PHYSICS

BOOKS - RESNICK AND HALLIDAY PHYSICS (HINGLISH)

MAGNETIC FORCE

Sample Problem

1. A proton of energy $200MeV$ enters the magnetic field of $5T$. If direction of field is from south to north and motion is upward, the force acting on it will be

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2. An electron moving with a kinetic energy of 1.5×10^3 eV enters in a region of uniform magnetic field of induction $4 \times 10^{-3} Wb/m^2$ at right

angles to the direction of motion of the electron . The radius of circular path of the electron in the magnetic field is

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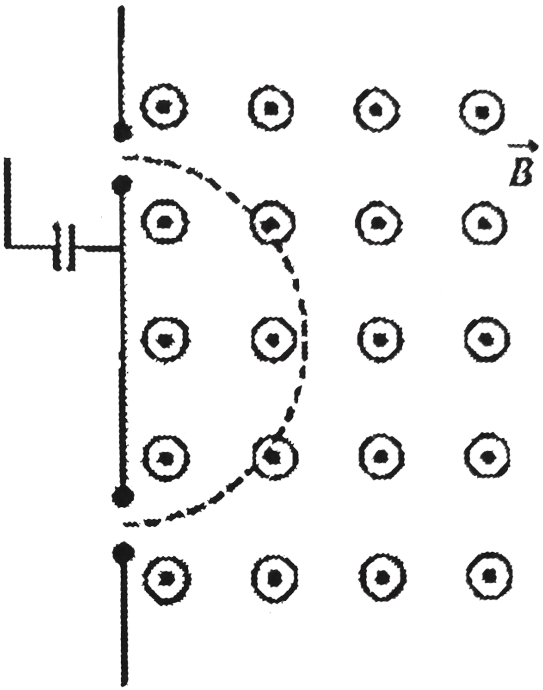
3. A mass spectrometer is a device which selelct particle of equal mass. An ion with an electric charge $q > 0$. Starts at rest from s ource S and is accelerated through a potential difference V. it passes thorugh a hole into a region of constant magnetic field $\vec{B}$ perpendicular to the plane of the paper as shown in the figure. The particle is deflected by the magnetic field and emerges thorugh the bottom hole at a distance d from the top

hole. The mass of the particle is:



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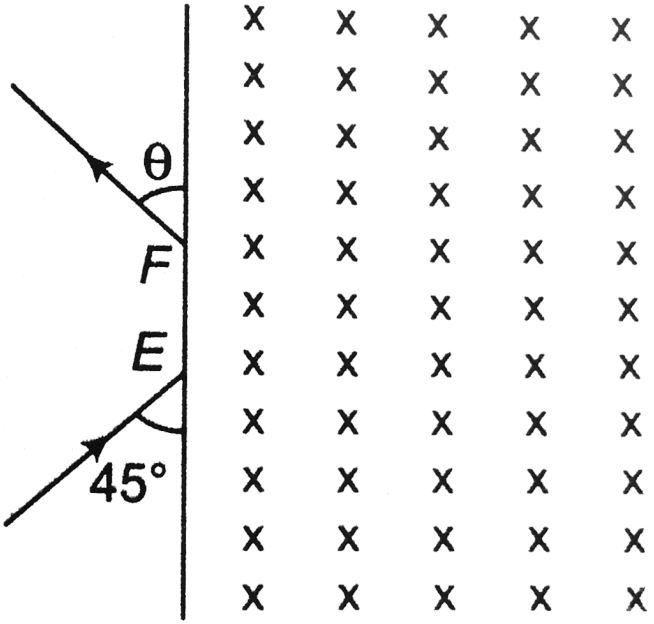
4. A particle of mass $m = 1.6 \times 10^{-27}$ kg and charge $q = 1.6 \times 10^{-19} C$ enters a region of uniform magnetic field of stregth $1T$ along the direction shown in figure. The speed of the particle is $10^7 m/s$



a. The magnetic field is directed along the inward normal to the plane of the paper. The particle leaves the region of the fiedl at the point F. Find the distasnce EF and the angle theta.

b. If the direction of the field is along the outward normal to the plane of the paper find the time spent by the particle in the regin of the magnetic field after entering it at E.

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5. A cyclotron is operated at an oscillator frequency of 12 MHz and has a dee radius R 50 cm. What is the magnitude of the magnetic field needed for a proton to be accelerated in the cyclotron?

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6. A cyclotron is operated at an oscillator frequency of 12 MHz and has a dee radius R 50 cm. What is the magnitude of the magnetic field needed for a proton to be accelerated in the cyclotron?

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7. A particle of mass m and charge q is moving in a region where uniform, constant electric and mangetic fields $\vec{E}$ and $\vec{B}$ are present. $\vec{E}$ and $\vec{B}$ are parallel to each other. At time $t = 0$, the velocity $\vec{v}_0$ of the particle is perpendicular to $\vec{E}$ (Assume that its speed is always $< < c$, the speed of light in vacuum). Find the velocity $\vec{v}$ of the particle at time t. You must

express your answer in terms of $t, q, m,$ the vector $\vec{v}_0, \vec{E}$ and $\vec{B}$ and their magnitudes $\vec{v}_0, \vec{E}$ and $\vec{B}$.

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8. A positively charged disk is rotated clockwise as shown in Fig. The direction of hte magnetic field at a point A in the plane of the disk is

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9. A straight horizontal copper wire carries a current i = 30 A. The linear mass density of the wire is 45 g/m. What is the magnitude of the magnetic field needed to balance its weight?

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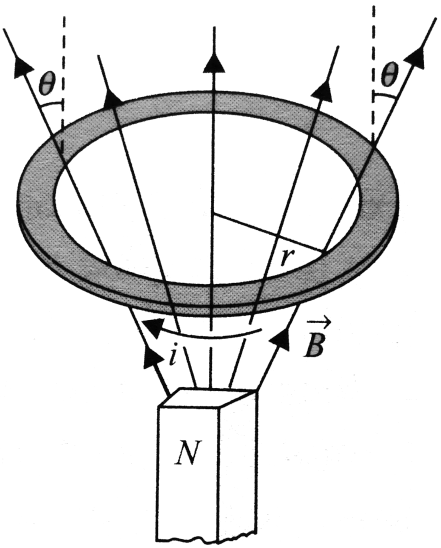
10. A strong magnet is placed under a horizontal conducting ring of radius r that carries current i as shown in Fig. If the magnetic field makes

an angle θ with the vertical at the ring's location, what are the magnitude and direction of the resultant force on the ring?



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11. A flat coil of n turns, area A and carrying a current I is placed in a uniform magnetic field of magnitude B. The plane of the coil makes an angle θ with the direction of the field. The torque acting on the coil is

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12. The radius of a circular coil having 100 turns is 5 cm and a current of $0.5A$ is flowing through this coil. If it is placed in a uniform magnetic field of stregth 0.001 T, then what torque will act on the coil, when the plane of the coil is inclined at 30° with the magnetic field,

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13. A uniform constant magnetic field B is directed at an angle of 45° to the $xa\xi s$ in the xy- plane . $PQRS$ is a rigid, square wire frame carrying a steady current I_0, with its centre at the origin O. At time $t = 0$, the frame is at rest in the position as shown in figure , with its sides parallel to the x and y axis. Each side of the frame is of mass M and length L.

(a) What is the torque τ about O acting on the frame due to the magnetic field?

(b) Find the angle by which the frame rotates under the action of this

torque in a short interval of time Δt, and the axis about this rotation occurs .

