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PHYSICS · CLASS 9 · CHAPTER 08

MAGNETISM

Complete Solved Exercise — MCQs, Short Answers, Constructed Response & Comprehensive Questions

A. Multiple Choice Questions

B. Short Answer Questions

C. Constructed Response Questions

D. Comprehensive Questions

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A. Multiple Choice Questions

Tick (✔) the correct answer.

8.1 Which one of the following is not a magnetic material?

(a) Cobalt

(b) Iron

✓ **(c) Aluminium**

(d) Nickel

Explanation:

Cobalt, Iron, and Nickel are ferromagnetic materials, meaning they are strongly attracted to magnets and can be magnetized. Aluminium is paramagnetic, meaning it is only very weakly attracted to magnets and is not considered a practical magnetic material.

8.2 Magnetic lines of force:

(a) are always directed in a straight line

(b) cross one another

(c) enter into the north pole

✓ **(d) enter into the south pole**

Explanation:

By convention, magnetic field lines emerge from the North pole, curve through the surrounding space, and *enter into the South pole. They never cross each other and are curved (not straight) outside the magnet.*

8.3 Permanent magnets cannot be made by:

✓ **(a) soft iron**

(b) steel

(c) neodymium

(d) alnico

Explanation:

Soft iron is easily magnetized but loses its magnetism quickly when the external magnetic field is removed, making it suitable only for temporary magnets (like electromagnets). Steel, neodymium, and alnico retain their magnetism for a long time.

8.4 Permanent magnets are used in:

(a) circuit breaker

✓ **(b) loudspeaker**

(c) electric crane

(d) magnetic recording

Explanation:

Loudspeakers contain a permanent magnet that creates a steady magnetic field, which interacts with the varying magnetic field of a voice coil to produce sound. Circuit breakers and electric cranes typically *use electromagnets. (While magnetic recording can use permanent magnets, the loudspeaker is the standard textbook example).*

8.5 A common method used to magnetise a material is:

✓ **(a) stroking**

(b) hitting

(c) heating

(d) placing inside a solenoid having A.C

Explanation:

Stroking a magnetic material with a permanent magnet in a consistent direction aligns its magnetic domains, magnetizing it. Hitting and heating cause random vibrations that demagnetize a material. A solenoid requires Direct Current (D.C.) to effectively magnetize a material; A.C. would demagnetize it.

8.6 A magnetic compass is placed around a bar magnet at four points as shown in figure below. Which diagram would indicate the correct directions of the field?

(a) Top right, Bottom right, Left right, Right left.

(b) Top left, Bottom right, Left left, Right left.

(c) Top right, Bottom left, Left right, Right right.

✓ **(d) Top right, Bottom left, Left left, Right left.**

Explanation:

Magnetic field lines exit the North (N) pole and enter the South (S) pole. In option (d), the compass needle at the top points right (away from N), at the bottom points left (towards S), on the left points left (away from N), and on the right points left (towards S). This perfectly aligns with the magnetic field lines running from N to S.

8.7 A steel rod is magnetised by double touch stroking method. Which one would be the correct polarity of the AB magnet?

(a) N...S

✓ **(b) S...N**

(c) S...S

(d) N...N

Explanation:

In the double-touch method, if the North pole of the permanent magnet is stroking towards end A, it induces a South pole at A. Similarly, the South pole of the magnet stroking towards end B induces a North pole at B. Therefore, A becomes South (S) and B becomes North (N).

8.8 The best material to protect a device from external magnetic field is:

(a) wood

(b) plastic

(c) steel

✓ **(d) soft iron**

Explanation:

Soft iron has a very high magnetic permeability. It acts as a magnetic shield by diverting external magnetic field lines through itself and around the device, leaving the interior of the shield (and the device) virtually field-free.

B. Short Answer Questions

8.1 What are temporary and permanent magnets?

Temporary magnets are made from soft iron. They act as magnets only as long as they are in an external magnetic field and lose their magnetism once it is removed. **Permanent magnets** are made from materials like steel, cobalt, or nickel. They retain their magnetism for a long time even after the external magnetizing field is removed.

8.2 Define magnetic field of a magnet.

The magnetic field of a magnet is the region or space around the magnet where its magnetic force can be detected. It is a vector field, meaning it has both magnitude and direction at every point in space.

8.3 What are magnetic lines of force?

Magnetic lines of force are imaginary continuous curves used to represent a magnetic field. The tangent drawn at any point on these lines gives the direction of the magnetic field at that point.

