



PHYSICS
PAPER 1
(THEORY)
ANSWER KEY

(Equivalent answers are acceptable.)

SECTION A– 14 MARKS

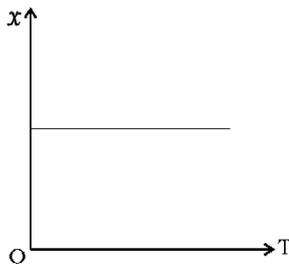
Question 1

(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]

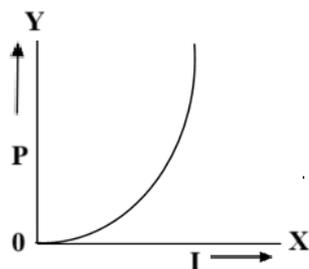
(v) (b) or Only (R) [1]

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

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

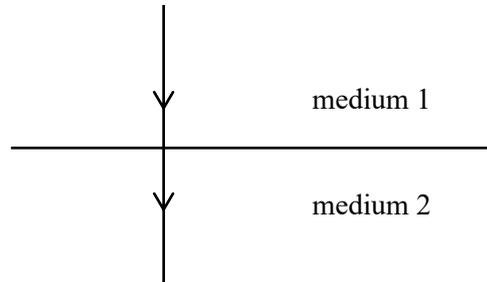
(B) Answer the following questions briefly:

(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 1 is 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

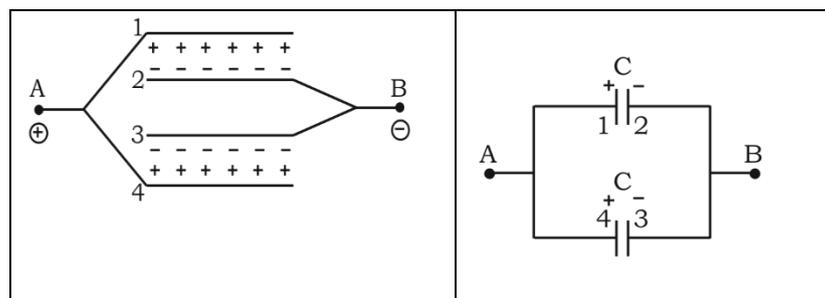
Graph B refers to heavier particles.

- (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

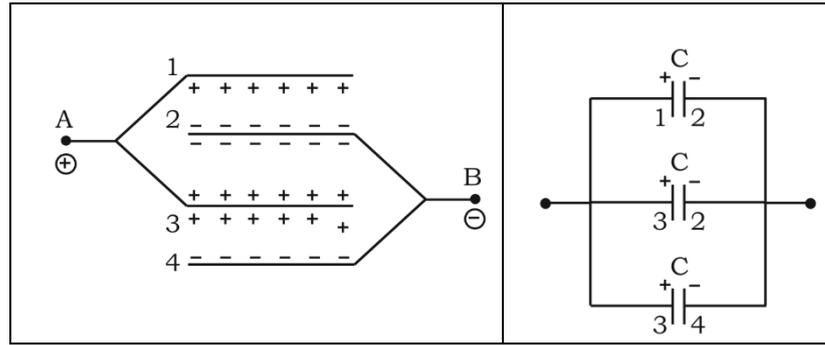
- (i) (a) When A and B are connected to the positive and negative plates of the battery respectively, the charges will appear on them as: [2]



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

$$P_1 = P_2 = e \times l$$

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

[2]

Question 4

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

[2]

Question 5**[2]**

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

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

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

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]**

$$a_1 = h\nu - W_0$$

$$a_2 = h(k\nu) - W_0$$

$$a_2 - a_1 = (kh\nu - W_0) - (h\nu - W_0)$$

$$= kh\nu - h\nu$$

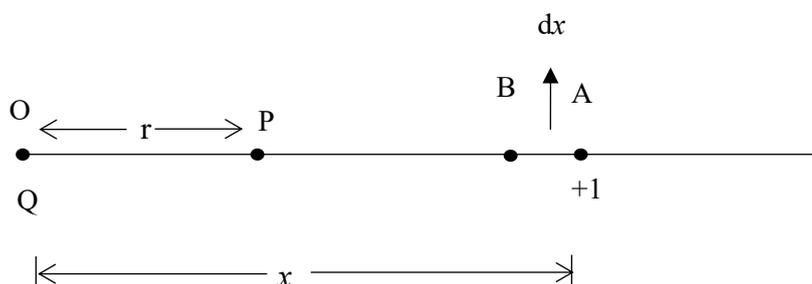
$$= (k-1) h\nu$$



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.

$$\text{Force acting on } q \text{ due to } Q_3 \text{ is } F_3 = \frac{qQ_3}{4\pi\epsilon_0 R^2}$$

Force acting on q due to Q_2 and Q_4

Resolving in two-component method:

(1) Vertical Component:

$Q_2 \sin \theta$ and $Q_4 \sin \theta$ are equal and opposite directions, so they cancel to each other.

