Simple phenomena of magnetism

Key terms:

- **Magnetic substances:** Substances that are attracted by magnets are called as magnetic substances.

Examples of magnetic substances: Iron , steel ,nickel and cobalt.

- **Ferromagnetism:** It is the basic mechanism by which certain materials such as iron form permanent magnets or are attracted to magnets.
- **Magnetic field:** It is a region around which a magnet can attract other magnetic substances.

Properties of magnets:

- Magnets can attract another magnet.
- Magnets can attract unmagnetised magnetic substances.
- Magnets attract magnetic substances like iron, cobalt, nickel and steel.
- The ends of magnets are called as the poles of the magnets, namely the north and the south poles. The poles are of equal strength.
- A freely suspended magnet always points in the north south direction.
- Like poles repel and unlike poles attract. Hence South-South poles and North -North poles repel; whereas North-South poles attract.

Magnetically hard and magnetically soft substances

Magnetically hard substances:

- Substances that are hard to magnetise and retain their magnetism are said to be magnetically hard substances.
- These are often alloys of iron, nickel and cobalt.

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Magnetically soft substances:

- Substances that are easy to magnetise but retain their magnetism are said to be magnetically hard substances.
- They lose their magnetic properties very quickly once they have left a magnetic field.
- Alloys with less iron, nickel or cobalt will be magnetically soft and have a weaker magnetic field

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Types of magnets:

- **Permanent magnets:**

Magnets that retain their magnetism once magnetised are called as permanent magnets.

Ferromagnetic materials such as iron, nickel, cobalt, some alloys of rare earth and some naturally occurring minerals such as loadstone are permanent magnets.

Use: In electric motors, compasses, fridge doors etc

- **Temporary magnets:**

These are magnets that act as magnets in the presence of magnetic fields but lose their magnetism in the absence of magnetic field.

Example: Electromagnets

Use: Junk yards to lift the scrap

- **Electromagnets:**

They are wound coils of wire that act like magnets when an electric current is passed through them .The electromagnets can be made stronger either by passing a large current or using a metal such as iron or steel in the core of the coil.

Use: Junk yards to lift the scrap

Note:

- Substances that can be permanently magnetised are magnetically hard substances.
- Substances that can only be temporarily magnetised are described as magnetically soft substances.

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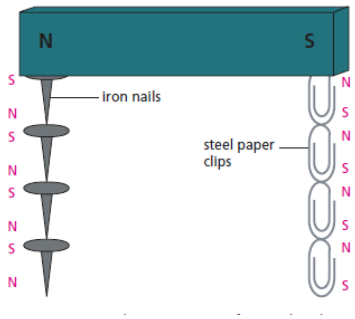
Magnetic induction:



- When a magnetic substance is brought near a magnet , an opposite pole is induced in the side of the substance touching the magnet.

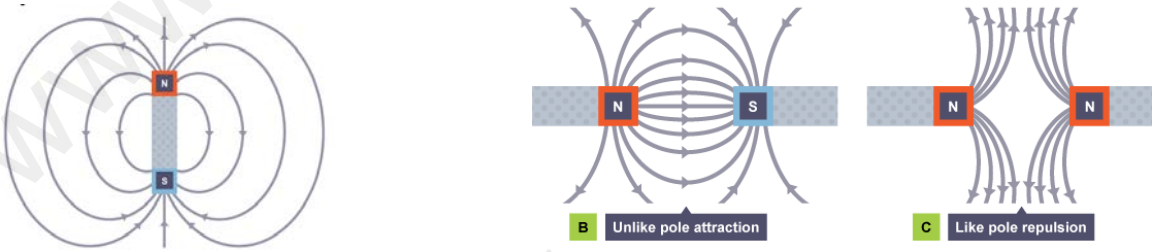
Core of electromagnets

Material used in the core is related to its use: Steel core cannot be used to separate magnetic substances from non-magnetic substances as steel forms a permanent magnet.

Magnetic field

- The region around a magnet where the magnet attracts other magnetic substances is called as a magnetic field.
- The field lines have arrows on them
- The magnetic field lines always point from the north to the south poles of the magnet.
- The magnetic field is are more concentrated at the poles and hence is the strongest at the poles.

