

**BEAMBEPREP**

THE SOLVED PAST PAPER CHAMBER

**SCAN TO SOLVE LIVE**

Timed grind, instant scoring, and active recall on beambeprep.com

PHY • PHYSICS

10. Electromagnetism

Official PMDC Solved Past Paper Topical Booklet • High-Yield Examination Series

58 Solved Questions

2008 to 2024 Archive

Boards: BUMHS, DUHS, KMU, KU, MDCAT, NUMS

Weightage: 27% of MDCAT (54 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

SZABMU 2024

A what value of angle between the magnetic field intensity and vector area, the magnetic flux becomes zero?

[SZABMU 2024]

- (A) 0°
- (B) 30°
- (C) 45°
- (D) 90°

Q2.

SZABMU 2024

Tesla is the SI-unit of magnetic field intensity. Tesla can also be expressed as ____.

[SZABMU 2024]

- (A) $\text{N A}^{-1}\text{m}^{-1}$
- (B) N Am^{-1}
- (C) NA^{-1}m
- (D) NA m^{-1}

Q3.

SZABMU 2024

The SI unit of magnetic flux is weber. Weber can also be expressed as ____.

[SZABMU 2024]

- (A) Joule per ampere
- (B) Joule per coulomb
- (C) Newton per ampere
- (D) Newton per coulomb

Q4.

KU 2024

An electron is moving perpendicular to the magnetic field, which of the following is correct statement about electromagnetic force acting on the electron?

[KU 2024]

- (A) Force acting is equal to electron charge
- (B) Zero force is acting on it
- (C) Force acting is equal to the magnetic field strength
- (D) Force acting is maximum

Q5.

KU 2024

For a positive charged particle (q) moving with a velocity (v) in a magnetic Field of flux density B, the force (F) acting on the charge particle is given by the expression?

[KU 2024]

- (A) $\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$
- (B) $q = \mathbf{F} \cdot (\mathbf{v} \times \mathbf{B})$
- (C) $\mathbf{F} = \frac{\mathbf{v} \times \mathbf{B}}{q}$
- (D) $q = \frac{\mathbf{v} \times \mathbf{B}}{\mathbf{F}}$

Q6.

UHS 2024

The unit of magnetic flux density is:

[UHS 2024]

- (A) Wbm^{-1}
- (B) Wb m^{-2}
- (C) Wb
- (D) Wbm

Q7.

UHS 2024

Which of the following statement is incorrect for any magnetic field lines?

[UHS 2024]

- (A) Lines start at north pole and ends at south pole
- (B) The lines are curved
- (C) Lines never touch or cross each other
- (D) Magnetic field is strongest when lines are farthest

Q8.

UHS 2024

The formula $\Phi = \mathbf{B} \cdot \mathbf{A}$ represents

[UHS 2024]

- (A) Magnetic flux
- (B) Electric flux
- (C) Electric flux density
- (D) Gravitational flux

Q9.

NUMS 2024

The wire of length 100 cm is perpendicular to the magnetic field of 0.5 T. If it carries 10 A of current then force acting on the wire will be:

[NUMS 2024]

- (A) 25 N
- (B) 10 N
- (C) 5 N
- (D) 50 N

Q10.

BUMHS 2024

Magnetic field lines set up in the surrounding of current carrying wire will be:

[BUMHS 2024]

- (A) Circular
- (B) Along the current
- (C) Radially outward
- (D) Opposite to current

Q11.

BUMHS 2024

Electrons of mass m and charge e are accelerated through a potential difference V and strike the target. The maximum speed of these electrons is:

[BUMHS 2024]

- (A) $\sqrt{\frac{2eV}{m}}$
- (B) $\frac{eV}{m}$
- (C) $\sqrt{\frac{eV}{m}}$
- (D) $\frac{eV^2}{m}$

Q12.

UHS 2023

If 0.5 T field is applied over area of 2-meter square which lies at an angle of 60 degree with the field, then the resulting flux will be:

[UHS 2023]

- (A) 0.5 T
- (B) 0.5 Wb
- (C) 0.25 Wb
- (D) 0.25 T

Q13.

UHS 2023

The magnitude of magnetic force will be maximum on current carrying conductor in uniform magnetic field if conductor is placed?

[UHS 2023]

- (A) Parallel to magnetic field
- (B) At 45 degree in magnetic field
- (C) Perpendicular to magnetic field
- (D) Antiparallel in magnetic field

Q14.

SZABMU 2023

The unit of magnetic flux is:

[SZABMU 2023]

- (A) Weber (Wb)
- (B) Wbm
- (C) Wbm^{-1}
- (D) Wbm^{-2}

Q15.

SZABMU 2023

Magnetic flux is the dot product of:

[SZABMU 2023]

- (A) Magnetic field and scalar area
- (B) Magnetic field and vector area
- (C) Magnetic field per unit scalar area
- (D) Magnetic field per unit vector area

Q16.

SZABMU 2023

The dimension of magnetic field is same as that of:

[SZABMU 2023]

- (A) Magnetic flux density
- (B) Magnetic flux
- (C) Magnetic force
- (D) Work done

Q17.

DUHS 2023

Which of the following defines the change in magnetic flux per unit area?

[SINDH 2023]

- (A) Magnetic flux
- (B) Magnetic force
- (C) Magnetic dipole
- (D) Magnetic flux density

Q18.

DUHS 2023

What is the dot product of magnetic induction and unit area?

[SINDH 2023]

- (A) Magnetic flux
- (B) Magnetic induction
- (C) Magnetic field
- (D) Magnetic pole

Q19.

DUHS 2023

What does the magnetic flux measure?

[SINDH 2023]

- (A) Area surrounded by a magnet
- (B) Strength of the magnetic field
- (C) Rate of change of magnetic force
- (D) The number of magnetic lines of force

Q20.

NUMS 2023

If a charged particle enters the magnetic field parallel, it will:

[NUMS 2023]

- (A) Deflect toward north
- (B) Deflect toward south
- (C) Move straight
- (D) Move in circular path

Q21.

NUMS 2023

The dimension of magnetic field strength is same as that of:

[NUMS 2023]

- (A) Magnetic flux
- (B) Magnetic induction
- (C) Work done
- (D) Magnetic force

Q22.

NUMS 2023

The weber is unit of measure of:

[NUMS 2023]

- (A) Conductance
- (B) Electric current
- (C) Magnetic flux
- (D) Electric flux

Q23.

NUMS 2023

In Fleming's right-hand rule, the second finger indicates:

[NUMS 2023]

- (A) Force
- (B) Magnetic field
- (C) Induced current
- (D) Motion

Q24.

UHS 2022

Electric forces change the magnitude and direction of velocity while magnetic forces change _ of velocity.

[UHS 2022]

- (A) Only magnitude
- (B) Only direction
- (C) Magnitude and direction
- (D) Neither magnitude nor direction

Q25.

UHS 2022

Which surface has greater magnetic flux in same magnetic field, each has an area 1m^2 ?

[UHS 2022]

- (A) Circular
- (B) Rectangular
- (C) Square
- (D) Flux is independent of shape

Q26.

SZABMU 2022

The force exerted on charge particle will be maximum when it enters the magnetic field at:

[SZABMU 2022]

- (A) 60°
- (B) 90°
- (C) 0°
- (D) 45°

Q27.

SZABMU 2022

When a charged particle enters the magnetic field parallel, then it will:

[SZABMU 2022]

- (A) Deflect toward north
- (B) Deflect toward south
- (C) Move straight
- (D) Move in circular path

Q28.

SZABMU 2022

The SI unit for magnetic induction B is tesla (T). 1 Tesla is equal to:

[SZABMU 2022]

- (A) $\text{NA}^{-1}\text{m}^{-1}$
- (B) NmA^{-1}
- (C) N^{-1}mA
- (D) NmA

Q29.

KMU 2022

Magnetic lines of force are:

[ETEA 2022]

- (A) Imaginary lines which show actual magnetic field
- (B) Actual lines which show actual magnetic field
- (C) Imaginary lines which show imaginary magnetic field
- (D) Actual lines which show imaginary magnetic field

Q30.

KMU 2022

A charged particle entered in a magnetic field anti parallel to the field, magnetic force on this particle is:

[ETEA 2022]

- (A) BINA
- (B) $BeV \sin(0)$
- (C) Zero
- (D) $Iqlv$

Q31.

KMU 2022

When a neutron enters into a magnetic field B perpendicularly with velocity v, its acceleration is:

[ETEA 2022]

- (A) Zero
- (B) Centripetal
- (C) Positive
- (D) Uniform and non-zero

Q32.

KMU 2022

The unit of magnetic flux is:

[ETEA 2022]

- (A) NA^{-1}m
- (B) $\text{NA}^{-1}\text{m}^{-1}$
- (C) NA^2m^{-4}
- (D) Tesla

Q33.

BUMHS 2022

A magnetic field is produced by:

[BMU 2022]

- (A) Moving charges
- (B) Stationary charges
- (C) Both 'A' and 'B'
- (D) Only ions

Q34.

BUMHS 2022

Magnetic flux is zero when angle between magnetic field and vector area is:

[BMU 2022]

- (A) 0°
- (B) 90°
- (C) 60°
- (D) 30°

Q35.