8.4 Name some uses of permanent magnets and electromagnets.

Permanent Magnets: Loudspeakers, magnetic compasses, magnetic recording devices (hard drives),

and refrigerator magnets.
Electromagnets: Electric bells, electric cranes (for lifting scrap metal), circuit breakers, electric motors, and generators.

8.5 What are magnetic domains?

Magnetic domains are microscopic regions within a magnetic material where the magnetic moments of atoms are aligned in the same direction. In an unmagnetized material, these domains are randomly oriented, canceling out each other's magnetic effects. Magnetization aligns these domains.

8.6 Which type of magnetic field is formed by a current-carrying long coil?

A current-carrying long coil, known as a solenoid, creates a strong, uniform (or nearly uniform) magnetic field inside its core. Outside the solenoid, the field is weak and resembles that of a bar magnet.

8.7 Differentiate between paramagnetic and diamagnetic materials.

Paramagnetic materials (e.g., aluminium, wood) are weakly attracted by a magnet. They have unpaired electrons, and their atomic dipoles align slightly with an external magnetic field.
Diamagnetic materials (e.g., copper, water, bismuth) are weakly repelled by a magnet. They have no

permanent atomic dipoles, and an external magnetic field induces opposing magnetic moments.

C. Constructed Response Questions

8.1 Two bar magnets are stored in a wooden box. Label the poles of the magnets and identify P and Q objects.

Answer:

P and Q are **soft iron keepers** (or bars). They are used to connect the opposite poles of the two magnets, completing the magnetic circuit. This prevents the magnets from demagnetizing over time.

Labeling:

• **Top Magnet:** Left side = North (N) pole, Right side = South (S) pole.
• **Bottom Magnet:** Left side = South (S) pole, Right side = North (N) pole.

Explanation: The soft iron keepers (P and Q) connect the N pole of one magnet to the S pole of the other, forming a closed loop that keeps the magnetic domains aligned.

8.2 A steel bar has to be magnetised by placing it inside a solenoid such that end A of a bar becomes N-pole and end B becomes S-pole. Draw circuit diagram of solenoid showing steel bar inside it.

Answer:

To make end A the North pole, the current in the solenoid must flow in a direction such that it creates a magnetic field pointing towards A.

Diagram Description: Draw a solenoid (coil of wire) with a steel bar inside it. Connect the ends of the coil to a battery. Using the right-hand grip rule: Curl the fingers of your right hand in the direction of the current, and your thumb will point in the direction of the magnetic field (North). Therefore, the current must enter the solenoid from the **A side** and flow in a way that it curls anticlockwise when viewed from end A.

8.3 Two bar magnets are lying as shown in the figure. A compass is placed at the middle of the gap. Its needle settles in the north-south direction. Label N and S poles of the magnets. Justify your answer by drawing fields lines.

Answer:

The left magnet must have its **South (S)** pole facing the gap, and the right magnet must have its **North (N)** pole facing the gap (or vice versa, as long as they are opposite).

Justification: The compass needle aligns itself with the magnetic field at its location. If the needle settles exactly in the North-South direction, the magnetic field in the gap is uniform and horizontal. This occurs when opposite poles face each other. The field lines travel straight across the gap from the N pole of one magnet to the S pole of the other. If you draw field lines, they will be straight, parallel lines bridging the gap horizontally.

8.4 Electric current or motion of electrons produce magnetic field. Is the reverse process true, that is the magnetic field gives rise to electric current? If yes, give an example and describe it briefly.

Answer:

Yes, the reverse process is true. This phenomenon is called **Electromagnetic Induction**.

Example: An electric generator.

Description: When a magnet is moved (or rotated) inside a coil of wire, the changing magnetic field lines cut through the wire. This induces an electromotive force (EMF) and causes an electric current to flow in the wire. This is the fundamental principle behind how power plants generate electricity.

8.5 Four similar solenoids are placed in a circle as shown in the figure... Show by diagram, the

direction of current in each solenoid such that when current in any one solenoid is switched OFF, the net magnetic field at the centre O is directed towards that solenoid. Explain your answer.

Answer:

For the net magnetic field to point towards a solenoid when it is switched OFF, the fields produced by the other three must vector-sum to point in that direction.

Field Directions at O (if all are ON):
• For A (left): The field must point RIGHT.
• For B (bottom): The field must point UP.
• For C (right): The field must point LEFT.
• For D (top): The field must point DOWN.

