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Moving Charges and Magnetism — CBSE Class 12 Physics Chapter Test

FREE CHAPTER TEST · CLASS XII · PHYSICS (042) · PATTERN OF THE CBSE SAMPLE QUESTION PAPER 2026-27

TIME ALLOWED	MAXIMUM MARKS	QUESTIONS	NAME / ROLL NO.
1½ hours	37	17 (A 8 · B 3 · C 3 · D 1 · E 2)	

GENERAL INSTRUCTIONS

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 17 questions. All questions are compulsory.
2. This question paper is divided into five sections: A, B, C, D and E.
3. Section A (Q1–8) contains 6 multiple choice questions and 2 assertion-reason based questions of 1 mark each.
4. Section B (Q9–11) contains short answer questions of 2 marks each.
5. Section C (Q12–14) contains short answer questions of 3 marks each.
6. Section D (Q15) contains case study based questions of 4 marks each, with four sub-parts of 1 mark.
7. Section E (Q16–17) contains long answer questions of 5 marks each.
8. There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 2 questions in Section E. Attempt only one of the alternatives in such questions.
9. Use of calculators is not allowed. You may use: $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}, e = 1.6×10^{-19} C, $m_e = 9.1 \times 10^{-31}$ kg, $m_p = 1.67 \times 10^{-27}$ kg.
10. This chapter test follows the section structure, question types and marks per question of the CBSE Class XII Physics (042) Sample Question Paper 2026-27, at about half the length of the 70-mark board paper: 37 marks in 1½ hours.
11. The answer key and the marking scheme are at the end of this booklet. Attempt the paper in 1½ hours before you look at them.

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Chapter: Moving Charges and Magnetism · **Topics:** Magnetic force on a moving charge · Motion in a magnetic field · Biot-Savart law and the circular loop · Ampère's circuital law, solenoid · Force between parallel currents · Torque on a current loop and the moving coil galvanometer

SECTION A

This section comprises 8 questions of 1 mark each: 6 multiple choice questions (MCQs) and 2 assertion-reason based questions.

1. A proton moving at 2.0×10^6 m s^{-1} enters a uniform magnetic field of 0.50 T at right angles to the field. The radius of its circular path is ($m_p = 1.67 \times 10^{-27}$ kg) 1

(A) 4.2 cm (B) 0.42 cm

(C) 42 cm (D) 8.4 cm

2. Two long straight parallel wires carry currents in the same direction. The wires 1

(A) repel each other (B) exert no force on each other

(C) attract each other (D) only exert a torque on each other

3. A circular coil of 50 turns and radius 10 cm carries a current of 2.0 A. The magnetic field at its centre is 1

(A) 3.14×10^{-4} T (B) 6.28×10^{-4} T

(C) 1.26×10^{-5} T (D) 6.28×10^{-6} T

4. A moving coil galvanometer is converted into an ammeter by connecting 1

(A) a high resistance in series (B) a high resistance in parallel

(C) a low resistance in series (D) a low resistance in parallel

5. The magnetic field at a distance of 10 cm from a long straight wire carrying a current of 5 A is 1

(A) 1×10^{-4} T (B) 5×10^{-6} T

(C) 1×10^{-5} T (D) 3.14×10^{-5} T

6. A charged particle moves in a uniform magnetic field. The magnetic force on it does no work because the force is 1

(A) parallel to the velocity (B) always perpendicular to the velocity

(C) zero for all directions of motion (D) opposite to the field

7. **Assertion (A) :** A charged particle moving parallel to a uniform magnetic field experiences no magnetic force. 1

Reason (R) : The magnetic force qv × B is zero when v is parallel to B.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

8. **Assertion (A) :** The time period of revolution of a charged particle in a uniform magnetic field increases with its speed. 1

Reason (R) : The radius of its circular path is independent of its speed.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

SECTION B

This section comprises 3 short answer questions of 2 marks each.

9. A solenoid of length 0.50 m has 500 turns and carries a current of 2.0 A. Find the magnetic field inside it, well away from its ends. 2

10. (a) Derive the expression for the force per unit length between two long straight parallel wires carrying currents I_1 and I_2 a distance d apart. Hence define one ampere. 2

OR

(b) A rectangular coil of 25 turns and area 0.020 m^2 carries a current of 0.40 A in a uniform magnetic field of 0.50 T. The plane of the coil makes an angle of 60° with the field. Find the torque on the coil.

