# Physics Grade 9 — Chapter 8

*Magnetism · Tests from supplied DeepSeek notes PDF*

## Chapter Test 1 — Foundation and Understanding

Instructions:
Section A: 15 MCQs (1 mark each)
Section B: 5 Short Questions (2 marks each)
Section C: 2 Long Questions (5 marks each)
Section D: 3 Numerical Problems (3 marks each) — Note: This chapter has limited numerical content. Only 2 numerical problems are supported by the notes.
Total: 37 marks (adjusted for available content)
Section A — Multiple Choice Questions (15 × 1 = 15 marks)
MCQ 1. The basis of magnetism is the motion of:
A. Neutrons
B. Charged particles (electrons)
C. Protons
D. Photons
Correct Answer: B. Charged particles (electrons)
Explanation: The basis of magnetism is the motion of charge particles.
MCQ 2. A group of atoms with their magnetic fields aligned is called a:

A. Molecule
B. Domain
C. Crystal
D. Lattice
Correct Answer: B. Domain
Explanation: A domain is a group of atoms having parallel magnetic field.
MCQ 3. In an unmagnetized material, the domains are:
A. Aligned
B. Randomly oriented
C. Missing
D. All pointing north
Correct Answer: B. Randomly oriented
Explanation: In unmagnetized material, the domains are randomly oriented.
MCQ 4. In a magnetized material, the domains are:
A. Randomly oriented
B. Aligned
C. Missing
D. All pointing south
Correct Answer: B. Aligned
Explanation: In a magnetized material, the domains are aligned.
MCQ 5. The process of aligning domains in a material is called:
A. Demagnetization
B. Magnetization
C. Ionization
D. Polarization
Correct Answer: B. Magnetization
Explanation: Magnetization is the process of aligning the domains.
MCQ 6. The process of randomizing domains in a material is called:

A. Magnetization
B. Demagnetization
C. Ionization
D. Polarization
Correct Answer: B. Demagnetization
Explanation: Demagnetization is the process of randomizing the domains.
MCQ 7. Which of the following is a ferromagnetic material?
A. Copper
B. Iron
C. Wood
D. Plastic
Correct Answer: B. Iron
Explanation: Iron is a ferromagnetic material that can be strongly magnetized.
MCQ 8. Like magnetic poles:
A. Attract each other
B. Repel each other
C. Have no effect on each other
D. Cancel each other out
Correct Answer: B. Repel each other
Explanation: In magnets, like poles repel each other.
MCQ 9. Unlike magnetic poles:
A. Attract each other
B. Repel each other
C. Have no effect on each other
D. Cancel each other out
Correct Answer: A. Attract each other
Explanation: Unlike poles attract each other.
MCQ 10. Magnets are always:

A. Monopolar
B. Bipolar
C. Tripolar
D. Non-polar
Correct Answer: B. Bipolar
Explanation: Magnets are always bipolar (they have two poles: N and S).
MCQ 11. The region around a magnet where it exerts a force is called the:
A. Electric field
B. Gravitational field
C. Magnetic field
D. Temperature field
Correct Answer: C. Magnetic field
Explanation: The magnetic field is the region around a magnet where it exerts a force on other magnetic poles.
MCQ 12. The SI unit of magnetic field strength is the:
A. Newton
B. Joule
C. Tesla
D. Watt
Correct Answer: C. Tesla
Explanation: The intensity of magnetic field (B) is measured in tesla (T).
MCQ 13. The direction of the magnetic field at a point is the direction of the force on a:
A. South pole
B. North pole
C. Positive charge

D. Negative charge
Correct Answer: B. North pole
Explanation: The direction of the magnetic field is the direction of force on the N-pole.
MCQ 14. Magnetic field lines emerge from the:

A. South pole and enter the North pole
B. North pole and enter the South pole
C. Center of the magnet
D. Equator of the magnet
Correct Answer: B. North pole and enter the South pole
Explanation: The field lines originate from the N-pole and terminate at the S-pole (outside the magnet).
MCQ 15. The magnetic field is strongest where the field lines are:
A. Farthest apart
B. Closest together
C. Parallel
D. Perpendicular
Correct Answer: B. Closest together
Explanation: The field is stronger where the field lines are closer.
Section B — Short Questions (5 × 2 = 10 marks)
Q1. State the domain theory of magnetism.
Answer:
The domain theory of magnetism explains that magnetic materials are composed of small regions called domains. Each domain is a group of atoms (about atoms) whose magnetic fields are aligned in the same direction. In an unmagnetized material, the domains are randomly oriented, so their magnetic effects cancel each other out, and the material has no net magnetic field. When the material is placed in an external magnetic field, the domains tend to align with the field, producing a net magnetic field and magnetizing the material. The theory explains why ferromagnetic materials (like iron) can be strongly magnetized and why they lose their magnetism when heated or hammered (which randomizes the domains).
Q2. State the rule for the force between magnetic poles. Give one example.
Answer:
The rule for the force between magnetic poles is: like poles repel each other, and unlike poles attract each other. For example, if you bring the north pole of one magnet near the north pole of another magnet, they will repel each other. If you bring the north pole of one magnet near the south pole of another, they will attract each other. This is similar to the behavior of electric charges. The force is strongest at the poles and decreases with distance. This principle is used in compasses (where the north pole of the compass