Explanation: If all are ON, Right + Up + Left + Down = 0 (net field is zero).
• If A is OFF: Up (B) + Left (C) + Down (D) = Left. The net field points towards A.
• If B is OFF: Right (A) + Left (C) + Down (D) = Down. The net field points towards B. (Assuming A and C cancel horizontally).
• If C is OFF: Right (A) + Up (B) + Down (D) = Right. The net field points towards C.
• If D is OFF: Right (A) + Up (B) + Left (C) = Up. The net field points towards D.

Current Directions (Using Right-Hand Grip Rule):

- **Solenoid A:** Current must flow such that the right end is North.
- **Solenoid B:** Current must flow such that the top end is North.
- **Solenoid C:** Current must flow such that the left end is North.
- **Solenoid D:** Current must flow such that the bottom end is North.

D. Comprehensive Questions

8.1 How can you identify whether an object is a magnet or a magnetic material?

Answer:

1. **Suspension Test:** Suspend the object freely from a string. If it comes to rest pointing in the North-South direction, it is a magnet. If it rests in any random direction, it is a magnetic material (like soft iron).

2. **Attraction/Repulsion Test:** Bring a known magnet near the object. Both magnets and magnetic materials will be attracted to the known magnet. However, if the known magnet *repels* the object, the object must be a magnet (since magnetic materials are only attracted, never repelled).

8.2 Describe the strength of a magnetic field in terms of magnetic lines of force. Explain it by drawing a few diagrams for the fields as examples.

Answer:

The strength of a magnetic field is directly proportional to the density (closeness) of the magnetic lines of force.

• **Stronger Field:** Represented by lines that are very close together.

• **Weaker Field:** Represented by lines that are farther apart.

Diagrams:
• *Bar Magnet:* The field lines are very dense near the poles (strongest field) and spread out as you move away (weaker field).
• *Solenoid:* The field lines inside a long solenoid are parallel, equally spaced, and very dense, indicating a strong, uniform magnetic field. Outside, the lines are widely spaced and curved.

8.3 What is a circuit breaker? Describe its working with the help of a diagram.

Answer:

A circuit breaker is an automatic electrical switch designed to protect an electrical circuit from damage caused by excess current (overload or short circuit).

Working:
1. It contains an electromagnet connected in series with the circuit.
2. Under normal current, the electromagnet is weak. A spring-loaded contact keeps the circuit closed.
3. When a fault causes excessive current, the electromagnet becomes very strong.

4. It pulls down an iron lever, which overcomes the spring tension and breaks the contacts, instantly breaking the circuit and stopping the current flow.

(Diagram would show a battery, a switch (the breaker), an electromagnet, and a load. The electromagnet is positioned to pull a latch that opens the switch.)

8.4 A magnet attracts only a magnet. Explain the statement.

Answer:

This statement is slightly inaccurate but refers to the principle of magnetic induction. A magnet does not *only* attract magnets; it also strongly attracts ferromagnetic materials (like iron, nickel, cobalt). When a magnet is brought near a ferromagnetic material, it induces magnetism in that material (making it a temporary magnet). The opposite poles of the induced magnet are then attracted to the permanent magnet. Therefore, while a magnet attracts other magnets, it also attracts magnetic materials by first magnetizing them.

8.5 Differentiate between paramagnetic, diamagnetic and ferromagnetic materials with reference to the domain theory.

Answer:

• **Ferromagnetic Materials:** (e.g., Iron, Nickel, Cobalt). Domain theory explains that these materials have large, strongly aligned magnetic domains even in the absence of an external field. They are strongly attracted to magnets and can become permanent magnets.

• **Paramagnetic Materials:** (e.g., Aluminium, Platinum). These materials have magnetic domains, but they are randomly oriented. When an external field is applied, the domains align weakly with it, causing a weak attraction. They do not retain magnetism when the field is removed.

• **Diamagnetic Materials:** (e.g., Copper, Water, Bismuth). Domain theory is less applicable here as they lack permanent magnetic domains. Instead, an external magnetic field induces weak, opposing magnetic moments in the atoms, causing a weak repulsion.

8.6 Why ferromagnetic materials are suitable for making magnets?

Answer:

Ferromagnetic materials (like iron, cobalt, and nickel) are ideal for making magnets because of their domain structure. In these materials, the magnetic domains can be easily aligned in the same direction by an external magnetic field. Once aligned, the domains tend to stay aligned even after the external field is removed, resulting in a strong and permanent magnetic field. Additionally, they exhibit strong magnetic permeability, allowing them to concentrate magnetic field lines effectively.

Chapter Complete!

Chapter 08 — Magnetism

You've worked through every MCQ, short answer, constructed-response and comprehensive question. Keep practising — mastery is built one chapter at a time.