DUHS 2022

The path of a neutron moving perpendicular to magnetic field is:

[DUHS 2022]

- (A) Curve
- (B) Straight line
- (C) Circle
- (D) Ellipse

Q36.

DUHS 2022

A charged particle of mass 'm' and charge 'q' is projected in a magnetic field of induction B at the angle ' θ '. The radius of curvature of its curved path given by:

[DUHS 2022]

- (A) $r = \frac{mv}{qB}$
- (B) $r = \frac{mv}{qB \sin \theta}$
- (C) $r = \frac{mv \cos \theta}{qB}$
- (D) $r = \frac{mv \sin \theta}{qB}$

Q37.

NUMS 2022

The magnetic field inside the current carrying wire varies:

[NUMS 2022]

- (A) Inversely with r
- (B) Inversely with r^2
- (C) Directly with r
- (D) Directly with r^2

Q38.

NUMS 2022

Magnetic flux is maximum when angle between magnetic field and vector area is:

[NUMS 2022]

- (A) 0°
- (B) 90°
- (C) 180°
- (D) 45°

Q39.

PMDC 2021

Formula of toroid for magnetic field is

[NMDCAT 2021]

- (A) $\mu_0 NI$
- (B) $\frac{\mu_0 NI}{2\pi r}$
- (C) $\frac{\mu_0 NI}{2\pi}$
- (D) $\mu_0 I$

Q40.

PMDC 2021

Unit of Magnetic flux

[NMDCAT 2021]

- (A) Tm^2
- (B) Weber
- (C) Both A and B
- (D) Tesla

Q41.

PMDC 2021

Magnitude of magnetic field of Earth

[NMDCAT 2021]

- (A) 0.6 G
- (B) 0.4 T
- (C) 6 T
- (D) 4 T

Q42.

PMDC 2021

Magnetic force depends upon

[NMDCAT 2021]

- (A) Current
- (B) Length
- (C) Magnetic field
- (D) All

Q43.

PMDC 2020

Magnetic flux is maximum when angle between magnetic field and vector area is

[NMDCAT 2020]

- (A) 0°
- (B) 90°
- (C) 180°
- (D) 45°

Q44.

MDCAT 2018

Two long, parallel conductors which are free to move are arranged 1.0 cm apart. A steady current of 20 A flows in each of the conductor in the same direction. The conductors

[MDCAT 2018]

- (A) Remain stationary
- (B) Move towards each other
- (C) Move away from each other
- (D) Move at right angles to each other

Q45.

MDCAT 2018

A neutron having mass equal to a proton ($m_p = 1.6 \times 10^{-27}$ kg) is moving in a magnetic field of intensity 1.20×10^{-3} T with a speed of 2.0×10^7 ms⁻¹ what is the Maximum force experienced by the neutron.

[MDCAT 2018]

- (A) 3.84×10^{-15} N
- (B) 0 N
- (C) 3.84×10^{12} N
- (D) 38.4×10^{-15} N

Q46.

MDCAT 2018

e/m of an electron is given by the relationship,

[MDCAT 2018]

- (A) $e/m = \frac{2V}{B^2 r^2}$
- (B) $e/m = \left(\frac{V}{Br}\right)^2$
- (C) $e/m = \frac{Vr}{B}$
- (D) $e/m = \frac{VB}{r}$

Q47.

MDCAT 2017

If the value of magnetic flux is 10 Wb, when magnetic lines of force containing magnetic field strength of 1 Tesla passing through unit area of 10 m² then the angle between magnetic field and unit area is:

[MDCAT 2017]

- (A) 180°
- (B) 360°
- (C) 90°
- (D) 45°

Q48.

MDCAT 2017

A charge is projected with velocity of 10 m/s in a magnetic field of 10 T at angle of 60°. If force of 2.78×10^{-17} N is exerted on the charge then value of charge will be:

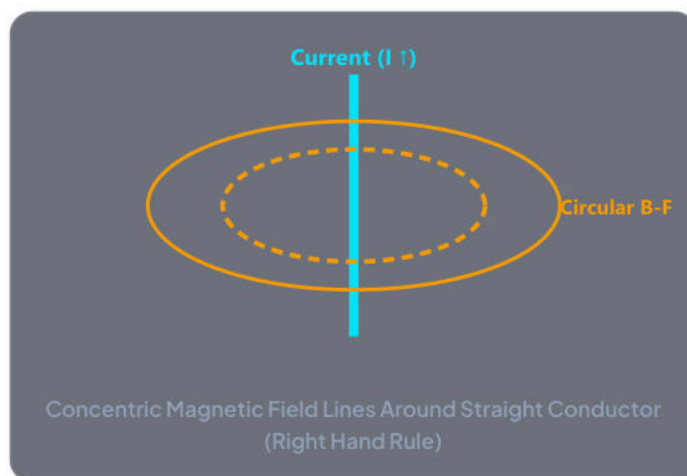
[MDCAT 2017]

- (A) 1.60×10^{-19} C
- (B) 2.70×10^{-19} C
- (C) 4.80×10^{-19} C
- (D) 3.20×10^{-19} C

Q49.

MDCAT 2017

Electric current is flowing through a straight conductor as shown in figure given below. The direction of magnetic lines of force will be


[MDCAT 2017]

- (A) Anticlockwise
- (B) Clockwise
- (C) From Bottom to Top
- (D) From Top to Bottom

Q50.

MDCAT 2014

Due to current in straight conductor the distance between magnetic field lines.

[MCAT 2014]

- (A) Increases away from conductor
- (B) Increases towards conductor
- (C) Decreases away from conductor
- (D) Decreases and then increases towards conductor

Q51.

MDCAT 2013

A long straight current carrying conductor has current direction from bottom to top when held vertically. What will be the direction of magnetic field lines when observed from below the conductor?

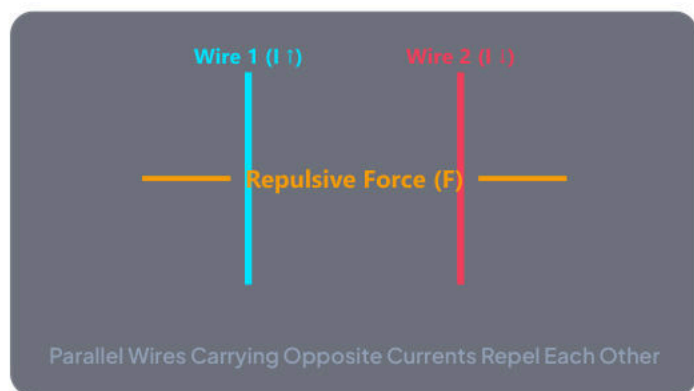
[MCAT 2013]

- (A) Clockwise
- (B) Vertically upward
- (C) Anticlockwise
- (D) Vertically downward

Q52.

MDCAT 2012

Two long straight parallel wires held vertically, have equal but opposite currents as shown in the figure. Which of the following effect will be observed?

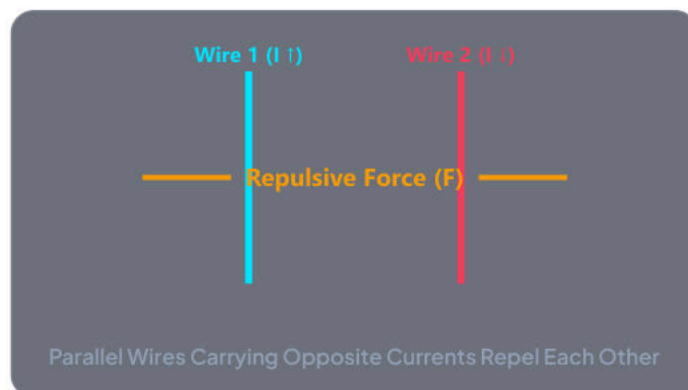
**[MCAT 2012]**

- (A) Magnetic field at 'X' is stronger than that at 'Y' and 'Z'
- (B) Magnetic field at 'X', and 'Z' are same
- (C) Magnetic field at 'X' is weaker than that at Z
- (D) Magnetic field at 'X' is weaker than that at out, stronger than that at 'Z'

Q53.

MDCAT 2011

Two long parallel wires Wire 1 and Wire 2 repel each other as shown in the figure. What could be the reasons?

**[MCAT 2011]**

- (A) Both carry current in same direction
- (B) Both carry current in opposite direction
- (C) Wire 1 has current, but Wire 2 has no current
- (D) Wire 2 has current, wire 1 has no current

Q54.

KMU 2011

The SI unit of magnetic flux is weber which is equal to:

[ETEA 2011]

- (A) NmA^{-1}
- (B) Nm^2A^{-1}
- (C) Nm
- (D) AmA^{-2}

Q55.

MDCAT 2010

Which one of the following relations is correct?

[MCAT 2010]

- (A) $1 \text{ wb m}^{-2} = \text{N m}^{-1} \text{A}^{-1}$
- (B) $1 \text{ Tesla} = 10^4 \text{ Gauss}$
- (C) $1 \text{ wb m}^{-2} = 1 \text{ Tesla}$
- (D) All of these

Q56.