Magnetic field diagrams



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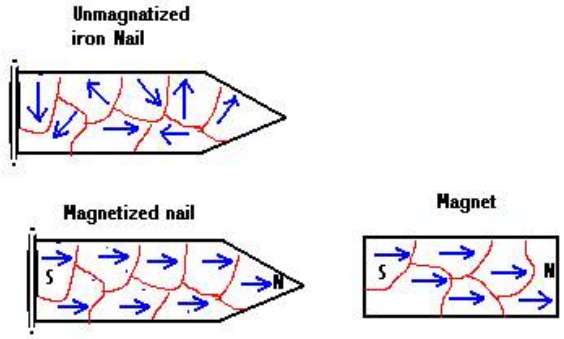
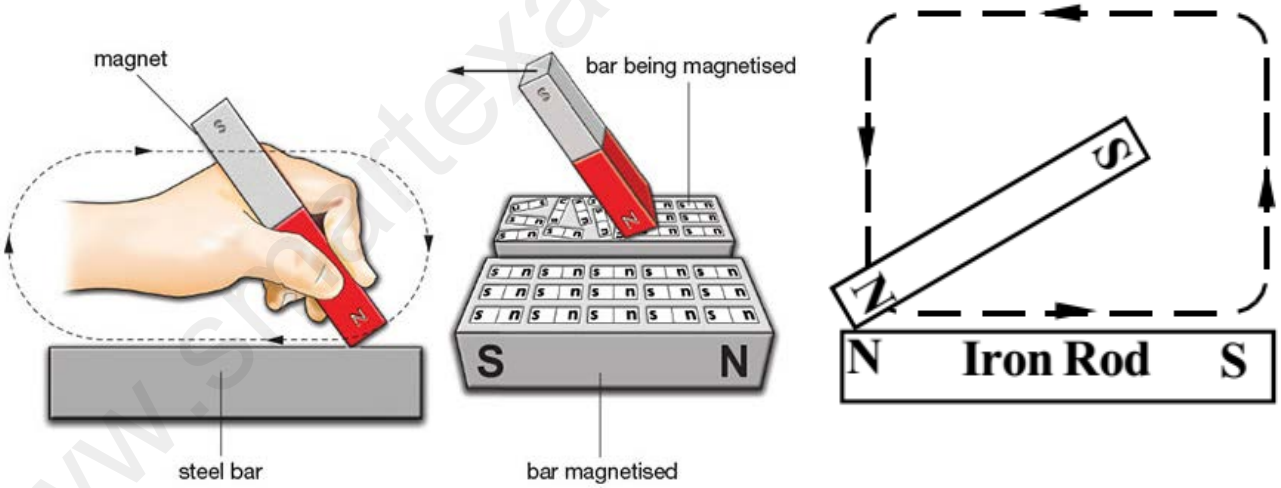
Domains in a magnets and non-magnets:



Magnetising magnetic substances

1. A piece of magnetic material can be stroked with a permanent magnet consistently from one end to other (never going in the reverse direction. This causes it to gain magnetism
2. Place a material in a strong magnetic field, as produced by an electromagnet. It becomes magnetised.



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Demagnetising magnetic substances

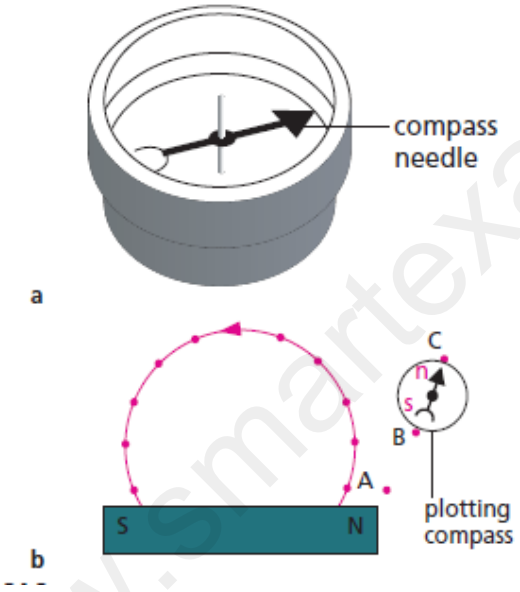
- Hammering
- Heating
- Using alternating current in the coil

Magnetic Induction:

When a magnetic material is brought near a magnet, the material gets attracted to the magnet. The substance is said to have got temporarily magnetised.

Method of finding the direction of magnetic field lines :

- **Using a plotting compass:**



- Lay a bar magnet on a sheet of paper
- Place the plotting compass near any pole of a magnet; say the North pole and mark the North and South poles shown by the compass needle as points A and B respectively.
- Then place the compass at point B and mark the new position where the North of the compass points as C.
- Continue this till you reach the south pole of the magnet.
- Join the dots to give one line of the magnetic field line.
- Put an arrow on the line going from North to South.
- Plot more field lines by placing the compass at different positions around the magnet.

