Ankit Gupta Classes

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UNIT—01

ELECTROSTATICS

1 Marks Questions:

Q.1 A certain region has cylindrical symmetry of electric field. Name the charge distribution producing such a field.

Q.2 Represent graphically the variation of electric field with distance, for a uniformly charged plane sheet.

Q.3 How will the radius of a flexible ring change if it is given positive charge?

Q.4 Five Charges of equal amount (q) are placed at five corners of a regular hexagon of side 10 cm. What will be the value of sixth charge placed at sixth corner of the hexagon so that the electric field at the centre of hexagon is zero ?.

Q.5 Two conducting spheres of radii r_1 & r_2 are at same potential. What is the ratio of charges on the spheres?.

Q.6 Why do we use nitrogen or methane gas in Van-de-Graff generator ?

Q.7 An electric charge q is placed at one of the corner of a cube of side 'a'. What will be the electric flux through its one of the face?

Q.8 A square surface of side L meters is in the plane of the paper. A uniform electric field E (volts/m), also in the plane of paper, is limited only to lower half of the square as shown in the diagram. What will be the electric flux (in SI units) associated with the surface.

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E

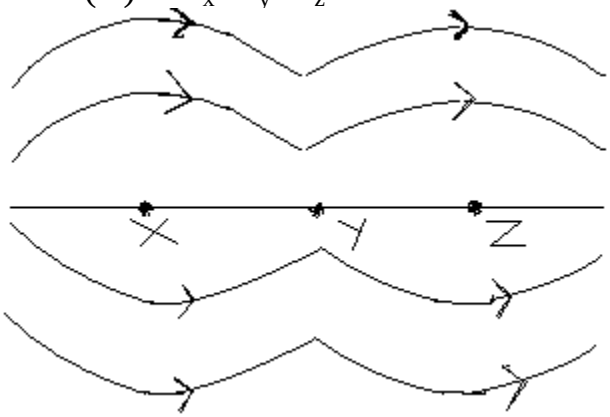
Q.9 Which of the following statement is true & why?

(A) $E_x = E_y = E_z$

(B) $E_x > E_y > E_z$

(C) $E_x = E_z < E_y$

(D) $E_x < E_y < E_z$



Q.10 The distance of the field point on the equatorial plane of a small electric dipole is halved. By what factor will the electric field change for the dipole?

2 Marks Questions:

Q.11 A charge of 10 μc is brought from point A (0,4 cm,0) to C (3 cm,0,0) via point B (0,0,6 cm) in vacuum. Calculate the work done if the charge at origin is 20 μc.

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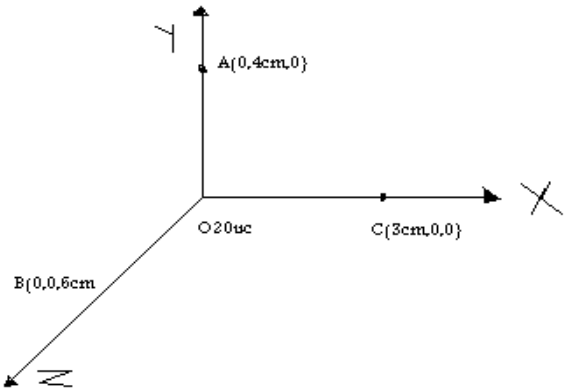
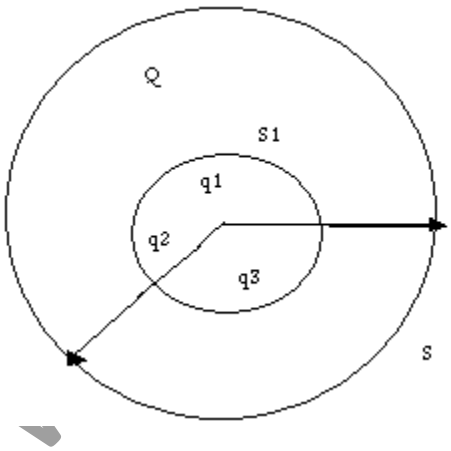


Q.12 A charged particle is free to move in an electric field. Will it always move along an electric line of force? Justify your answers?.
(2 marks)

