PHYSICS

BOOKS - NN GHOSH PHYSICS (HINGLISH)

MAGNETIC EFFECT OF CURRENT

Examples

1. A small current element 5×10^{-5} A m is placed at the corner A along AB of an

equilateral trianle ABC. Calculate the intensity of the magnetic field at B and C. Each side of the triangle is 20cm.

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2. A circular loop of mean radius 5 cm, which has 40 turns of insulated copper wire, is placed in the magnetic meridian. A compass needle is placed at the center of the loop. What direction is produced by a current of 0.1

A through the coil? (H-vector of the earth's field at the place = 29 A m^{-1}

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3. A circulalr coil carrying a current of 0.5 A is initially set in the magnetic meridian. It is turned till the magnetic needle pivoted at its center becomes parallel to the plane of the coil. If in the position the plane of the coil is 30° away from the magnetic meridian, calcualte the horizontal component of the

earth's magnetic field. (Radius of coil = 5cm and number of the turns = 50)

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4. A circular loop is placed in the magnetic meridian. Find the deflectioin it will produce in a compass it will produce in a compass needle placed 10cm from its center. H-vector of earth's field = 30Am^(-1)`. Radius of the loop = 10cm and number of turns = 10. Current through the loop = 0.5A

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5. Calcualte the magnetic field at the center of a square conductor carrying a current of $1A$. The square is 10 cm on each side.

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6. Calculate the magnetic field at the center of a semicircular conductor carrying a current of I ampere. The radius of the semicircle is equal to a.

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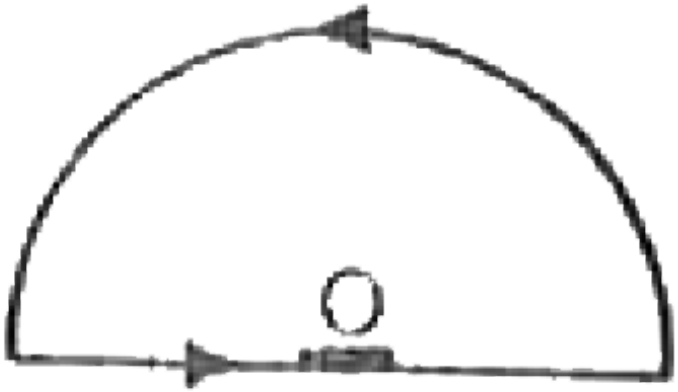
7. A thin wire of length l=1m is shipped into a semicircle with diameter. Calculate the force per unit length at the mid-point of the diameter when it carries a current I = 8A.



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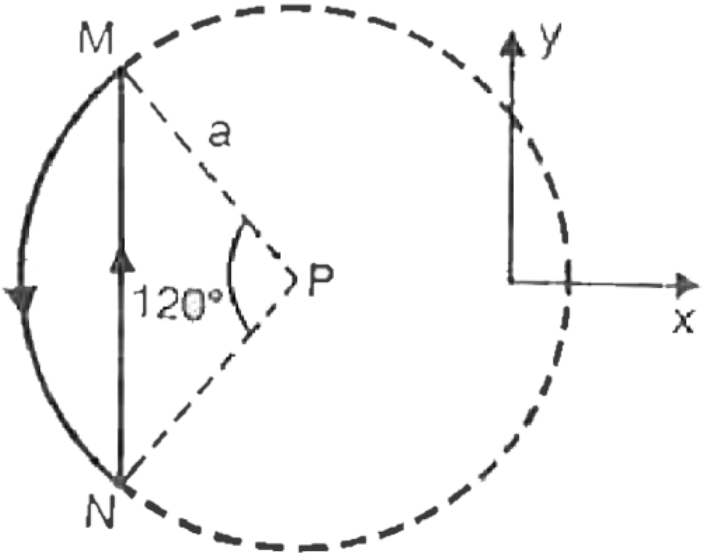
8. A wire loop carrying a current I is placed in the x-y plane. (a) If a particle with charge +Q and mass m is placed at the center P and given a velocity $\overrightarrow{v}$ along NP, find its acceleration. (b) if an external uniform magnetic induction $\overrightarrow{B}$ =B$\hat{i}$ is applied, find the force and the torque

acting on the top due to this field.