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Application based past paper questions:

1. Identify the poles induced in a magnetic material

25 The north pole of a bar magnet is placed next to end P of an iron bar PQ, as shown. As a result, magnetic poles are induced in the iron bar.

What are the magnetic poles induced at P and at Q? **0625/11/M/J/09**

	magnetic pole at P	magnetic pole at Q
A	north	north
B	north	south
C	south	north
D	south	south

2.Identify the suitable material for the core of an electromagnet

26 An electromagnet is used to separate magnetic metals from non-magnetic metals.

Why is steel unsuitable as the core of the electromagnet? **0625/11/M/J/09**

A It forms a permanent magnet.

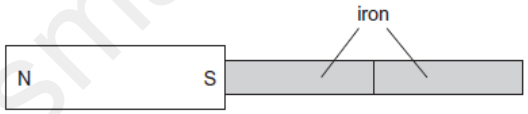
B It has a high density.

C It has a high thermal capacity.

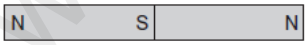
D It is a good conductor of electricity.

3. Identify the induced poles

26 A magnet attracts two pieces of iron. **0625/11/M/J/10**



What is the arrangement of the induced poles in the pieces of iron?

A 

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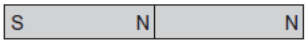
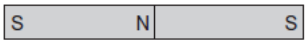
C 

D 

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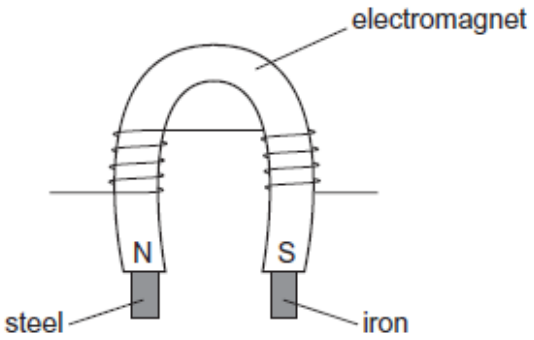
4. Identify the behaviour of magnetically hard and soft substances

27 A piece of iron and a piece of steel are picked up by an electromagnet as shown. 210



0625/11/M/J/10

The current to the electromagnet is switched off.

What happens?

A Both the iron and the steel remain magnetised.

B Neither the iron nor the steel remain magnetised.

C Only the iron remains magnetised.

D Only the steel remains magnetised.

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5. Identify the induced poles of a magnet

25 Which test could be used to find which end of a magnet is the north pole? 219

A putting it near a compass needle 0625/11/M/J/11

B putting it near a ferrous metal

C putting it near a non-ferrous metal

D putting it near a steel spoon

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6 .Ways of de-magnetising steel

25 Which action will demagnetise a magnetised piece of steel? 0625/13/M/J/15

A Cool it in a freezer for several hours.

B Hit it repeatedly with a hammer.

C Put it in a coil carrying a direct current (d.c.).

D Put it near an unmagnetised piece of iron.

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7.Ways to demagnetise permanent magnets

27 How can a permanent magnet be demagnetised? **0625/11/O/N/13**

A cool the magnet for a long time

B hit the magnet repeatedly with a hammer

C leave the magnet in a coil which is connected to a battery

D shine bright light onto the magnet

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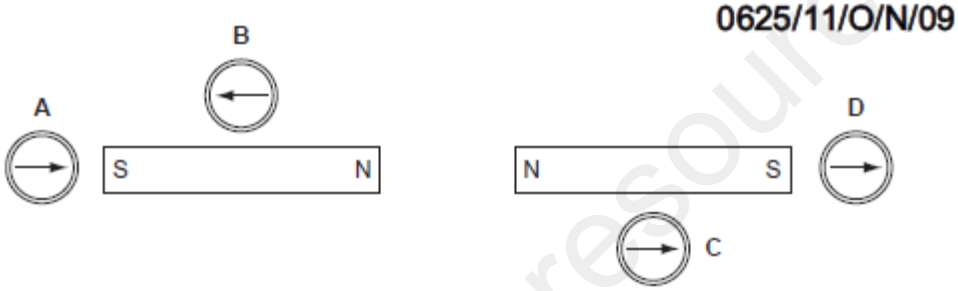
8. Direction of the magnetic field lines

26 Four plotting compasses are placed in the magnetic field of two identical bar magnets as shown in the diagram.

Which compass is shown pointing in the wrong direction? **0625/11/O/N/09**



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25 A permanent magnet is brought near to a piece of copper. The copper is not attracted by the magnet.