needle is attracted to the Earth's magnetic south pole) and in magnetic levitation (where like poles repel to lift objects).
Q3. What is a magnetic field? How is its direction determined?
Answer:
A magnetic field is the region or space around a magnet where it exerts a force on other magnetic poles or magnetic materials. It is a vector field, meaning it has both magnitude and direction at every point. The direction of the magnetic field at any point is defined as the direction of the force that would act on a North pole placed at that point. In practice, this can be determined by placing a small compass at the point; the north pole of the compass will point in the direction of the magnetic field. The field is represented graphically by magnetic field lines, with the tangent to a field line at any point giving the direction of the field at that point. The field is strongest at the poles and weakest far from the magnet.

Q4. What is induced magnetism? How can a material be magnetized by the stroking method?
Answer:
Induced magnetism is the phenomenon in which a material that is not normally a magnet becomes magnetized when it is placed in an external magnetic field. The material becomes a temporary magnet. One method of inducing magnetism is the stroking method. In this method, a permanent magnet is stroked along a bar of magnetic material (like iron or steel) in one direction. The magnetic field of the permanent magnet aligns the domains in the bar, magnetizing it. The end of the bar where the magnet is lifted becomes the opposite pole to the magnet's pole used. Repeating the stroking process several times increases the magnetization. The stroking method is a simple way to make a temporary magnet.
Q5. What is the difference between a permanent magnet and an electromagnet?
Answer:
A permanent magnet is made from a hard magnetic material (like steel) and retains its magnetism for a long time without the need for an external power source. It has a fixed magnetic field strength and fixed poles. Examples include bar magnets and refrigerator magnets. An electromagnet is made from a soft magnetic material (like soft iron) and acts as a magnet only while an electric current flows through a coil wrapped around it. When the current stops, it loses its magnetism. The strength of an electromagnet can be varied by changing the current, and its polarity can be reversed by reversing the current. Electromagnets are used in devices like electric motors, relays, and lifting cranes.

Section C — Long Questions (2 × 5 = 10 marks)
Q1. Describe the domain theory of magnetism. Explain how it accounts for magnetization, demagnetization, and the behavior of ferromagnetic materials.
Answer:
Introduction: The domain theory explains the magnetic behavior of ferromagnetic materials (like iron, nickel, and cobalt) based on the arrangement of atomic magnetic moments.
Domains: In ferromagnetic materials, the exchange interaction between neighboring atoms causes their magnetic moments to align parallel to each other over small regions called domains. Each domain acts like a tiny magnet. In an unmagnetized material, the domains are randomly oriented, so their magnetic fields cancel out, and the material has no net magnetic field.
Magnetization: When a ferromagnetic material is placed in an external magnetic field, the domains tend to align with the field. Domains that are already aligned with the field grow at the expense of others (domain wall motion), and at stronger fields, the domains rotate to align with the field. This produces a net magnetic field, magnetizing the material. If the material is a hard magnetic material (like steel), the domains remain aligned after the external field is removed, creating a permanent magnet.
Demagnetization: Heating a magnet increases the thermal energy of the atoms, causing them to vibrate more vigorously. This randomizes the domain orientations, reducing the net magnetic field and demagnetizing the material. Hammering also demagnetizes by providing mechanical energy that disrupts the domain alignment. Exposing the material to an alternating magnetic field can also randomize the domains.
Ferromagnetic Behavior: The domain theory explains why ferromagnetic materials can be strongly magnetized (due to domain alignment) and why they have a maximum magnetization (saturation) when all domains are aligned. It also explains the hysteresis effect (the lag between magnetization and the applied field) and why materials have different coercivities (resistance to demagnetization).
Conclusion: The domain theory provides a comprehensive explanation for the magnetic behavior of ferromagnetic materials. It accounts for magnetization, demagnetization, and

the properties of permanent magnets, and it is fundamental to understanding magnetic materials and their applications.

Q2. Describe the methods of magnetization and demagnetization. Explain how a solenoid can be used to magnetize a material.

Answer:

Introduction: Magnetization is the process of aligning the domains in a magnetic material. Demagnetization is the process of randomizing them. Several methods can achieve these effects.

