H4 Force on a Conductor in a Magnetic Field

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Ignore the Earth's magnetic field unless specifically asked. Assume the horizontal component of the Earth's field points North, and the vertical down.

The horizontal component of the Earth's magnetic field in Britain is 6.91×10^{-5} T, while the vertical component is 1.55×10^{-4} T.

H4.1 Complete the questions in the table:

Length	Current	Field	Field–current angle	Force
0.30 m	10 A	5.0 T	90°	(a)
2.0 cm	200 A	0.040 T	30°	(b)
56 m	20 mA	(c)	90°	3.5 N
2.0 m	(d)	7.0×10^{-5} T	90°	0.032 N

H4.2 Calculate the force on 3.0 mm of wire carrying a 4.0 A current in a 0.020 T field, if the current is perpendicular to the field.

H4.3 Calculate the force on 3.0 mm of wire carrying an 8.0 A current in a 0.0040 T field, if the current is parallel to the field.

H4.4 Calculate the current needed in a wire if you wish it to levitate in a 0.50 T field. Assume that the wire has a weight of 0.14 N, and 3.0 cm of it is inside the magnetic field region.

H4.5 There is a bad electrical fault in a house. A 6.0 m wire running North-South carries a current of 6000 A for a short time.

a) Calculate the magnitude of the force on it due to the Earth's magnetic field.

b) At an instant when the current in the wire is running from North to South, what is the direction of the force?

H4.6 A rail gun consists of two metal rails 8.0 cm apart in a magnetic field with a projectile (shell) placed to bridge the rails. A large current is passed from one rail to the other through the projectile, which then experiences a force and shoots off the end of the rails. A 100 N force needs to act on the projectile. Assuming permanent magnets provide a 0.16 T magnetic field, how much current needs to pass through the projectile?