Electric and magnetic field: Numerical

1. A charge $q_1 = 3 \times 10^{-6}$ C is located at the origin of the x-axis. A second charge $q_2 = -5 \times 10^{-6}$ C is also on the x-axis 4m from the origin in the positive x-direction

a. calculate the electric field at the mid point p of the line joining the two charges.

Ans 18×10^3 N/m

b. At what point P on the line is the resultant field zero? Ans 13.75 m

2. Three charges $q_1 = 3 \times 10^{-6}$ C , $q_2 = -5 \times 10^{-6}$ C iand $q_3 = -8 \times 10^{-6}$ C are positioned on a straight line. Find the potential energy of the charges. Ans 1.43×10^{-2} J

3. A potential difference of 100V is establish between the two plates A and B. Plate B being high potential. A porton of charge $q = 1.6 \times 10^{-19}$ C is released from plate B. What will be the velocity of the proton when it reaches plate A? The mass of the proton is 1.67×10^{-27} Kg.

Ans 1.38×10^5 m/Sec

4. Assume tat the electron in a hydrogen atom is essentially in a circular orbit of radius 0.5×10^{-10} m and rotates about the nucleus at the rate of 10^{14} times per second. What is the magnetic moment of the Hydrogen atom due to the orbital motion of the electron ? Ans: 1.26×10^{-25} Am^2

5. The current of 50A is established in a slab of copper 0.5 cm thick and 2 cm wide. The slab is placed in a magnetic field B of 1.5T. The magnetic field is perpendicular to the plane of the slab and to the current. The free electron concentration in copper is 8.4×10^{28} electrons/m^3 . What will be the magnitude of the Hall voltage across the width of the slab? Ans: 1.12×10^{-6} V

6. Four charges of equal magnitude 3×10^{-6} C , -3×10^{-6} C , -3×10^{-6} C and 3×10^{-6} C , are placed at the corners of a square of length 25 cm. What is the electric field at the centre of the square.

Ans: 0 NC^{-1}

7. Two large parallel plates are separated by a distance of 5 cm. The plates have equal but opposite charges that create and electric field in the region between the plates. An α-particle ($q = 3.2 \times 10^{-19}$ C , $m = 6.68 \times 10^{-27}$ Kg) is released from the positively charged plate and it strikes the negatively charged plate 2×10^{-6} sec later. Assuming that the electric field between the plates is uniform and perpendicular to the plates, what is the strength of the electric field? Ans: 522 NC^{-1}

8. An electron is placed midway between two fixed charges, $q_1 = 2.5 \times 10^{-10}$ C and $q_2 = 5 \times 10^{-10}$ C. If the charges are 1m apart, what is the velocity of the electron when it reaches a point 10 cm from q_2 ? Ans: 1.125×10^6 m/sec

9. What force is experienced by a wire of length l=0.08 m at an angle of 20^0 to the magnetic field direction carrying a current of 2A in a magnetic field 1.4T? Ans: 7.66×10^{-2} N

10. The earth magnetic field at the equator is 4×10^{-5}T and is parallel to the surface of the earth in the south-north direction. A wire 2m long of mass m=9 gm is suspended by a string. The wire is also parallel to the earth's surface and carries a current of 150 A in the east-west direction.

a. What is the tension of the string? Ans: 10.02×10^{-2} N

b. What would be the tension if the current was in the west-east direction ?

Ans: 7.62×10^{-2} N

11. A proton is moving with a velocity $v = (3 \times 10^5 \, i + 7 \times 10^5 \, j)$ m/sec in a region where ther is a magnetic field B =0.4 j T. What is the force experienced by the proton ?

Ans: $(1.92 \, k - 4.48 \, i) \times 10^{-14}$ N

12. A proton is accelerated through a potential difference of 200 V. It then enters a region where there is a magnetic field B=0.5 T. The magnetic field is perpendicular to the direction of motion of the proton. What is the force experienced by the proton. Ans: 1.568×10^{-14} N