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DEPARTMENT: PRE-MEDICINE AND SURGERY

LEVEL: 100

 ASSIGNMENT

QUESTION 1(a) Explain with the aid of diagram how you can produce a negatively charged sphere by induction.

ANSWER: Electric charges can be obtained on an object without touching it, by a process called **Electrostatic Induction.**

 Consider a positively charged rubber rod brought near a neutral (uncharged) conducting sphere that is insulated so that there is no conducting path to the ground as shown below. The repulsive force between the electrons in the rod and those in the sphere causes a redistribution of charges on the sphere so that some electrons move to the side of the sphere farthest away from the rod (fig 1). The region of the sphere nearest the positively charged rod has an excess of negatively charge because of the migration of electrons away from this location. If a grounded conducting wire is then connected to the sphere, as in (fig2), some of the electrons leave the sphere and then travel to the earth. If the wire to the ground is then removed (fig3), the conducting sphere is left with an excess of induced negative charge.

 Finally, when the rubber rod is removed from the vicinity of the sphere (fig4), the induced negative charge remains on the ungrounded sphere and becomes uniformly distributed over the surface of the sphere.

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Fig 1 Fig2

Fig3 Fig 4

QUESTION 1(B) . Each of the small sphere is charged positively, the combined charge

5.0 x10e-5C. If each of the sphere is repelled from the other by a force of 1.0N when the sphere are 2.0m apart. Calculate the charge on each sphere.

ANSWER. q1= first sphere, q2=second sphere, F= 1.0N r= 2.0m , k= 9 x10e9Nm2c-2

 q1+ q2= 5.0 x 10e-5…. Equation1

 Using columb’s law

F= Kq1q2

 r2

q1q2 = f x r2 = 1 x 22

 k 9x10e9 = 4.44 x 10e-10C

Q1= 5.0 X 10e- 5 – q2 … equation2

Substitute equation 2 into equation 1

( 5.0 x10e-5 – q2) q2 = 4.44x10e-10

5x10e-5q2 – (q2)2 + 4.44x20e-10

q22 – (5.0x10-5)q2 + 4.44 x10e-10 = 0

q2 = 3.845 x 10e -5C or q2= 1.154x10e-5C

when q2= 3.845x10e-5C q1=1.154x10e-5C

q2= 1.154x10e-5C q1= 3.845x10e-5C

QUESTIONC

 Electric field at P= 0

 2d = 1m

 P

 2d

Q1 d q d Q2

 1.0 x

 0.5

Using Pythagoras triangle,

 C

|  |  |  |  |
| --- | --- | --- | --- |
| Vector | Angle | X-components | Y-components |
| 57600  | 63.43° | -25781.93 | 51507.78 |
| 57600 | 63.43° | 25781.93 | 51507.78 |
| 9×10e9q  | 90° | 0 | 9×10e9q |
|  | 0 | (103015.56)+9×10e9q |

 QUESTION 2

1. (a) Electric field is a region of space in which an electric charge will experience an electric force.

Electric field intensity can be defined as force per unit charge. It is measured by Newton per Coulomb (N\C).

(b) Y-axis

 Point Q

 3m 5m

 Q1 Q2 point P

 X-axis

 0 4m 7m

q₁=8nC, q₂=12nC, r₁=7m, r₂=3m, k=9×10e9Nm²/C²

|  |  |  |  |
| --- | --- | --- | --- |
| Vector | Angle | X-component | Y-component |
| 1.469 | 0 | 1.469 | 0 |
| 12 | 0 | 12 | 0 |
|  |  | 13.469 | 0 |

(ii) q₁=8nC, q₂=12nC, r₁=3m, r₂=5m, k=9×10e9Nm²/C²

|  |  |  |  |
| --- | --- | --- | --- |
| Vector | Angle | X-components | Y-components  |
| 8N/C | 90° | 0 | 8 |
| 4.32N/C | 53.13° | 2.59 | 3.46 |
|  |  | 2.59 | 11.46 |

 SECTION B

QUESTION 4

1. (a) Magnetic flux is defined as the strength of magnetic field represented by lines of force. It is represented by the symbol Φ.

(b) M= 9.11×10e-31kg, r= 1.4×10e-7m, B= 3.5×10e-1 Webster/meter², q=1.6×10e-19C

(c) The cyclotron frequency is the inverse of the period which is the time taken for the accelerated electron to complete a cycle in the magnetic field.

The cyclotron frequency is also known as the angular speed of the particle.

 QUESTION 5

1. (a) Biot-savart law states that the magnetic intensity at any point due to a steady current in an infinitely long straight wire is directly proportional to the current and inversely proportional to the distance from point to wire.

 (b) +a

 dl

 y P

 x dB

 l

 -a

 A section of a straight current carrying conductor

Applying the Biot-Savart Law, we find the magnitude of the field d B

From the diagram, r²=x²+y² (Pythagoras theorem)

 Substituting (\*\*) into (\*), we have

Recall dl=dy

 Using special integrals:

 Equation (\*\*\*) therefore becomes

When the length 2a of the conductor is very great in comparison to its distance x from point P, we consider it infinitely long. That is, when a is much larger than x,

In a physical situation, we have axial symmetry about the y-axis. Thus, at all points in a circle of radius r, around the conductor, the magnitude of B is

Equation (#) defines the magnitude of the magnetic field of flux density B near a long, straight current carrying conductor.