Methods of Magnetization:

1. Stroking Method: A permanent magnet is stroked along a bar of magnetic material in one direction. The magnetic field of the magnet aligns the domains in the bar, magnetizing it. The end where the magnet is lifted becomes the opposite pole.
2. Hammering Method: A magnetic material is placed in a magnetic field and hammered. The hammering provides energy to help the domains align with the external field. This method is often used for steel.
3. Solenoid (Electromagnet) Method: A coil of wire (solenoid) is wrapped around the magnetic material. When a current flows through the coil, it creates a magnetic field that aligns the domains, magnetizing the material. This is the most common method.

Methods of Demagnetization:

1. Heating: Heating a magnet increases thermal energy, randomizing the domain orientations and demagnetizing it. Above the Curie temperature, the material becomes paramagnetic.
2. Hammering: Mechanical shock disrupts the domain alignment, randomizing the domains.
3. Alternating Magnetic Field: Exposing the material to an alternating magnetic field can randomize the domains, especially if the field is gradually reduced to zero.

Solenoid Method: A solenoid is a coil of wire wrapped around a cylindrical core. When a current flows through the coil, it generates a magnetic field similar to that of a bar magnet. If a magnetic material is placed inside the solenoid, its domains align with the solenoid's field, magnetizing it. The polarity of the magnet depends on the direction of the current. Using direct current (DC), the polarity remains constant, so the material is magnetized in one direction. Using alternating current (AC), the polarity alternates, which can demagnetize the material. The strength of the electromagnet can be controlled by adjusting the current, the number of turns, or the core material.

Conclusion: Magnetization and demagnetization can be achieved through various methods. The solenoid method is the most versatile and is widely used in electromagnets, motors, and generators. Understanding these methods is essential for designing magnetic devices and for controlling magnetism in technology.

Section D — Numerical Problems (2 × 3 = 6 marks)

Note: This chapter has limited numerical content. Only two numerical problems are supported by the supplied notes.

Q1. A solenoid of length 50 cm has 100 turns and carries a current of 2 A. Calculate the magnetic field inside the solenoid. (Take )

Solution:

μ =0 4π×10  T□m/A−7

Given:

Length

Number of turns

Current

Permeability

Required:

Magnetic field

Formula:
where .
Substitution:
Final Answer:
Verification: Units: . Correct.
Q2. A wire carries a current of 5 A. Calculate the magnetic field at a distance of 10 cm from the wire. (Take )
Solution:
Given:
Current
Distance
Permeability
Required:
Magnetic field
Formula:
L=50 cm=0.5 m
N=100
I=2 A
μ =0 4π×10  T□m/A−7
B
B=μ nI0
n=N/L
n= =0.5100 200 turns/m
B=(4π×10 )×−7 200×2
B=4π×10 ×−7 400
B=1600π×10−7
B≈5.03×10  T−4
B≈5.03×10  T−4
T□m/A×m ×−1 A=T
μ =0 4π×10  T□m/A−7
I=5 A
r=10 cm=0.1 m
μ =0 4π×10  T□m/A−7
B
B=
2πr
μ I0
Substitution:
Final Answer:
Verification: Units: . Correct.
Answer Key and Detailed Solutions — Test 1
MCQ Answers
1. B
2. B
3. B
4. B
5. B
6. B
7. B
8. B
9. A
10. B

11. C
12. C
13. B
14. B
15. B

Short Answers

(Provided above in Section B.)

Long Answers

B=

$2\pi \times 0.14\pi \times 10 \times 5-7$

B=

$0.12 \times 10 \times 5-7$

B=

$0.110 \times 10-7$

B=10 T−5

B=1×10 T−5

T□m/A×A/m=T

(Provided above in Section C.)

Numerical Solutions

(Provided above in Section D.)

## Chapter Test 2 — Understanding and Application

Board: FBISE
Class: 9
Subject: Physics
Section A — Multiple Choice Questions (15 × 1 = 15 marks)
MCQ 1. When a bar magnet is broken in half, each piece will have:
A. Only a north pole
B. Only a south pole
C. Both a north and a south pole
D. No poles
Correct Answer: C. Both a north and a south pole
Explanation: Magnets are always bipolar. Breaking a magnet creates two new magnets, each with both poles.
MCQ 2. The magnetic field is strongest at the:
A. Center of the magnet
B. Poles of the magnet
C. Equator of the magnet
D. Far away from the magnet
Correct Answer: B. Poles of the magnet
Explanation: The magnetic force is strongest at the poles (north and south).
MCQ 3. Which of the following is a method of inducing magnetism?
A. Cooling the material
B. Stroking with a permanent magnet
C. Breaking the material
D. Dissolving the material
Correct Answer: B. Stroking with a permanent magnet
Explanation: Stroking with a permanent magnet aligns the domains in the material, inducing magnetism.
MCQ 4. A solenoid is:

