Worksheet: Motor Effect Calculations (F = B I l)

PhysicsSheets

Specification: GCSE Physics (AQA / Edexcel / OCR Gateway)

Motor Effect Formula: $F = B \times I \times l$

Rearranged Forms:

$B = \dfrac{F}{I \times l}$ | $I = \dfrac{F}{B \times l}$ | $l = \dfrac{F}{B \times I}$

Units:

F = Force (Newtons, N) B = Magnetic Flux Density (Tesla, T) I = Current (Amperes, A) l = Length of conductor (metres, m)

Section A: Units, Rearranging & Conversions

1. Complete the table below by stating the correct SI unit and its symbol for each variable in the motor effect formula.

Variable	SI Unit	Symbol
Force (F)	_____	_____
Magnetic Flux Density (B)	_____	_____
Current (I)	_____	_____
Length (l)	_____	_____

2. Rearrange the formula $F = B \times I \times l$ to make each of the following variables the subject:

a) Magnetic Flux Density (B): $B =$ _____

b) Current (I): $I =$ _____

c) Length (l): $l =$ _____

3. Convert the following values into their standard SI units.

a) 250 mA = _____ A

b) 15 cm = _____ m

c) 0.03 kN = _____ N

d) 50 mT = _____ T

Section B: Practice Calculations

1) A straight wire of length 0.20 m carries a current of 3.0 A and is placed in a uniform magnetic field of strength 0.50 T. Calculate the force acting on the wire.

2) A conductor of length 0.12 m experiences a force of 0.048 N when a current of 2.0 A flows through it, perpendicular to a magnetic field. Calculate the magnetic flux density of the field.

3) A 25 cm long wire is placed in a magnetic field of 0.80 T. If the wire experiences a force of 0.16 N, calculate the current flowing through the wire.

4) A 0.50 A current flows through a conductor in a magnetic field of 0.04 T. If the force on the conductor is 0.006 N, calculate the effective length of the conductor in the magnetic field. Give your answer in centimetres.

Section C: Challenge & Contextual Questions

5. A student sets up an experiment to investigate the motor effect. They use a conductor of mass 5.0 g and length 8.0 cm in a uniform magnetic field of 25 mT.

a) When a current of 4.0 A is passed through the conductor, calculate the force acting on it. Give your answer to an appropriate number of significant figures.

b) The student wants to double the force acting on the conductor without changing the magnetic field strength or the length of the conductor. Explain two different ways they could achieve this, referring to the formula $F = B \times I \times l$.

6. A small electric motor uses a coil with an effective length of 0.050 m in a magnetic field. The table below shows the force produced by the motor at different currents.

Current (I / A)	**Force (F / N)**	**Magnetic Flux Density (B / T)**
0.20	0.0040	_____
0.30	0.0060	_____
0.40	0.0080	_____

a) Complete the table by calculating the magnetic flux density (B) for each current value. Show your working for one calculation.

b) The motor is then used in a different magnetic field where the magnetic flux density is 0.60 T. If the motor needs to produce a force of 0.015 N, calculate the current required.