Chapter 29 - Magnetic Fields Due to Currents

Magnetic Field Due to Currents

Q1. A segment of wire is formed into the shape shown in Figure (5) and carries a current I. What is the magnitude of the resulting magnetic field at the point P? Ans:3μI/8R.

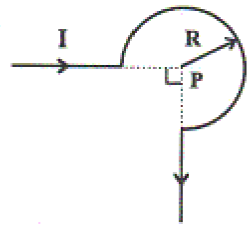

Figure # 5

Q2. Three long wires parallel to the x-axis carry currents as shown in Fig. 6. If I=20 A, what is the magnitude of the magnetic field at the origin? Ans:12 micro T.

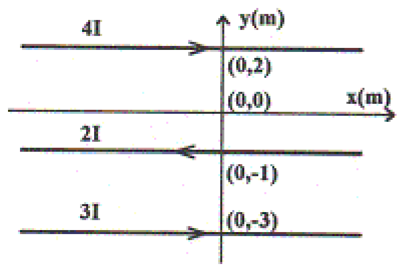

Figure # 6

Q3. What is the magnitude of the magnetic field at point P due to the current carrying wire shown in Figure 7, if I = 2.0 A, a = 20 cm and b = 2a? Ans:0.8 micro-T

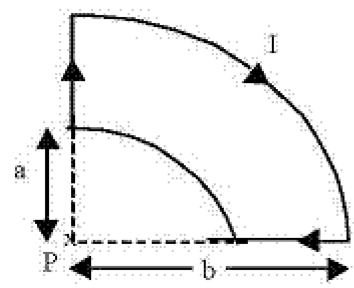

Figure 7

Q4. A segment of wire is formed into the shape shown in Figure 5 and carries a current I = 1.0 A. What is the magnitude of the resulting magnetic field at the point P if R = 10 cm? Ans:5.5 micro-T into the page

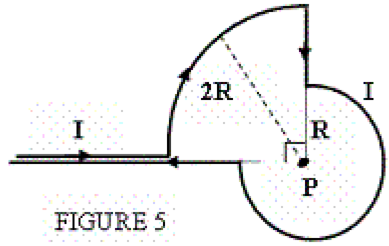

FIGURE 5

Q5. Two long wires parallel to the x-axis carry currents I_1 and I_2 as shown in Figure 6. If I_1 = 5 A, what is the magnitude and direction of I_2 if the net magnetic field at the origin is 0.35 micro-T and directed out the page. Ans:1 A   to the left

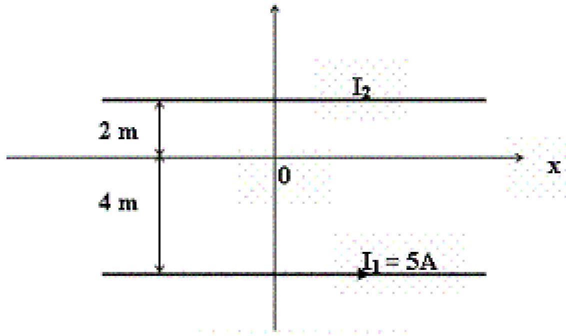

FIGURE 6

Force Between Two Parallel Currents

Q6. Figure 8 shows a cross section of three long parallel wires each carrying a current of 15 A. The currents in the wires A and C are out of the paper, while that in wire B is into the paper. If the distance a = 5.0 mm, what is the magnitude of the force per unit length on wire C? Ans:4.5 milli-N/m

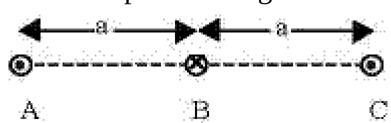

Figure 8

Q7. Two long parallel wires carrying equal currents of 10 A in opposite directions. The force per unit length of one wire on the other is 1 milli-N/m. If both currents are doubled, the force per unit length of one wire on the other will be:Ans:4 milli-N/m, repulsive

Q8. Suppose that the identical currents I in figure (7) are all out of the page. The magnitude of the force per unit length on the wire at the origin is: [take I = 10.0 A, and a = 1.0×10^{-4} m.] Ans:0.28 N/m.

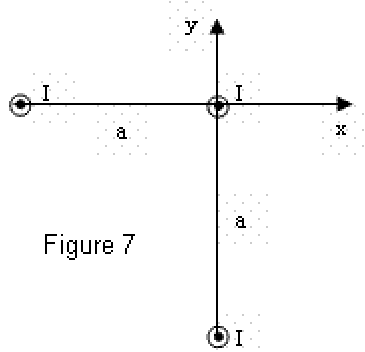

Figure 7

Q9. Three parallel wires lie in the xy-plane. The separation between adjacent wires is 0.1 m, and each wire carries a 10-A current in the same direction. Find the magnitude of the net force per unit length on one of the outer wires.Ans:3.0×10^{-4} N.
Q10. Two parallel wires, carrying equal currents of 10 A, attract each other with a force F. If both currents are doubled, and the distance between them reduced by 50%, the new force will be:Ans:8F.

Ampere's Law

Q11. A long cylindrical wire has a radius R = 2.0 cm and carries a current I = 40 A that is uniformly distributed through the cross-section of the wire. What is the magnitude of the magnetic field at a point which is 1.5 cm from the axis of the wire?Ans:3×10^{-4} T
Q12. What must be the radius R of a long current-carrying wire if the magnetic field at r1 = 2.0 cm (inside the wire) is equal to three times the magnetic field at r2 = 8.0 cm (outside the wire).Ans:2.3 cm
Q13. A long solid cylindrical conductor of radius R= 4.0 mm carries a current I parallel to its axis. The current density in the wire is 2×10^4 A/m^2. Determine the magnitude of the magnetic field at a point that is 5.0 mm from the axis of the conductor.Ans:40 micro-T
Q14. Consider an infinitely long straight wire carrying a current I. If the magnetic field at r_1 = 2.5 mm inside the wire and at r2 = 10 mm outside the wire are equal, then the radius of the wire is:Ans:5.0 mm.
Q15. A cylindrical conductor of radius R = 2.50 cm carries a current of I = 2.50 A along its length. This current is uniformly distributed throughout the cross section of the conductor. Calculate the magnitude of the magnetic field at a point that is 1.25 cm from the axis of the conductor.Ans:10.0 microTesla

Solenoids

Q16. What current in a solenoid 15-cm long wound with 100 turns would produce a magnetic field equal to that of the earth, which is 5.1×0^{-5} T?Ans:61×10^{-3} A.
Q17. A solenoid is formed by tightly winding a single layer of wire. The wire is 1.0 mm in diameter. What is the magnitude of the magnetic field inside the solenoid when there is a current of 0.081 A in the windings?Ans:102 micro-T.
Q18. A 500 turns solenoid is 30 cm long, has a radius of 0.5 cm and carries a current of 2.0 A. The magnitude of the magnetic field at the center of the solenoid is:Ans:4.2×10^{-3} T
Q19. A solenoid is 3.0 m long and has a circumference of 9.4×10^{-2} m. It carries a current of 12.0 A. The magnetic field inside the solenoid is 25.0×10^{-3} T. The length of the wire forming the solenoid is:Ans:467 m.
Q20. A current of 2.5 A passes in a solenoid of length L = 50 cm. It produces a magnetic field of 2.3×10^{-3} T at its center. The number of turns in the solenoid is:Ans:366.