MDCAT 2009

A charge of two micro coulombs ($2 \mu\text{C}$) moves with velocity of two meter per second (2 m/sec) in the direction of two Tesla magnetic field. The force that will act on it will be:

[MCAT 2009]

- (A) 2 N
 - (B) Zero
 - (C) 8 N
 - (D) 4 N
-

Q57.

MDCAT 2009

Force experienced by a moving charge in a magnetic field is:

[MCAT 2009]

- (A) $F = BA \cos(\theta)$
 - (B) $F = \mu_0 NI$
 - (C) $F = q(\mathbf{v} \times \mathbf{B})$
 - (D) $F = I(\mathbf{L} \times \mathbf{B})$
-

Q58.

MDCAT 2008

An electric charge in uniform motion produces:

[MCAT 2008]

- (A) An electric field
 - (B) A magnetic field
 - (C) Both magnetic and electric fields
 - (D) Neither magnetic nor electric fields
-

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 10. Electromagnetism.

beambeprep.com

Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	D	SZABMU 2024	13	C	UHS 2023	25	D	UHS 2022	37	C	NUMS 2022	49	A	MDCAT 2017
2	A	SZABMU 2024	14	A	SZABMU 2023	26	B	SZABMU 2022	38	A	NUMS 2022	50	A	MDCAT 2014
3	A	SZABMU 2024	15	B	SZABMU 2023	27	C	SZABMU 2022	39	B	PMDC 2021	51	A	MDCAT 2013
4	D	KU 2024	16	A	SZABMU 2023	28	A	SZABMU 2022	40	C	PMDC 2021	52	A	MDCAT 2012
5	A	KU 2024	17	D	DUHS 2023	29	A	KMU 2022	41	A	PMDC 2021	53	B	MDCAT 2011
6	B	UHS 2024	18	A	DUHS 2023	30	C	KMU 2022	42	D	PMDC 2021	54	A	KMU 2011
7	D	UHS 2024	19	D	DUHS 2023	31	A	KMU 2022	43	A	PMDC 2020	55	D	MDCAT 2010
8	A	UHS 2024	20	C	NUMS 2023	32	A	KMU 2022	44	B	MDCAT 2018	56	B	MDCAT 2009
9	C	NUMS 2024	21	B	NUMS 2023	33	A	BUMHS 2022	45	B	MDCAT 2018	57	C	MDCAT 2009
10	A	BUMHS 2024	22	C	NUMS 2023	34	B	BUMHS 2022	46	A	MDCAT 2018	58	C	MDCAT 2008
11	A	BUMHS 2024	23	C	NUMS 2023	35	B	DUHS 2022	47	A	MDCAT 2017			
12	B	UHS 2023	24	B	UHS 2022	36	D	DUHS 2022	48	D	MDCAT 2017			

TOTAL
MCQS
58

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in
BeambePrep Grind Mode for automated error
autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (D)

SZABMU 2024

A what value of angle between the magnetic field intensity and vector area, the magnetic flux becomes zero? [S...

CORE CONCEPT AND DERIVATION

Magnetic flux is a dot product. It drops to zero when the two vectors are perfectly orthogonal (perpendicular) to each other.

Formula:

$$\Phi = BA \cos(\theta)$$

Solution:

- We need to find the angle θ that makes $\cos(\theta) = 0$.
- From basic trigonometry, the cosine function hits zero at 90° (and 270°).
- At 90° , the magnetic field is grazing parallel to the actual surface plane, so exactly zero field lines "pierce" through the area.

Why other options are incorrect:

Option A (0°) maximizes the flux. Options B and C result in a fraction of the maximum flux (0.866 and 0.707 respectively).

Question #2 Key: (A)

SZABMU 2024

Telsa is the SI-unit of magnetic field intensity. Tesla can also be expressed as _____. [SZABMU 2024]

CORE CONCEPT AND DERIVATION

The Tesla is mathematically derived from the macroscopic magnetic force exerted on a current-carrying wire.

Formula:

$$F = ILB \sin(\theta)$$

Solution:

- Rearrange the force formula to isolate B : $B = \frac{F}{IL \sin \theta}$.
- Substitute the fundamental SI units for each variable:

$$1 \text{ Tesla} = \frac{1 \text{ Newton}}{(1 \text{ Ampere})(1 \text{ meter})}$$
- Move the denominators to the numerator using negative exponents: $\text{N} \cdot \text{A}^{-1} \cdot \text{m}^{-1}$.

Why other options are incorrect:

Options B, C, and D contain incorrect exponents, representing dimensionally nonsensical units that do not equate to a Tesla.

Question #3 Key: (A)

SZABMU 2024

The SI unit of magnetic flux is weber. Weber can also be expressed as _____. [SZABMU 2024]

CORE CONCEPT AND DERIVATION

Units in electromagnetism can be heavily intertwined using work, force, and current relationships. The Weber can be derived down to energy and current.

Formula:

$$\Phi = B \cdot A \quad \text{and} \quad W = F \cdot d$$

Solution:

- Start with the base definition: $1 \text{ Weber} = 1 \text{ Tesla} \cdot \text{m}^2$.
- Expand Tesla: $\text{Weber} = \left(\frac{\text{N}}{\text{A} \cdot \text{m}} \right) \cdot \text{m}^2 = \frac{\text{N} \cdot \text{m}}{\text{A}}$.
- Recall that $1 \text{ Newton} \cdot \text{meter}$ is the unit of mechanical work, the Joule (J).
- Substitute Joule in: $1 \text{ Weber} = \frac{\text{Joule}}{\text{Ampere}}$.

Why other options are incorrect:

Option B is the definition of a Volt. Option C is incomplete (missing the meter to make it a Joule). Option D is the unit for the Electric Field.

Question #4 Key: (D)

KU 2024

An electron is moving perpendicular to the magnetic field, which of the following is correct statement about e...

CORE CONCEPT AND DERIVATION

The magnetic force acting on a moving charged particle relies on the angle between its velocity vector and the magnetic field vector.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- The term "perpendicular" indicates that the angle θ between the electron's velocity and the magnetic field is exactly 90° .
- The sine function reaches its maximum possible value at this angle: $\sin(90^\circ) = 1$.
- Substitute this into the formula: $F = qvB(1) = qvB$.
- Because the trigonometric multiplier is at its absolute peak, the resulting magnetic force acting on the electron is **maximum**.

Why other options are incorrect:

Option B would only be true if the electron was moving parallel to the field ($\theta = 0^\circ$). Options A and C falsely equate the total force to just one of its component variables, ignoring velocity and the other parameters.

Question #5 Key: (A)

KU 2024

For a positive charged particle (q) moving with a velocity (v) in a magnetic field of flux density B , the force...

CORE CONCEPT AND DERIVATION

The macroscopic magnetic force (Lorentz force) acting on a moving point charge is defined fundamentally by the vector cross product of velocity and the magnetic field.

Formula:

$$\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$$

Solution:

- The force $\mathbf{F}$ is a vector that is always strictly perpendicular to both the velocity vector $\mathbf{v}$ and the magnetic field vector $\mathbf{B}$.
- In mathematics, a vector that is perpendicular to two other vectors is found using the cross product.
- The magnitude is scaled by the scalar value of the electric charge q .
- Therefore, the correct standard expression is $\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$.

Why other options are incorrect:

Option C incorrectly places the charge in the denominator. Options B and D mathematically misarrange the vector relations and isolate the scalar charge q using invalid vector division.

Question #6 Key: (B)

UHS 2024

The unit of magnetic flux density is: [UHS 2024]

CORE CONCEPT AND DERIVATION

Magnetic flux density is a measure of the concentration of magnetic field lines within a given area. It is synonymous with the magnetic field vector $\mathbf{B}$.

Formula:

$$B = \frac{\Phi}{A}$$

Solution:

- Look at the formula: B is equal to magnetic flux (Φ) divided by Area (A).
- The SI unit for magnetic flux is the Weber (Wb).
- The SI unit for area is square meters (m^2).
- Dividing them gives $\frac{\text{Wb}}{\text{m}^2}$, which is expressed mathematically with a negative exponent as Wb m^{-2} (equivalent to 1 Tesla).

Why other options are incorrect:

Option C is the unit for total flux, not density. Options A and D represent incorrect dimensional scaling by length rather than area.

Question #7 Key: (D)

UHS 2024

Which of the following statement is incorrect for any magnetic field lines? [UHS 2024]

CORE CONCEPT AND DERIVATION

Magnetic field lines are visual aids whose spacing visually indicates the relative magnitude of the magnetic field vector in that region of space.

Solution:

- By convention, the density of magnetic field lines (how closely packed they are) directly correlates to the strength of the magnetic field.
- Where lines are very close together, the field is remarkably strong (like near the poles of a magnet).
- Conversely, where lines are farthest apart, the magnetic field is at its weakest.
- Therefore, the statement "Magnetic field is strongest when lines are farthest" is fundamentally **incorrect**.

Why other options are incorrect:

Options A, B, and C are all true, factual properties of standard magnetic field mapping, meaning they are not the "incorrect" statement being asked for.

Question #8 Key: (A)

UHS 2024

The formula [Formula] represents [UHS 2024]

CORE CONCEPT AND DERIVATION

In physics, "flux" generally refers to the flow or permeation of a vector field across a defined surface area. The specific type of flux depends entirely on the specific vector field being measured.

