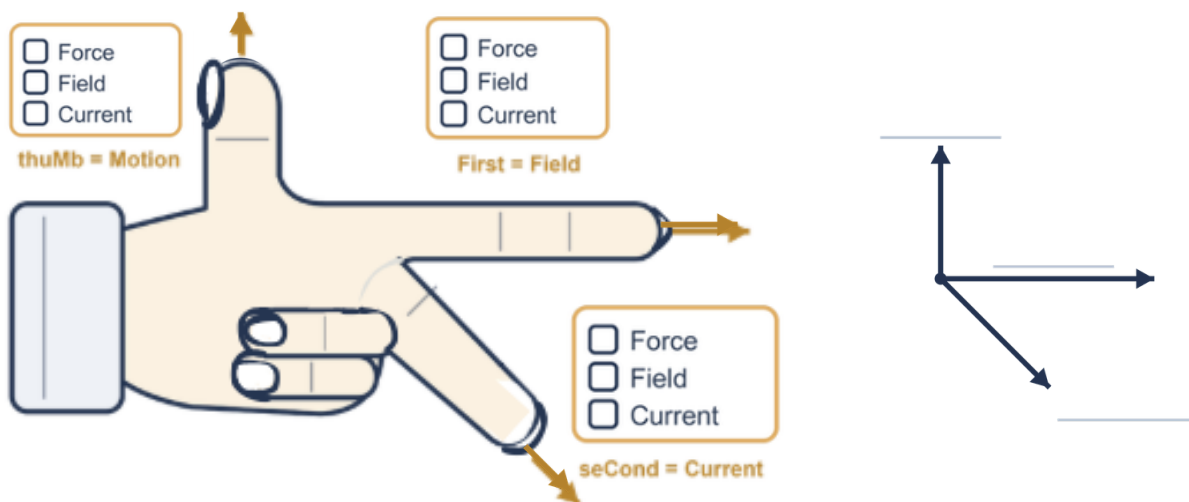


Fleming's Left-Hand Rule

The left-hand rule

tick a label on each finger



Use your **left** hand. Hold the thumb and first two fingers at **right angles** to each other.

Thumb → _____ (motion)

First finger → _____, from _____ to _____

Second finger → _____, from _____ to _____

Which way is the force on the wire?

tick one direction for each

Find the **field** (N → S) and the **current** (+ → -; the **long** line of a cell is +). ⊙ = current out of the page, ⊗ = into the page. Find the force on the **thick** wire.

1



- ☐ ↑ up
- ☐ ↓ down
- ☐ ← left
- ☐ → right
- ☐ ⊙ out of page
- ☐ ⊗ into page

2



- ☐ ↑ up
- ☐ ↓ down
- ☐ ← left
- ☐ → right
- ☐ ⊙ out of page
- ☐ ⊗ into page

3



wire



- ☐ ↑ up
- ☐ ↓ down
- ☐ ← left
- ☐ → right
- ☐ ⊙ out of page
- ☐ ⊗ into page

4



wire



- ☐ ↑ up
- ☐ ↓ down
- ☐ ← left
- ☐ → right
- ☐ ⊙ out of page
- ☐ ⊗ into page

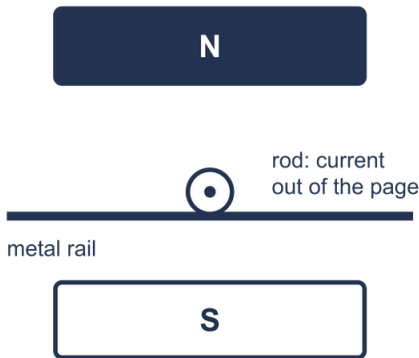
4.7.2.2

Diagram illustrating the experimental setup for measuring the magnetic force on a current-carrying wire. A wire is suspended between the North (N) and South (S) poles of a magnet. A clamp holds the wire between the poles. The balance scale shows a reading of 0.26 g. Labels indicate the current is out of the page and the setup is a top-pan balance.

