Answer on Question #59066, Physics / Electromagnetism |

A straight wire 1.0m long carries a current of 100A at right-angles to a uniform magnetic field of 1.0T. Find the mechanical force on the wire and the power required to move it at 15m/s in a plane at right-angles to the field.

100N and 1.5kW

200N and 2.5kW

300N and 1.4kW

200N and 2.7kW

Solution:

The force on the current-carrying conductor in a magnetic field depends upon:

(a) the flux density of the field, B teslas

(b) the strength of the current, I amperes,

(c) the length of the conductor perpendicular to the magnetic field, *l* metres, and

(d) the directions of the field and the current.

When the magnetic field, the current and the conductor are mutually at right angles then the force is:

$$F = BIl$$

In our case:

$B = 1.0\ \text{T}$,

$I = 100\ \text{A}$,

$l = 1.0\ \text{m}$

Thus,

$$F = 1 \cdot 100 \cdot 1 = 100\ \text{N}$$

The power equals force times speed:

$$P = Fv = 100 \cdot 15 = 1500\ \text{W} = 1.5\ \text{kW}$$

Answer: 100N and 1.5kW