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Exercises

1. A current element of strength 2×10^{-4} Am is at the corner A of a cube ABCDEFGH of sides 10cm, the element lying along the edge AB. Calcualte the B-field and H-field of the element at the diagonally opposite corner.

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2. Two current elements of strengths 0.2 Am 0.4A m from a cross at the center of a circle of radius 10cm. Calculate the magnetic field at a

point on the circle 30° away(anticlockwise) from the first element.

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3. What current must be passed through a vertical coil of 50 turns of average radius 8 cm in order to neutralize the horizontal component of the earth's field (15 Am^{-1} at its center?

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4. A circular loop of 100 turns and radius 10 cm is placed witih its plane at an angle of 60° with the magnetic meridian. Calculate the angle made with the magnetic meridian by a small magnetic needle placed at the center of the loop when 1-A current is placed through it. The horizontal component of the earth's field is $3.6x10^{-5}$T.

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5. A coil of 50 turns and radius 10 is placed with its plant at right angles to the magnetic meridian. It is connected to a cell of steady emf and a rheostat. The current through the coil is gradually increased till a compass needle at its center just turns through 180°. Find the strength and direction of current through the coil.

(Horizontally intensity of earth's field = 30 A m^{-1}

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6. Calcualte the current in amperes through a circular loop of 40 turns and mean radius 5cm placed with its planein the magnetic meridian that will produce a deflection of 60° in a compass needle placed at its center. (The value of horizontal induction = `3.5 xx 10^(-5)T)

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7. A circular coil has 63 turns, each of radius 22cm. It is placed in the magnetic meridian. A

current of 0.5A is passed through the coil. What is the deflectio of a compass needle placed at its center is 45°. Calcualte the intensity of the earth's horizontal field.

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8. A circular coil with 10 turns of mean radius 10 cm is placed in the magnetic meridian. A current of 0.5 A is passed through the coil. What is the defelctioin of a compass needle placed at the center of the coil? If the coil is

rotated, at wht angle will the needle placed to the plane of the coil? If the coil is rotated, at what angle will the needle set parallel to the plane of the coil?)H of earth's field = 30 Am^(-1)`

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9. A current of 0.1A passes through a circular coil, 15 cm in diameter and consisting of 50 closely wound time of fine insulated wire. Calculate the intensity of field (H-vector) (i) at

the center of the coil, (ii) at a point on its axis 7.5 cm from the center.

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10. Calculate the magnetic field at the center of a regualr hexagon, 10 cm on each side, when the current through the wire forming the hexagon is 5A.

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11. Two long, straight parallel conductors each carrying 2A current in the same direction are 10 cm apart. Calculate the magnetic field at a distance a) at a point which is midway between the wires b) at a point which is 15 cm from one wire and 5cm from the other.

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12. Calculate the magnetic field at the orthocenter of an equilateral triangle, 20 cm

on each side. The current through the wire forming the triangle is 10A.

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13. Calculate the magnetic field at the corner of a right angled triangle ABC, A being 90°, when two long conductors each carrying 2A pass perpendicular to the plane of the triangle through the corners B and C. The sides of the trianlge are AB=3cm, AC=4cm.

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14. The circular coil of tangent galvanometer is set at right angles to the magnetic meridian. It is found that the coil has gone through 20° from its initial position. Calcualte the horizontal intensity of the earth's magnetic field. The coil has only two turns of mean radius 8cm.

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15. A long thin wire is placed along the y-axis (just outside) of a frame of refernce. There exists a uniform magnetic field of 10^{-6} T along the x-axis. Calculate the magnetic field at the points (0,0,2m),(0,2m,0) and (2m,0,0) when the wire carries 10A current. Revise the calculation for a thick wire.

