 19 **[5]**

(i) (a) Study the graph shown below and answer the questions that follow. **(Recall)**



Indicate which region corresponds to:

(1) Nuclei prone to fission
(2) Nuclei prone to fusion
(3) Most stable nuclei

(b) In Rutherford's scattering experiment when an alpha particle (charge = +2e, mass = $4m_p$) approaches a gold nucleus (Z = 79), it is continuously repelled, so it loses its kinetic energy(K) and its potential energy increases. Finally, α-particle comes to rest momentarily when whole of the kinetic energy is change into the potential energy of the charge at that distance from the nucleus. Let this distance be r_o after which α-particle returns back again due to electrostatic repulsion.
Using the above information, derive an expression for r_o. **(Application)**

OR

(ii) (a) In an atom X, electrons absorb the energy from an external source. This energy "excites" the electrons from a lower-energy level to a higher-energy level around the nucleus of the atom. When electrons return to the ground state, they emit photons.
Figure 15 below is the energy level diagram of atom X with three energy levels, $E_1 = 0{\cdot}00$eV, $E_2 = 1{\cdot}78$eV and $E_3 = 2{\cdot}95$eV. **The ground state is considered 0 eV for reference.**

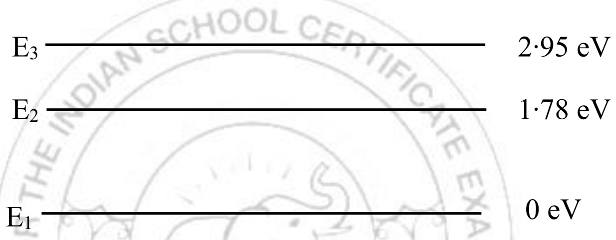


Figure 15

What wavelength of radiation is needed to excite the atom to energy level E_2 from E_1? **(Application)**

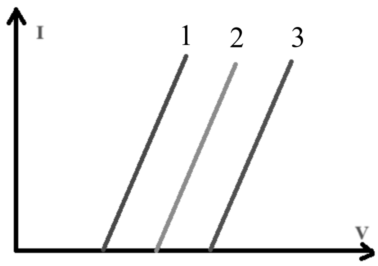
(b) According to Bohr's theory of hydrogen atom, calculate **(Application)**

(1) angular momentum of the electron in second Bohr orbit.

(2) radius of the third Bohr orbit.

Question 20 **[5]**

(i) A band gap is the distance between the valence band of electrons and the conduction band. Essentially, the band gap represents the minimum energy that is required to excite an electron up to a state in the conduction band where it can participate in conduction. The lower energy level is the valence band, and thus if a gap exists between this level and the higher energy conduction band, energy must be input for electrons to become free.
An LED is made of a p-type semiconductor material (which has a higher concentration of "holes" or positive charge carriers) and an n-type semiconductor material (which has a higher concentration of electrons or negative charge carriers). This recombination process releases energy in the form of light and heat. The specific wavelength (and therefore the colour) of the emitted light depends on the energy band gap of the semiconductor material used.
I-V characteristic of LED bulb is given below.



Identify the wavelength that has: **(Application)**

(a) The maximum energy gap

(b) The minimum energy gap

(ii) E is the energy of the incident photon and Eg is energy gap, which is produced across the depletion layer. What will happen in the following cases: **(Understanding)**

(a) E > Eg

(b) E = Eg

(c) E < Eg

USEFUL CONSTANTS AND RELATIONS

1.	Planck's constant	h	=	$6{\cdot}6 \times 10^{-34}$ Js
2.	Speed of light in vacuum	c	=	3×10^{8} ms^{-1}
3.	Charge of a proton = Charge of an electron	e	=	$\pm 1{\cdot}6 \times 10^{-19}$ C
4.	Mass of an electron	m	=	$9{\cdot}1 \times 10^{-31}$ Kg
5.	Bohr radius	a_o	=	$5{\cdot}3 \times 10^{-11}$ m
6.	Ionisation energy of hydrogen atom	E	=	$13{\cdot}6$ eV
7.	One electron volt	1 eV	=	$1{\cdot}6 \times 10^{-19}$ J

PHYSICS

PAPER 1

(THEORY)

ANSWER KEY

(Equivalent answers are acceptable.)