Formula:

$$\Phi_B = \mathbf{B} \cdot \mathbf{A}$$

Solution:

- Identify the primary vector in the equation: **B** is the universal symbol for the **Magnetic Field** (or magnetic induction).
- Identify the operation: The dot product with the area vector **A** calculates the projection of this field through the surface.
- Because the field is magnetic, the resulting scalar value is explicitly defined as the **Magnetic flux**.

Why other options are incorrect:

Option B (Electric flux) uses the electric field vector **E** (i.e., $\Phi_E = \mathbf{E} \cdot \mathbf{A}$). Option D uses the gravitational field vector **g**. Option C is a density, not a total flux calculation.

Question #9 Key: (C)

NUMS 2024

The wire of length [Formula] is perpendicular to the magnetic field of [Formula]. If it carries [Formula] of ...

CORE CONCEPT AND DERIVATION

A straight wire carrying an electric current through a uniform external magnetic field experiences a macroscopic Lorentz force.

Formula:

$$F = ILB \sin(\theta)$$

Solution:

- First, convert all units to standard SI units: The length $L = 100 \text{ cm} = 1.0 \text{ m}$.
- Identify the other givens: Magnetic field $B = 0.5 \text{ T}$, Current $I = 10 \text{ A}$.
- Determine the angle: The problem states the wire is "perpendicular" to the field, so $\theta = 90^\circ$, and $\sin(90^\circ) = 1$.
- Calculate the force: $F = (10)(1.0)(0.5)(1)$.
- $F = 5 \text{ N}$.

Why other options are incorrect:

Option D occurs if one forgets to convert centimeters to meters, resulting in $10 \times 100 \times 0.5 = 500$ or similar scaling errors. Options A and B are simple math errors.

Question #10 Key: (A)

BUMHS 2024

Magnetic field lines set up in the surrounding of current carrying wire will be: [BUMHS 2024]

CORE CONCEPT AND DERIVATION

Hans Christian Ørsted discovered that a straight current-carrying conductor generates a magnetic field in the surrounding three-dimensional space, the shape of which is determined by the Right-Hand Grip Rule.

Solution:

- If you grasp a straight wire with your right hand such that your thumb points in the direction of the conventional current...
- Your fingers will naturally curl around the wire.
- This curl physically traces the path of the magnetic field lines, forming closed, concentric **circular** loops centered on the wire axis.

Why other options are incorrect:

Options B and D imply the field lines are straight and parallel to the wire, which is entirely false. Option C describes the topology of an electric field extending from a line of static charge, not a magnetic field.

Question #11 Key: (A)

BUMHS 2024

Electrons of mass m and charge e are accelerated through a potential difference V and strike the target. The m ...

CORE CONCEPT AND DERIVATION

When a charged particle is accelerated across a voltage gap (potential difference), the electrical work done on the particle is completely converted into its kinetic energy (assuming starting from rest).

Formula:

$$W = \Delta K.E \implies qV = \frac{1}{2}mv^2$$

Solution:

- Substitute the specific charge of an electron: $q = e$. The electrical energy given to the electron is $E = eV$.
- Equate this to the classic formula for kinetic energy: $eV = \frac{1}{2}mv^2$.
- Multiply both sides by 2 to clear the fraction: $2eV = mv^2$.
- Divide by mass m : $v^2 = \frac{2eV}{m}$.
- Take the square root to isolate the maximum velocity v :
$$v = \sqrt{\frac{2eV}{m}}$$

Why other options are incorrect:

Option C forgets the factor of 2 originating from the $\frac{1}{2}$ in the kinetic energy equation. Options B and D lack the necessary square root required to solve for v from v^2 .

Question #12 Key: (B)

UHS 2023

If [Formula] field is applied over area of 2-meter square which lies at an angle of 60 degree with the field, ...

CORE CONCEPT AND DERIVATION

Magnetic flux is the dot product of the magnetic field vector and the area vector. Care must be taken depending on whether the angle is given relative to the surface plane or the normal vector. *Historical Note: In many past papers from this region, "angle with the field" is interpreted as the angle with the area vector unless specified as the plane.*

Formula:

$$\Phi = BA \cos(\theta)$$

Solution:

- Identify parameters: $B = 0.5 \text{ T}$, $A = 2 \text{ m}^2$.
- Use the angle provided exactly as $\theta = 60^\circ$.
- Recall that $\cos(60^\circ) = 0.5$.
- Calculate: $\Phi = (0.5)(2) \cos(60^\circ) = 1 \times 0.5 = 0.5 \text{ Wb}$.

Why other options are incorrect:

Option A has the incorrect unit (Tesla is for field, not flux). Options C and D calculate flux using a sine or a 30° angle, or just have incorrect math/units.

Question #13 Key: (C)

UHS 2023

The magnitude of magnetic force will be maximum on current carrying conductor in uniform magnetic field if con...

CORE CONCEPT AND DERIVATION

A macroscopic current-carrying wire experiences a magnetic Lorentz force. The magnitude relies heavily on its geometric orientation inside the external magnetic field.

Formula:

$$F = ILB \sin(\theta)$$

Solution:

- To maximize the force F , the trigonometric multiplier $\sin(\theta)$ must be at its maximum value of 1.
- This occurs when the angle θ between the wire and the field is 90° .
- An angle of 90° corresponds geometrically to being placed strictly **perpendicular** to the magnetic field lines.

Why other options are incorrect:

Options A and D result in a force of absolutely zero. Option B results in a force reduced by a factor of 0.707 ($\sin 45^\circ$).

Question #14 Key: (A)

SZABMU 2023

The unit of magnetic flux is: [SZABMU 2023]

CORE CONCEPT AND DERIVATION

Magnetic flux defines the total magnetic field cutting through a defined geometrical area. It has a specific derived SI unit.

Formula:

$$\Phi = \int \mathbf{B} \cdot d\mathbf{A}$$

Solution:

- The SI unit for the magnetic field B is Tesla (T).
- The SI unit for area A is square meters (m^2).
- The product is $\text{T} \cdot \text{m}^2$.
- In the International System of Units, this combination is given the dedicated name **Weber (Wb)**.

Why other options are incorrect:

Options B, C, and D inappropriately attach extra distance dimensions (meters) to the Weber, creating nonsensical units that do not represent physical flux.

Question #15 Key: (B)

SZABMU 2023

Magnetic flux is the dot product of: [SZABMU 2023]

CORE CONCEPT AND DERIVATION

In physics, an area is treated not just as a size (scalar), but as a mathematical vector whose direction is strictly perpendicular (normal) to the physical surface plane.

Formula:

$$\Phi_B = \mathbf{B} \cdot \mathbf{A}$$

Solution:

- Magnetic flux is defined as the measure of magnetic field lines passing through a surface.
- Mathematically, this requires a projection of the magnetic field vector onto the normal of the surface.
- This projection is calculated using a mathematical dot product between the **Magnetic field vector (B)** and the **vector area (A)**.

Why other options are incorrect:

Option A is impossible because you cannot take a dot product with a scalar. Options C and D define flux density/gradients, not the flux itself, and are mathematically structured backward.

Question #16 Key: (A)

SZABMU 2023

The dimension of magnetic field is same as that of: [SZABMU 2023]

CORE CONCEPT AND DERIVATION

In electromagnetism, the vector **B** is commonly referred to by two different but synonymous names depending on context, yet they describe the exact same physical property and share the same dimensions.

Formula:

$$\mathbf{B} = \frac{\Phi}{A}$$

Solution:

- The term "Magnetic Field" or "Magnetic Induction" refers to the vector **B** measured in Tesla.
- Because flux Φ is field multiplied by area, rearranging gives $B = \Phi/A$.
- Therefore, **B** is mathematically the amount of magnetic flux per unit area.
- Thus, its formal descriptive name is **Magnetic flux density**, proving they have identical dimensions.

Why other options are incorrect:

Option B (Flux) differs by a dimension of area (L^2). Option C is a force (Newtons). Option D is energy (Joules). None share the dimensions of Tesla.

Question #17 **Key: (D)**

DUHS 2023

Which of the following defines the change in magnetic flux per unit area? [SINDH 2023]

CORE CONCEPT AND DERIVATION

The quantity of magnetic field lines packed into a specific area defines the strength of the field in that region.

Formula:

$$B = \frac{\Phi}{A}$$

Solution:

- The phrase "magnetic flux per unit area" is a direct verbal translation of the formula Φ/A .
- By definition, flux divided by area yields the magnetic field **B**.
- Another formal scientific term for **B** is **Magnetic flux density**.

Why other options are incorrect:

Option A is the numerator itself. Option B relates to the physical push/pull on moving charges. Option C refers to a source of magnetic field (like a bar magnet), not the field distribution itself.

Question #18 **Key: (A)**

DUHS 2023

What is the dot product of magnetic induction and unit area? [SINDH 2023]

CORE CONCEPT AND DERIVATION

This is a direct translation of the fundamental mathematical definition of a physical quantity in electromagnetism.

Formula:

$$\Phi = \mathbf{B} \cdot \mathbf{A}$$

Solution:

- "Magnetic induction" is another term for the magnetic field vector **B**.
- The text specifies the operation is a "dot product" (·) with the "area" vector **A**.
- The mathematical evaluation of $\mathbf{B} \cdot \mathbf{A}$ generates a scalar quantity known globally as **Magnetic flux**.

