

Tutorial 7 : Magnetism: Magnetic Force

1. Find the vector component for the force experience on each segment of the wire shown in figure 5.1

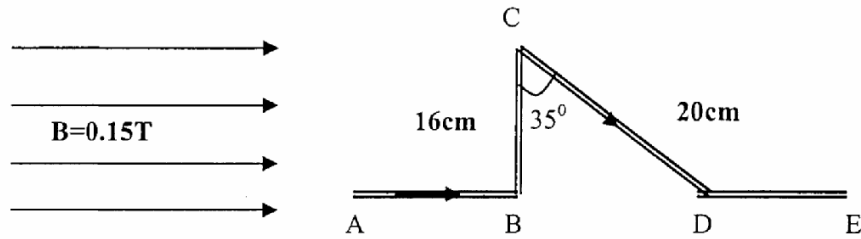


Figure 5.1

(Answer : $BC = -0.12 \text{ k N}$; $CD = +0.12 \text{ k N}$, AB and $DE = 0$)

2. As a diagram in figure 5.2, two long straight parallel wires, X and Y carry a current of 20A and 10A respectively are 40cm apart.
- Identify the direction of force on conductor X due to conductor Y.
 - Find the magnitude of force per unit length on conductor X due to conductor Y

(Answer : $F_x = \text{East}$, $1 \times 10^{-4} \text{ N/m}$)

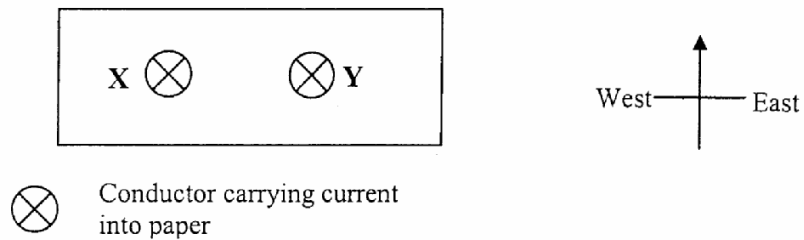


Figure 5.2

3. As in a diagram in figure 5.3, two long straight parallel wires, P and Q carry a current of 30A and 15A respectively are 40cm apart.

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- (i) Identify the force direction on conductor P due to conductor Q.
 - (ii) Find the force per unit length on conductor P due to conductor Q
- (Answer : $F_p = \text{West}$, $2.25 \times 10^{-4} \text{ N/m}$)

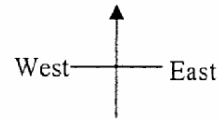


Figure 5.3

4. A long straight wire carries a current of 30A as shown in figure 5.4. A rectangular loop carries a current of 20A as shown in figure 5.4. Calculate the resultant force acting on the loop. Given that $a=1\text{ cm}$, $b= 8\text{ cm}$ and $L=30\text{ cm}$.
(Answer : 3.2 mN, toward the wire)

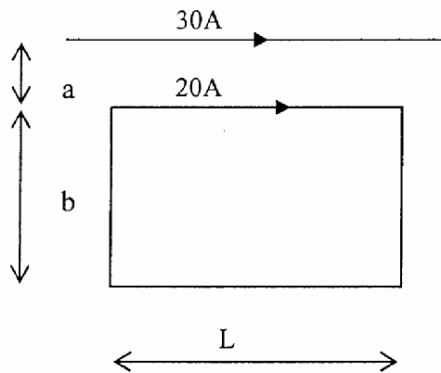


Figure 5.4

5. A rectangular coil 4.3 cm wide by 5.0 cm long is made from 6 turns wire. The coil carries a current of 200 mA in a magnetic field $B = 0.055\text{ T}$. Find torque is required to hold the coil so that it makes an angle of 50° with the magnetic field?
(Answer : $9.12 \times 10^{-5} \text{ Nm}$)
6. The plane of a single square loop of wire with side 22 cm is placed at an angle of 30° to a magnetic field. When a current of 6.3 A flows in the coil , the torque on it is 0.325 Nm. What is the magnetic field strength?
(Answer : 1.23 T)
7. A rectangular coil with 25 loops is suspended in a field of 0.2 Wb/m^2 . The plane of the coil is parallel to the direction of the field. The dimension of the coil is 15 cm perpendicular to the field lines and 12 cm parallel to them. What is the current in a coil if there is a torque of 5.4Nm acting on it?
(Answer : 60 A)
8. A hydrogen ion of mass $1.67 \times 10^{-27} \text{ kg}$ and charge $+1.6 \times 10^{-19} \text{ C}$ with velocity

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- 1.0×10^4 m/s is injected perpendicularly into a magnetic field of 40 mT.
- Calculate the magnitude of the force on the ion due to the magnetic field?
 - Calculate the radius of curvature of the path of the ion in the magnetic field
(Ans: 6.4×10^{-17} N, 2.6×10^{-3} m)
9. What is the value of q/m (ratio of charge to its mass) for a charged particle that moves in a circle of radius 8 mm in a 0.46 T magnetic field if the crossed 200 V/m electric field will make the path straight?
(Ans: 1.18×10^5 C/kg)
10. The magnetic field of the earth at a certain location is directed vertically downward and has a magnetic of $50 \mu\text{T}$. A proton is moving horizontally toward the west in this field with a speed of 6.6×10^6 m/s. Determine
- the direction and magnitude of the magnetic force the field exerts on this charge.
 - the of the circular arc followed by this proton.
(Ans: 5.28×10^{-17} N, southward, 1.377×10^3 m)
1. Alfa particles ($m = 6.68 \times 10^{-27}$ kg, and $q = 1.6 \times 10^{-19}$ C) accelerate from rest through a potential difference of 1.5 kV. They enter a magnetic field $B = 0.5$ T perpendicular to their direction of motion. Calculate the radius of their path in the magnetic field.
(Ans: 0.022m)