Q.13 The flux of the electrostatic fields, through the closed spherical surface S,' is found to be four times that through the closed sphere 'S1'. Find the magnitude of the charge Q . Given, q1= 1 µc,q2=-2µc and q3=9.854 µc
(2 marks)



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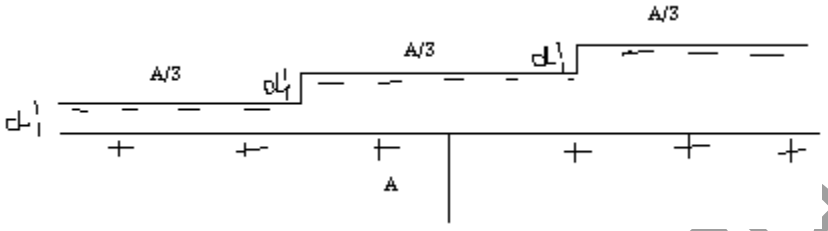
Q.14 A charge Q is divided in two parts q and Q - q separated by a distance R. If force between the two charges is maximum, find the relationship between q & Q.
(2 marks)

Q.15 A capacitor is made of a flat plate of area A and second plate having a stair like structure as shown in figure below. If width of each stair is A/3 and height is d. Find the capacitance of the arrangement.
(2 marks)



3 marks question:

Q16. A parallel plate capacitor is charged to potential V by a source of emf . After removing the source, the separation between the plates is doubled . How will the following change electric field change on each plate potential difference capacitance of the capacitor Justify your answer

Q 17 If N drops of same size ,each having the same charge ,coalesce to form a bigger drop . How will the following vary with respect to single small drop?

(i)Total charge on bigger drop
(ii) Potential on the bigger drop
(iii) The capacitance on the bigger drop

Q18 Work done to move a charge along a closed path inside an electric field is always zero, using this fact, prove that it is impossible to produce an electric field in which all limes of force would be parallel lines and density of their distribution would constantly increase in a direction perpendicular to the lines of force.

Q 19. The graph shows the electric force of repulsion on tiny charged conducting sphere A, as a function of its separation from a sphere B. The sphere B has 10 times the charge on the sphere A ; Explain the behavior of the force between separation 2cm and 1cm.

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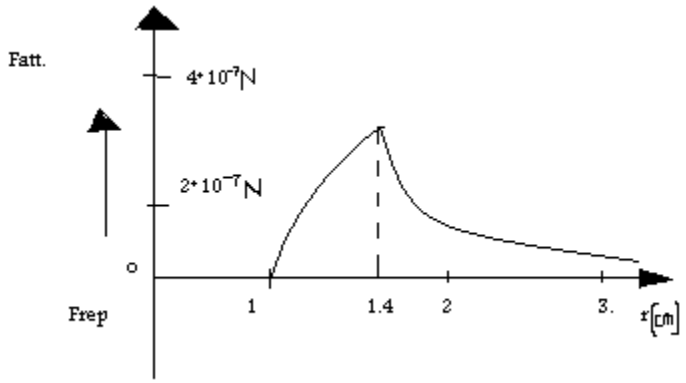
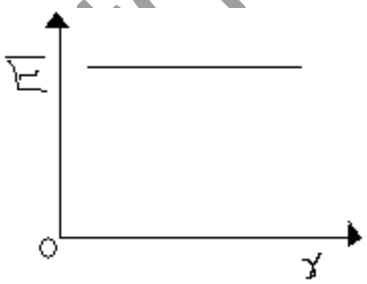


Q 20. Obtain the formula for electric field due to a long thin wire of uniform linear charge density without using Gauss's law.

ANSWERS/HINTS

1 mark question

Q.1 Uniform linear charge distribution



Q.2 E is constant with r.

Q3. Increases due to repulsion

Q.4 6th Charge is Q

Q.5 $Q_1/Q_2=R_1/R_2$

Q.6 It transfers the leakage of Charge to earth through earthed steel chamber

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Q.7 $Q/24\ \acute{\varepsilon}_0$

Q.8 Zero

Q9. $E_x=E_z<E_y$

Q.10 $E \alpha 1/r^3$ if $r=r/2$, E= 8 times

2 marks question

Q 11 work done is independent of path

$w= \frac{1}{4}\pi\varepsilon_O\ q_1\ q_2\ (1/r_1 - 1/r_2)$ putting the values & ans 15 J

Q 12 if charge is positive & at rest in electric field then it will move along electric line of force. If charge has initial velocity making some angle with electric field than it will along parabolic path.