Why other options are incorrect:

Options B and C are the same thing (the vector **B** itself). Option D is a theoretical magnetic monopole or the physical ends of a magnet, completely unrelated to this calculation.

Question #19 Key: (D)

DUHS 2023

What does the magnetic flux measure? [SINDH 2023]

CORE CONCEPT AND DERIVATION

Magnetic flux is a conceptual and mathematical tool used to quantify the overall amount of a magnetic field permeating a given 2D surface.

Solution:

- Imagine the magnetic field as a stream of water, and a wire loop as a net.
- The flux is the total volume of water passing through the net.
- Visually, in physics, this is represented by counting how many imaginary field lines pierce through the specified area.
- Therefore, flux is an abstract measure of **the number of magnetic lines of force** crossing a boundary.

Why other options are incorrect:

Option A is purely geometrical space. Option B defines the density of lines, not the total count. Option C is a time-derivative completely unrelated to static flux.

Question #20 Key: (C)

NUMS 2023

If a charged particle enters the magnetic field parallel, it will: [NUMS 2023]

CORE CONCEPT AND DERIVATION

The magnetic force requires a cross product. If vectors are perfectly parallel, their cross product, and therefore the resulting force, collapses to zero.

Formula:

$$\mathbf{F} = q(\mathbf{v} \times \mathbf{B}) = qvB \sin(\theta)$$

Solution:

- The term "parallel" defines the angle θ between velocity and field as exactly 0° .
- The sine of zero is zero ($\sin 0^\circ = 0$).
- This renders the entire magnetic force equation to $F = 0$.
- Lacking any deflecting force, Newton's law dictates the particle must persist in a **straight** line.

Why other options are incorrect:

Options A, B, and D describe paths curved by a net transverse force, which is mathematically impossible in a parallel trajectory.

Question #21 Key: (B)

NUMS 2023

The dimension of magnetic field strength is same as that of: [NUMS 2023]

CORE CONCEPT AND DERIVATION

In foundational physics terminology, several names describe the exact same underlying vector field denoted by **B**.

Solution:

- The vector **B** is heavily referenced in physics as either the "magnetic field", "magnetic flux density", or "magnetic induction".
- Because "magnetic field strength" (when used colloquially to mean **B**) refers to the exact same Tesla-measured phenomenon, it shares identical dimensions with **Magnetic induction**.

Why other options are incorrect:

Option A (Flux) is measured in Webers ($\text{T} \cdot \text{m}^2$). Option C is Joules. Option D is Newtons. None of these share the unit of Tesla ($\text{kg s}^{-2} \text{A}^{-1}$).

Question #22 Key: (C)

NUMS 2023

The weber is unit of measure of: [NUMS 2023]

CORE CONCEPT AND DERIVATION

The Weber (Wb) is the official SI unit for a specific electromagnetism scalar quantity.

Formula:

$$1 \text{ Wb} = 1 \text{ T} \cdot \text{m}^2$$

Solution:

- By standard international agreement (SI units), the Weber is dedicated to measuring the total magnetic field traversing an area.
- This physical quantity is exclusively known as **Magnetic flux**.

Why other options are incorrect:

Option A (Conductance) uses Siemens. Option B (Current) uses Amperes. Option D (Electric flux) uses Newton-meters squared per Coulomb ($\text{N} \cdot \text{m}^2/\text{C}$).

Question #23 Key: (C)

NUMS 2023

In Fleming's right-hand rule, the second finger indicates: [NUMS 2023]

CORE CONCEPT AND DERIVATION

Fleming's Right-Hand Rule is a mnemonic used to determine the direction of induced current when a conductor moves through a magnetic field (generator effect).

Solution:

- The **Thumb** represents the direction of the applied **Motion** (or Force).
- The **First (Index) finger** points in the direction of the **Magnetic Field** (North to South).
- The **Second (Middle) finger** is extended orthogonally to represent the direction of the **Induced current**.

Why other options are incorrect:

Option A and D refer to the thumb. Option B refers to the first (index) finger.

Question #24 Key: (B)

UHS 2022

Electric forces change the magnitude and direction of velocity while magnetic forces change _ of velocity. [UH...]

CORE CONCEPT AND DERIVATION

Electric forces can do work on a charge, speeding it up or slowing it down. Magnetic forces, however, always act perpendicular to the velocity vector of the charge.

Formula:

$$W = \mathbf{F}_m \cdot \mathbf{v} dt = q(\mathbf{v} \times \mathbf{B}) \cdot \mathbf{v} dt = 0$$

Solution:

- Because the magnetic force is always perpendicular to velocity, the dot product of force and velocity is zero.
- This means magnetic forces do absolutely no mechanical work ($W = 0$) on a moving charge.
- By the work-energy theorem, if no work is done, kinetic energy (and thus speed or velocity magnitude) remains constant.
- The perpendicular force acts strictly as a centripetal force, altering **only the direction** of the velocity vector.

Why other options are incorrect:

Option A is false because magnetic fields cannot change speed. Option C conflates magnetic forces with electric forces. Option D is false because a force must cause an acceleration, which is a change in velocity (direction in this case).

Question #25 Key: (D)

UHS 2022

Which surface has greater magnetic flux in same magnetic field, each has an area [Formula] ? [UHS 2022]

CORE CONCEPT AND DERIVATION

Magnetic flux depends only on the area's magnitude, the magnetic field strength, and their relative angle, not the geometrical perimeter or shape.

Formula:

$$\Phi = B \cdot A$$

Solution:

- The formula for flux $\Phi = BA \cos(\theta)$ requires only the numerical value of the Area A .
- Whether the 1 m^2 area is cut into a circle, a long rectangle, or a square, the total number of field lines intersecting that boundary remains identically the same (assuming uniform field and orientation).
- Therefore, the flux is entirely independent of the surface's 2D shape.

Why other options are incorrect:

Options A, B, and C incorrectly imply that geometry affects the counting of field lines over a flat plane, which is topologically false.

Question #26 **Key: (B)**

SZABMU 2022

The force exerted on charge particle will be maximum when it enters the magnetic field at: [SZABMU 2022]

CORE CONCEPT AND DERIVATION

The force on a charge particle in a magnetic field is governed by the vector cross product, mathematically relying on the sine of the incident angle.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- To maximize the force F , the trigonometric function $\sin(\theta)$ must be at its maximum positive value.
- The maximum value of the sine function is 1.
- This occurs exactly when the angle $\theta = 90^\circ$ (perpendicular entry).
- Thus, entering the field perpendicularly results in maximum deflection force.

Why other options are incorrect:

Option C results in 0 force. Options A and D result in intermediate fractional forces ($\frac{\sqrt{3}}{2}$ and $\frac{\sqrt{2}}{2}$ of the maximum, respectively).

Question #27 **Key: (C)**

SZABMU 2022

When a charged particle enters the magnetic field parallel, then it will: [SZABMU 2022]

CORE CONCEPT AND DERIVATION

If a charge enters a magnetic field parallel to the field lines, the cross product of its velocity and the magnetic field is zero, resulting in no force.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- "Parallel" implies the angle θ between velocity $\mathbf{v}$ and magnetic field $\mathbf{B}$ is 0° (or 180°).
- Substitute this into the formula: $\sin(0^\circ) = 0$.
- The calculated magnetic force is therefore zero.
- According to Newton's First Law, with no net force, the particle continues moving in a **straight line** at constant speed.

Why other options are incorrect:

Options A, B, and D describe deflections, which can only happen if a non-zero magnetic force acts on the particle (requiring a non-zero angle).

Question #28 Key: (A)

SZABMU 2022

The SI unit for magnetic induction B is tesla (T). 1 Tesla is equal to:
[SZABMU 2022]

CORE CONCEPT AND DERIVATION

The Tesla is a derived SI unit defined by the magnetic force formula on a current carrying wire.

Formula:

$$F = ILB \implies B = \frac{F}{IL}$$

Solution:

- Write out the SI units for the variables in the rearranged formula: Force F is in Newtons (N), Current I is in Amperes (A), and Length L is in meters (m).
- Substitute the units: $1 \text{ Tesla} = \frac{1 \text{ N}}{1 \text{ A} \cdot 1 \text{ m}}$.
- Bring the denominator to the numerator using negative exponents: $\text{N A}^{-1} \text{ m}^{-1}$.

Why other options are incorrect:

Option B is the unit for magnetic flux (Weber). Options C and D are nonsensical arrangements of the constituent base units.

Question #29 Key: (A)

KMU 2022

Magnetic lines of force are: [ETEA 2022]

CORE CONCEPT AND DERIVATION

Magnetic field lines are a visual tool introduced by Michael Faraday to conceptualize and map the invisible magnetic field.

Solution:

- The magnetic field itself is a real physical entity that stores energy and exerts real forces.
- However, the "lines" drawn to represent it do not exist physically in space; they are an illustrative abstraction.
- Therefore, they are **imaginary lines** used to accurately depict a real (**actual**) physical field.

Why other options are incorrect:

Option B is false because you cannot touch or extract a "line" from a vacuum. Option C is false because the magnetic field itself is a real phenomenon. Option D is an oxymoron.