SECTION A– 14 MARKS

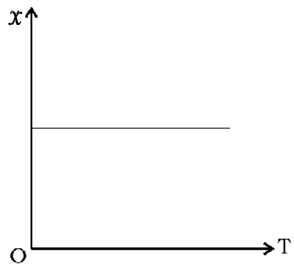
Question 1

(A) **In answering Multiple Choice Questions, candidates have to write either the correct option number or the statement against it. Please note that only ONE correct answer should be written.**

(i) (d) or Zero **[1]**

(ii) (c) or $I_2 = 2I_1$ and directed out of the page **[1]**

(iii) (a) or **[1]**



(iv) (c) or $\lambda_p \propto \lambda_e^2$ **[1]**

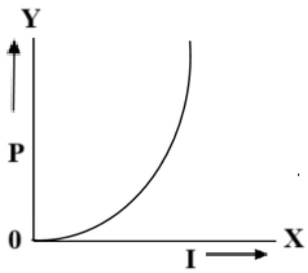
(v) (b) or Only (R) **[1]**

(vi) (c) or deviates as well as disperses incident light. **[1]**

(vii) (d) or Assertion is false and Reason is true. **[1]**

(B) Answer the following questions briefly:

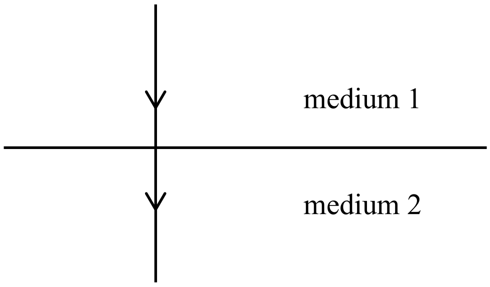
(i) **[1]**



(ii) By winding the primary and secondary coils close together, ideally one over the other (interleaving), and by using a core with a high permeability. **[1]**

(iii) Images formed by a reflecting telescope are free from the defect of chromatic aberration. / Images formed by a reflecting telescope are free from the defect of spherical aberration. / Images formed by a reflecting telescope are brighter. **[1]**

(iv) When a ray of light is incident normally on the surface of separation **[1]**



OR

When refractive index of medium 1is equal to refractive index of medium 2.

OR

$$\mu_1 = \mu_2$$

(v) $M_B > M_A$ as slope of line B >slope of line A. $S = \frac{h}{\sqrt{2meV}}$ **[1]**

OR

Graph B refers to heavier particles.

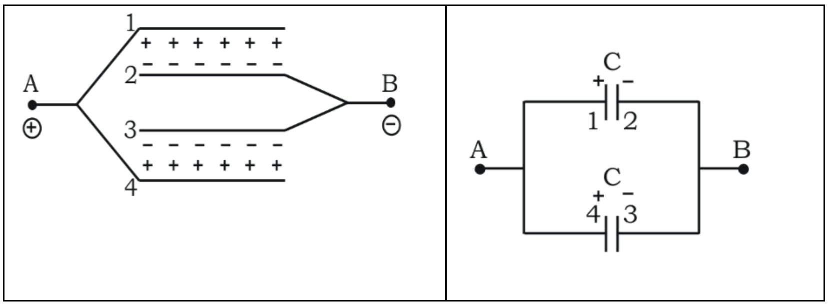
(vi) They annihilate each other producing gamma ray photons. **[1]**

(vii) Electrons move towards the n-type material, and holes move towards the p-type material, creating a flow of current when a circuit is connected. **[1]**

SECTION B – 14 MARKS

Question 2 **[2]**

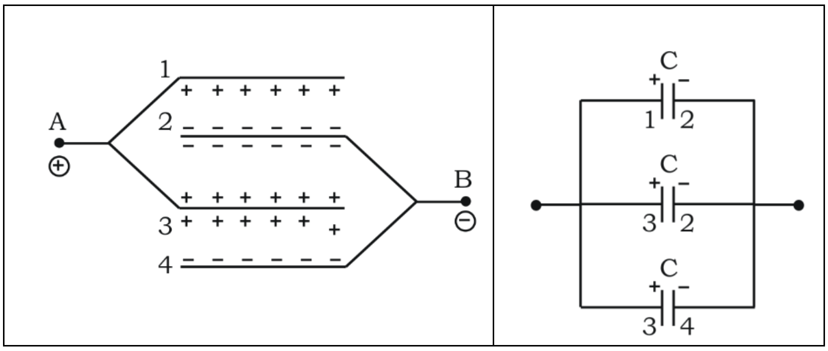
(i) (a) When A and B are connected to the positive and negative plates of the battery respectively, the charges will appear on them as:



It is clear from the figure that two capacitors form which are in parallel. Thus,

$$C_{AB} = 2C = \frac{2\epsilon_0 A}{d}$$

(b)



There are three capacitors in parallel. Thus, $C_{AB} = 3C = \frac{3\epsilon_0 A}{d}$

OR

(ii) (a) For the I-V graph, the slope of the I-V graph gives the conductance

$R = \frac{V}{I} = \frac{1}{\tan\theta}$

Since $\theta_1 > \theta_2$

$\tan\theta_1 > \tan\theta_2$

So Resistance at T_1 < Resistance at T_2.

