12 Magnetic fields and forces – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
magnetic field			
magnetic force			

Recall

You have played with magnets:

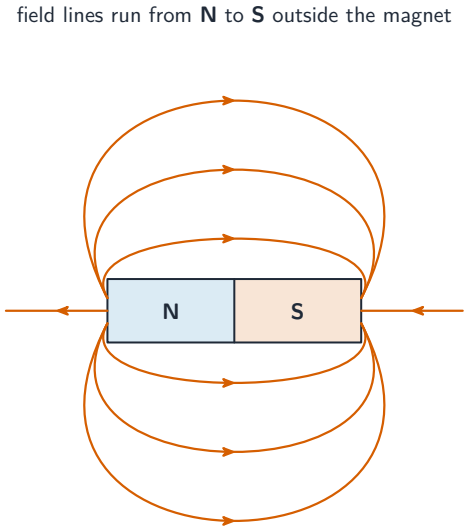
- A magnet has a north and a south pole; like poles repel, opposite attract.
- Magnets pull on iron and steel.
- A coil of wire carrying a current becomes a magnet.

This sheet adds the forces magnetic fields make. Each idea has a worked example.

New ideas

■ 1 Magnetic fields

A **magnetic field** B surrounds every magnet. Field lines run from the **north** pole to the **south** pole outside the magnet.

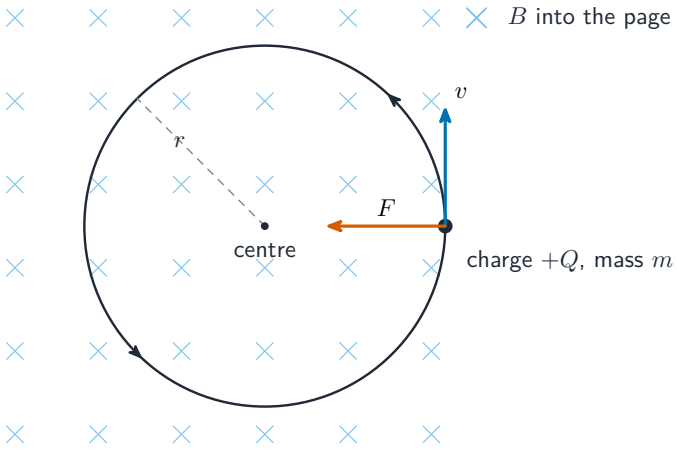


2 Force on a moving charge

A charge moving **across** a magnetic field feels a **magnetic force** :

$$F = qvB\sin\theta.$$

The force is at right angles to the motion, so it bends the charge into a **circle**.



$$BQv = \frac{mv^2}{r} \Rightarrow r = \frac{mv}{BQ}$$

Worked example. A charge of 1.6×10^{-19} C moving at 2.0×10^5 m/s across a 0.50 T field feels $F = qvB = 1.6 \times 10^{-19} \times 2.0 \times 10^5 \times 0.50 = 1.6 \times 10^{-14}$ N.

■ 3 Force on a wire

A current is moving charge, so a magnetic field pushes on a **current-carrying wire**: $F = BIL$. This push turns an electric motor.

■ 4 No force when parallel

Watch out: a charge that is **not moving**, or one moving **along** the field lines, feels **no** magnetic force. The charge must move **across** the field to feel a push.

Practice

Try these in order. The methods are all above.

2.1 State the direction field lines run outside a bar magnet. [1]

2.2 A charge of 2.0×10^{-19} C moves at 1.0×10^{5} m/s across a 0.40 T field. Find the force. [3]

2.3 State the shape of the path of a charge moving across a uniform magnetic field. [1]

2.4 A 0.50 m wire carries 3.0 A across a 0.10 T field. Find the force on it ($F = BIL$). [2]

2.5 State when a moving charge feels no magnetic force. [2]