Q 13 $\Phi' = 4\Phi$

$Q + q_1 + q_2 + q_3/ \varepsilon_o = 4 \text{ X } (q_1+q_2+q_3)/\varepsilon_o$

putting the values & finding $Q = 3*8.854\ \mu C$

Q 14. $F=K\ q(Q-q) / r\ 2$

for max. &min.$dF / dq=0$, $q=Q/2$

Q 15. All are in parallel

$C= \varepsilon_o A/3d+\varepsilon_o A/6d+ \varepsilon_o A/9d= 11\varepsilon_o A/18\ d$

3 marks question

Q.16 a. E same
b. Q same
c. V same
d. C is halved with reasons

Q.17 i. N times the charge on small drop
ii. N 2/3 times the potential on small drop
iii N 1/3 times the capacitance on small drop

Q.18 If q is moved along abcd then $W_{abcda} = 0$

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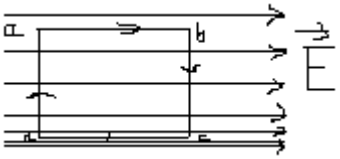
$W_{ab} + W_{bc} + W_{cd} + W_{da} = 0$



as E perpendicular to bc & da
so $W_{bc} = W_{da} = 0$
therefore $W_{ab} = -W_{cd}$
But W_{ab} can never be equal to W_{cd} as the lines of force are closer to cd
therefore $W_{cd} > W_{ab}$
therefore W_{abcda} is not equal to 0 hence such electric field E is impossible

Q.19 i As the charge move closer the charge on large sphere ` is redistributed as shown in diagram

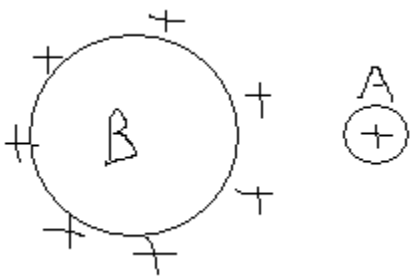
ii As the spheres move more closer than the charge is redistributed as shown in diagram

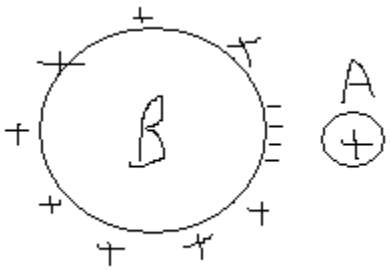
iii Behaviour of force between 2 cm & 1 cm :

force of repulsion increases upto 1.4 cm & F rep. is max. at r=1.4 cm

If 1.2 cm<r<1.4 cm F rep. is decreasing Fatt. increases due to inductive effect.

At r=1.2 cm F rep. = F att. & if r<1.2 cm force is strongly attractive





Q.20 X=q/length = q/l change on dl length
dq = λ dl At point l
$dE = 1 / 4\pi\varepsilon_o * dq / op2 = 1/ 4\pi\varepsilon_o * \lambda\, dl / r2 + l2$ l= rtan Q
find dl .$dE = 1 / 4\pi\varepsilon_o \lambda \cos\theta\, dq / r$
integrate between $-\pi/2$ to $+\pi/2$ than E is $\lambda/2\pi\varepsilon_o r$

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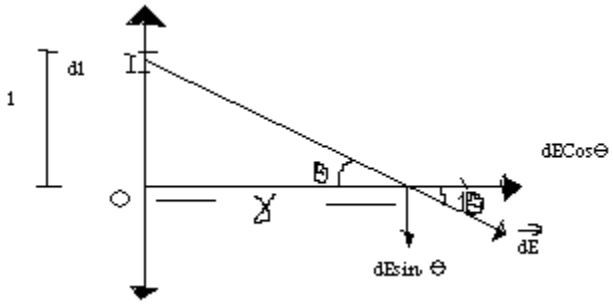

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