Question #30 Key: (C)

KMU 2022

A charged particle entered in a magnetic field anti parallel to the field, magnetic force on this particle is:...

CORE CONCEPT AND DERIVATION

The magnetic force requires a perpendicular velocity component relative to the magnetic field. Anti-parallel means they are exactly aligned but pointing in opposite directions.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- Anti-parallel implies the angle between the velocity vector and magnetic field vector is $\theta = 180^\circ$.
- Calculate the sine of this angle: $\sin(180^\circ) = 0$.
- Substitute this into the force equation: $F = qvB(0) = 0$.
- The resulting force is exactly **Zero**.

Why other options are incorrect:

Option A is the torque on a coil. Option B uses an angle of 0° which equals zero, but anti-parallel strictly means 180° . Option D is dimensional gibberish.

Question #31 Key: (A)

KMU 2022

When a neutron enters into a magnetic field B perpendicularly with velocity v , its acceleration is: [ETEA 2022...]

CORE CONCEPT AND DERIVATION

A magnetic field only exerts force on moving particles that have a net electric charge.

Formula:

$$F = qvB \sin(\theta) \quad \text{and} \quad a = \frac{F}{m}$$

Solution:

- A neutron, by definition, is a neutral particle. Therefore, its charge $q = 0$.
- Substitute this into the force formula: $F = (0)vB \sin(90^\circ) = 0 \text{ N}$.
- According to Newton's Second Law, acceleration is force divided by mass. Since force is zero, $a = \frac{F}{m} = 0$.
- The particle continues completely undeflected without any acceleration.

Why other options are incorrect:

Options B, C, and D assume the particle is charged (like a proton or electron) and would therefore experience a deflecting centripetal acceleration.

Question #32 Key: (A)

KMU 2022

The unit of magnetic flux is: [ETEA 2022]

CORE CONCEPT AND DERIVATION

Magnetic flux is the product of magnetic field and area. To find its fundamental derived SI unit, we combine the constituent equations.

Formula:

$$\Phi = B \cdot A = \left(\frac{F}{IL}\right) \cdot A$$

Solution:

- Start with the formula substituting standard units: $\text{Wb} = \text{Tesla} \cdot \text{m}^2$.
- Expand Tesla using the force law: $T = \frac{N}{A \cdot \text{cdotm}}$.
- Multiply by area (m^2): $\Phi = \left(\frac{N}{A \cdot \text{cdotm}}\right) \cdot \text{m}^2$.
- Simplify the meters: $\frac{N \cdot \text{cdotm}}{A} = N \text{ A}^{-1} \text{m}$.

Why other options are incorrect:

Option B is the unit for the magnetic field (Tesla) itself. Options C is an incorrect dimension. Option D is specifically the unit of magnetic field strength, not flux.

Question #33 Key: (A)

BUMHS 2022

A magnetic field is produced by: [BMU 2022]

CORE CONCEPT AND DERIVATION

Electromagnetism defines that magnetic fields are strictly the relativistic result of electric charges in motion (currents).

Solution:

- A stationary charge creates an electrostatic field in space, but no magnetic field.
- When a charge moves, it forms an electric current.
- According to Biot-Savart Law and Ampere's Law, a current (moving charge) induces a circulating magnetic field around its path.
- Therefore, only moving charges produce magnetic fields.

Why other options are incorrect:

Option B is false because stationary charges lack the necessary velocity. Option C is false for the same reason. Option D is too restrictive; moving electrons, protons, and other charged particles also produce magnetic fields, not just ions.

Question #34 Key: (B)

BUMHS 2022

Magnetic flux is zero when angle between magnetic field and vector area is: [BMU 2022]

CORE CONCEPT AND DERIVATION

Magnetic flux measures how much magnetic field "pierces" through a given surface. The vector area is defined as normal (perpendicular) to the surface plane.

Formula:

$$\Phi = BA \cos(\theta)$$

Solution:

- We want the flux Φ to be zero. This requires $\cos(\theta) = 0$.
- The cosine of an angle is zero when the angle is 90° .
- Physically, this means the magnetic field lines are perfectly parallel to the surface plane (sliding across it), meaning none of them pierce through it.

Why other options are incorrect:

Option A yields maximum flux. Options C and D yield fractional flux values since $\cos(60^\circ) = 0.5$ and $\cos(30^\circ) = 0.866$.

Question #35 Key: (B)

DUHS 2022

The path of a neutron moving perpendicular to magnetic field is:
[DUHS 2022]

CORE CONCEPT AND DERIVATION

A magnetic field exerts a deflecting force to curve the path of a particle ONLY if that particle carries an electric charge.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- A neutron is an uncharged particle ($q = 0$).
- Therefore, regardless of its angle of entry (even perpendicular, $\sin(90^\circ) = 1$), the force evaluates to $F = 0$.
- According to Newton's First Law, an object in motion stays in motion in a **straight line** unless acted upon by a net external force.

Why other options are incorrect:

Options A, C, and D describe trajectories that require a continuous perpendicular force (centripetal force) acting on the object, which is impossible for a neutral particle in a magnetic field.

Question #36 Key: (D)

DUHS 2022

A charged particle of mass 'm' and charge 'q' is projected in a magnetic field of induction B at the angle ' [...

CORE CONCEPT AND DERIVATION

When a charged particle enters a magnetic field at an arbitrary angle θ , its velocity vector is resolved into parallel and perpendicular components. Only the perpendicular component causes the circular motion.

Formula:

$$\frac{m(v_{\perp})^2}{r} = qv_{\perp}B$$

Solution:

- The perpendicular component of velocity is $v_{\perp} = v \sin(\theta)$.
- Equate the magnetic Lorentz force to the centripetal force: $q(v \sin \theta)B = \frac{m(v \sin \theta)^2}{r}$.
- Cancel one factor of $(v \sin \theta)$ from both sides: $qB = \frac{m(v \sin \theta)}{r}$.
- Rearrange to solve for the radius r : $r = \frac{mv \sin \theta}{qB}$.

Why other options are incorrect:

Option A assumes a strictly perpendicular entry (90°). Option B incorrectly divides by the sine term. Option C incorrectly uses the parallel velocity component (cosine) which contributes to the helical pitch, not the radius.

Question #37 Key: (C)

NUMS 2022

The magnetic field inside the current carrying wire varies: [NUMS 2022]

CORE CONCEPT AND DERIVATION

For a thick, uniform current-carrying cylindrical wire, the magnetic field behavior differs inside the wire compared to outside the wire. This is determined using Ampere's Law.

Formula:

$$\oint B \cdot dl = \mu_0 I_{\text{enc}}$$

Solution:

- Inside the wire (at a radius $r < R$, where R is wire radius), the current enclosed by an Amperian loop depends on the area: $I_{\text{enc}} = I \frac{r^2}{R^2}$.
- Apply Ampere's law: $B(2\pi r) = \mu_0 I \frac{r^2}{R^2}$.
- Solve for B : $B = \left(\frac{\mu_0 I}{2\pi R^2} \right) r$.
- Because all terms in the parenthesis are constants, the magnetic field strictly increases **linearly (directly)** with r from the center to the surface.

Why other options are incorrect:

Option A is true for the field outside the wire. Options B and D represent completely incorrect mathematical relationships.

Question #38 Key: (A)

NUMS 2022

Magnetic flux is maximum when angle between magnetic field and vector area is: [NUMS 2022]

CORE CONCEPT AND DERIVATION

Magnetic flux measures the total magnetic field passing directly through a given surface area. Maximum flux occurs when the field passes perpendicular to the surface (which means parallel to the area's normal vector).

Formula:

$$\Phi = BA \cos(\theta)$$

Solution:

- The variable θ is the angle between the magnetic field vector and the vector area (normal vector).
- The mathematical function $\cos(\theta)$ dictates the magnitude. It hits its maximum positive value of 1 when $\theta = 0^\circ$.
- Therefore, flux is maximized at 0° .

Why other options are incorrect:

Option B yields exactly zero flux (lines scrape the surface). Option C gives the maximum negative value (depending on sign convention, but 0 is standard for max positive). Option D gives a partial flux value.

Question #39 Key: (B)

PMDC 2021

Formula of toroid for magnetic field is [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

A toroid can be thought of as a solenoid bent into a circular donut shape. The magnetic field inside the core of a toroid is found using Ampere's Law.

Formula:

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I_{\text{enc}}$$

Solution:

- Choose a circular Amperian loop of radius r strictly inside the toroidal core. The length of this loop is $2\pi r$.
- If there are N total turns of wire, the total enclosed current is NI .
- Applying Ampere's law gives: $B(2\pi r) = \mu_0 NI$.
- Rearranging for B gives: $B = \frac{\mu_0 NI}{2\pi r}$.

Why other options are incorrect:

Option A is the formula for the interior of a straight, infinitely long solenoid using turn density n , not total turns N . Options C and D are dimensionally incorrect.

Question #40 Key: (C)

PMDC 2021

Unit of Magnetic flux [NMDCAT 2021]

CORE CONCEPT AND DERIVATION

Magnetic flux (Φ) quantifies the total magnetic field passing perpendicularly through a given surface area.