11. A galvanometer of resistance 20 Ω gives full-scale deflection for a current of 5 mA. How can it be converted into a voltmeter of range 0 − 15 V? 2

SECTION C

This section comprises 3 short answer questions of 3 marks each.

12. State Ampère's circuital law. Using it, derive the expression for the magnetic field inside a long straight solenoid of n turns per unit length carrying a current I. 3

13. (a) In a region, a uniform electric field E and a uniform magnetic field B are perpendicular to each other and to the velocity of a beam of charged particles. Show that particles of speed v = E/B pass through undeflected. Find this speed for E = 3.0×10^4 V m^{-1} and B = 0.020 T. 3

OR

(b) (i) Why is the magnetic field in a moving coil galvanometer made radial?
(ii) Write the expression for its current sensitivity.
(iii) State two ways of increasing the current sensitivity.

14. Two long straight parallel wires 10 cm apart carry currents of 4 A and 6 A in opposite directions. Find (i) the magnetic field at the point midway between them and (ii) the force per metre length between them. Is the force attractive or repulsive? 3

SECTION D

This section comprises 1 case study based question of 4 marks, with four sub-parts of 1 mark each.

15. In older television and oscilloscope tubes, a beam of electrons is bent by magnetic fields to hit the screen at the right place. Consider an electron moving at 3.0×10^{7} m s^{-1} perpendicular to a uniform magnetic field of 1.0×10^{-3} T ($m_e = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C).

(I) The radius of its circular path is about

(A) 1.7 cm (B) 17 cm (C) 1.7 m (D) 0.17 cm [1]

(II) The time for one revolution is about

(A) 3.6×10^{-8} s (B) 1.8×10^{-8} s (C) 3.6×10^{-6} s (D) 5.7×10^{-9} s [1]

(III) If the speed of the electron is doubled, the time for one revolution

(A) doubles (B) halves (C) becomes four times (D) does not change [1]

(IV) If the electron enters the field at 60° to the field direction, its path is

(A) a straight line (B) a circle (C) a helix (D) a parabola [1]

SECTION E

This section comprises 2 long answer questions of 5 marks each.

16. (a) (i) State the Biot-Savart law. Using it, derive the expression for the magnetic field at the centre of a circular loop of radius R carrying a current I. 5

(ii) Two concentric circular loops of radii 10 cm and 20 cm lie in the same plane and carry currents of 4 A and 6 A in the same sense. Find the magnetic field at their common centre.

OR

(b) (i) Using Ampère's circuital law, find the magnetic field at a distance r from a long straight wire carrying a current I.

(ii) A long straight cylindrical conductor of radius R carries a current I distributed uniformly over its cross-section. Find the magnetic field at a distance r from its axis (I) inside and (II) outside the conductor, and state where it is largest.

17. (a) (i) Derive the expression for the torque on a rectangular current loop of area A carrying a current I placed in a uniform magnetic field B, and write it in vector form. 5

(ii) A circular coil of 100 turns and radius 5.0 cm carries a current of 1.0 A in a uniform magnetic field of 0.20 T. Find the maximum torque on it.

OR

(b) (i) Derive the expression for the shunt needed to convert a galvanometer of resistance G and full-scale current I_g into an ammeter of range 0 − I.

(ii) A galvanometer of resistance 60 Ω gives full-scale deflection for 1.0 mA. Find the shunt needed for an ammeter of range 0 − 5 A, and the resistance of the ammeter.

END OF THE QUESTION PAPER

ANSWER KEY — SECTION A

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
(A)	(C)	(B)	(D)	(C)	(B)	(A)	(D)

MARKING SCHEME AND WORKED SOLUTIONS

Marks for each step are shown in brackets, as in the CBSE marking scheme. Any correct alternative method earns full marks.

Q1. Answer (A). $r = mv/qB = 1.67 \times 10^{-27} \times 2.0 \times 10^{6}/(1.6 \times 10^{-19} \times 0.50) \approx 4.2 \times 10^{-2}$ m.

