	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII All Sections	**Department: SCIENCE 2025 – 26** **SUBJECT: PHYSICS**	**Date: 06/05/2025**
Worksheet No: 2	**CHAPTER: 2; ELECTROSTATIC POTENTIAL AND CAPACITANCE**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.**

SECTION A

Directions (Q1-Q6) Select the most appropriate option from those given below each question

1. Consider a group of charges q_1, q_2, q_3 ... such that $\Sigma q \neq 0$. Then equipotentials at a large distance, due to this group are approximately :

(A) Plane (B) Spherical surface

(C) Paraboloidal surface (D) Ellipsoidal surface

2. A proton is taken from point P_1 to point P_2, both located in an electric field. The potentials at points P_1 and P_2 are – 5 V and + 5 V respectively. Assuming that kinetic energies of the proton at points P_1 and P_2 are zero, the work done on the proton is :

(A) $-1{\cdot}6 \times 10^{-18}$ J (B) $1{\cdot}6 \times 10^{-18}$ J

(C) Zero (D) $0{\cdot}8 \times 10^{-18}$ J

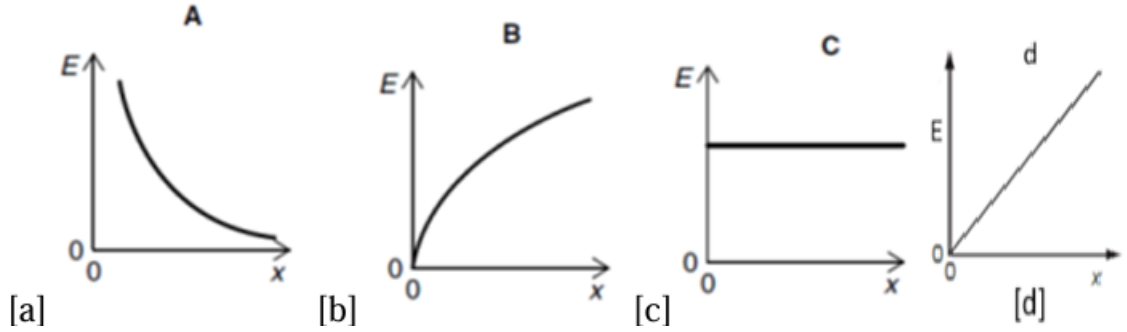
3.A capacitor of capacitance C is charged to a potential V. The flux of the electric field through a closed surface enclosing the capacitor is

[a] $\frac{CV}{\varepsilon o}$ [b] $\frac{2CV}{\varepsilon o}$ [c] $\frac{2V}{c\varepsilon o}$ [d] zero

4.A small oil drop of mass m carries a charge +q The potential difference across the plates is V and the separation is d. The weight of the drop is balanced by the electric force [Buoyancy forces may be considered to be negligible].Which formula gives the charge on the drop ?

[a] q = $\frac{gv}{d}$ [b] q = $\frac{mv}{d}$ [c] q= $\frac{mgv}{d}$ [d] q= $\frac{mgd}{v}$

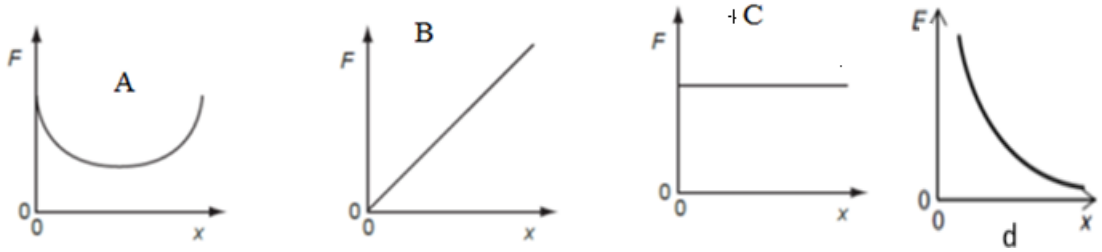
5.Two parallel conducting plates are connected to a battery, one plate to the positive terminal and the other plate to the negative. The plate separation is gradually increased, the plates remaining connected to the battery. Which graph shows how the electric field E between the plates depends on the plate separation x ?



[a] [b] [c] [d]

[a] graph A [b] graph B [c] graph C [d] graph D

6.Two oppositely –charged parallel plates are arranged as shown . An electron is released from rest from the surface of the negatively charged plate. The electron travels from the negatively charged plate towards the positively charged plate. Which graph shows how the force F on the electron varies with its distance X from the negative plate ?