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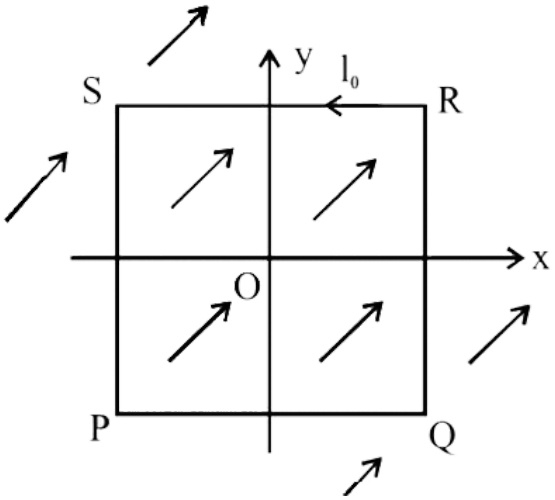

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14. A uniform constant magnetic field B is directed at an angle of 45° to the x-axis in the xy plane. PQRS is a rigid square wire frame carrying a steady current I (clockwise), with its center at the origin O. At time t = 0, the frame is at rest in the position shown in fig. With its sides parallel to

the x and y axes. Each side of the frame is of mass M and length L.

Find the initial angular acceleration of the frame. Assume that the frame is in a gravity free space free from any other influence.

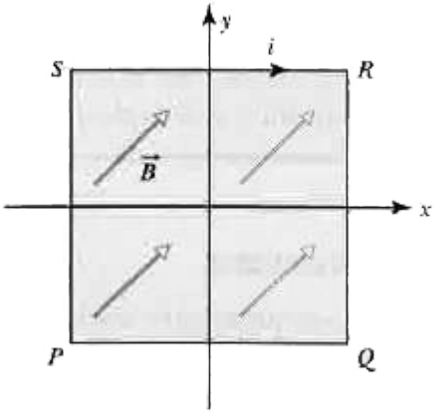
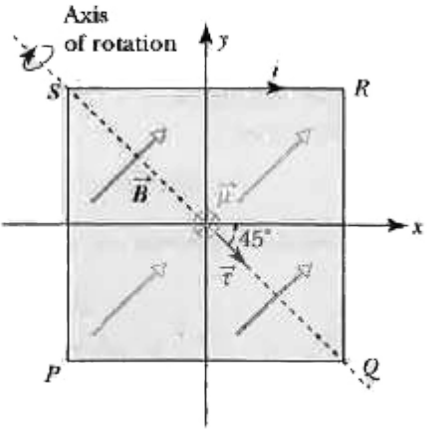


Figure 28-37 A wire frame kept in a uniform magnetic field.



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Check Point

1. You are given two bars of same resistance, one of them is a conductor and the other is a semiconductor. How will you distinguish them experimentally?

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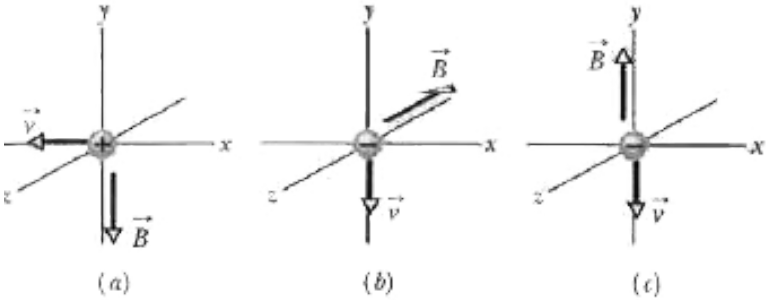
2. The figure shows three situations in which a charged particle with velocity $\vec{v}$ travels through a uniform magnetic field $\vec{B}$. In each situation, what is the direction of the magnetic force $\vec{F}_B$ on the particle ?



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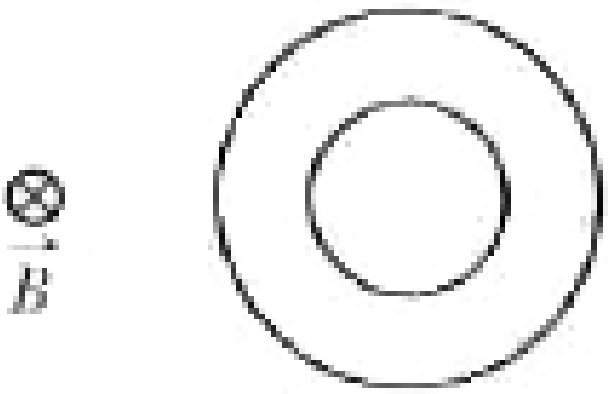
3. The figure here shows the circular path of two particles that travel at the same speed in a uniform magnetic field $\vec{B}$, which is directed into the page. One particle is a proton, the other is an electron (which is less massive). (a) which particle follows the smaller circle. and (b) does that particle travel clockwise or counterwise ?



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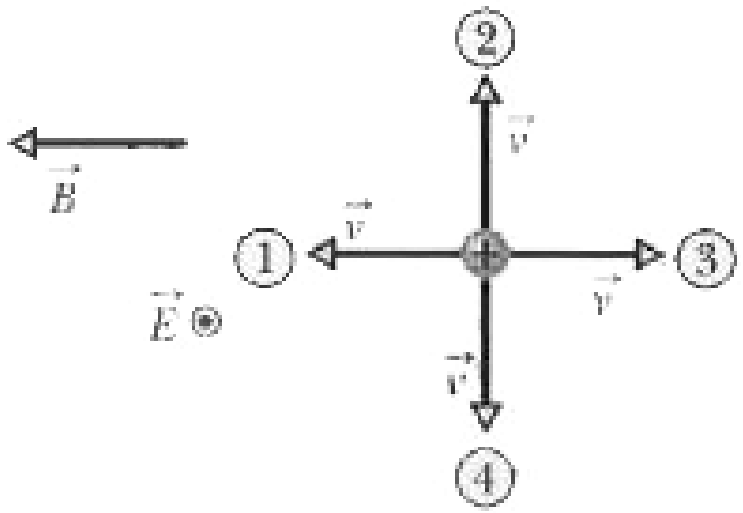
4. The figure shows four directions for the velocity vector $\vec{v}$ of a positively charged particle moving through a uniform electric field $\vec{E}$ (directed out of the page and represented with an encircled dot) and a uniform magnetic field $\vec{B}$. (a) Rank directions 1, 2 and 3 according to the

magnitude of the net force on the particle, greatest first. (b) Of all four directions, which might result in a net force of zero ?



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5. समीकरण $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$ में यदि q तृणात्मक हो तो $\vec{F}$ तथा $\left(\vec{v} \times \vec{B}\right)$ के बीच कोण क्या होगा?

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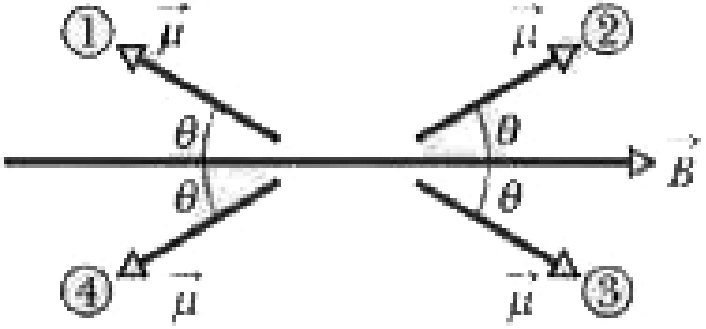
6. The figure shows four orientations, at angle θ, of a magnetic dipole moment $\vec{\mu}$ in a magnetic field. Rank the orientations according to (a) the magnitude of the torque on the dipole and (b) the orientation energy of the dipole greatest first.