Formula:

$$\Phi = \vec{B} \cdot \vec{A} = BA \cos \theta$$

Solution:

- Option A ($\text{T} \cdot \text{m}^2$):** Looking at the defining equation $\Phi = B \cdot A$, the SI unit of magnetic flux density (B) is Tesla (T) and the unit of Area (A) is square meters (m^2), yielding $\text{T} \cdot \text{m}^2$.
- Option B (Weber):** In the SI system, $1 \text{ T} \cdot \text{m}^2$ is given the special name **Weber (Wb)**:

$$1 \text{ Wb} = 1 \text{ T} \cdot \text{m}^2 = 1 \text{ N} \cdot \text{m} \cdot \text{A}^{-1} = 1 \text{ J} \cdot \text{A}^{-1}$$
- Therefore, both $\text{T} \cdot \text{m}^2$ and Weber are identical, correct SI representations of magnetic flux.
- Option C (Both A and B)** is the comprehensive correct answer.

Why other options are incorrect:

- D (Tesla):** Tesla (T) is the unit for magnetic flux density (magnetic field strength B), not magnetic flux (Φ).

Question #41 Key: (A)

PMDC 2021

*Magnitude of magnetic field of Earth [NMDCAT 2021]***CORE CONCEPT AND DERIVATION**

The Earth possesses a relatively weak intrinsic magnetic field that protects the atmosphere from solar wind.

Formula:

Earth's field range: $25 \mu\text{T}$ to $65 \mu\text{T}$

Solution:

- Expressed in Tesla, the Earth's field is about $0.25 \times 10^{-4} \text{ T}$ to $0.65 \times 10^{-4} \text{ T}$.
- The unit Gauss (G) is related to Tesla by $1 \text{ T} = 10^4 \text{ G}$.
- Converting the range to Gauss gives: 0.25 G to 0.65 G .
- Option A (0.6 G) falls perfectly within this standard physical range.

Why other options are incorrect:

Options B, C, and D are extremely massive magnetic fields (MRI machines operate around 1.5 to 3 Tesla). Life on Earth would be vastly different if the field was on the order of full Teslas.

Question #42 Key: (D)

PMDC 2021

*Magnetic force depends upon [NMDCAT 2021]***CORE CONCEPT AND DERIVATION**

The macroscopic magnetic force exerted on a straight current-carrying wire situated in a uniform magnetic field depends on multiple physical parameters.

Formula:

$$F = ILB \sin(\theta)$$

Solution:

- From the formula, I represents the electric **Current**.
- L represents the **Length** of the wire inside the field.
- B represents the external **Magnetic field** strength.
- Since the force scales linearly with all three of these parameters, it depends on all of them.

Why other options are incorrect:

Choosing only A, B, or C is incomplete because the force relies on the combination of all these factors.

Question #43 **Key: (A)**

PMDC 2020

Magnetic flux is maximum when angle between magnetic field and vector area is [NMDCAT 2020]

CORE CONCEPT AND DERIVATION

Magnetic flux measures the number of magnetic field lines passing perpendicularly through a surface. It is mathematically the dot product of the magnetic field vector and the area vector (which is normal to the surface).

Formula:

$$\Phi = \mathbf{B} \cdot \mathbf{A} = BA \cos(\theta)$$

Solution:

- The flux is maximized when the mathematical function $\cos(\theta)$ reaches its maximum positive value.
- The maximum value of $\cos(\theta)$ is 1, which occurs exactly at $\theta = 0^\circ$.
- At this angle, the magnetic field is perfectly parallel to the area vector (meaning the field is hitting the surface perfectly face-on).

Why other options are incorrect:

Option B (90°) yields zero flux. Option C (180°) gives the maximum negative flux. Option D (45°) yields an intermediate value.

Question #44 **Key: (B)**

MDCAT 2018

Two long, parallel conductors which are free to move are arranged 1.0 cm apart. A steady current of 20 A flows...

CORE CONCEPT AND DERIVATION

When two parallel wires carry currents, they exert a magnetic force on each other. If the currents are in the **same direction**, they attract.

Formula:

$$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

Solution:

- The magnetic field created by one wire at the location of the other can be found using the right-hand rule.
- Applying Fleming's left-hand rule (or $\mathbf{F} = I(\mathbf{L} \times \mathbf{B})$) shows that the force on each wire points towards the other wire.
- Because they are free to move, the attractive force will cause them to **move towards each other**.

Why other options are incorrect:

Option A ignores the existence of the magnetic force. Option C would happen if the currents were in opposite directions. Option D is physically impossible for parallel uniform fields.

Question #45 Key: (B)

MDCAT 2018

A neutron having mass equal to a proton ([Formula]) is moving in a magnetic field of intensity [Formula] with...

CORE CONCEPT AND DERIVATION

The magnetic force acting on a particle depends fundamentally on the electric charge of that particle. Neutral particles do not interact with magnetic fields in this manner.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- Identify the particle: A neutron.
- Recall the charge of a neutron: $q = 0$ C.
- Substitute this into the Lorentz force equation: $F = (0) \cdot vB \sin(\theta)$.
- Therefore, regardless of velocity or magnetic field strength, the magnetic force is exactly **0 N**.

Why other options are incorrect:

Options A, C, and D are calculated by falsely assuming the neutron has the charge of a proton (1.6×10^{-19} C) and running the numbers.

Question #46 Key: (A)

MDCAT 2018

[Formula] of an electron is given by the relationship, [MDCAT 2018]

CORE CONCEPT AND DERIVATION

In J.J. Thomson's experiment (or in a standard mass spectrometer setup), an electron is accelerated through a potential difference V and then enters a perpendicular magnetic field B , moving in a circle of radius r .

Formula:

$$\frac{1}{2}mv^2 = eV \quad \text{and} \quad evB = \frac{mv^2}{r}$$

Solution:

- From the magnetic force providing centripetal force: $v = \frac{eBr}{m}$.
- Substitute this velocity v into the kinetic energy equation: $\frac{1}{2}m \left(\frac{eBr}{m} \right)^2 = eV$.
- Simplify the square: $\frac{1}{2}m \left(\frac{e^2 B^2 r^2}{m^2} \right) = eV$.
- Cancel m and rearrange to isolate $\frac{e}{m}$: $\frac{e B^2 r^2}{2m} = V \implies \frac{e}{m} = \frac{2V}{B^2 r^2}$.

Why other options are incorrect:

Option B uses the square of V incorrectly. Options C and D mix up the dimensions and fail to account for the kinetic energy relationship.

Question #47 Key: (A)

MDCAT 2017

If the value of magnetic flux is [Formula], when magnetic lines of force containing magnetic field strength o...

CORE CONCEPT AND DERIVATION

Magnetic flux depends on the angle θ between the magnetic field vector and the normal vector to the area.

Formula:

$$\Phi = BA \cos(\theta)$$

Solution:

- Identify the givens: Magnitude of flux $|\Phi| = 10 \text{ Wb}$, $B = 1 \text{ T}$, $A = 10 \text{ m}^2$.
- Substitute into the formula: $10 = (1)(10) \cos(\theta)$.
- Solve for the cosine term: $\cos(\theta) = 1$ (or -1 if we consider the absolute magnitude of the flux).
- Angles that satisfy $|\cos(\theta)| = 1$ are 0° and 180° .
- Since 0° is not in the options, the correct answer must be 180° , which gives a flux of -10 Wb (magnitude is 10).

Why other options are incorrect:

Option B (360°) is a full rotation yielding the same as 0° , but conventionally 180° is used for anti-parallel vectors. Option C yields zero flux. Option D yields 7.07 Wb .

Question #48 Key: (D)

MDCAT 2017

A charge is projected with velocity of [Formula] in a magnetic field of [Formula] at angle of [Formula]. If f...

CORE CONCEPT AND DERIVATION

The magnetic force on a charge moving at an angle θ to a magnetic field is given by the Lorentz force equation.

Formula:

$$F = qvB \sin(\theta) \implies q = \frac{F}{vB \sin(\theta)}$$

Solution:

- List the variables: $F = 2.78 \times 10^{-17} \text{ N}$, $v = 10 \text{ m/s}$, $B = 10 \text{ T}$, $\theta = 60^\circ$.
- Recall that $\sin(60^\circ) = \frac{\sqrt{3}}{2} \approx 0.866$.
- Calculate the denominator: $vB \sin(60^\circ) = (10)(10)(0.866) = 100 \times 0.866 = 86.6$.
- Divide the force by this value: $q = \frac{2.78 \times 10^{-17}}{86.6} = 0.0321 \times 10^{-17} \text{ C}$.
- Convert to scientific notation: $q \approx 3.20 \times 10^{-19} \text{ C}$ (which is exactly the charge of an alpha particle or two protons).

Why other options are incorrect:

Option A is the charge of a single electron/proton. Options B and C are mathematically incorrect derivations that occur if you fail to use the sine function or multiply incorrectly.

Question #49 **Key: (A)**

MDCAT 2017

Electric current is flowing through a straight conductor as shown in figure given below. The direction of magn...

CORE CONCEPT AND DERIVATION

The direction of magnetic field lines around a straight current-carrying conductor is determined using the **Right-Hand Grip Rule**.

