# PHYSICS

## PAPER – 1

## (THEORY)

***(Maximum Marks: 70)***

***(Time allowed: Three hours)***

*(Candidates are allowed additional 15 minutes for **only** reading the paper. They must NOT start writing during this time.)*

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*Answer **all** questions in **Part I** and **ten** questions from **Part II**, choosing **four** questions from Section **A**, **three** questions from Section **B** and **three** questions from Section **C**.*

*All working, including rough work, should be done on the same sheet as, and adjacent to, the rest of the answer.*

*The intended marks for questions or parts of questions are given in brackets [ ].*

*(Material to be supplied: Log tables including Trigonometric functions)*

*A list of useful physical constants is given at the end of this paper.*

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### PART I (20 Marks)

*Answer **all** questions.*

**Question 1**

**A.** Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: **[5]**

(i) The electrostatic potential energy of two point charges, 1 μC each, placed 1 meter apart in air is:

(a) $9\times10^{3}$J
(b) $9\times10^{9}$J
(c) $9\times10^{-3}$J
(d) $9\times10^{-3}$eV

(ii) A wire of resistance 'R' is cut into 'n' equal parts. These parts are then connected in parallel with each other. The equivalent resistance of the combination is:

(a) nR
(b) R/n
(c) $n/R^2$
(d) $R/n^2$

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(iii) Magnetic susceptibility of platinum is 0·0001. Its relative permeability is:

(a) 1·0000

(b) 0·9999

(c) 1·0001

(d) 0

(iv) When a light wave travels from air to glass:

(a) its wavelength decreases.

(b) its wavelength increases.

(c) there is no change in wavelength.

(d) its frequency decreases.

(v) A radioactive substance decays to $1/16^{th}$ of its initial mass in 40 days. The half life of the substance, in days, is:

(a) 20

(b) 10

(c) 5

(d) 2·5

**B.** Answer **all** questions given below **briefly** and to the point: **[15]**

(i) **Maximum** torque acting on an electric dipole of moment $3\times10^{-29}$ Cm in a uniform electric field E is $6\times10^{-25}$ Nm. Find E.

(ii) What is meant by **drift speed** of free electrons?

(iii) On which conservation principle is **Kirchoff's Second Law** of electrical networks based?

(iv) Calculate magnetic flux density of the magnetic field at the centre of a circular coil of 50 turns, having radius of 0·5m and carrying a current of 5 A.

(v) An a.c. generator generates an emf '$\varepsilon$' where $\varepsilon = 314\ Sin(50\pi t)\ volt.$ Calculate the **frequency** of the emf $\varepsilon$.

(vi) With what type of source of light are **cylindrical** wave fronts associated?

(vii) How is fringe width of an interference pattern in **Young's double slit experiment** affected if the two slits are brought closer to each other?

(viii) In a **regular** prism, what is the relation between angle of incidence and angle of emergence when it is in the **minimum deviation** position?

(ix) A converging lens of focal length 40 cm is kept in contact with a diverging lens of focal length 30 cm. Find the focal length of the combination.

(x) How can the **spherical aberration** produced by a lens be minimised?

(xi) Calculate the **momentum** of a **photon** of energy $6\times10^{-19}$J.

(xii) According to **Bohr**, 'Angular momentum of an orbiting electron is quantised'. What is meant by this statement?

(xiii) Why nuclear fusion reaction is also called **thermo-nuclear** reaction?

(xiv) What is the **minimum** energy which a gamma ray photon must possess in order to produce **electron-positron** pair?

(xv) Show the variation of voltage with time, for a **digital** signal.