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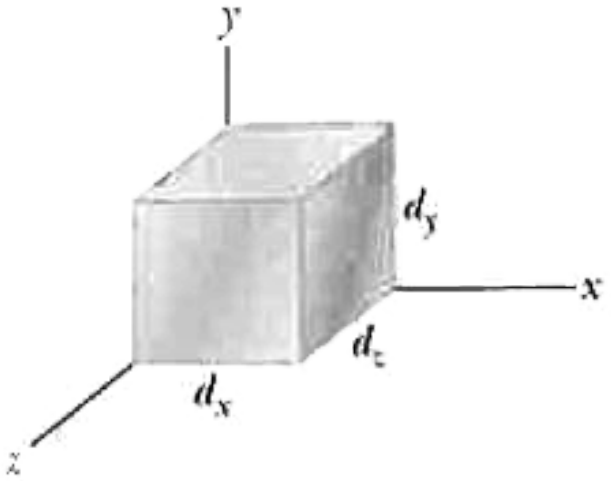
Problems

1. A conducting rectangular solid of dimensions $d_x = 5.00m$, $d_y = 3.00m$, and $d_z = 2.00m$ moves with a constant velocity $\vec{v} = (20.0m/s)\hat{i}$ through a uniform magnetic field $\vec{B} = (40.0mT)\hat{j}$ (Fig.). What are the

resulting (a) electric field within the solid im unit -vector notation. and (b) potential difference across the solid ? (c) Which face becomes negatively charged ?



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2. A neutral particle is at rest in a uniform magnetic field $\vec{B}$.At $t = 0$,particle decays into two particles each of mass m and one of them having charge q Both of these move off in separate paths lying in plane perpendicular to $\vec{B}$.A later time,the particles collide.Find this time of collision neglecting the interaction force.

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3. An electron follows a helical path in uniform magnetic field given by $\vec{B} = \left(20\hat{i} - 50\hat{j} - 30\hat{k}\right)$ mT. At time t = 0, the electrons velocity is given by $\vec{v} = \left(40\hat{i} - 30\hat{j} + 50\hat{k}\right)$ m/s. (a) What is the angle ϕ between $\vec{v}$ and $\vec{B}$? The electron's velocity changes with time. Do (b) its speed and (c) the angle ϕ change with time? (d) What is the radius of the helical path ?

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4. A long rigid wire lies along the X - axis and carries a current of 10 A in the positive X - direction. Round the wire, the external magnetic field is $\vec{B} = \hat{i} + 2x^2\hat{j}$ with x in meters and B is Tesla. The magnetic force (in SI units) on the segment of the wire between x = 1 m and x = 4 m is

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5. A wire 2.30 m long carries a current of 13.0 A and makes an angle of 35.0° with a uniform magnetic field of magnitude B = 1.50 T. Calculate the

magnetic force on the wire.

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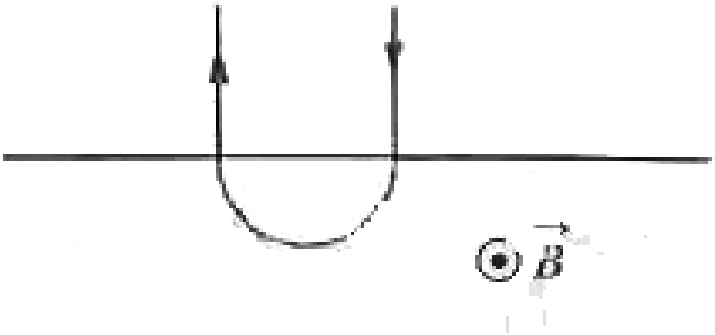
6. In Fig. a charged particle moves into a region of uniform magnetic field $\vec{B}$, goes through half a circle and then exist that region. The particle is either a proton or an electron (you must decide which). It spends 160 ns in the region. (a) What is the magnitude of $\vec{B}$? (b) If the particle is sent back through the magnetic field (along the same initial path) but with 2.00 times its previous kinetic energy, how much time does it spend in the field during this trip ?



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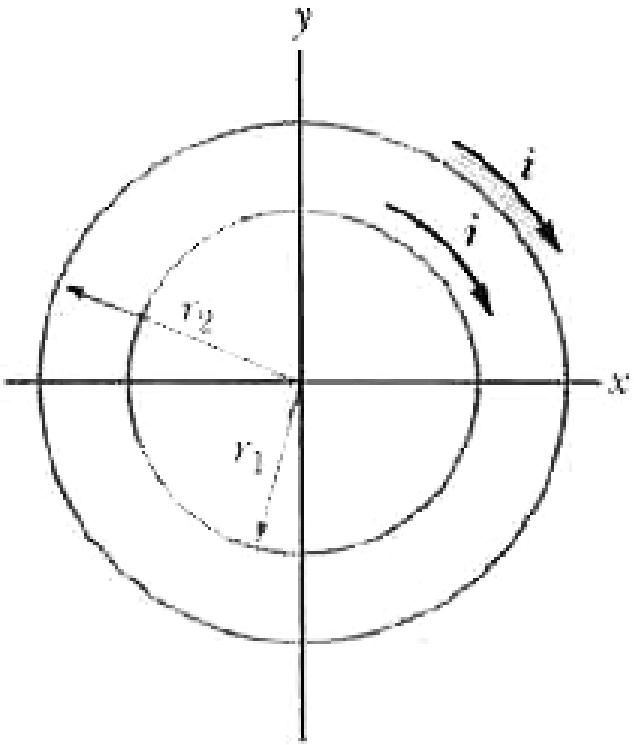
7. Two concentric circular wire loops, of radii $r_1 = 20.0cm$ and $r_2 = 40.0cm$ are located in a xy plane, each carries a clock wise current of 11.0. A (Fig.). (a) Find the magnitude of the net magnetic dipole moment of the system. (b) Repeat for reversed current in the inner loop.



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8. An electron experiences a magnetic force of magnitude$4.60 \times 10^{-15} N$, when moving at an angle of 60° with respect to a magnetic field of magnitude $3.50 \times 10^{-3} T$. Find the speed of the electron.

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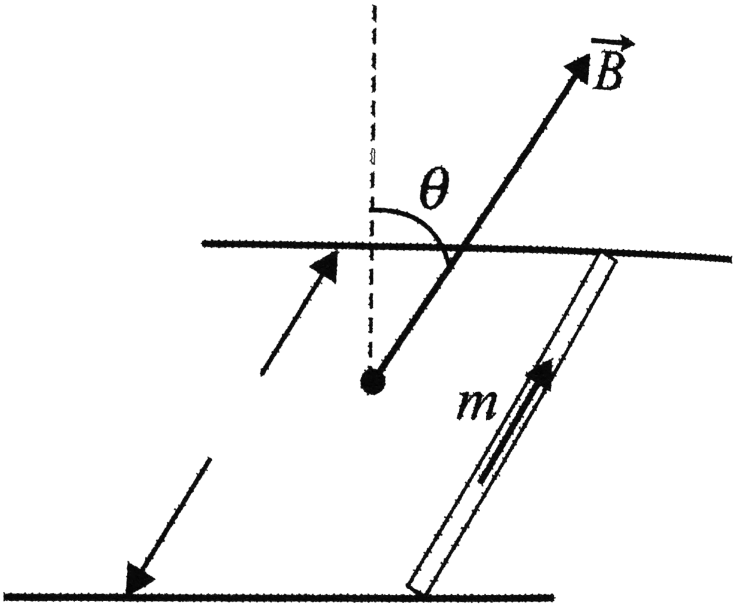
9. A conductor (rod) of mass m, length l carrying a current i is subjected to a magnetic field of induction B. If the coefficients of friction between the conducting rod and rail is μ, find the value of I if the rod starts

sliding.



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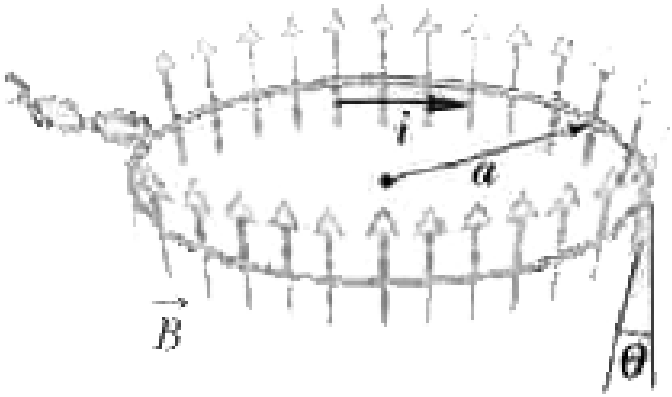
10. Figure shows a wire ring of radius a = 1.8 cm that is perpendicular to the general direction of a radially symmetric, diverging magnetic field. The magnetic field at the ring is everywhere of the same magnitude B = 3.0 mT, and its direction at the ring everywhere makes an angle $\theta = 15^{\circ}$ with a normal to the plane of the ring. The twisted lead wires have no effect on the problem. Find the magnitude of the force of the field exerts

on the ring if the ring carries a current i = 4.6 m A.