A. A permanent magnet
B. A coil of wire
C. A type of magnetic material
D. A device for measuring magnetism
Correct Answer: B. A coil of wire
Explanation: A solenoid is a coil of wire wrapped around a cylindrical core.
MCQ 5. An electromagnet is a:
A. Permanent magnet
B. Temporary magnet
C. Non-magnetic material
D. Type of solenoid
Correct Answer: B. Temporary magnet
Explanation: An electromagnet acts as a magnet only while current flows.
MCQ 6. Materials that easily magnetize and demagnetize are called:
A. Hard magnetic materials
B. Soft magnetic materials
C. Non-magnetic materials
D. Permanent magnets
Correct Answer: B. Soft magnetic materials
Explanation: Materials that easily magnetize and demagnetize are soft magnetic materials.
MCQ 7. Which of the following is a hard magnetic material?
A. Soft iron
B. Steel

C. Copper
D. Aluminum
Correct Answer: B. Steel
Explanation: Steel is a hard magnetic material; it cannot be easily magnetized and demagnetized.
MCQ 8. Heating a magnet:
A. Increases its magnetism
B. Demagnetizes it
C. Has no effect
D. Reverses its poles
Correct Answer: B. Demagnetizes it
Explanation: Heat randomizes the domains, causing demagnetization.
MCQ 9. A permanent magnet is made from:
A. Soft magnetic materials
B. Hard magnetic materials
C. Non-magnetic materials
D. Conducting materials
Correct Answer: B. Hard magnetic materials
Explanation: Permanent magnets are made from hard magnetic materials.
MCQ 10. An electromagnet is made from:
A. Hard magnetic materials
B. Soft magnetic materials
C. Non-magnetic materials
D. Insulating materials
Correct Answer: B. Soft magnetic materials
Explanation: Electromagnets are made from soft magnetic materials.
MCQ 11. Which of the following is a use of permanent magnets?
A. Lifting crane
B. Doorbell
C. Compass
D. Relay
Correct Answer: C. Compass
Explanation: A compass uses a permanent magnet (the compass needle).
MCQ 12. Which of the following is a use of electromagnets?
A. Refrigerator magnet
B. Compass
C. Lifting crane
D. Bar magnet
Correct Answer: C. Lifting crane
Explanation: Lifting cranes use powerful electromagnets to lift heavy metal objects.
MCQ 13. A loudspeaker uses:
A. Only permanent magnets
B. Only electromagnets
C. Both permanent magnets and electromagnets
D. Neither permanent magnets nor electromagnets
Correct Answer: C. Both permanent magnets and electromagnets
Explanation: A loudspeaker uses a permanent magnet and an electromagnet (voice coil).
MCQ 14. Magnetic recording stores information by:
A. Burning the medium
B. Magnetizing portions of the medium
C. Melting the medium
D. Freezing the medium

Correct Answer: B. Magnetizing portions of the medium
Explanation: Magnetic recording saves data by selective magnetization of a magnetic material.
MCQ 15. A magnetic door lock uses:
A. A permanent magnet only
B. An electromagnet and a metal plate
C. A spring mechanism
D. A hydraulic system
Correct Answer: B. An electromagnet and a metal plate
Explanation: Door locks have an electromagnet on the frame and a metal plate on the door.

Section B — Short Questions (5 × 2 = 10 marks)
Q1. Explain why a magnetic compass needle points north.
Answer:
A magnetic compass needle is a small permanent magnet that is free to rotate. The Earth itself acts like a giant magnet, with a magnetic field that extends into space. The north pole of the compass needle is attracted to the Earth's magnetic south pole, which is located near the geographic North Pole. Therefore, the compass needle aligns itself with the Earth's magnetic field, with its north pole pointing toward the geographic North Pole. This is why a compass is used for navigation. The Earth's magnetic field is generated by the motion of molten iron in its outer core. The magnetic poles are not exactly aligned with the geographic poles, so there is a small magnetic declination that must be accounted for in precise navigation.
Q2. Explain why soft iron is used as the core of an electromagnet, while steel is used for permanent magnets.
Answer:
Soft iron is used as the core of an electromagnet because it is a soft magnetic material. It is easily magnetized when a current flows through the coil, and it easily demagnetizes when the current is switched off. This allows the electromagnet to be turned on and off quickly and efficiently. Steel is used for permanent magnets because it is a hard magnetic material. It is difficult to magnetize, but once magnetized, it retains its magnetism for a long time. This makes it suitable for permanent magnets that must maintain a constant magnetic field without a power source. The choice of material depends on whether the magnet needs to be temporary (electromagnet) or permanent.
Q3. Explain how a magnetic door lock works.
Answer:
A magnetic door lock uses an electromagnet mounted on the door frame and a metal plate (armature) mounted on the door. When the electromagnet is energized (current flows through it), it creates a strong magnetic field that attracts the metal plate, locking the door securely. When the correct credentials are provided (e.g., a key card is swiped), the control system interrupts the current to the electromagnet. The magnetic field collapses, and the armature is released, allowing the door to be opened. When the door is closed again, the control system re-energizes the electromagnet, and the door is locked again. This is a practical application of electromagnetism for security.
Q4. Explain how a loudspeaker produces sound using magnets.