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16. A circular loop of radius 10 cm carries a current of 15A. At its center is placed a small loop of radius 1cm with 50 turns and a current of 1A. A) what is the B-vector of the magnetic field produced by the large loop at its center? (b) What is the H-vector of the field? (c) What torque acts on the small loop when its plane is perpendicular to the plane of the large loop?

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17. Two long straight conductors carrying current I are located at the corners A and B of an equilateral triangle ABC of side 2a and they are perpendicular to the plane of the triangle. Calcualte the force on a conductor carrying the same current and placed along the median CD and equal to it in length.

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18. A thin disc of dielectric material, with a total charge +q distributed uniformly over its surface rotates n times per second about an axis perpendicualr to the surface of the disc and passing through its center. Find the magnetic induction at the center of the disc. The radius of the disc is equal to r.

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19. A conductor of lengh l is placed in the east-west line on a table. Suddenly a certain amount of charge is passed through it when it, is found to jump to a height h. Calculate the amount of charge passed through it. The earth's horizontal magnetic induction is B.

[Hint: idt=q]

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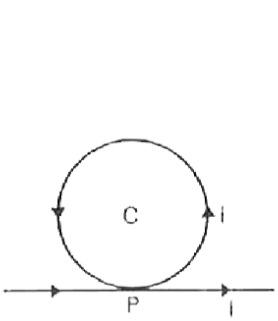
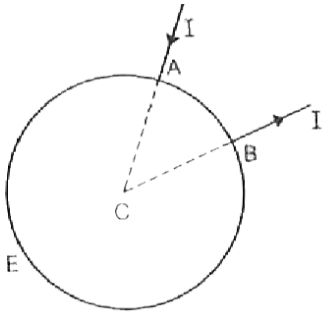
20. A long wire is bent into the shape shown in the figure. Without cross-contact at P. Determine the magnitude and direction of B at the center of the circular portion of radius R when a current I flows as indicated.





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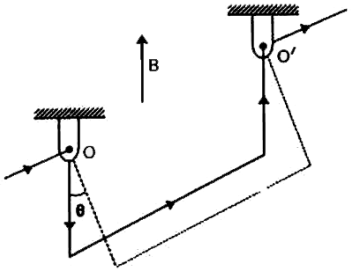
21. Two long straight conductors are connected radially to two arbitary points A and B of a circular conductor. Calculate the magnetic field at the center of the coil.



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22. Calculate the force of attraction per unit length between two long straight conductors

10 cm apart, each carrying 5A, when they are at (i) 0° (ii) 90° (iii) 60° inclinationi to each other.

[Hint: $\Delta F = \dfrac{\mu_0 I_1 I_2 \cos\theta}{2\pi d}$

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23. A wire of c.s.S = $2.5mm^2$ is bent to make the three sides of a square and is free to turn about the horizontal axis $\in fity$ Find the magnetic induction B which is vertically upward if the frame is deflected by $\theta = 30^\circ$)

from the vertical when a current I=16A is passed through the wire. The density of the wire $\sigma = 8900 kgm^{-3}$

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24. A current I flows along a thin-walled, long, half-cylinder of radius R(figure) Find the magnetic induction at a point on the axis of the cylinder

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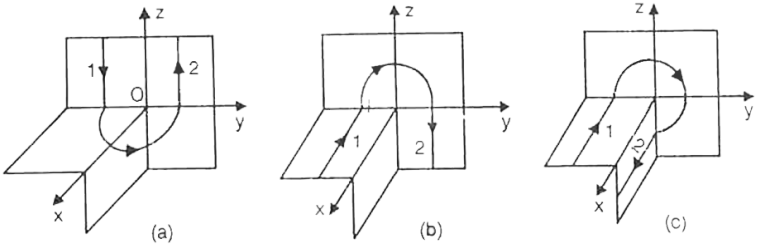
25. Find the magnetic induction at the point O of the following figures if the wire carrying a current I = 15A has the shapes shown here. The radius of the curved part R=5cm, the linear parts of the wire are very long.



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