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11. The radius of circular path of an electron when subjected to a perpendicular magnetic field is

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12. A square loop of sides $10cm$ carries a current of $10A$.A uniform magnetic field of magnitude $0.20T$ exists parallel to one of the side of the

loop.(a)What is the force acting on the loop? (b)What is the torque acting on the loop?

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13. An electron after being accelerated through a potential difference of 100 V enters a uniform magnetic field of $0 \cdot 004T$, perpendicular to its direction of motion. Calculate the radius of the path described by the electron.

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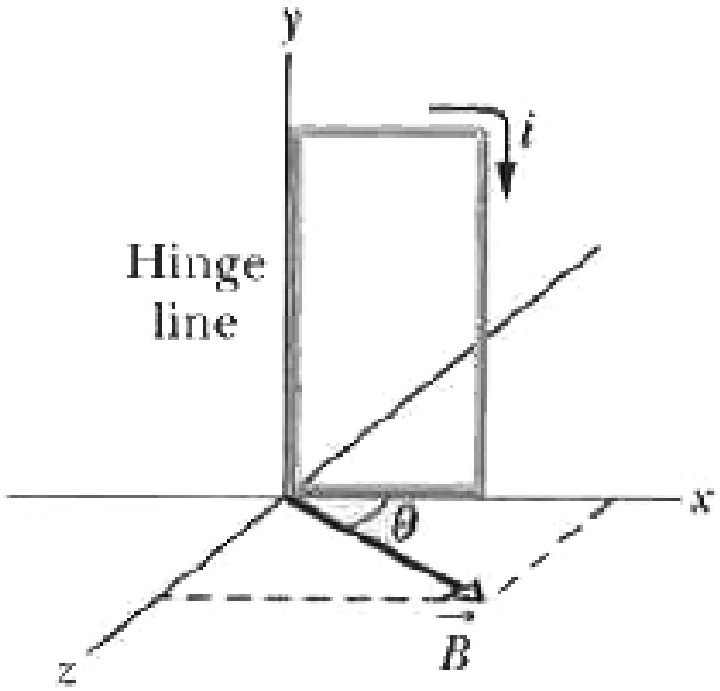
14. Figure shows a rectangular 28-turns coil of wire, of dimensions 10 cm by 5.0 cm. It carries a current of 0.80 A and is hinged along one long side. It s mounted in the xy plane, at angle $\theta = 25^\circ$ to the direction of a uniform magnetic field of magnitude 0.50 T. In unit vector notation, what

is the torque acting on the coil about the hinge line ?



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15. A rectangular loop of sides 20 cm and 10 cm carries a current of 5.0 A. A uniform magnetic field of magnituded 0.20 T exists parallel ot the longer side of the loop (a) What is the force acting on the loop? (b) what is the torque acting on the loop?

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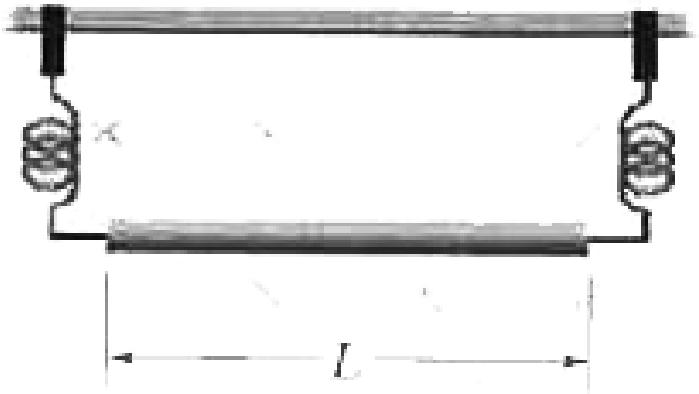
16. A 6.75 g wire of length L = 15.0 cm is suspended by a pair of flexible leads in a uniform magnetic field of megnitude 0.440 T (Fig.). What are the (a) magnitude and (b) direction (left or right) of the current required to remove the tension in the supporting leads ?



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17. An electron moves in a circle of radius $r = 5.29 \times 10^{-11} M$ with speed $4.12 \times 10^{6} m / s$. Treat the circular path as a current loop with a constant current equal to the ratio of the electron charge magnitude to the period of the motion. If the circle lies in a uniform magnetic field of magnitude B

= 7.10 mT, what is the maximum possible magnitude of the torque produced on the loop by the field ?

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18. If momentum of a body increases by 100% then what will be percentage increase in its kinetic energy ?

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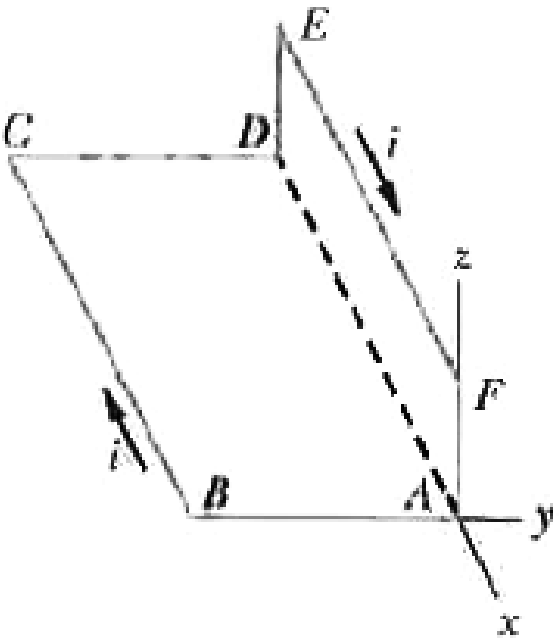
19. Figure shows a current loop ABCDEFA carrying a current i = 300 A. The sides of the loop are parallel to the coordinate axes shown with AB = 20.0 cm, BC = 30.0 cm, and FA = 10.0 cm. In unit-vectr notation, what is the magnetic dipole moment of this loop ? (Hint: Imagine equal and opposite currents i in the line segment AD : then treat then two rectangular loops

ABCDA and ADEFA.)



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20. What is the magnitude of torque which acts on a coil carrying current placed in a uniform radial magnetic field?

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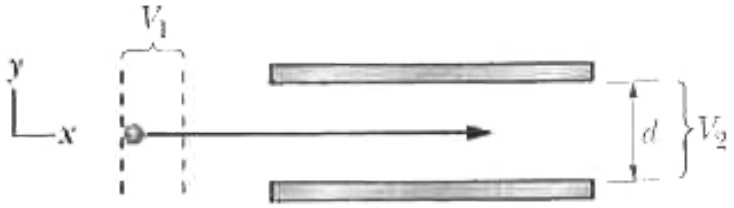
21. In Fig. , an electron accelerated from rest through potential difference $V_1 = 2.50kV$ enters the gap between two parallel plates having separation d = 16.0 mm and potential difference $V_2 = 100V$. The lower plate is at the lower potential.Neglect fringing and assume that the electron's velocity is perpendicuar to the electric field vector between magntic field allows the electron to travel in a stright line in the gap ? (b) If the potential difference is increased slightly, in what direction does the electron veer from straight-line motion.