(b) Since the resistance of a conductor rises with temperature and 'R' at T_2 is higher than 'R' at T_1, so $T_2 > T_1$.

Question 3 **[2]**

$P_1 = P_2 = e \times l$

$P = 2p \cos \alpha = 2\, e \times l \cos (\theta/2)$

Question 4 **[2]**

(i) The total emf in the circuit is, $E+E=2E$

The total resistance in the circuit is, $R+r_1+r_2$

The current in the circuit is given by: $I = \frac{2E}{R+r_1+r_2}$

Given $V = E - Ir_1 = 0$

$\therefore Ir_1 = E$

$\therefore \frac{2E}{R + r_1 + r_2} \times r_1 = E$

$R = r_1 - r_2$

OR

(ii) (a) Wheatstone Bridge Principle

(b) $R = \frac{X(100-l)}{l}$

Question 5 **[2]**

Voltage sensitivity $\beta = \frac{BAN}{CR}$

$$\beta\ (G_1) = \frac{B.A.50}{C.10} = 5\frac{BA}{c}$$

$$\beta\ (G_2) = \frac{B.A.20}{C.1} = 20\frac{BA}{c}$$

G_2 has greater voltage sensitivity.

Question 6 **[2]**

(i) Two images

(ii) One image

Question 7 **[2]**

(i) Microwaves

(ii) X rays

Question 8 **[2]**

$a_1 = h\nu - Wo$

$a_2 = h\,(k\nu) - Wo$

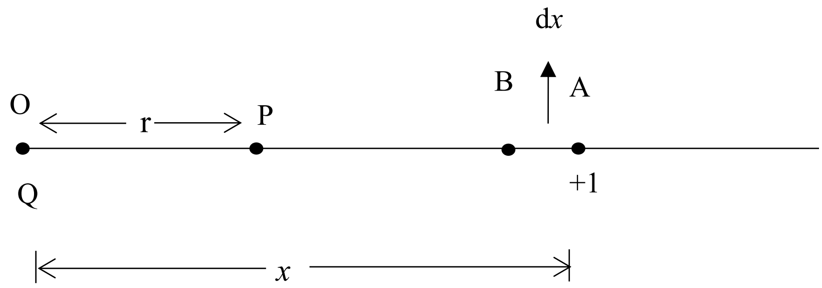
$a_2 - a_1 = (kh\nu - Wo) - (h\nu - Wo)$

$= kh\nu - h\nu$

$= (k-1)\,h\nu$

SECTION C – 27 MARKS

Question 9 **[3]**



$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{Q\times 1}{x^2} = \left(\frac{1}{4\pi\epsilon_0}\right)\frac{Q}{x^2}$

$dW = -Fdx$

$= -\left(\frac{1}{4\pi\epsilon_0}\right)\frac{Q}{x^2}\,dx$

$V = W = \int_{\infty}^{r} dW = \int_{\infty}^{r} -\left(\frac{1}{4\pi\epsilon_0}\right)\frac{Q}{x^2}\,dx$

$V = \left(\frac{1}{4\pi\epsilon_0}\right)\frac{Q}{r}$

This is the desired expression.

Question 10 **[3]**

(i) Force acting on q due to Q_1 and Q_5 are opposite direction, so cancel to each other.

Force acting on q due to Q_3 is $F_3 = \frac{qQ3}{4\pi\varepsilon_o R^2}$

Force acting on q due to Q_2 and Q_4

Resolving in two-component method:
(1) Vertical Component:
Q_2 Sin θ and Q_4 Sinθ are equal and opposite directions, so they cancel to each other.
(2) Horizontal Component:
Q_2 Sin θ and Q_4 cos θ are equal and same direction, so they can get added.
$F_{24} = F_{2q} + F_{4q} = F_2 \cos 45° + F_4 \cos 45°$
$F_{24} = \frac{qQ2}{4\pi\varepsilon_o R^2}\cos 45° + \frac{qQ4}{4\pi\varepsilon_o R^2}\cos 45°$
Resultant net force F