Q2. Answer (C). The field of one wire at the other, crossed with the current there, points towards the first wire: like currents attract.

Q3. Answer (B). $B = \mu_0 NI/2R = 4\pi \times 10^{-7} \times 50 \times 2.0/(2 \times 0.10) = 6.28 \times 10^{-4}$ T.

Q4. Answer (D). A low resistance (shunt) in parallel carries most of the current, so the ammeter has a small total resistance.

Q5. Answer (C). $B = \mu_0 I/2\pi r = 2 \times 10^{-7} \times 5/0.10 = 1 \times 10^{-5}$ T.

Q6. Answer (B). $F = qv \times B$ is perpendicular to v, so $F \cdot v = 0$: the speed and kinetic energy stay constant.

Q7. Answer (A). $|F| = qvB \sin\theta = 0$ for $\theta = 0°$: R states exactly why A holds. Answer (A).

Q8. Answer (D). $r = mv/qB$ grows with v, and $T = 2\pi r/v = 2\pi m/qB$ does not depend on v. Both statements are false. Answer (D).

Q9. (2 marks) Answer: $\approx 2.5 \times 10^{-3}$ T.
n = 500/0.50 = 1000 turns per metre. [1]
$B = \mu_0 nI = 4\pi \times 10^{-7} \times 1000 \times 2.0 \approx 2.5 \times 10^{-3}$ T, along the axis. [1]

Q10. (2 marks) Answer: (a) $F/L = \mu_0 I_1 I_2/2\pi d$; (b) 5.0×10^{-2} N m.
(a) Wire 1 sets up $B_1 = \mu_0 I_1/2\pi d$ at wire 2; the force on length L of wire 2 is $F = I_2 L B_1$, so $F/L = \mu_0 I_1 I_2/2\pi d$ (attractive for like currents). [1]
One ampere is the current which, maintained in two long parallel wires 1 m apart in vacuum, produces a force of 2×10^{-7} N per metre of length between them. [1]
OR (b) $\tau = NIAB \sin\theta$, θ being the angle between the normal and B: $\theta = 90° - 60° = 30°$. [1]
$\tau = 25 \times 0.40 \times 0.020 \times 0.50 \times \sin 30° = 5.0 \times 10^{-2}$ N m. [1]

Q11. (2 marks) Answer: 2980 Ω in series.
A resistance R in series: $I_g(G + R) = V$. [1]
$R = V/I_g - G = 15/0.005 - 20 = 2980$ Ω in series. [1]

Q12. (3 marks) Answer: $B = \mu_0 nI$.
$\oint B \cdot dl = \mu_0 I_{enclosed}$: the line integral of B round any closed loop equals μ_0 times the current threading it. [1]
Take a rectangle PQRS with side PQ = l inside along the axis and RS outside. Inside B is uniform and axial; outside $B \approx 0$; on the sides QR and SP, $B \perp dl$. So $\oint B \cdot dl = Bl$. [1]
Current threading = nlI, so $Bl = \mu_0 nlI$ and $B = \mu_0 nI$. [1]

Q13. (3 marks) Answer: (a) $v = E/B = 1.5 \times 10^{6}$ m s^{-1}; (b) NAB/k.

(a) The electric force qE and the magnetic force qvB act along the same line in opposite directions. [1]

No deflection when qE = qvB, i.e. v = E/B (independent of q and m). [1]

$v = 3.0 \times 10^{4}/0.020 = 1.5 \times 10^{6}$ m s^{-1}. [1]

OR (b) (i) In a radial field the plane of the coil is always along B, so the torque NIAB is the same at every position and the deflection $\varphi = (NAB/k)\, I$ is proportional to I (linear scale). [1]

(ii) Current sensitivity = $\varphi/I = NAB/k$. [1]

(iii) Increase N, A or B, or use a suspension of smaller torsional constant k. [1]

Q14. (3 marks) Answer: (i) 4.0×10^{-5} T; (ii) 4.8×10^{-5} N m^{-1}, repulsive.