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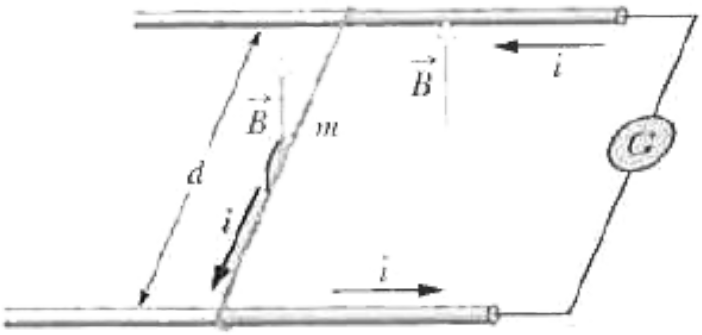
22. In Fig., a metal wire of mass m = 24.1 mg can slide with nagligible friction on two horizontal parallel rails separated by distance d = 2.56 cm. The track lies in a vertical uniform magnetic field of magnitude 73.5 mT. At time t = 0, device G is connected to the rails, producing a constant

current i = 9.13 mA in the wire and rails (even as the wire moves). At t = 61.1 ms, what are the wire's (a) speed and (b) direction of motion (left or right) ?



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23. A wire placed along the north-south direction carries a current of 8A from south to north. Find the magnetic field due to a 1cm piece of wire at a point 200 cm north-east from the piece.

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24. A circular loop of wire having a radius of $8.0cm$ carries a current of $0.20A$. A vector of unit length and parallel to the dipole moment W of the

loop is given by $0.60\hat{i} - 0.80\hat{j}$. if the loop located in uniform magnetic field given by $B = (0.25T)\hat{i} + (0.30T)\hat{k}$ find,

(a) the torque on the loop and

(b) the magnetic potential energy of the loop.

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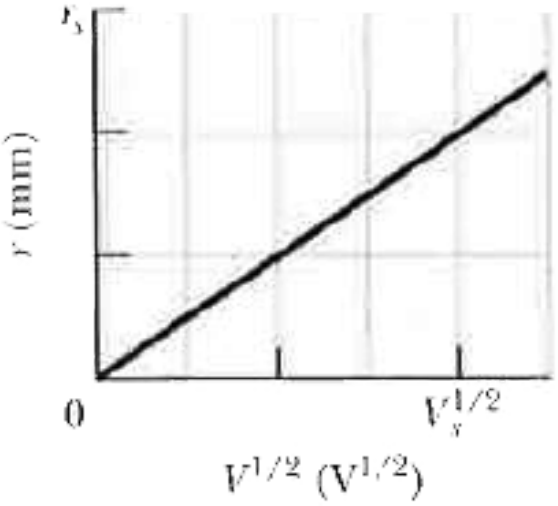
25. An electron is accelerated from rest through potential difference V and then enters a region of uniform magnetic field, where it undergoes uniform circular motion. Figure gives the radius r of that motion versus $V^{1/2}$. The vertical axis scale is set by $r_s = 9.0mm$, and the horizontal axis scale is set by $V_s^{1/2} = 40.0V^{1/2}$. What is the magnitude of the

magnetic field ?



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26. A electron moves through a uniform magnetic field given by $\vec{B} = B_x\hat{i} + (3B_x)\hat{j}$. At a particular instant, the electron has the velocity $\vec{v} = \left(2.0\hat{i} + 4.0\hat{j}\right)m/s$ and magnetic force acting on it is $\left(6.4 \times 10^{-19}N\right)\hat{k}$. Find B_x.

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27. A cyclotron is operated at an oscillator frequency of 12 MHz and has a dee radius R 50 cm. What is the magnitude of the magnetic field needed for a proton to be accelerated in the cyclotron?

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28. What uniform magnetic field applied perpendicular to a beam of electrons moving at $1.3 \times 10^6 ms^{-1}$ is required to make the electrons travel in a circular arc of radius 0.35 m

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29. The magnetic moment of the assumed dipole at the earth's centre is $8.0 \times 10^{22} Am^2$. Calculate the magnetic field B at the geomagnetic poles of the earth. Radius of the earth is $6400 km$.

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30. An electron enters perpendicular to a uniform magnetic field with a speed of $10^8 cm/s$. The particle experiences a force due to the magnetic field and the speed of the electron

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31. A particle of mass 12g and charge $80\mu C$ moves through a uniform magnetic field, in a region where the free - fall acceleration is $-9.8\hat{j}m/s^2$. The velocity of the particle is a constant $20\hat{i}km/s$, which is perpendicular to the magnetic field. What then is the magnetic field ?

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32. The electric field in a certain region of space is $\left(5\hat{i}+4\hat{j}-\hat{k}\right)\times 10^5 N/C$. Calculate electric flux due to this field over an area of $\left(2\hat{i}-\hat{j}\right)\times 10^{-2}m^2$.

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33. A particle undergoes uniform circular motion of radius $28.7\mu m$ in a uniform magnetic field. The magnetic force on the particle has a magnitude of $1.60 \times 10^{-17} N$. What is the kinetic energy of the particle ?

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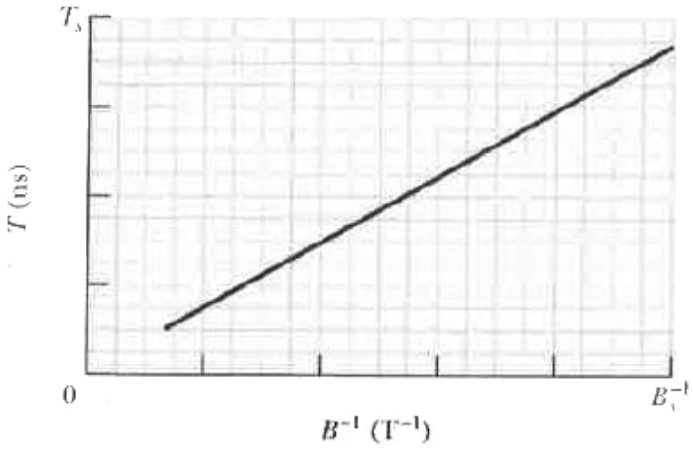
34. A certain particle is sent into a uniform magnetic field, with the particle'a velocity vector perpendicular to the direction of the field. Figure gives the period T of the particles motion versus the inverse of the field magnitude B. The vertical axis scale is set by $T_s = 80.0ns$, and the horizontal axis scale is set by $B_s^{-1} = 10.0T^{-1}$. What is the ratio m/q of

the particle's mass to the magnitude of its charge ?



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35. A magnetic dipole with a dipole moment of magnitude $0.020\frac{J}{T}$ is released from rest in a uniform form magnetic field of magnitude $52mT$. The rotation of the dipole due to the magnetic force on it is unimpeded. When the dipole rotates through the orientations where its dipole moment is aligned with the magnetic field, its kinetic energy is $0.80mJ$.

(a) What is the initial angle between the dipole moment and the magnetic field?

(b) What is the angle when the dipole is next (momentarily) at rest?

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36. A strip of copper $75.0\mu m$ thick and 4.5 mm wide is placed in a uniform magnetic field $\overrightarrow{B}$ of magnitue 0.65 T. with $\overrightarrow{B}$ perpendicular to the strip. A current I = 57 A is then sent through the strip such that a hall potential difference V appears across the width of the strip. Calculate V. (The number of charge carries per unit volume for coppper is 8.47×10^{28} electrons/m^3).

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37. An α particle travels at an angle of 30° to a magnetic field 0.8 T with a velocity of 10^5 m/s. The magnitude of force will be-

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38. A proton travels through uniform magnetic and electric tric fields. The magnetic field is $\overrightarrow{B} = -3.25\hat{i}mT$. At one instant the velocity of the

proton is $\vec{v} = 2000\hat{j}m/s$. At that instant and in unit-vector notation. What is the net force acting on the proton if the electric field is (a) $4.00\hat{k}$ V/m, (b) $-4.00\hat{k}$ V/m, and (c) $4.00\hat{i}$ V/m ?