$$F = \frac{1}{4\pi\varepsilon_0}\frac{qQ}{R^2}\left[1+\sqrt{2}\right]N$$

OR

(ii) $I_3 = I_3 + I_2$

Applying KVL to the loop ABCDEFA,

$2I_1 + 8\,(I_1 + I_2) + 1I_1 = 33$

$11I_1 + 8I_2 = 33$

Applying KVL to the loop BCDEB,

$6I_2 + 8\,(I_1 + I_2) + 2I_2 = 26$

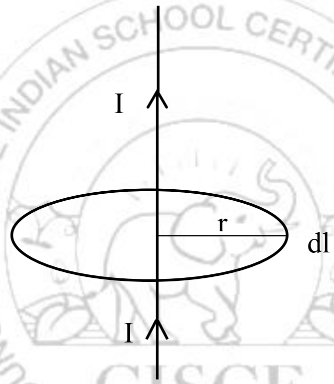
$8I_1 + 9I_2 = 24$

On solving, we get

$I_1 = 3A, \qquad I_2 = 0$

$\therefore\ I_3 = 3A$

Question 11 **[3]**



By Ampere Circuital law,

$\oint \vec{B}.\vec{dl} = \mu_0 I$

$\oint Bdl\ \cos\theta° = \mu_0 I$

$\oint Bdl = \mu_0 I$

$B \oint dl = \mu_0 I$

$B.2\pi r = \mu_0 I$

$B = \frac{\mu_0 I}{2\pi r}$

Question 12 **[3]**

(i) The expression for B at an axial point of a circular coil carrying current is,

$B = \frac{\mu 0}{4\pi}\frac{2NI(\pi a^2)}{r^3}$, for N turns

$B = \frac{\mu 0}{4\pi}\frac{2I(\pi a^2)}{r^3}$, for N= 1 turn

At the center, x = 0: $= \frac{\mu 0}{2}\frac{I}{a}$

At $x = a: = \frac{B_0}{2\sqrt{2}}$

At $x = 2a : = \frac{B_0}{5\sqrt{5}}$

At $x = 3a : = \frac{B_0}{10\sqrt{10}}$

OR

(ii) (a) Because force exerted by the magnetic field is always perpendicular to its velocity. So, it provides the necessary centripetal force to the electron.

(b) $\frac{e}{m} = \frac{v}{Br}$

$\frac{1 \cdot 6 \times 10^{-19}}{9 \cdot 1 \times 10^{-31}} = \frac{8 \times 10 \times 7}{1 \cdot 3 \times 10^{-3} \times r}$

So, r = 0·35m

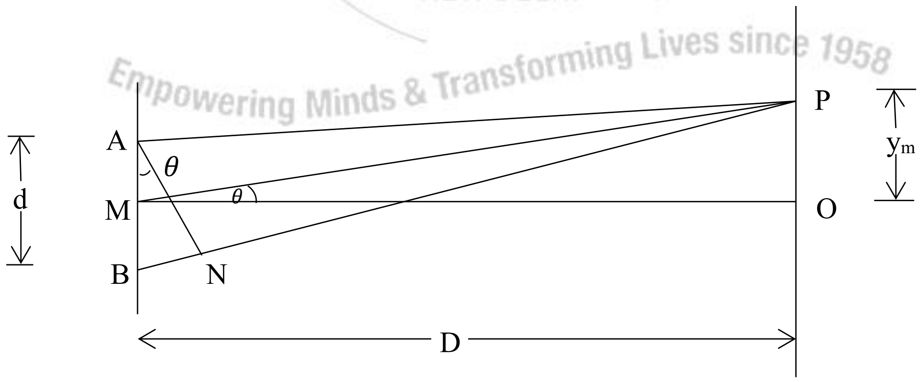
Question 13 **[3]**

(i) ABCD

(ii) A'B'C'D'

(iii) SDD' or SCC' or SBB' or SAA'

Question 14 **[3]**



Because θ is small,
$\tan \theta \approx \sin \theta$

$\frac{y_m}{D} = \frac{BN}{AB} = \frac{m\lambda}{d}$

$y_m = \frac{m\lambda}{d}$

$\omega = y_m - y_{m-1}$

$= \frac{m\lambda D}{d} - (m-1)\frac{\lambda D}{d}$

$\omega = \frac{\lambda D}{d}$ (Proved)