Why is there no attraction? **0625/11/O/N/09**

A Copper is ferrous but is only attracted by an electromagnet.

B Copper is ferrous but is not attracted by any type of magnet.

C Copper is not ferrous and is only attracted by an electromagnet.

D Copper is not ferrous and is not attracted by any type of magnet.

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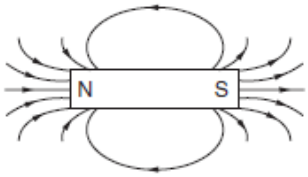
26 Which diagram best shows the pattern of field lines around a bar magnet?

0625/1/M/J/02

A



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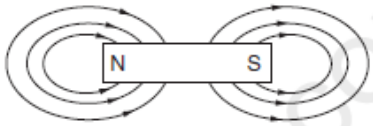

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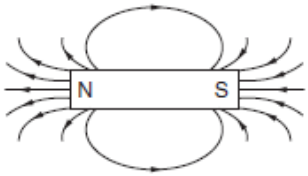

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EXTENDED THEORY QUESTIONS

8 **(a)** Fig. 8.1 shows a coil wound around a steel bar that is initially unmagnetised.

Any appropriate power supply can be connected between the terminals A and B. No other apparatus is available.

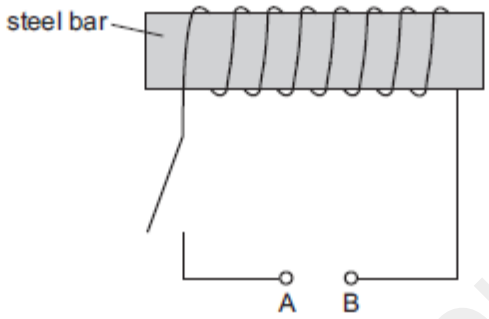

Fig. 8.1

Describe

- how the steel bar can be magnetised,
- how the steel bar can then be demagnetised.

magnetised: .....

.....

.....

demagnetised: .....

.....

..... [4]

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7 A physics teacher suspends two pointers in a magnetic field. One pointer is made of brass and the other is a magnet.

She holds the pointers in the initial positions shown in the two upper circles of Fig. 7.1. She then releases the pointers.

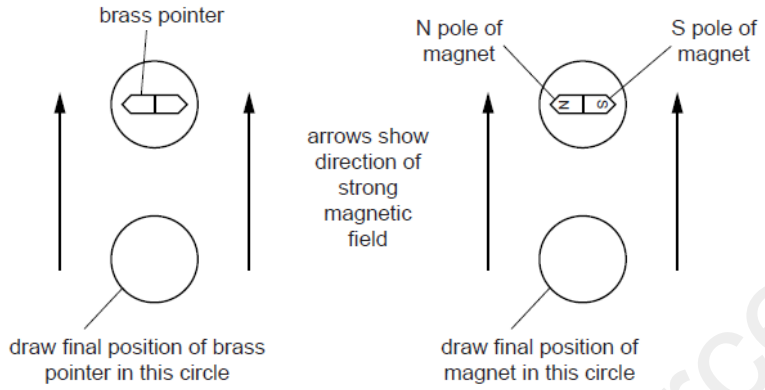

Fig. 7.1

(a) In the lower circles of Fig. 7.1, draw the settled final positions of the two pointers. [2]

(b) **(i)** Explain the final position of the brass pointer.

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.....

.....

(ii) Explain the final position of the magnet.

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.....

.....

[2]

(c) Suggest a material from which the magnet is made.

.....[1]

[Total: 5]

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10 **(a)** Fig. 10.1 shows the gap between the N-pole and the S-pole of a magnet.

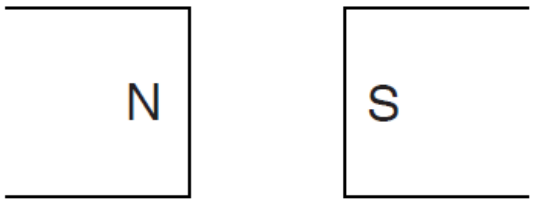

Fig. 10.1

The magnetic field in the gap is uniform.

On Fig. 10.1, draw four field lines to show the pattern and direction of the magnetic field in the gap. [2]

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