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39. एक प्रोटॉन 2.5 टेस्ला के चुम्बकीय क्षेत्र में उसके 30° के कोण पर 2×10^7 मीटर प्रति सेकंड के वेग से प्रवेश करता है प्रोटॉन पर लगने वाले बल की गणन कीजिये।

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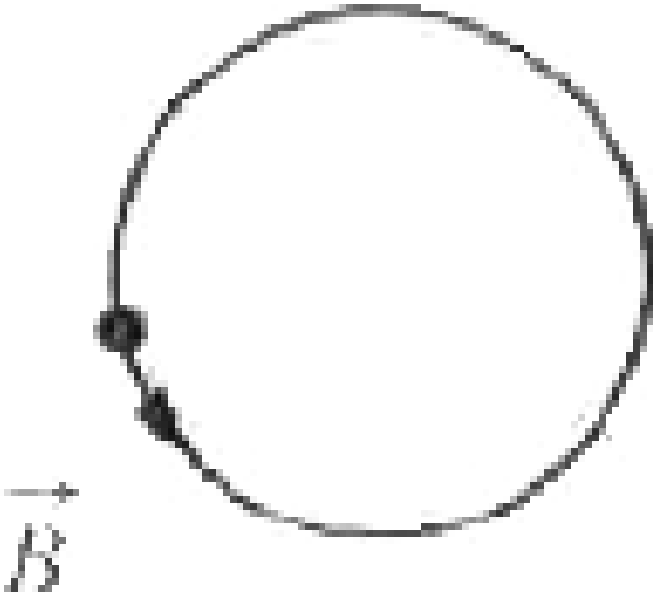
40. In Fig., a particle moves along a circle in a region of uniform magnetic field of magnitude B = 5.00 mT. The particle is either a proton or an electron (you must decide which). It experiences a magnetic force of magnitude $3.20 \times 10^{-15}N$. What are (a) the particle's speed (b) the

radius of the circle, and (c) the period of the motion ?



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41. An electron travels in a circular path of radius 20 cm in a magnetic field of $2 \times 10^{-3} T$. Calculate the speed of the electron. What is the potential difference through which the electron must be accelerated to acquire this speed?

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42. एक f आवृत्ति के प्रत्यावर्ती धारा क्षेत्र को एक साइक्लोट्रॉन डीज (त्रिज्या=R) का उपयोग प्रोट्रॉनों (द्रव्यमान =m) को त्वरित करने के लिए किया जा रहा है। साइक्लोट्रॉन में प्रयुक्त प्रचालन चुंबकीय क्षेत्र (B) तथा उत्पन्न प्रोट्रॉन किरण पुंज की गतिज ऊर्जा (K) होगी-

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43. A electron moves through a uniform magnetic field given by $\vec{B} = B_x\hat{i} + (3B_x)\hat{j}$. At a particular instant, the electron has the velocity $\vec{v} = \left(2.0\hat{i} + 4.0\hat{j}\right)m/s$ and magnetic force acting on it is $\left(6.4 \times 10^{-19}N\right)\hat{k}$. Find B_x.

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44. A square loop of sides $10cm$ carries a current of $10A$.A uniform magnetic field of magnitude $0.20T$ exists parallel to one of the side of the loop.(a)What is the force acting on the loop? (b)What is the torque acting on the loop?

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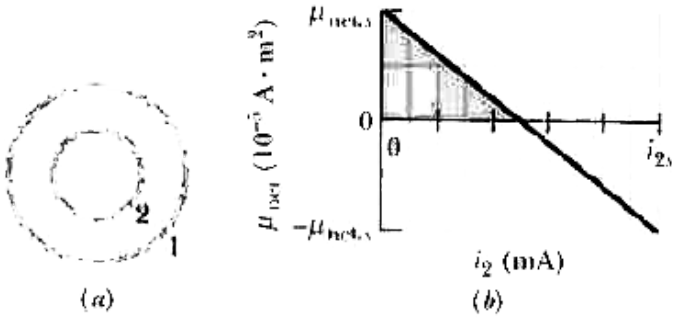
45. Figure, two concentric coils, lying in the same plane, carry currents in opposite directions. The current in the larger coil 1 is fixed. Current i_2 in coil 2 can be varied. Figure gives the net magnetic moment of the two coil system as a function of i_2. The vertical axis scale is set by $\mu_{\text{net.s}} = 2.0 \times 10^{-5} A.\, m^2$, and the horizontal axis scale is set by $i_{2s} = 20.0mA$. If the current in coil is then reversed, what is the magnitude of the net megnetic moment of the two-coil system when $i_2 - 7.0mA$?



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46. An electric field of 1500 V/m and a magnetic field of 0.40 Wb/m^2 act on a moving electron. The minimum uniform speed along a straight line, the electron could have is

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47. Fe^+ ions are accelerated through a potential difference of 500 V and are injected normally into a homogeneous magnetic field B of strength 20.0 m T. Find the radius of the circular paths followed by the isotopes with mass numbers 57 and 58. Take the mass of an $ion = A\left(1.6X10^{-27}\right)$ kg where A is the mass number.

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48. An electron has velocity $v = \left(2.0 \times 10^6 \frac{m}{s}\right)\hat{i} + \left(3.0x10^6 \frac{m}{s}\right)\hat{j}$. Magnetic field present in the region is $B = (0.030T)\hat{i} - (0.15T)\hat{j}$.

(a) Find the force on electron.

(b) Repeat your calculation for a proton having the same velocity.

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49. An alpha particle can be produced in certain radioactive decays of nuclei and consists of two protons and two neutrons. The particle has a charge of q = +2e and a mass of 4.00 u, where u is the atomic mass unit, with $1u = 1.661 \times 10^{-27} kg$. Suppose an alpha particle travels in a circular path of radius 4.50 cm in a uniform magnetic field with B = 1.20 T. Calculate (a) its speed, (b) its period of revolution, (c) its is kinetic energy, and (d) the potential difference through which it would have to be accelerated to achieve this energy. (e) If the field magnitude is doubled what is the ratio of the new value of kinetic energy to the initial value ?

View Text Solution

Practice Questions Single Correct Choice Type

1. Magnetic intensity for an axial point due to a short bar magnet of magnetic moment M is given by

A. $\frac{\mu_0}{4\pi} \times \frac{M}{d^3}$

B. $\frac{\mu_0}{4\pi} \times \frac{M}{d^2}$

C. $\frac{\mu_0}{2\pi} \times \frac{M}{d^3}$

D. $\frac{\mu_0}{2\pi} \times \frac{M}{d^2}$

Answer: C

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2. The material for making permanent magnets should have:

A. High retentivity high coercivity

B. Low retentivity low coercivity

C. Low retentivity high coercivity

D. High retentivity low coercivity

Answer: A

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3. If $\vec{A}$, $\vec{B}$ and $\vec{C}$ are three vectors, then the wrong relation is :

A. $\vec{B} = \mu_0\left(\vec{H} \times \vec{I}\right)$

B. $\left|\vec{B}\right| = \dfrac{\left|\vec{I}\right|}{\left|\vec{H}\right|}$

C. $\left|\vec{B}\right| = \mu_0\left(\overline{H} - \vec{I}\right)$

D. $\left|\vec{B}\right| = \mu_0\left(\vec{H} + \vec{I}\right)$

Answer: D

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4. A magnetic needle suspended by a silk thread is vibrating in the earth's magnetic field. If the temperature of the needle is increased by $500^\circ C$, then

A. 82°

B. 71°

C. 90°

D. 65°

Answer: B

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5. If a bar magnet of pole strength m and magnetic moment M is cut equally 5 times parallel to its axis and again 3 times perpendicular to its axis, then the pole strength and magnetic moment of each piece are respectively.

A. $\frac{m}{20}, \frac{M}{20}$

B. $\frac{m}{4}, \frac{M}{20}$

C. $\frac{m}{20}, \frac{5}{20}$

D. $\frac{m}{5}, \frac{M}{4}$

Answer: C

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6. A compass needle whose magnetic moment is $60Am^2$ points geographic north at a certain place where $H = 40\mu T$. The compass needle experience a torque of $1 \cdot 2 \times 10^{-3}N - m$. What is the declination at the place?