Answer:
A loudspeaker uses the interaction between a permanent magnet and an electromagnet (the voice coil) to produce sound. The permanent magnet provides a constant magnetic field. The voice coil is attached to a diaphragm (cone) and is free to move within the magnetic field. When an audio signal (alternating current) flows through the voice coil, it creates a varying magnetic field. This interacts with the permanent magnet's field, causing the voice coil to move back and forth. The diaphragm moves with the coil,

compressing and rarefying the air, which creates sound waves. The frequency of the sound is determined by the frequency of the alternating current, and the loudness is determined by the amplitude of the current.

Q5. Explain the difference between diamagnetic, paramagnetic, and ferromagnetic materials.

Answer:

Diamagnetic materials are weakly repelled by a magnetic field and have no net magnetic moment. Examples include copper, gold, and water. Paramagnetic materials are weakly attracted by a magnetic field and have a small net magnetic moment due to unpaired electrons. Examples include aluminum and tungsten. Ferromagnetic materials are strongly attracted by a magnetic field and can be permanently magnetized. They have domains that can align with an external field. Examples include iron, nickel, and cobalt. The key difference lies in the strength of their response to a magnetic field: diamagnetic (repelled, very weak), paramagnetic (attracted, weak), and ferromagnetic (attracted, strong, can be permanent).

Section C — Long Questions (2 × 5 = 10 marks)

Q1. Describe the magnetic field of a bar magnet. Explain how it can be visualized and what the field lines indicate about the strength and direction of the field.

Answer:

Introduction: A bar magnet produces a magnetic field in the space around it. This field can be represented by magnetic field lines.

Visualization: The magnetic field of a bar magnet can be visualized by placing compass needles or sprinkling iron filings around the magnet. The compass needles align themselves with the field, and the iron filings form patterns that trace the field lines.

Field Lines: The field lines emerge from the North pole, curve through the surrounding space, and enter the South pole. Inside the magnet, they continue from the South pole to the North pole, forming closed loops. The lines never cross each other.

Direction: The direction of the magnetic field at any point is the direction of the force on a North pole placed at that point. The tangent to a field line at any point gives the direction of the field at that point.

Strength: The density of the field lines indicates the strength of the magnetic field. Where the lines are close together, the field is strong; where they are farther apart, the field is weak. The field is strongest at the poles, where the lines are most concentrated.

Applications: The magnetic field of a bar magnet is used in compasses, electric motors, and generators. Understanding the field pattern is essential for designing magnetic devices.

Conclusion: The magnetic field of a bar magnet is a dipole field, with field lines emerging from the North pole and entering the South pole. The field lines show the direction and relative strength of the magnetic field, and they can be visualized using compass needles or iron filings.

Q2. Explain the concept of magnetic shielding. Describe how it works and give two applications.

Answer:

Introduction: Magnetic shielding is the process of protecting a sensitive device or region from external magnetic fields by surrounding it with a material that redirects the magnetic field lines.

How It Works: Materials with high magnetic permeability (such as soft iron, nickel, and cobalt) provide a low-resistance path for magnetic field lines. When a shield made of such a material is placed around a device, the field lines concentrate in the shield and bypass the protected region. This creates a region of reduced or zero magnetic field inside the shield.

Shape of the Shield: Shields are usually made with rounded corners because magnetic

field lines can easily flow around curves but have difficulty making sharp turns. A complete enclosure is necessary for effective shielding.
Applications:
1. Electronic Devices: Magnetic shielding is used to protect sensitive electronic circuits from external magnetic fields that could cause interference.
2. MRI Machines: The strong magnetic fields of MRI machines must be contained to prevent interference with nearby equipment and to protect patients and staff.
Other Applications: Shielded cables, magnetic field-free rooms for sensitive experiments, and protection of pacemakers and other medical implants.
Conclusion: Magnetic shielding is an important technique for protecting sensitive devices from magnetic interference. It relies on high-permeability materials to redirect magnetic field lines around the protected region.

Section D — Numerical Problems (2 × 3 = 6 marks)
Note: This chapter has limited numerical content. Only two numerical problems are supported by the supplied notes.
Q1. A solenoid of length 40 cm has 200 turns and carries a current of 1.5 A. Calculate the magnetic field inside the solenoid. (Take )
Solution:
Given:
Length
Number of turns
Current
Permeability
Required:
Magnetic field
Formula:
where .
Substitution:
Final Answer:
Verification: Units: . Correct.
Q2. A wire carries a current of 8 A. Calculate the magnetic field at a distance of 20 cm from the wire. (Take )
Solution:
Given:
Current
μ =0 4π×10  T□m/A−7
L=40 cm=0.4 m
N=200
I=1.5 A
μ =0 4π×10  T□m/A−7
B
B=μ nI0
n=N/L
n= =0.4200 500 turns/m
B=(4π×10 )×−7 500×1.5
B=4π×10 ×−7 750
B=3000π×10−7
B≈9.42×10  T−4
B≈9.42×10  T−4
T□m/A×m ×−1 A=T
μ =0 4π×10  T□m/A−7
I=8 A

Distance
Permeability
Required:
Magnetic field
Formula:
Substitution:
Final Answer:
Verification: Units: . Correct.