Formula:

Right-Hand Grip Rule

Solution:

- According to the provided diagram, the electric current is flowing vertically **upwards** ($I \uparrow$).
- Grasp the conductor with your right hand such that your thumb points upward in the direction of the conventional current.
- Your curled fingers encircle the wire in an **anticlockwise** direction (when viewed from above).
- Therefore, the direction of the circular magnetic lines of force is **Anticlockwise**.

Why other options are incorrect:

- **B (Clockwise):** The magnetic field would be clockwise only if the current flowed vertically downward ($I \downarrow$).
- **C & D (Bottom to Top / Top to Bottom):** The magnetic field lines form closed concentric loops perpendicular to the wire, never straight vertical lines.

Question #50 **Key: (A)**

MDCAT 2014

Due to current in straight conductor the distance between magnetic field lines. [MCAT 2014]

CORE CONCEPT AND DERIVATION

The magnetic field strength created by a long straight current-carrying wire is inversely proportional to the radial distance from the wire. Visually, stronger fields are represented by lines closer together.

Formula:

$$B = \frac{\mu_0 I}{2\pi r}$$

Solution:

- Observe the formula: $B \propto \frac{1}{r}$. As distance r increases, the magnetic field strength B decreases.
- In field line diagrams, a weaker field is depicted by field lines that are spaced further apart.
- Therefore, as you move away from the conductor, the distance between the consecutive magnetic field lines **increases**.

Why other options are incorrect:

Option B implies the field gets weaker near the wire, which is false. Option C implies the field gets stronger away from the wire. Option D implies a complex oscillatory field which doesn't apply to a straight DC wire.

Question #51 Key: (A)

MDCAT 2013

A long straight current carrying conductor has current direction from bottom to top when held vertically. What...

CORE CONCEPT AND DERIVATION

The direction of magnetic field lines around a straight current-carrying conductor is determined by the Right-Hand Grip Rule. Perspective completely changes whether it appears clockwise or anticlockwise.

Formula:

Right-Hand Grip Rule

Solution:

- Point your right thumb in the direction of the current (bottom to top, i.e., upwards).
- Your fingers curl around the wire in an anticlockwise direction if you were looking from the **top** down.
- However, the question asks for the perspective from **below** the conductor looking upwards.
- When viewed from below, an anticlockwise curl spatially translates to a **clockwise** observation.

Why other options are incorrect:

Option C is the perspective from above. Options B and D are impossible because the magnetic field forms closed loops around the wire, not straight lines parallel to it.

Question #52 Key: (A)

MDCAT 2012

Two long straight parallel wires held vertically, have equal but opposite currents as shown in the figure. Whi...

CORE CONCEPT AND DERIVATION

When two parallel wires carry currents in opposite directions, the magnetic fields generated by each wire reinforce one another in the space between them and partially cancel out in the regions outside them.

Formula:

$$B_{\text{net}} = B_1 + B_2 \quad (\text{in between})$$

Solution:

- Let 'X' be the region directly between the two wires, and 'Y' and 'Z' be the regions outside.
- Using the Right-Hand Rule, the field lines from both wires point in the same direction in region 'X', adding together constructively.
- In regions 'Y' and 'Z', the field vectors from the two wires point in opposite directions, leading to a destructive superposition.
- Therefore, the net magnetic field at 'X' is strictly stronger than at 'Y' and 'Z'.

Why other options are incorrect:

Options B, C, and D violate the superposition principle by falsely assuming the fields cancel between the wires or claiming the external fields are stronger.

Question #53 **Key: (B)**

MDCAT 2011

Two long parallel wires Wire 1 and Wire 2 repel each other as shown in the figure. What could be the reasons? ...

CORE CONCEPT AND DERIVATION

Parallel conductors carrying electric current exert magnetic forces on one another. The direction of the force depends on the relative directions of the currents.

Formula:

$$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

Solution:

- According to the right-hand grip rule, a current produces a concentric magnetic field.
- If currents are in the **same** direction, the magnetic fields between the wires cancel out (weaker field), causing them to attract.
- If currents are in **opposite** directions, the magnetic fields between the wires reinforce each other (stronger field), causing the wires to repel.
- Since the question states they repel, they must carry currents in opposite directions.

Why other options are incorrect:

Option A leads to attraction. Options C and D result in zero magnetic force because both wires must carry current to produce a mutual magnetic force.

Question #54 **Key: (A)**

KMU 2011

The SI unit of magnetic flux is weber which is equal to: [ETEA 2011]

CORE CONCEPT AND DERIVATION

Magnetic flux is defined as the dot product of the magnetic field and the area vector. Its SI unit is the Weber (Wb).

Formula:

$$\Phi = B \cdot A$$

Solution:

- Start with the units: $\text{Wb} = \text{Tesla} \times \text{m}^2$.
- Recall that $B = \frac{F}{IL}$, meaning $1 \text{ Tesla} = 1 \frac{\text{N}}{\text{A} \cdot \text{m}}$.
- Substitute this into the flux unit: $\text{Wb} = \left(\frac{\text{N}}{\text{A} \cdot \text{m}} \right) \times \text{m}^2$.
- Simplify the expression: $\text{Wb} = \frac{\text{N} \cdot \text{m}}{\text{A}} = \text{N m A}^{-1}$.

Why other options are incorrect:

Option B represents an incorrect dimensional analysis where the meter squared is not fully canceled. Option C is the unit for torque or work (Joule). Option D is dimensionally nonsensical for flux.

Question #55 Key: (D)

MDCAT 2010

Which one of the following relations is correct? [MCAT 2010]

CORE CONCEPT AND DERIVATION

Magnetic field strength (or magnetic flux density) has the SI unit Tesla (T). It can be expressed in various derived SI units and relates to the CGS unit (Gauss).

Formula:

$$B = \frac{\Phi}{A} = \frac{F}{IL}$$

Solution:

- Evaluate Option C: Tesla = $\frac{\text{Weber}}{\text{m}^2}$. This is correct.
- Evaluate Option A: Using $B = \frac{F}{IL}$, $1 \text{ T} = \frac{\text{N}}{\text{A} \cdot \text{cdotm}} = \text{N m}^{-1} \text{A}^{-1}$. Since $1 \text{ T} = 1 \text{ wb m}^{-2}$, this is also correct.
- Evaluate Option B: The conversion factor between SI (Tesla) and CGS (Gauss) is exactly $1 \text{ T} = 10^4 \text{ G}$. This is correct.
- Since all individual statements are correct, the answer is "All of these".

Why other options are incorrect:

No single option (A, B, or C) is incorrect; therefore, selecting only one of them would be incomplete.

Question #56 Key: (B)

MDCAT 2009

A charge of two micro coulombs ([Formula]) moves with velocity of two meter per second ([Formula]) in the ...

CORE CONCEPT AND DERIVATION

The magnetic force acting on a moving charge depends on the cross product of its velocity and the magnetic field. If the charge moves parallel to the magnetic field, no magnetic force acts on it.

Formula:

$$F = qvB \sin(\theta)$$

Solution:

- Identify the given values: $q = 2 \times 10^{-6} \text{ C}$, $v = 2 \text{ m/s}$, $B = 2 \text{ T}$.
- Determine the angle θ : The phrase "in the direction of" means the velocity vector is parallel to the magnetic field vector, so $\theta = 0^\circ$.
- Calculate the sine of the angle: $\sin(0^\circ) = 0$.
- Substitute into the formula: $F = (2 \times 10^{-6})(2)(2)(0) = 0 \text{ N}$.

Why other options are incorrect:

Options A, C, and D are the results of multiplying the magnitudes while incorrectly assuming $\theta = 90^\circ$ (which would yield $8 \times 10^{-6} \text{ N}$) or ignoring the micro prefix.

Question #57 **Key: (C)**

MDCAT 2009

Force experienced by a moving charge in a magnetic field is: [MCAT 2009]

CORE CONCEPT AND DERIVATION

The magnetic Lorentz force on a point charge is determined by the vector cross product of its velocity and the external magnetic field.

Formula:

$$\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$$

Solution:

- Recall the standard expression for magnetic force on a single moving charge q with velocity $\mathbf{v}$ in field $\mathbf{B}$.
- Match the formulation to the options provided. Option C correctly represents this vector cross product.

Why other options are incorrect:

Option A is the formula for magnetic flux. Option B is the magnetic field of a solenoid. Option D is the magnetic force on a current-carrying conductor, not a single point charge.

Question #58 **Key: (C)**

MDCAT 2008

An electric charge in uniform motion produces: [MCAT 2008]

CORE CONCEPT AND DERIVATION

A stationary electric charge produces only an electric field in the space around it. However, when the charge is in motion, it constitutes an electric current, which generates a magnetic field in addition to its intrinsic electric field.

Formula:

$$\mathbf{B} = \frac{\mu_0}{4\pi} \frac{q(\mathbf{v} \times \hat{\mathbf{r}})}{r^2}$$

Solution:

- Identify the state of the charge: It is in uniform motion.
- Recall that any charge inherently has an electric field.
- Apply the principle of electromagnetism: moving charges create magnetic fields.
- Therefore, it produces both fields simultaneously.

Why other options are incorrect:

Option A is true only for a stationary charge. Option B ignores the fundamental electric field that always exists around a charge. Option D is entirely false as charges always produce fields.