A. 30°

B. 60°

C. 45°

D. 90°

Answer: A

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7. A magnetic field of $1600Am^{-1}$ produces a magnetic flux of $2 \cdot 4 \times 10^{-5}$ weber in a bar of iron of cross section $0 \cdot 2cm^2$. Calculate permeability and susceptibility of the bar.

A. 596.8

B. 288.9

C. 2

D. None of these

Answer: A

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8. Two short magnets placed along the same axis with their like poles facing each other repel each other with a force which varies inversely as

A. $4 \times 25N$

B. $4 \times 4 \times 25N$

C. $4 \times 4 \times 4 \times 25N$

D. $4 \times 4 \times 4 \times 4 \times 25N$

Answer: D

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9. The time period of a freely suspended magnetic needle does not depend upon

A. Length of the magnet

B. Pole strength of the magnet

C. Horizontal component of Earth's magnetic field

D. Length of the suspension thread

Answer: D

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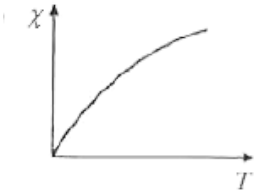
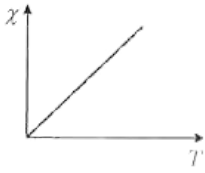
10. Which among the four χ versus T graphs shown in the following figure is the correct one for a paramagnetic substsnace will look like ?

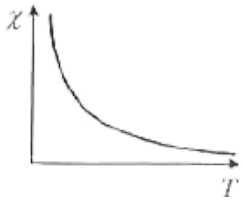
A.



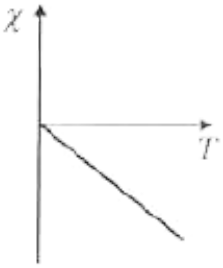
B.



C.



D.



Answer: C

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11. An electron is travelling horizontally towards east. A magnetic field in vertically downward direction exerts a force on the electron along

A. To the right

B. To the left

C. upward

D. downward

Answer: C

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12. An electron and a proton are moving on straight parallel paths with same velocity. They enter a semi infinite region of uniform magnetic field perpendicular to the velocity.

Which of the following statement(s) is /are true?

A. Velocity v of the proton remains constant

B. Speed v of the proton remains constant

C. Both direction and speed of the proton change

D. Direction of the proton remains constant although its speed increases

Answer: B

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13. Assertion: If an electron, while coming vertically from outerspace, enter the earth's magnetic field, it is deflected towards west.

Reason: Electron has negative charge.

A. Northward

B. Southward

C. Eastward

D. Westward

Answer: D

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14. Cosmic rays (atomic nuclei stripped bare of their electrons) would continuously bombard Earth's surface if most of them were not deflected by earth's magnetic field. Given that earth is, to an excellent approximation, a magnetic dipole, the intensity of cosmic rays bombarding its surface is greatest at the

A. Poles

B. Mid-latitudes

C. Equator

D. Mid-Longitude

Answer: A

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15. A charged particle enters a uniform magnetic field perpendicular to it. The magnetic field

A. Curve to the right with radius R = mv/qB

B. Curve to the left with radius R = mv/qB

C. Curve upward with radius R = mv/qB

D. not be affected at all

Answer: D

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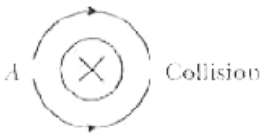
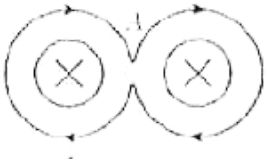
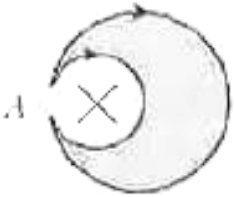
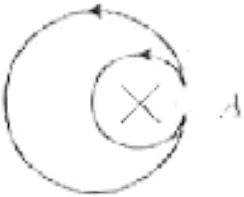
16. A neutral particle at rest in a magnetic field decays into two charged particles of different mass. The energy released goes into their kinetic energy. Then what can be the path of the particles. Neglect any interaction between the two charges.

A.



B. 

C. 

D. 

Answer: A

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17. What is the direction of angular velocity of a rotating body ?

A. Net magnetic force as well as torque on the dipole is zero

B. Net magnetic force as well as torque on the dipole is nonzero

C. Net magnetic force on the dipole is zero but the net torque on the dipole is nonzero

D. Net magnetic force on the dipole is not zero but the net torque on the dipole is zero

Answer: D

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18. An electron moving with a uniform velocity along the positive x-direction enters a magnetic field directed along the positive y-direction. The force on the electron is directed along

A. E = 100 V/m in the z direction

B. E = 100 V/m, in the negative z direction

C. E = 100 V/m in the x direction

D. E = 100 V/m in the negative y direction

Answer: B

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19. Which of the following particle can be deflected by electric and magnetic field?

A. Chamber with electric field perpendicular and magnetic field parallel to the velocity of the charged particle

B. Chamber with electric field parallel, and magnetic field perpendicular to the velocity of the charged particle

C. Chamber with electric field parallel, and magnetic field anti-parallel to the velocity of the charged particle

D. Chamber with electric field as well as magnetic field perpendicular to the velocity of the charged particle

Answer: B

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20. An α -particle and a proton are accelerated from rest thruogh the same potential difference and both enter a uniform perpendicular magnetic field. Find the ratio of their radii of curvature.

A. Deflected in the +x direction

B. Deflected in the - x direction

C. Deflected in the +y direction

D. Deflected in the -y direction

Answer: B

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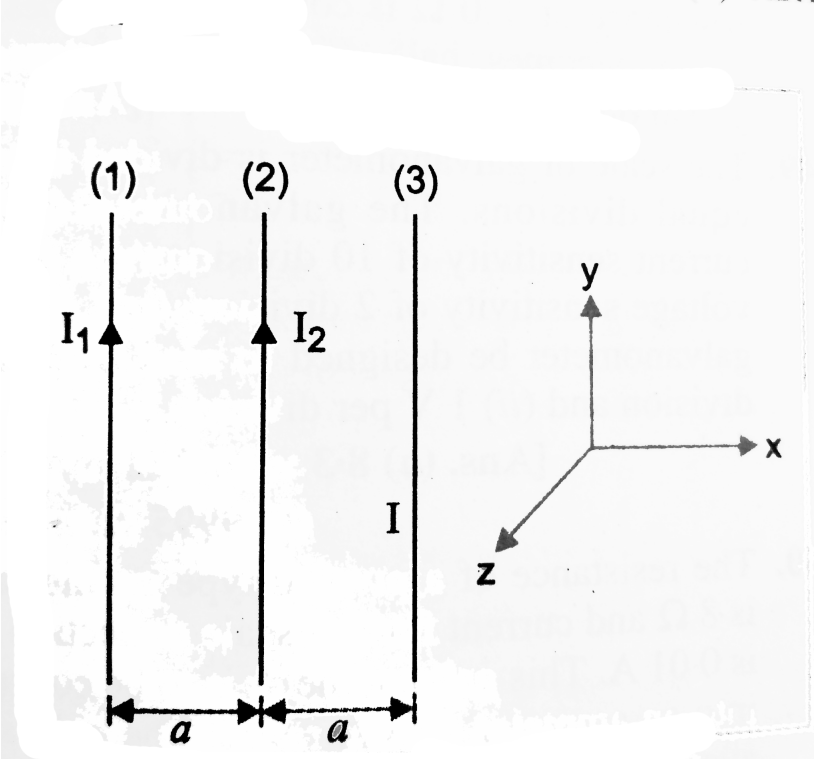
21. Three long straight parallel wires are kept as shown in figure. The wire (3) carries a current I.



(i) The direction of flow of current I in wire (3), is such that the net force, on wire (1), due to other two wires, is zero (ii) By reversing the direction of I, the net force, on the wire (2) due to the other two wires, becomes zero. What will be the directions of current I, in the two cases? Also obtain the relation between the magnitudes of current I_1, I_2 and I.