Answer Key and Detailed Solutions — Test 2

MCQ Answers

1. C
2. B
3. B
4. B
5. B
6. B
7. B
8. B
9. B
10. B
11. C

r=20 cm=0.2 m

μ =0 4π×10  T□m/A−7

B

B=

2πr

μ I0

B=

2π×0.2

4π×10 ×8−7

B=

0.2

2×10 ×8−7

B=

0.2

16×10−7

B=80×10−7

B=8×10  T−6

B=8×10  T−6

T□m/A×A/m=T

12. C
13. C
14. B
15. B

Short Answers

(Provided above in Section B.)

Long Answers

(Provided above in Section C.)

Numerical Solutions

(Provided above in Section D.)

## Chapter Test 3 — Application, Reasoning, and Exam Preparation

Board: FBISE
Class: 9
Subject: Physics
Section A — Multiple Choice Questions (15 × 1 = 15 marks)
MCQ 1. A material is placed in a magnetic field and its domains align. This material is most likely:
A. Diamagnetic
B. Paramagnetic
C. Ferromagnetic
D. Non-magnetic
Correct Answer: C. Ferromagnetic
Explanation: Ferromagnetic materials have domains that can align with an external field, producing strong magnetization.
MCQ 2. The Earth's magnetic field is similar to the field of a:
A. Current-carrying wire
B. Bar magnet
C. Single electric charge
D. Gravitational field
Correct Answer: B. Bar magnet
Explanation: The Earth's magnetic field is similar to the magnetic field of a bar magnet.
MCQ 3. The magnetosphere protects the Earth from:
A. Meteorites
B. The solar wind
C. Gravitational waves
D. Cosmic rays
Correct Answer: B. The solar wind
Explanation: The magnetosphere deflects the solar wind, protecting the Earth's atmosphere and life from harmful radiation.
MCQ 4. A compass needle points toward the geographic North Pole because:
A. The geographic North Pole is a magnetic north pole
B. The magnetic south pole is near the geographic North Pole
C. The Earth's rotation causes it
D. The Sun's gravity pulls it
Correct Answer: B. The magnetic south pole is near the geographic North Pole
Explanation: The magnetic south pole is near the geographic North Pole, so the north pole of a compass needle is attracted to it.
MCQ 5. Auroras are caused by:
A. The Moon's gravity
B. Charged particles from the solar wind interacting with the atmosphere
C. The Earth's rotation
D. Volcanic eruptions
Correct Answer: B. Charged particles from the solar wind interacting with the atmosphere
Explanation: Auroras are caused by charged particles from the solar wind being guided by the Earth's magnetic field toward the poles.
MCQ 6. A material has a relative permeability slightly less than 1. It is:
A. Diamagnetic
B. Paramagnetic
C. Ferromagnetic
D. Non-magnetic
Correct Answer: A. Diamagnetic

Explanation: Diamagnetic materials have a relative permeability slightly less than 1.
MCQ 7. A material has a relative permeability much greater than 1. It is:
A. Diamagnetic
B. Paramagnetic
C. Ferromagnetic
D. Non-magnetic
Correct Answer: C. Ferromagnetic
Explanation: Ferromagnetic materials have a relative permeability much greater than 1.
MCQ 8. A soft iron core is used in an electromagnet because:

A. It is cheap
B. It is easily magnetized and demagnetized
C. It is a permanent magnet
D. It is non-magnetic
Correct Answer: B. It is easily magnetized and demagnetized
Explanation: Soft iron is a soft magnetic material, meaning it is easily magnetized and demagnetized.
MCQ 9. A magnetic shield is made from:
A. Copper
B. Aluminum
C. Soft iron
D. Plastic
Correct Answer: C. Soft iron
Explanation: Soft iron is a high-permeability material used for magnetic shielding.
MCQ 10. In a magnetic door lock, when the electromagnet is energized, the door is:
A. Unlocked
B. Locked
C. Open
D. Broken
Correct Answer: B. Locked
Explanation: When the electromagnet is energized, it attracts the metal plate, locking the door.
MCQ 11. A fail-safe magnetic lock:
A. Locks when power is off
B. Unlocks when power is off
C. Is not affected by power
D. Uses a permanent magnet
Correct Answer: B. Unlocks when power is off
Explanation: A fail-safe lock releases (unlocks) when power is off, allowing escape in an emergency.