[a] graph A [b] graph B [c] graph C [d] graph D

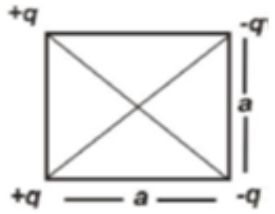
7. A dipole is placed parallel to electric field .If W is the workdone in rotating the dipole from 0^0 to 60^0 ,then work done in rotating it from o^o to 180^0 is

[a] 2W[b] 3W [c] 4W [d] $\frac{W}{2}$

8.A parallel plate capacitor is charged by a batter. Once it is charged, battery is removed. Now a dielectric material is inserted between the plates of the capacitor, which of the following does not change?

[a] Electric field[b] potential difference [c] charge on the plates[d] energy stored

9.The potential at the centre of the square is



[a] zero [b] 2kq [c] $\frac{kq}{a^2}$ [d] $\frac{kq}{2a^2}$

10. [1]A pith ball A of mass 9 x $1O^{-5}$ kg carries & charge of 5 μc. What must be the magnitude of charge and its sign on the pith ball B held 2 cm directly above the ball A such that the ball A remains stationary.

[a]4.84 x 10^{-12} C [b] 7.84 x 10^{-12} C [c] 7.84 x 10^{-12} C [d] 7.84 x 10^{-12} C

SECTION B [2 marks]

[1] 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 electric field between the plates of the capacitor be effected ?

[2] Derive an expression to find the potential at a point on the axial line of an electric dipole

[3] Derive an expression to find the potential at a point on the equatorial line of an electric dipole

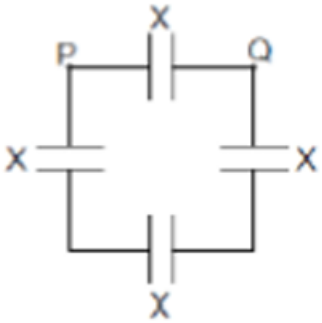
[4] A 4μF capacitor is charged by a 200 v supply.It is then disconnected from the supply and is connected to another 2 μF capacitor. How much energy of the first capacitor is lost in the form of radiation?

[5] The electric field intensity at a point due to a point charge is 20 N/C and the electric potential is 10 J/C. Find the magnitude of the charge and distance of the point from charge.

[6]A capacitor with air between the plates has a capacitance of 8F.The separation between the plates is now reduced by half and the space between them is filled with a medium of dielectric constant 5.Calculate the value of the capacitance of the capacitor in second case.

SECTION C[3 marks]

[1] Four identical capacitors of capacitance X are connected as shown in the figure .What is the effective capacitance between P and Q ?



[2] Derive an expression to find the potential at any point between the axial and equatorial line

[3] A capacitor of unknown capacitance is connected across a battery of v volts. The charge stored in it is 360μC.When the potential across the capacitor is reduced by 120V,the charge stored in it becomes 120 μC. Calculate the potential

[4] Derive an expression for capacitance of a parallel plate capacitor

[5] A charge +lμc is placed at a distance of 0.lm from another charge of +4μc in air. At what point on the line joining the charges, is the electric field intensity zero?

[6] Two point charges of $+3 \times 10^{-19}$ C and $+12 \times 10^{-19}$ C are separated by a distance of 2.5m. Find the point on the line joining them where electric field intensity is zero.

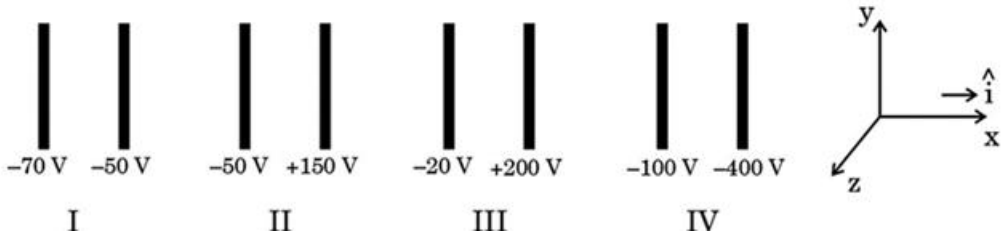
[7] A neutral hydrogen molecule has two protons and two electrons. If one of the electrons is removed, we get a hydrogen molecule ion (H_2). In the ground state of H_2 the protons are separated by roughly 1.5A° and the electron is roughly 1A° from each proton. Estimate the potential energy of the system.

[8][a] Define electrostatic potential energy[b] Derive the expression for electrostatic potential energy of a system of 3 charges q1, q2 and q3

[9] Derive the expression for the capacitance of a capacitor in presence of a dielectric

CASE STUDY [4MARKS]

1 The figure shows four pairs of parallel identical conducting plates, separated by the same distance 2·0 cm and arranged perpendicular to x-axis. The electric potential of each plate is mentioned. The electric field between a pair of plates is uniform and normal to the plates.