A. $A > B > C$

B. $B > A > C$

C. $C > B > A$

D. $A > C > B$

Answer: B

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22. Which of the following setups can make a small conductor coil that is placed horizontally float on top of an object ?

A. The object is a magnet that provides a magnetic field pointing straight downward, whereas the coil carries an electric current flowing clockwise as viewed from top down

B. The object is a magnet that provides a magnetic field pointing straight downward, while the coil carries an electric current flowing counterclockwise as viewed from top down

C. The object carries positive electric charge while the coil carries negative charge

D. The object as well as coil carries negative electric charge

Answer: D

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23. An electric current runs counter clockwise in a rectangular loop around the outside edge of this page, which lies flat on your table. A uniform magnetic field is then turned on, directed parallel to the page from top to bottom, the magnetic force on the page will cause

A. The left edge to lift up

B. The right edge to lift up

C. The top edge to lift up

D. The bottom edge to lift up

Answer: C

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24. Two particles , each of mass m and charge q, are attached to the two ends of a light rigid rod of length $2R$. The rod is rotated at constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod is

A. q/2m

B. q/m

C. 2q/m

D. $q/\pi m$

Answer: A

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Practice Questions More Than One Correct Choice Type

1. Choose the correct answer

A. Diamagnetism occurs in all materials

B. Diamagnetism is the result of partial alignment of permanent magnetic moment

C. The magnetic field due to induced magnetic moment is opposite to the applied field

D. The magnetizing field intensity is always zero in free space

Answer: A::C

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2. Choose the correct answer

A. All electrons possess magnetic moment

B. All protons possess magnetic moment

C. All nuclei possess magnetic moment

D. All atoms possess magnetic moment

Answer: A::B

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3. A beam of electrons moving with a momentum p enters a uniform magnetic field of flux density B perpendicular to its motion. Which of the following statement(s) is (are) true?

A. Energy gained is $p^2 / 2m$

B. Centripetal force on the electron is Be(p/m)

C. Radius of the electron's path is p/Be

D. Work done on the electrons by the magnetic field is zero

Answer: B::C::D

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4. The radius of curvature of the path of a charged particle moving in a static uniform magnetic field is

A. Directly propotional to the magnitude of the charge on the particle

B. Directly propotional to the magnitude of the liner momentum of the particle

C. Directly proportional to the kinetic energy of the particle

D. Inversely proportional to the magnitude of the magnetic field

Answer: B::D

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5. An α -particle and a proton are accelerated from rest thruogh the same potential difference and both enter a uniform perpendicular magnetic field. Find the ratio of their radii of curvature.

A. Their kinetic energies before entering the magnetic field are equal and remain equal in the magnetic field

B. They trace circular orbits of the same radii in the magnetic field.

C. The radius of the circular orbit of the heavier isotope in the magnetic field is greater than that of the lighter isotope

D. The radii of the circular orbits in the magnetic field are in the direct ratio of the magnitude of their momenta

Answer: A::C::D

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6. A positively charged particle is moving along the positive X-axis.You want to apply a magnetic field for a short time so that the particle may reverse its direction and move parallel to the negative X-axis.This can be done be applying the magnetic field along.

A. y axis

B. z axis

C. Any direction in ys plane

D. z axis only

Answer: A::B::C

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7. A charged particle of charge q and mass m is shot into a uniform magnetic field of induction B at an angle θ with the field. The frequency of revolution of the particle

A. Depends on the angle θ

B. Is independent of the angle θ

C. Is proportional to the specific charge q/m of the particle

D. Is inversely proportional to the value of B

Answer: B::C::D

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8. A particle of mass m and charge Q moving with a velocity v enters a region on uniform field of induction B Then its path in the region is s

A. Its path in the region of the field is always circular

B. Its path in the region of the field is circular if $\overrightarrow{v} \times \overrightarrow{B} = 0$

C. Its path in the region of the field is a straight line if $\overrightarrow{v} \times \overrightarrow{B} = 0$

D. Distance traveled by the particle in time T does not depend on the angle between $\overrightarrow{v}$ and $\overrightarrow{B}$

Answer: C::D

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9. A charged particle would continue to move with a constant velocity in a region wherein, which of the following conditions is not correct?

A. There must be no electric or magnetic fields in this region

B. There could be an electric field without any magnetic field

C. There could be a magnetic field without any electric field

D. There can be electric field as well as magnetic field

Answer: C::D

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10. What is the direction of the force acting on a charged particle q, moving with a velocity $\vec{v}$ a uniform magnetic field $\vec{B}$?

A. $\vec{E}$ must be perpendicular to $\vec{B}$

B. $\vec{v}$ must be perpendicular to both $\vec{E}$ and $\vec{B}$

C. $\vec{E}$ must be perpendicular to both $\vec{v}$ and $\vec{B}$

D. $\vec{E}$ and $\vec{B}$ must be in same direction

Answer: A::C

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11. The current sensitivity of a moving coil galvanometer can be increased by

A. Increasing the magnetic field of the permanent magnet

B. Increasing the area of the deflecting coil

C. Increasing the number of turns in the coil

D. Increasing the torsional constant of the coil

Answer: A::B::C

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Practice Questions Linked Comprehension

1. The lines of the magnetic field B generally emerge in the southern hemisphere and reenter the Earth in the northern hemisphere. Thus, the

magnetic pole that is in the Earth's northern hemisphere and known as a "north magnetic pole" is really the south pole of the Earth's magnetic dipole.

The statement in the paragraph means that

A. The north pole of a compass is attracted to Earth's geographic north pole

B. The north pole of a compass is attracted to the Earth's geographic south pole

C. The north pole of a compass is repelled to the Earth's geographic north pole

D. The north pole of a compass is repelled to the Earth's geographic south pole

Answer: A

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2. In the northern hemisphere, do magnetic lines of force due to earth's field point towards or away from earth?

A. The direction of the magnetic field does not vary from location to location on earth

B. The direction of the magnetic field varies from location to location on earth

C. The direction of the magnetic field is same in all location on earth

D. The direction of the magnetic field is zero on all location on earth

Answer: B

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Practice Questions Matrix Match

1.

Column I	Column II
(a) The end of a magnet from which the field lines emerge	(p) Attract one another
(b) Opposite magnetic poles	(q) South pole
(c) The end of a magnet into which the field lines enter	(r) Repel one another
(d) Like magnetic poles	(s) North Pole

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2.

Column I	Column II
(a) Magnetic susceptibility	(p) $\Phi_B = \oint \vec{B} \cdot d\vec{A} = 0$
(b) Curie's law	(q) $B = \frac{\mu_0}{4\pi} \frac{2m}{r^3}$
(c) magnetic field on axial line of a bar magnet	(r) $M - C\frac{B_{ext}}{T}$
(d) Gauss's law for magnetic fields	(s) $\chi = \frac{M}{H}$

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Practice Questions Integer Type

1. A steel wire of length l has a magnetic moment M. It is bent into a semicircular arc. What is the new magnetic moment?

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2. A bar magnet suspended freely has period of oscillation of 2s. Now, the bar magnet is broken into equal halves and one-half is suspended to oscillate freely in the same magnetic field. Find the time period of oscillation of this half of the magnet.

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3. Two bar magnets of equal length and equal magnetic moment are placed at right angles to each other in such a way that the north pole of one is in touch with the south pole of the other at the junction. What is the magnetic moment of the combination?

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4. Two equal magnetic poles placed 10 cm apart in air attract each other with a force of $0.4 \times 10^{-4} N$. What should be the distance of separation between them so that the force of attraction of $0.6 \times 10^{-4} N$?

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5. The work done in turning a magnet of magnetic moment M by an angle of 90° from the magnetic meridian is n times the corresponding work done to turn through an angle of 60°. What is the value of n ?

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6. At a certain place, a magnet makes 30 oscillations per minute. At another place, the magnetic field is double. What is the its time period ?

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7. A bar magnet has a magnetic moment of 2.5 J/T and is placed in a magnetic field of 0.2 T. find the work done in turning the magnet from parallel to anti-parallel position relative to field direction.

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