MCQ 12. The playback process in magnetic recording relies on:
A. Electromagnetic induction
B. Thermionic emission
C. Photoelectric effect
D. Nuclear fission
Correct Answer: A. Electromagnetic induction
Explanation: The playback head detects the magnetic pattern by electromagnetic induction.
MCQ 13. A material is attracted to a magnet. It is likely:
A. Diamagnetic
B. Paramagnetic
C. Ferromagnetic
D. Non-magnetic

Correct Answer: C. Ferromagnetic
Explanation: Ferromagnetic materials are strongly attracted to magnets.
MCQ 14. A material is not attracted to a magnet. It is likely:
A. Ferromagnetic
B. Paramagnetic or diamagnetic
C. Always a metal
D. Always a permanent magnet
Correct Answer: B. Paramagnetic or diamagnetic
Explanation: Non-magnetic materials (diamagnetic and paramagnetic) are not strongly attracted to magnets.
MCQ 15. The magnetic poles of the Earth:
A. Are fixed and never move
B. Drift over time
C. Are exactly aligned with the geographic poles
D. Are located at the equator
Correct Answer: B. Drift over time
Explanation: The magnetic poles drift over time due to changes in the flow of molten iron in the Earth's core.

Section B — Short Questions (5 × 2 = 10 marks)
Q1. Explain why the Earth's magnetic field is important for life on Earth.
Answer:
The Earth's magnetic field is important for life on Earth because it creates the magnetosphere, which protects the planet from the solar wind. The solar wind is a stream of charged particles emitted by the Sun. Without the magnetosphere, these particles would strip away the atmosphere and expose life to harmful radiation. The magnetic field also enables navigation for many animals (e.g., birds, sea turtles) that can sense it. Additionally, the magnetic field is responsible for the auroras (Northern and Southern Lights), which are a spectacular natural phenomenon. Overall, the Earth's magnetic field plays a crucial role in maintaining a habitable environment.
Q2. Explain why a magnetic shield is made with rounded corners.
Answer:
A magnetic shield is made with rounded corners because magnetic field lines can easily flow around curves but have difficulty making sharp turns (90° angles). If the shield had sharp corners, the field lines would be less effectively redirected, and some field could leak into the protected region. Rounded corners allow the field lines to flow smoothly around the shield, providing better shielding. This is why magnetic shields are typically designed with smooth, curved shapes to maximize their effectiveness. The goal is to provide a continuous, low-reluctance path for the magnetic field lines to bypass the protected volume.
Q3. Explain why a rocket can accelerate in space where there is no air to push against.
Answer:
A rocket can accelerate in space due to the law of conservation of momentum, not because it pushes against air. When the rocket's engines burn fuel, they expel hot gases at high speed in the backward direction. These gases have momentum. According to Newton's third law and the conservation of momentum, the rocket gains an equal and opposite momentum in the forward direction. Since there is no external force (like air resistance) in space, the total momentum of the rocket-gas system remains constant. The continuous expulsion of gases results in continuous acceleration. This is why rockets can travel in the vacuum of space.
Q4. Explain the difference between a temporary magnet and a permanent magnet, giving examples.

Answer:
A temporary magnet (electromagnet) is a magnet that only acts as a magnet while an electric current flows through it. It is made from soft magnetic materials (like soft iron) that are easily magnetized and demagnetized. Examples include the electromagnets in electric motors, relays, and lifting cranes. A permanent magnet is a magnet that retains its magnetism for a long time without the need for a power source. It is made from hard magnetic materials (like steel or Alnico) that are difficult to magnetize but retain their magnetism once magnetized. Examples include bar magnets, refrigerator magnets, and compass needles. The key difference is that temporary magnets require a continuous power supply to maintain their magnetic field, while permanent magnets do not.
Q5. Explain how a loudspeaker works, including the role of the permanent magnet and the electromagnet.
Answer:
A loudspeaker converts electrical audio signals into sound using the interaction between a permanent magnet and an electromagnet (the voice coil). The permanent magnet provides a constant magnetic field. The voice coil is attached to a diaphragm (cone) and is free to move within the magnetic field. When an audio signal (alternating current) flows through the voice coil, it creates a varying magnetic field. This interacts with the permanent magnet's field, causing the voice coil to move back and forth. The diaphragm moves with the coil, compressing and rarefying the air, which creates sound waves. The frequency of the sound is determined by the frequency of the alternating current, and the loudness is determined by the amplitude of the current. The permanent magnet is essential for providing the static magnetic field that the voice coil interacts with.
Section C — Long Questions (2 × 5 = 10 marks)
Q1. Explain the nature of the Earth's magnetic field. Describe its origin, its poles, and its importance.
Answer:
Introduction: The Earth has a magnetic field that extends far into space, similar to the field of a giant bar magnet.
Origin: The Earth's magnetic field is generated by the geodynamo—the motion of molten iron and other metals in the Earth's outer core. This motion creates electric currents, which in turn generate the magnetic field. The field is not constant; it changes over time, and the magnetic poles have reversed many times in Earth's history.
Magnetic Poles: The Earth's magnetic field has a magnetic north pole and a magnetic south pole. The magnetic north pole is located near the geographic South Pole, and the magnetic south pole is located near the geographic North Pole. (The naming is based on geographic location, not magnetic polarity.) A compass needle's north pole is attracted to the Earth's magnetic south pole, which is why it points toward the geographic North Pole.
Magnetosphere: The Earth's magnetic field extends into space, forming the magnetosphere. The magnetosphere protects the Earth from the solar wind—a stream of charged particles emitted by the Sun. Without this protection, the atmosphere would be stripped away, and life would be exposed to harmful radiation.
Auroras: Charged particles from the solar wind are guided by the Earth's magnetic field toward the poles, where they collide with atoms in the upper atmosphere, creating the auroras (Northern and Southern Lights).
Importance: The Earth's magnetic field is essential for life. It protects the atmosphere, enables navigation for many animals, and creates the auroras. Understanding the Earth's magnetic field is also important for navigation, geology, and space weather prediction.
Conclusion: The Earth's magnetic field is a dynamic and essential feature of our planet. It is generated by the geodynamo, protects life from solar radiation, and has been a subject of scientific study for centuries.
Q2. Compare and contrast permanent magnets and electromagnets. Include their