(i) Each field at the midpoint (r = 0.05 m): $2 \times 10^{-7} \times 4/0.05 = 1.6 \times 10^{-5}$ T and $2 \times 10^{-7} \times 6/0.05 = 2.4 \times 10^{-5}$ T. For opposite currents both fields at the midpoint point the same way. [1] B = 4.0×10^{-5} T. [1]

(ii) $F/L = \mu_0 I_1 I_2/2\pi d = 2 \times 10^{-7} \times 24/0.10 = 4.8 \times 10^{-5}$ N m^{-1}, repulsive (unlike currents). [1]

Q15. (4 marks) Answer: (I) B; (II) A; (III) D; (IV) C.

(I) (B) $r = mv/eB = 9.1 \times 10^{-31} \times 3.0 \times 10^{7}/(1.6 \times 10^{-19} \times 1.0 \times 10^{-3}) \approx 0.17$ m. [1]

(II) (A) $T = 2\pi m/eB = 2\pi \times 9.1 \times 10^{-31}/1.6 \times 10^{-22} \approx 3.6 \times 10^{-8}$ s. [1]

(III) (D) $T = 2\pi m/eB$ does not depend on the speed. [1]

(IV) (C) The component along B is unchanged while the perpendicular component goes round in a circle: a helix. [1]

Q16. (5 marks) Answer: (a) $B = \mu_0 I/2R$; $\approx 4.4 \times 10^{-5}$ T; (b) $\mu_0 I/2\pi r$; inside $\mu_0 Ir/2\pi R^2$, outside $\mu_0 I/2\pi r$.

(a) (i) $dB = (\mu_0/4\pi)\, I\, dl \times \hat{r}/r^2$: the field of a current element is proportional to I dl and sin θ, inversely proportional to r^2, and perpendicular to both dl and r. [1]

At the centre every element is at distance R with dl ⊥ r, so $dB = (\mu_0/4\pi)\, I\, dl/R^2$, all along the axis. $B = (\mu_0/4\pi)(I/R^2) \times 2\pi R = \mu_0 I/2R$. [2]

(ii) The fields add (same sense): $B = (\mu_0/2)(4/0.10 + 6/0.20) = 2\pi \times 10^{-7} \times 70 \approx 4.4 \times 10^{-5}$ T, perpendicular to the plane. [2]

OR (b) (i) Ampère's loop: a circle of radius r centred on the wire; B is tangential and constant on it: $B \times 2\pi r = \mu_0 I$, so $B = \mu_0 I/2\pi r$. [2]

(ii) Inside (r < R) the loop encloses $I(r^2/R^2)$: $B \times 2\pi r = \mu_0 Ir^2/R^2$, so $B = \mu_0 Ir/2\pi R^2$ ($\propto r$). Outside ($r \geq R$): $B = \mu_0 I/2\pi r$ ($\propto 1/r$); the field is largest, $\mu_0 I/2\pi R$, at the surface. [3]

Q17. (5 marks) Answer: (a) $\tau = m \times B$; ≈ 0.157 N m; (b) $S = I_g G/(I - I_g)$; ≈ 0.012 Ω.

(a) (i) Sides a (perpendicular to B in the plane of rotation) and b. The forces on the two sides of length b are IbB, equal and opposite and not along the same line; the forces on the other two sides cancel. [1]

Their moment arm is a sin θ (θ between the normal and B): $\tau = IbB \times a \sin\theta = IAB \sin\theta$. [1] In vector form $\tau = m \times B$ with $m = IA\,\hat{n}$ (for N turns, m = NIA). [1]

(ii) $\tau_{max} = NIAB = 100 \times 1.0 \times \pi(0.050)^2 \times 0.20 \approx 0.157$ N m. [2]

OR (b) (i) The shunt S is in parallel with G: $I_g G = (I - I_g)S$, so $S = I_g G/(I - I_g)$. [2]

(ii) $S = 0.001 \times 60/(5 - 0.001) \approx 0.012$ Ω in parallel. [2] Resistance of the ammeter = $GS/(G + S) \approx 0.012$ Ω. [1]

All questions are original and © Master Testing Agency. Free to download and use for personal practice; not for resale. Every answer in this paper was checked independently by computer: the loop field by summing Biot-Savart elements, the electron orbit by stepping F = qv × B in time, every torque and field from the vector formulas.