## PART II (50 Marks)

*Answer **ten** questions in this part, choosing **four** questions from Section **A**, **three** questions from Section **B** and **three** questions from Section **C**.*

## SECTION A

*Answer any **four** questions.*

**Question 2**

(a) Show that **electric potential** at a point P, at a distance 'r' from a fixed point charge $Q$, is given by: **[4]**

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

(b) Intensity of electric field at a perpendicular distance of 0·5 m from an infinitely long line charge having linear charge density ($\lambda$) is $3\cdot6\times10^3$ $Vm^{-1}$. Find the value of $\lambda$. **[1]**

**Question 3**

(a) Three capacitors $C_1 = 3\mu F$, $C_2 = 6\mu F$ and $C_3 = 10\mu F$ are connected to a 50 V battery as shown in the ***Figure 1*** below: **[3]**

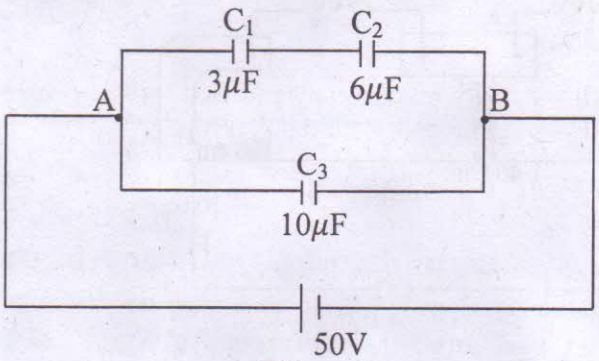


***Figure 1***

Calculate:

(i) The equivalent capacitance of the circuit between points A and B.

(ii) The charge on $C_1$.

(b) Two resistors $R_1$= 60 Ω and $R_2$ = 90 Ω are connected in **parallel**. If electric power consumed by the resistor $R_1$ is 15 W, calculate the power consumed by the resistor $R_2$. [2]

**Question 4**

(a) ***Figure 2*** below shows two resistors $R_1$ and $R_2$ connected to a battery having an emf of 40V and negligible internal resistance. A voltmeter having a resistance of 300Ω is used to measure potential difference across $R_1$. Find the reading of the voltmeter. [3]

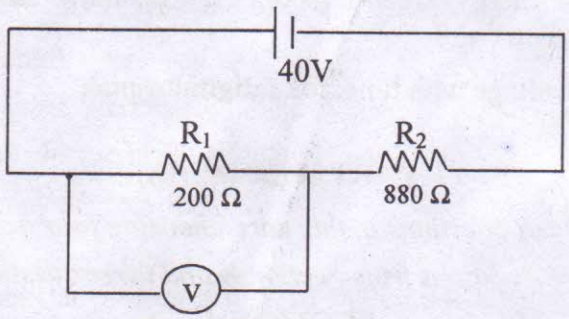


***Figure 2***

(b) A moving coil galvanometer has a coil of resistance 59Ω. It shows a full scale deflection for a current of 50 mA. How will you convert it to an **ammeter** having a range of 0 to 3A? [2]

**Question 5**

(a) In a meter bridge circuit, resistance in the left hand gap is 2 Ω and an unknown resistance X is in the right hand gap as shown in ***Figure 3*** below. The null point is found to be 40 cm from the left end of the wire. What resistance should be connected to X so that the new null point is 50 cm from the left end of the wire? [3]

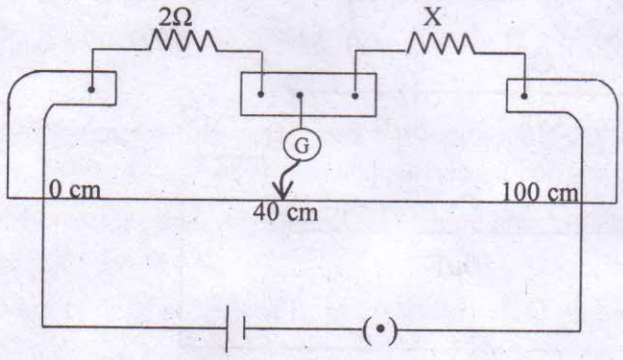


***Figure 3***

(b) The horizontal component of earth's magnetic field at a place is $\frac{1}{\sqrt{3}}$ times the vertical component. Determine the **angle of dip** at that place. [2]