(2) Horizontal Component:

$Q_2 \cos \theta$ and $Q_4 \cos \theta$ are equal and same direction, so they can get added.

$$F_{24} = F_{2q} + F_{4q} = F_2 \cos 45^\circ + F_4 \cos 45^\circ$$

$$F_{24} = \frac{qQ_2}{4\pi\epsilon_0 R^2} \cos 45^\circ + \frac{qQ_4}{4\pi\epsilon_0 R^2} \cos 45^\circ$$

Resultant net force F

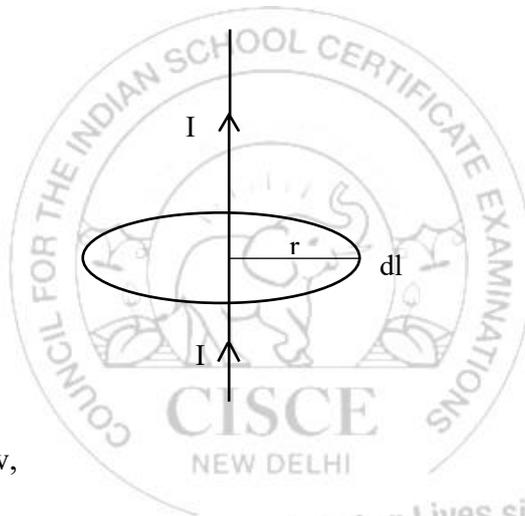
$$F = \frac{1}{4\pi\epsilon_0} \frac{qQ}{R^2} [1 + \sqrt{2}] \text{ N}$$

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
 $I_1 = 3A, \quad I_2 = 0$
 $\therefore I_3 = 3A$

Question 11

[3]



By Ampere Circuital law,

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$\oint B dl \cos \theta^\circ = \mu_0 I$$

$$\oint B dl = \mu_0 I$$

$$B \oint dl = \mu_0 I$$

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

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

Question 12

[3]

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

$$B = \frac{\mu_0 2NI(\pi a^2)}{4\pi r^3}, \text{ for } N \text{ turns}$$

$$B = \frac{\mu_0 2I(\pi a^2)}{4\pi r^3}, \text{ for } N=1 \text{ turn}$$

$$\text{At the center, } x = 0: = \frac{\mu_0 I}{2 a}$$

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

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

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

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

$$\frac{1.6 \times 10^{-19}}{9.1 \times 10^{-31}} = \frac{8 \times 10 \times 7}{1.3 \times 10^{-3} \times r}$$

$$\text{So, } r = 0.35\text{m}$$

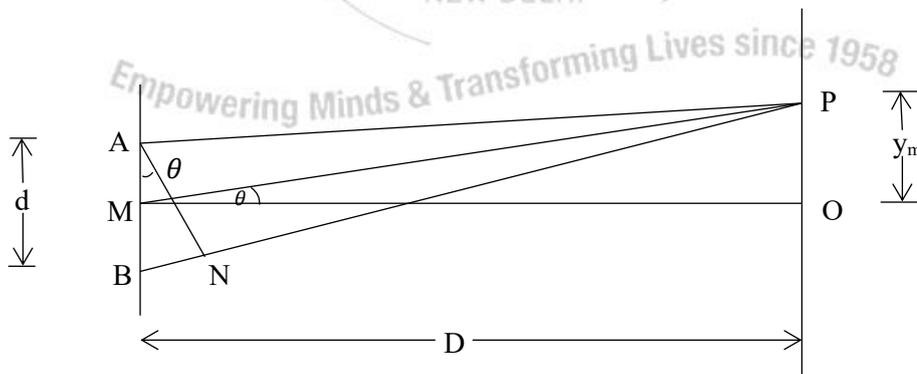
Question 13

[3]

- (i) ABCD
 (ii) A'B'C'D'
 (iii) SDD' or SCC' or SBB' or SAA'

Question 14

[3]



Because θ is small,

$$\tan \theta \approx \sin \theta$$

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

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

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

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

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

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

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

When $u = \infty$, $\vartheta = f$

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

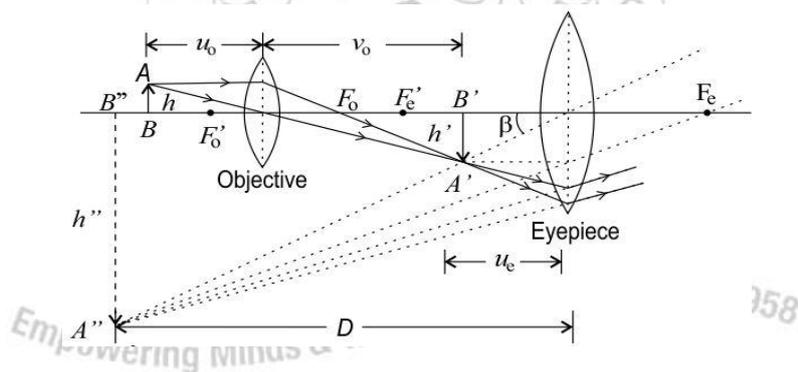
$$\therefore \frac{1}{f} = (\mu_2 - 1) \left(\frac{1}{R_1} + \frac{1}{R_2} \right)$$

Question 16

[3]

(i) Compound microscope

(ii)



Question 17

[3]

$$E = -3.4 - (-13.6) = 10.2 \text{ eV}$$

$$eV_0 = E - W_0$$

$$= 10.2 - 2$$

Or, $V = 8.2 \text{ V}$

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) $E = E_2 - E_1$
 $\frac{hc}{\lambda} = E_2 - E_1$
 $= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{\lambda} = (1.78 - 0) \times 1.6 \times 10^{-19}$
 $\lambda = \frac{6.6 \times 3 \times 10^{-26}}{1.78 \times 1.6 \times 10^{-19}}$
 $\lambda = 6.952 \times 10^{-7} m$

(b) (1) $l_2 = 2h = \frac{2h}{2\pi}$
 $= \frac{6.6 \times 10^{-34}}{3.14}$
 $= 2.1 \times 10^{-34} Js$

(2) $r_n = n^2 a_0$
 $r_3 = 3^2 \times 5.3 \times 10^{-11}$
 $= 47.7 \times 10^{-11} m$

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

Empowering Minds & Transforming Lives since 1958