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Matric no:19/mhs02/041

Section B

4a) what is magnetic flux?

Magnetic flux is defined as the strength of magnetic field represented by lines of force.

4b) an electron with a rest mass of 9.11 x 10-31kg moves in a circular orbit of radius 1.4x10-7m in a uniform magnetic field of 3.5x10-1 weber/meter square, perpendicular to the speed with which electron moves. Find the cyclotron frequency of the moving electron.

Answer

m= 9.1x 10-31kg r=1.4x10-7m b= 3.5x 10-1weber/meter

cyclotron frequency=angular frequency

w=v/r

w=qb/m=1.6x10-19x3.5x10-1/9.1x10-1

w=62222222222.2T-1

w=6.2x10-10T-1

4c. Discuss your answer above.

In the question above we were asked to find the cyclotron frequency which is the same as angular speed.it is called cyclotron frequency because it is the frequency of an accelerator called cyclotron. Since the answer above has a unit of 1/T, which is equal to the unit of frequency dimensionally.

5a. State the biot-savart law

Biot-savart law states that the magnetic intensity at a point due to current I flowing through a small element dl is directly proportional to current I, directly proportional to the length of the small element dl, directly proportional to the sine of the angle between the direction of the current and the line joining the element dl from the point A and inversely proportional to the square of the distance (x) of point A from the element dl.

5b)

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Applying the Biot-Savart law, we find the magnitude of the field

From diagram,

Substituting into , we have

Recall

Using special integrals:

Equation therefore becomes

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

In a physical situation, we have axial symmetry about the y- axis. Thus, at all points in a circle of radius , 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.

Section a

3a. state the formulation of the following identities of charges.

1. Volume charge density,
2. Surface charge density,
3. Linear charge density,

3b. Explain with appropriate equation,the electric potential difference.

The electric potential difference between two points in an electric field can be defined as the work done per unit charge against electrical forces when a charge is transported from one point to the other. It is measured in Volt or Joules per Coulomb . Electric potential difference is a scalar quantity.

Consider the diagram above, suppose a test charge is moved from point to point along an arbitrary path inside an electric field . The electric field exerts a force on the charge as shown in fig 3.1. To move the test charge from to at constant velocity, an external force of must act on the charge. Therefore, the elemental work done is given as:

But

Substituting equation in yields

Then total work done in moving the test charge from to is:

From the definition of electric potential difference, it follows that:

Putting equation in yields

3c.Two point charges q1=10uc and q2=-2uc are arranged along the x-axis at x=0 and x =4m respectively. Find the positions along the x-axis where v=0

q1=10x10-6c

q2=-2x10-6c

vp=

0=9x109

Divide through by 9x109 we have

2x10-6/6 = 10x10-6/4+x

x=1m

the position is 5m

2. Distinguish between the terms electric field and electric field intensity

Electric field is a region of space in which an electric charge will experience an electric force while electric field intensity is defined as the force per unit charge.

2b. A positive charge q1=8nC is at the origin, and a second positive charge q2=12nC is on the x-axis at x=4m. find

i)the net electric field at point p on the x-axis at x=7m

i)the electric field at point q on the y axis at y=3m due to the charges

Answer

E1=kq1/r2

9x109x8x10-6/72

E1=1.5n/ c

E2=kq2/r2

9x109x12x10-6/72

E2=12n/ c

Enet=E1+E2

1.5+12= 13.5n/ c

ii) E1=kq1/r2

9x109x8x10-6/32

E1=kq1/r2

9x109x8x10-6/72

E1=8n/ c

E2=kq2/r2

9x109x12x10-6/52

E2=4.32n/ c

|  |  |  |  |
| --- | --- | --- | --- |
| vector | angle | x- comp | y- comp |
| E1=8n/ c | 90° | 0n/ c | 8n/ c |
| E2=4.32n/ c | 36.87° | -3.45n/ c | 2.59n/ c |

Efx=-3.45n/ c

Efy=10.59n/ c

Enet2=Efx2+Efy2

Enet2= -3.452+ 10.592

Enet=11.2n/ c