Question 15 **[3]**

(i) (a) $\frac{\mu_1}{u} + \frac{\mu_2}{\vartheta'} = \frac{\mu_2 - \mu_1}{R_1}$

$\frac{1}{\mu} + \frac{\mu_2}{\vartheta'} = \frac{\mu_2 - 1}{R_1}$

(b) $\frac{\mu_2}{-\vartheta'} + \frac{\mu_2}{\vartheta} = \frac{\mu_2 - 1}{R_2}$

(ii) Adding

$\frac{1}{u} + \frac{1}{\vartheta} = (\mu_2 - 1)\,(\frac{1}{R_1} + \frac{1}{R_2})$

When u = ∞, $\vartheta = f$

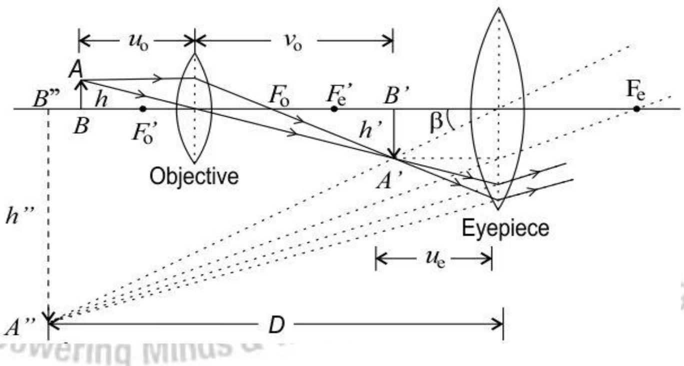
$\frac{1}{\infty} + \frac{1}{f} = (\mu_2 - 1)\,(\frac{1}{R_1} + \frac{1}{R_2})$

$\therefore \frac{1}{f} = (\mu_2 - 1)\,(\frac{1}{R_1} + \frac{1}{R_2})$

Question 16 **[3]**

(i) Compound microscope

(ii)



Question 17 **[3]**

E = -3.4 –(-13.6) = 10.2ev

eVo = E – Wo

= 10.2 – 2

Or, V = 8.2V

SECTION D – 15 MARKS

Question 18 **[5]**

(i) (a) It is defined as magnetic flux linked with the solenoid when unit current flows through it.

Or

It is defined as a ratio of magnetic flux linked with the solenoid to the current flowing through it.

(b) (1)

S.No.	V(volt)	I(A)	Inductive Reactance	Self - Inductance
1	3·0	0·5	6·0 Ω	0·015H
2	6·0	1·0	6·0 Ω	0·015H
3	9·0	1·5	6·0 Ω	0·015H

(2) Zero

OR

(ii) (a) Resistance used by X is the least and resistance used by Z is the maximum.

(b) Q will be maximum for X.

(c) At resonance impedance is equal to ohmic resistance.

(d) In a capacitor the current is dependent directly on frequency

$\frac{I_1}{I_2} = \frac{1}{2}$

Question 19 **[5]**

(i) (a) (1) Region C
(2) Region A
(3) Region B

(b) At the distance of closest approach r_0 this energy has changed into potential energy U of the α-particle.

$U = \frac{1}{4\pi\epsilon_0} \times \frac{(Ze \cdot 2e)}{r_0}$

where Z = 79 is the atomic number of gold nucleus

Thus we have,

$K = \frac{1}{4\pi\epsilon_0} \times \frac{2(79)e^2}{r_0}$

$r_0 = \frac{1}{4\pi\epsilon_0} \times \frac{158e^2}{K}$

OR

(ii) (a) $E = E_2 - E_1$

$\frac{hc}{\lambda} = E_2 - E_1$

$= \frac{6\cdot6 \times 10^{-34} \times 3 \times 10^{8}}{\lambda} = (1\cdot 78 - 0) \times 1\cdot6 \times 10^{-19}$

$\lambda = \frac{6\cdot6 \times 3 \times 10^{-26}}{1\cdot78 \times 1\cdot6 \times 10^{-19}}$

$\lambda = 6\cdot952 \times 10^{-7} m$

(b) (1) $l_2 = 2\text{h} = \frac{2h}{2\pi}$

$= \frac{6\cdot6 \times 10^{-34}}{3\cdot14}$

$= 2\cdot1 \times 10^{-34} Js$

(2) $r_n = n^2 a_0$

$r_3 = 3^2 \times 5\cdot3 \times 10^{-11}$

$= 47\cdot7 \times 10^{-11} m$

Question 20 **[5]**

(i) (a) 3

(b) 1

(ii) (a) Emission of photon with energy

(b) Emission of photon with no energy

(c) No emission of photon