construction, properties, and applications.
Answer:
Introduction: Permanent magnets and electromagnets are two types of magnets with different properties and uses.
Construction: Permanent magnets are made from hard magnetic materials (like steel, Alnico, or neodymium-iron-boron). These materials are difficult to magnetize but retain their magnetism once magnetized. Electromagnets are made from a coil of wire (solenoid) wrapped around a soft magnetic core (like soft iron). They require a current to generate a magnetic field.
Properties: Permanent magnets have a fixed magnetic field strength and fixed poles. They do not require a power source. Electromagnets have a magnetic field only while current flows. Their strength can be varied by changing the current, the number of turns, or the core material. Their polarity can be reversed by reversing the current.
Advantages and Disadvantages: Permanent magnets are simple, reliable, and require no power. However, their strength is fixed and generally lower than electromagnets. Electromagnets can be very strong and are controllable, but they require a continuous power supply and can generate heat.
Applications: Permanent magnets are used in compasses, refrigerator magnets, loudspeakers (as the static field), and permanent magnet motors. Electromagnets are used in electric motors, generators, relays, lifting cranes, doorbells, and MRI machines. Both types are used together in devices like loudspeakers and some electric motors.

Conclusion: Permanent magnets and electromagnets have complementary properties. Permanent magnets are ideal for applications requiring a constant magnetic field without power. Electromagnets are ideal for applications requiring a controllable magnetic field. Understanding the differences between them is essential for selecting the right magnet for a given application.
Section D — Numerical Problems (2 × 3 = 6 marks)
Note: This chapter has limited numerical content. Only two numerical problems are supported by the supplied notes.
Q1. A solenoid of length 60 cm has 300 turns and carries a current of 2.5 A. Calculate the magnetic field inside the solenoid. (Take )
Solution:
Given:
Length
Number of turns
Current
Permeability
Required:
Magnetic field
Formula:
where .
Substitution:
Final Answer:
Verification: Units: . Correct.
μ =0 4π×10  T□m/A−7
L=60 cm=0.6 m
N=300
I=2.5 A
μ =0 4π×10  T□m/A−7
B
B=μ nI0
n=N/L

n= =0.6300 500 turns/m
B=(4π×10 )×−7 500×2.5
B=4π×10 ×−7 1250
B=5000π×10−7
B≈1.57×10  T−3
B≈1.57×10  T−3
T□m/A×m ×−1 A=T

Q2. A wire carries a current of 12 A. Calculate the magnetic field at a distance of 30 cm from the wire. (Take )
Solution:
Given:
Current
Distance
Permeability
Required:
Magnetic field
Formula:
Substitution:
Final Answer:
Verification: Units: . Correct.

Answer Key and Detailed Solutions — Test 3
MCQ Answers
1. C
2. B
3. B
4. B
5. B
6. A
μ =0 4π×10  T□m/A−7
I=12 A
r=30 cm=0.3 m
μ =0 4π×10  T□m/A−7
B
B=
2πr
μ I0
B=
2π×0.3
4π×10 ×12−7
B=
0.3
2×10 ×12−7
B=
0.3
24×10−7
B=80×10−7
B=8×10  T−6
B=8×10  T−6
T□m/A×A/m=T

7. C
8. B

9. C
10. B
11. B
12. A
13. C
14. B
15. B

Short Answers

(Provided above in Section B.)

Long Answers

(Provided above in Section C.)

Numerical Solutions

(Provided above in Section D.)