Solutions

Each answer shows the steps, then the **result**.

2.1

- they repel (push apart)

2.2

- steel

2.3

- any two of: iron, nickel, cobalt (steel is an alloy of iron)

2.4

- a **S** pole: unlike poles attract

2.5

- a permanent magnet stays magnetised on its own; an induced magnet is magnetised only while it is near a magnet

3.1 B

- field lines run from N to S outside the magnet

3.2 D

- 2 and 3 are correct; permanent magnets are made of steel, not soft iron, so 1 is wrong

3.3

- from the N pole to the S pole
- strongest at the poles, where the field lines are closest together

3.4

- place paper over the magnet and sprinkle iron filings on top
- tap gently – the filings line up along the field lines, showing the pattern

3.5

- the magnet's field induces magnetism in the iron
- the near end gains the opposite pole, so the two attract

3.6

- bring each end of the steel bar in turn near the N pole of the magnet
- if one end is **repelled**, the bar is a magnet: only like poles repel
- attraction is not enough: a magnet induces magnetism in an unmagnetised steel bar, so it is attracted too

3.7

- place the compass near the N pole and mark the point the compass needle's N end points to
- move the compass so its tail is on that mark, mark again, and repeat until the S pole is reached
- join the marks with a smooth line and add an arrow pointing from N to S

3.8

(a)

- soft iron magnetises strongly when the current flows
- and loses its magnetism when the current is switched off, so the cars can be dropped; steel would stay magnetised

(b)

- it can be switched off to release the load

(c)

- they are not lifted: aluminium is not a magnetic material