

SECTION A (1 MARK)

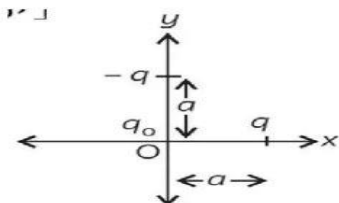
- Two charges- q each are placed at the vertices A and B of an equilateral triangle ABC. If M is the mid-point of AB, the net electric field at C will point along
(a) CA (b) CB (c) MC (d) CM
- Two identical small conducting balls B_1 and B_2 are given -7 pC and $+4\text{ pC}$ charges, respectively. They are brought in contact with a third identical ball B_3 and then separated. If the final charge on each ball is -2 pC , the initial charge on B_3 was
(a) -2 pC (b) -3 pC (c) -5 pC (d) -15 pC
- Two metallic spheres of radii a and b , respectively are charged and joined by a wire. The ratio of the electric field intensities at the surface of the spheres is
(a) a/b (b) b/a (c) a^2/b^2 (d) b^2/a^2
- An electric dipole placed in an electric field of intensity $2 \times 10^5\text{ N/C}$ at an angle of 30° experiences a torque equal to 4 Nm . The charge on the dipole of dipole length 2 cm is
(A) $7\mu\text{C}$ (B) 8 mC (C) 2 mC (D) 5 mC
- The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C . From the same charged object, the electric field of magnitude, 16 N/C will be at a distance of.
(A) 1 m (B) 2 m (C) 3 m (D) 6 m
- Which statement is true for Gauss law?
(A) All the charges whether inside or outside the Gaussian surface contribute to the electric flux.
(B) Electric flux depends upon the geometry of the Gaussian surface.
(C) Gauss theorem can be applied to a non-uniform electric field.
(D) The electric field over the Gaussian surface remains continuous and uniform at every point.

Answer following questions.**(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).****(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).****(C) Assertion (A) is true but Reason (R) is false.****(D) Assertion (A) is false but Reason (R) is true.**

- Assertion (A): In a non-uniform electric field, a dipole will have translatory as well as rotatory motion.
Reason (R): In a non-uniform electric field, a dipole experiences a force as well as torque.
- Assertion (A): Electric lines of force cross each other.
Reason (R): The resultant electric field at a point is the superposition of the electric fields at that point.
- Assertion (A): In Young's double slit experiment all fringes are of equal width.
Reason (R): The fringe width depends upon wavelength of light (λ) used, distance of screen from plane of slits (D) and slits separation (d)
- plane wavefront is incident on a concave mirror of radius of curvature R. The radius of the refractive wavefront will be
(a) R (b) $R/2$ (c) $2R$ (d) $R/4$
- In Young's double-slit experiment, the intensity on the screen is I_0 at a point where path difference is λ . The intensity at the point where path difference $\lambda/4$ is
(a) $I_0/4$ (b) $I_0/2$ (c) I_0 (d) zero
- Phase difference between any two points of a wavefront is
(A) π (C) 0 (B) $\pi/2$ (D) $\pi/4$
- In an experiment, photons of energy 7.5 eV are incident on a metal surface. Electrons emitted from the metal surface are stopped by an electrode at a potential of 4.5 V w.r.t. the metal. The work function of the metal is:
(a) 3.0 eV (b) 4.5 eV (c) 7.5 eV (d) 12.0 eV
- A heavy particle initially at rest splits spontaneously into two particles of masses m_1 and m_2 having non zero velocities. The ratio of de-Broglie wavelengths
a. m_1/m_2 b. m_2/m_1 c. 1 d. none
- Photons of energy 3.2 eV are incident on a photosensitive surface. If the stopping potential for the emitted electrons is 1.5 V , the work function for the surface is
(a) 1.5 eV (b) 1.7 eV (c) 3.2 eV (d) 4.7 eV

SECTION B (2 MARKS)

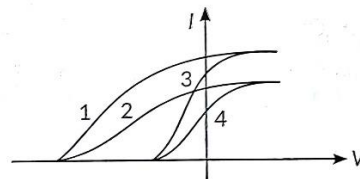
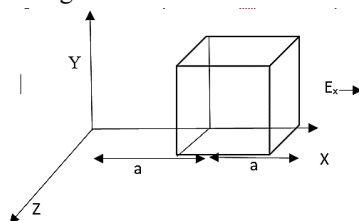
- State Gauss law in electrostatic? Use it to derive electric field due to a long conducting infinitely charged sheet.
- Three charges q , $-q$ and q_0 are placed as shown in figure. The magnitude on the net force on the charge q_0 at point O



14. Yellow light ($\lambda = 6000 \text{ \AA}$) illuminates a single slit of width $1 \times 10^{-4} \text{ m}$. Calculate (i) the distance between two dark lines on either side of central maximum, in the diffraction pattern observed on a screen kept 1.5 m away from the slit, and (ii) the angular spread of the first minimum

SECTION C (3 MARKS)

15. If a dipole is kept in a uniform electric field E then find the expression for torque. Diagrammatically represent the position of the dipole in stable and unstable equilibrium. Write the expression for torque in both cases.
16. The electric field component in the figure shown are $E_x = \beta x$, $E_y = 0$, $E_z = 0$. Where $\beta = 20 \text{ N/Cm}$. calculate the charge within the cube assuming $a = 0.1 \text{ m}$



17. The figure shows the variation of photoelectric current (I) versus applied voltage (V) for two photosensitive materials and for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials for same intensity of incident radiation. Justify your answers in brief.

SECTION D (5 MARKS)

18.

- An electric dipole of dipole moment \vec{P} consists of point charges $+q$ and $-q$ separated by a distance $2a$. deduce the expression for \vec{E} due to dipole at a distance x from the centre of dipole in equatorial plane.
- Two identical point charges, q each, are kept 2 m apart in the air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q .

OR

- Use Gauss' law to obtain an expression for the electric field due to an infinitely long thin straight wire with uniform linear charge density λ .
- An infinitely long positively charged straight wire has a linear charge density λ . An electron is revolving in a circle with a constant speed such that the wire passes through the centre and is perpendicular to the plane of the circle. Find the kinetic energy of the electron in terms of magnitudes of its charge and linear charge density λ on the wire.
- Draw a graph of kinetic energy as a function of linear charge density

19.

- In diffraction due to a single slit, the phase difference between light waves reaching a point on the screen is 5π . Explain whether a bright or a dark fringe will be formed at the point
- Prove wave form of light obey laws of refraction.
- Draw the plot of intensity distribution in a diffraction pattern due to a single slit.

OR

- Write different methods of electron emission. What is work function?
- Use Einstein's photoelectric equation to depict the variation of the maximum kinetic energy (E_k) of electrons emitted, with the frequency (ν) of the incident radiation.
- A photosensitive surface is illuminated with a beam of (i) yellow light, and (ii) red light, both of the same intensity.

In which case will

(I) photoelectrons have more E_k ?

(II) more numbers of electrons be emitted?

Justify your answer in each case.