(i) For which pair of the plates is the electric field $\vec{E}$ along $\hat{i}$?

(A) I (B) II

(C) III (D) IV

(ii) An electron is released midway between the plates of pair IV. It will :

(A) move along $\hat{i}$ at constant speed

(B) move along $-\hat{i}$ at constant speed

(C) accelerate along $\hat{i}$

(D) accelerate along $-\hat{i}$

(iii) Let V_0 be the potential at the left plate of any set, taken to be at x = 0 m. Then potential V at any point ($0 \le x \le 2$ cm) between the plates of that set can be expressed as :

(A) $V = V_0 + \alpha x$ (B) $V = V_0 + \alpha x^2$

(C) $V = V_0 + \alpha x^{1/2}$ (D) $V = V_0 + \alpha x^{3/2}$

where α is a constant, positive or negative.

(iv) (a) Let E_1, E_2, E_3 and E_4 be the magnitudes of the electric field between the pairs of plates, I, II, III and IV respectively. Then :

(A) $E_1 > E_2 > E_3 > E_4$ (B) $E_3 > E_4 > E_1 > E_2$

(C) $E_4 > E_3 > E_2 > E_1$ (D) $E_2 > E_3 > E_4 > E_1$

OR

(b) An electron is projected from the right plate of set I directly towards its left plate. It just comes to rest at the plate. The speed with which it was projected is about :
(Take (e/m) =$1{\cdot}76 \times 10^{11}$ C/kg)

(A) $1{\cdot}3 \times 10^5$ m/s (B) $2{\cdot}6 \times 10^6$ m/s

(C) $6{\cdot}5 \times 10^5$ m/s (D) $5{\cdot}2 \times 10^7$ m/s

SECTION D [5 marks]

[1] [a] Define electrostatic potential energy[b] Derive an expression for electrostatic potential energy of a system of 3 charges q1, q2 and q3

[2] What is an electric dipole? Derive an expression for electrostatic potential energy of an electric dipole in an external electric field of strength 'E'

[3] Derive an expression to find electric field, potential, capacitance of a capacitor in presence of a dielectric between the plates of a capacitor.

SECTION A

1. (B) Spherical surface
2. (B) 1.6 ×10-18 J
3. [d.] zero
4. [d]. q= $\frac{mgd}{v}$
5. [a.] graph A
6. [c.] graph C
7. [c.] 4W
8. [c.] charge on the plates
9. [a.] zero
10. [b] [7.84 x 10^{-12} C]

SECTION B[2 marks]

[1]V = changes, q = remains the same , d= 2d , C = $\frac{\epsilon 0A}{d}$

Hence remains the same

[2] REFER NOTES

[3] REFER NOTES

[4] E1 = ½ C1 $V1^2$

E2 = ½ C_p V^2

Energy lost = E1 – E2 = 2.67 x 10^{-2} J

[5] V = $\frac{KQ}{r}$, E = V/d

Q = 0.55 x 10^{-9} C

[6] C = $\frac{\epsilon oA}{d}$

$C^1 = \epsilon r \frac{\epsilon oA}{\frac{d}{2}}$

C^1 = 80F

SECTION C[3 marks]

[1]

1/C = 1/C1 + 1/C2 + 1/C3 or C = X/3

Net capacitance = X/3 + X

Ans.Ceff = 4x/3

[2] REFER NOTES

[3] V [a] V = 80V [b] V = 180V [c] V = 90V

[4] REFER NOTES

[5] E = Kq/r^2

E1 = E2

Kq/x^2 - $Kq/[0.1-x]^2$

[x = 10/3 cm from +1μc]

[6]$E = Kq/r^2$
E1 = E2
$Kq/x^2 - Kq/[2.5 - x]^2$
[x = 5/3cmfrom 12 x 10^{-19} c]
[7]

q1 = +1.6 x10^{-19}C , q2 = +1.6 x10^{-19}C , q3 = -1.6 x10^{-19}C ,
r12 = 1.5A^0 , r23 =1A^0 r31 = 1 A^0

$U = \frac{Kq1q2}{r12} + \frac{kq2q3}{r23} + \frac{kq3q1}{r31} = -19.2eV$

[8] REFER NOTES
[9] REFER NOTES

CASE STUDY [4MARKS]

[i] D [ii] D [iii] A [iv] C or B

SECTION D [5 marks]

[1] REFER NOTES

[2] REFER NOTES
[3] REFER NOTES

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