$m =$ kg $F = m \times g =$ N

Change	more than 0.26 g	less than 0.26 g	-0.26 g	0.26 g
The current is increased	☐	☐	☐	☐
The current is decreased	☐	☐	☐	☐
The current is reversed	☐	☐	☐	☐
Stronger magnets are used	☐	☐	☐	☐
The magnets are swapped round (N and S change places)	☐	☐	☐	☐
The current is reversed and the magnets are swapped round	☐	☐	☐	☐

(Total for question = 8 marks)



Calculating the Force: $F = BIl$ *Higher tier*

1 · The equation

given on the equation sheet — learn the words and units

IN WORDS

IN SYMBOLS

REARRANGE IT

 $B =$ $I =$ $l =$

UNITS — WRITE THE QUANTITY, TICK ITS UNIT, NAME THE UNIT

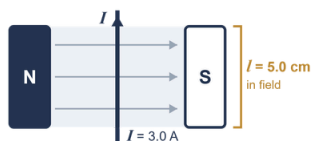
Symbol	Quantity	Unit (tick one)	Unit name
F	_____	☐ N ☐ T ☐ A ☐ m ☐ kg ☐ V	_____
B	_____	☐ N ☐ T ☐ A ☐ m ☐ kg ☐ V	_____
I	_____	☐ N ☐ T ☐ A ☐ m ☐ kg ☐ V	_____
l	_____	☐ N ☐ T ☐ A ☐ m ☐ kg ☐ V	_____

Convert first: l must be in **metres** (cm ÷ 100) and I in **amps** (mA ÷ 1000).
Only the part of the wire **inside the field** counts.

2 · Your turn: find F , then B , then I

the wire is at right angles to the field

1 Find the force, F



A wire carries a current of **3.0 A**. **5.0 cm** of it is in a magnetic field of flux density **0.20 T**. The wire is at right angles to the field.

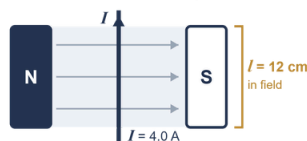
1 EQUATION

2 SUBSTITUTE

3 REARRANGE

4 ANSWER + UNIT

2 Find the flux density, B



A wire carrying **4.0 A** has **12 cm** of its length in a magnetic field. The force on it is **0.048 N**.

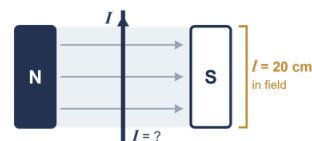
1 EQUATION

2 SUBSTITUTE

3 REARRANGE

4 ANSWER + UNIT

3 Find the current, I



20 cm of a wire is in a magnetic field of flux density **0.25 T**. The force on the wire is **0.015 N**.

1 EQUATION

2 SUBSTITUTE

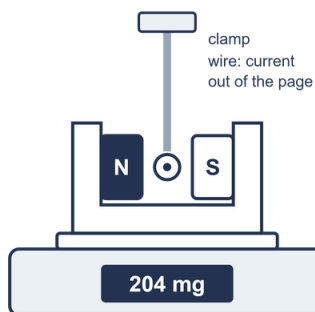
3 REARRANGE

4 ANSWER + UNIT

3 · Exam-style question

8 marks

Two magnets sit on a holder on a top-pan balance. A stiff wire is clamped between the poles so it cannot move. The balance is zeroed. When the current is switched on, the reading is **204 mg**.



(a) Convert the reading to kilograms. [1]

(b) Calculate the force on the magnets. Use $W = mg$ with $g = 9.8 \text{ N/kg}$. [2]

(c) The reading goes **up**, so the wire pushes the magnets **down**. Use Newton's third law to state the size and direction of the force on the wire. [1]

(d) **5.0 cm** of the wire is in the field and the current is **2.0 A**. Calculate the magnetic flux density. [3]

(e) The current is reversed. State the new balance reading. [1]