Physics 3204

Unit 2: Electromagnetism

Worksheet 6: Magnetic Force on a Straight Conductor

Motor Principle equation is used to calculate the **force** on a straight conductor when it is in a permanent magnetic field.

$$F = BIL \sin \theta$$

PART A: Multiple Choice

1. What is the force on a 2.1 m long wire, carrying 0.56 A of current, placed perpendicularly in a 4.6×10^{-4} T magnetic field?

   (A) 1.2×10^{-4} N
   (B) 5.4×10^{-4} N
   (C) 2.0×10^{-3} N
   (D) 8.2×10^{3} N

2. A current-carrying conductor is placed perpendicular to a magnetic field and experiences a force of magnitude, F_1. What will be the new force if the wire is placed at an angle of 30.0^{O} to the magnetic field?

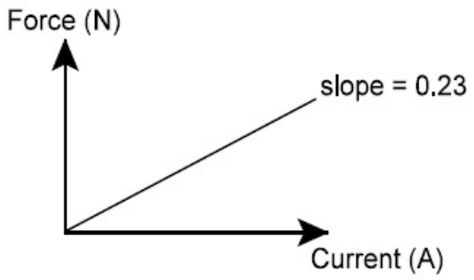
   (A) 0.500 F_1
   (B) 0.866 F_1
   (C) 1.00 F_1
   (D) 2.00 F_1

3. A 0.040 m long wire is placed in a 1.2×10^{-4} T magnetic field at an angle of 29^{O} to the field and experiences a force of 9.2×10^{-6} N. What is the current in the wire?

   (A) 0.25 A
   (B) 1.9 A
   (C) 2.2 A
   (D) 4.0 A

4. A 2.0 m long current-carrying conductor is placed perpendicular to an external magnetic field. The graph below shows how the force on the conductor changes as the current is varied. What is the magnitude of the external magnetic field?

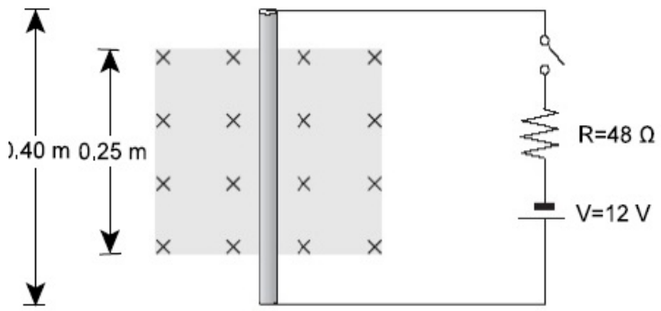
   (A) 0.12 T
   (B) 0.23 T
   (C) 0.46 T
   (D) 8.7 T



5. A 1.0 m wire carrying a current of 10 A is oriented parallel to a uniform magnetic field of 0.40 T. What is the magnitude of the force that it experiences?

   (A) 0 N
   (B) 2.0 N
   (C) 4.0 N
   (D) 8.0 N

6. A 0.40 m long copper wire is held perpendicularly to a 0.082 T magnetic field as shown. What is the magnitude and direction of the magnetic force on the copper wire when the switch is closed?



	Magnitude of Force (N)	Direction of Force
(A)	5.1×10^{-3}	left
(B)	5.1×10^{-3}	right
(C)	8.2×10^{-3}	left
(D)	8.2×10^{-3}	right

7. A 1.50 m long conductor, "floating" above a 5.00×10^{-3} T magnetic field, is held in static equilibrium by the field. If it is perpendicular to the magnetic field and carries a current of 25.0 A, what is the mass of the conductor?

(A) 1.28×10^{-2} kg
(B) 1.91×10^{-2} kg
(C) 1.88×10^{-1} kg
(D) 2.55×100 kg

8. If a 1.0 m wire, perpendicular to a 0.40 T uniform magnetic field, is carrying a 10.0 A current, what is the magnitude of its force?

(A) -4.0 N
(B) 0 N
(C) 4.0 N
(D) 8.0 N

9. A 0.20 m long conductor is placed in a magnetic field of 0.85 T. If the conductor is perpendicular to the magnetic field and the magnetic force acting on the conductor is 0.028 N, what is the current flowing through the conductor?

(A) 0.16 A
(B) 6.1 A
(C) 4.8×10^{-3} A
(D) 6.6×10^{-3} A

10. If a 0.25 m wire is perpendicular to a uniform 0.20 T magnetic field, what force is exerted on this wire when it carries a 15 A current?

(A) 0.12 N
(B) 0.75 N
(C) 3.0 N
(D) 6.0 N

11. A wire carries a current of 20.0 mA in a direction of 40.0° with respect to the direction of a 50.0 T magnetic field. What is the magnitude of the force on 2.0 m of the wire?

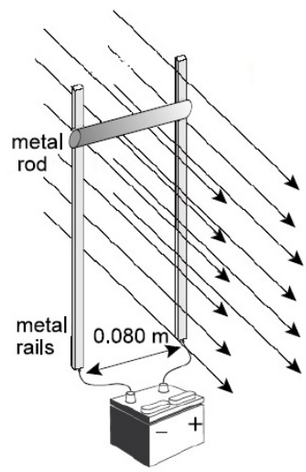
(A) 1.3 N
(B) 2.0×10^{1} N
(C) 31 N
(D) 8.0×10^{2} N

Part B: Written Response

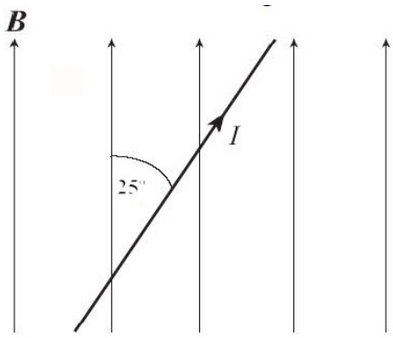
1. A 75 Ω resistor that is 0.28 m long is placed in a uniform magnetic field of 0.25 T. If the resistor experiences a force of 4.0×10^{-2} N when it is perpendicular to the magnetic field, calculate the voltage across the resistor. AUGUST 2009

2. A 0.025 m long wire segment, XY, is positioned perpendicular to a 0.750 T magnetic field as shown. When a current is passed through this wire segment, it experiences a 0.20 N force upwards. Calculate the magnitude and give the direction of the current through the wire. JUNE 2009

3. A 0.16 kg metal rod is placed in a horizontal magnetic field of 0.75 T and maintains contact with two vertical metal rails that are separated by a distance of 0.080 m. Calculate the current that must flow through the rod in order for it to remain at rest. JUNE 2008



4. The diagram below shows a wire of infinite length carrying a 15 A current in a uniform 0.55 T magnetic field, B. The wire is at angle of 25° to the magnetic field lines. What is the magnitude and direction of the magnetic force acting on a 1.0 m section of the wire? AUGUST 2004



5. What force is exerted on a straight conductor of length 1.5 m suspended in a magnetic field of strength 3.2×10^{-3} T with a current of 2.0 A if the wire is moving perpendicular to the field.

6. Calculate the current required to generate a force of 6.0×10^{-6} N in a long straight wire (L = 5.5 m) suspended in a magnetic field of 3.4×10^{-6} T if the wire is at an angle of 30° to the field.

7. What is the magnetic field if there is a force of 1.5 N generated on 17 m of copper conductor with a 2.0 A current when the wire is perpendicular to the magnetic field?