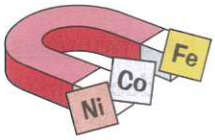
Permanent and Induced Magnets

Magnetic fields don't just affect magnets — they affect a few special magnetic materials too.

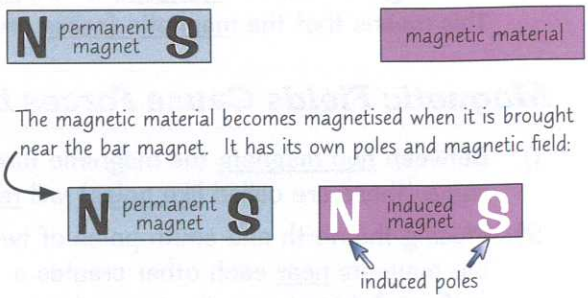
Very Few Materials are Magnetic



1) The main three magnetic elements are iron, nickel and cobalt.
2) Some alloys and compounds of these metals are also magnetic. For example, steel is magnetic because it contains iron.
3) If you put a magnetic material near a magnet, it is attracted to that magnet. The magnetic force between a magnet and a magnetic material is always attractive.

Magnets Can be Permanent or Induced

1) Permanent magnets (e.g. bar magnets) produce their own magnetic field all the time.
2) Induced (or temporary) magnets only produce a magnetic field while they're in another magnetic field.
3) If you put any magnetic material into a magnetic field, it becomes an induced magnet.
4) This magnetic induction explains why the force between a magnet and a magnetic material is always attractive — the south pole of the magnet induces a north pole in the material, and vice versa.



5) When you take away the magnetic field, induced magnets return to normal and stop producing a magnetic field. How quickly they lose their magnetism depends on the material they're made from.
   - Magnetically 'soft' materials, e.g. pure iron and nickel-iron alloys, lose their magnetism very quickly.
   - Magnetically 'hard' materials, e.g. steel, lose their magnetism more slowly. Permanent magnets are made from magnetically hard materials.

Magnetic Materials have Lots of Uses

There are many different uses of magnetic materials, the number of which has grown since the invention of electromagnets (p.198). For example:

1) Fridge doors — there is a permanent magnetic strip in your fridge door to keep it closed.
2) Cranes — these use induced electromagnets to attract and move magnetic materials — e.g. moving scrap metal in scrap yards.
3) Doorbells — these use electromagnets which turn on and off rapidly, to repeatedly attract and release an arm which strikes the metal bell to produce a ringing noise.
4) Magnetic separators — these are used in recycling plants to sort metal items (like cans).
5) Maglev trains — these use magnetic repulsion to make trains float slightly above the track (to reduce losses from friction) and to propel them along.
6) MRI machines — these use magnetic fields to create images of the inside of your body without having to use ionising radiation (like X-rays, p.171).
7) Speakers — these use the motor effect (p.197) to make a paper cone move, creating a sound wave.

Attractive and with a magnetic personality — I'm a catch...

Remember, induced magnets are also called temporary because they're only magnetic when in a magnetic field.

Q1 State three everyday uses of magnetic materials. [3 marks]

Q2 Give two differences between permanent and induced magnets. [2 marks]

Permanent and Induced Magnets

1 Magnets can be permanent or induced. Grade 4-6

a) Describe the difference between a permanent magnet and an induced magnet.

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[2]

b) Name **two** magnetic materials.

1. .....

2. .....

[2]

c) State **one** everyday use of magnets.

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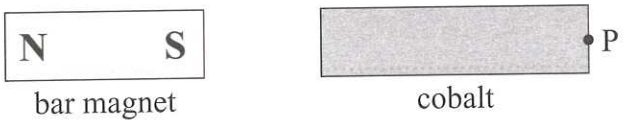
[1]

[Total 5 marks]

2 A block of cobalt is held in place near to a bar magnet, as shown in **Figure 1**. Grade 6-7

Figure 1



a) A steel paperclip is placed against the block of cobalt at point P, shown on **Figure 1**. The paperclip sticks to the block of cobalt. Explain why this happens.

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[3]

b) The bar magnet is removed. Explain what happens to the paperclip.

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[2]

[Total 5 marks]