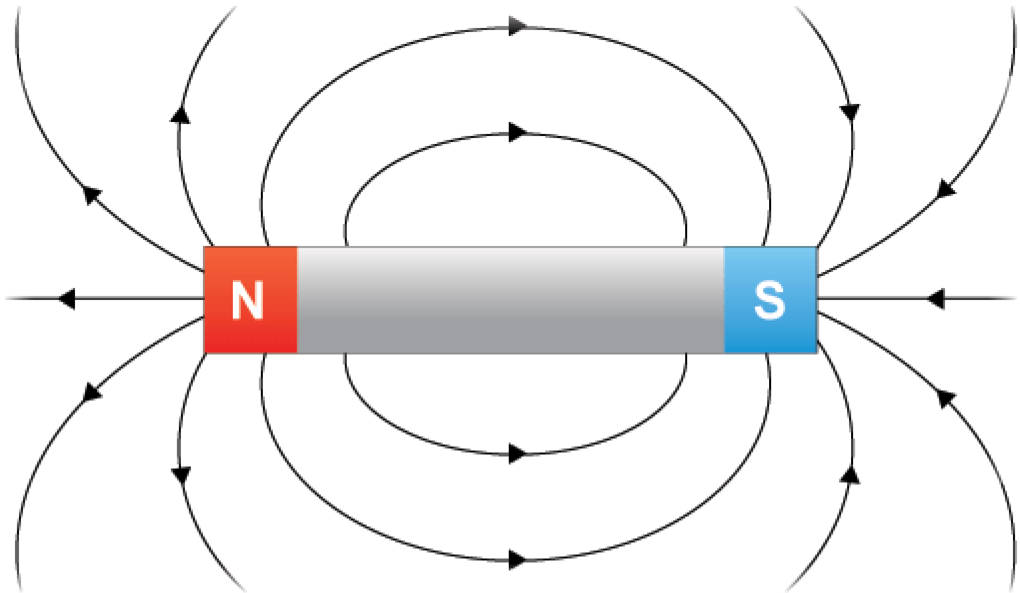
Bev

IB Physics

Unit D3

Electromagnetism



BIL

Revision Booklet

Rules, Rules, Rules!

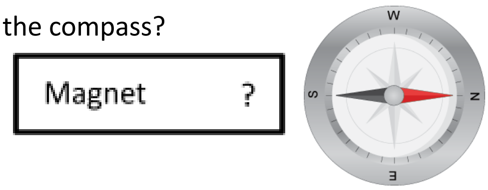
Review Questions

1. An iron bar is placed between two magnets as shown below, which makes the iron a temporary magnet. Sketch the magnetic field (the lines of flux) between the permanent magnets and the nearest end of the iron bar.

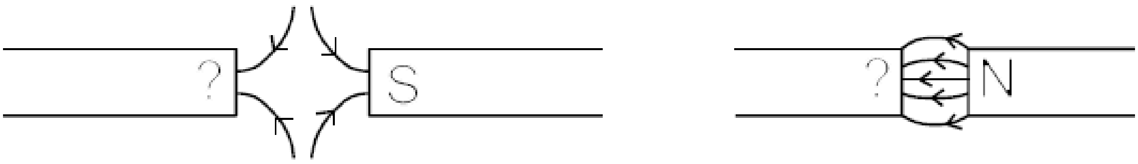
2. Lines of flux by convention point from the magnetic _____ pole to the magnetic _____ pole.

3. What pole of the bar magnet shown on the right is nearest the compass?

a) North b) South



4. In the case below, the poles of the left magnets are _____ poles.



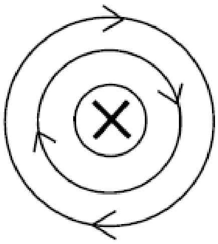
5. Attraction or repulsion of charges depends on their **signs**: positive or negative. Attraction of magnets depends on their magnetic _____: _____ or _____. Opposite poles _______; like poles _____.

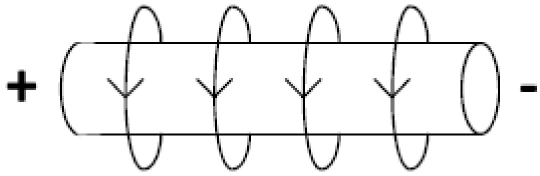
6. You have an electromagnet that is not quite strong enough. What three changes could you make to increase the strength of the magnetic?

1. ____
2. ____
3. ____

Right Hand Grip Rule

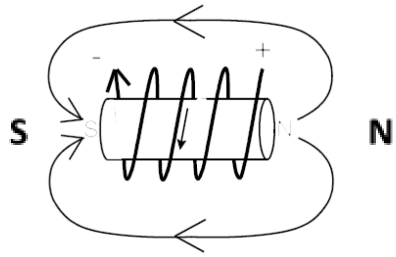
A straight current-carrying wire creates a radial magnetic field around it. To determine its orientation, point your thumb in the direction of the conventional current (from + to – along the length of the wire). Your fingers will curl around the wire in the same direction as the magnetic field.





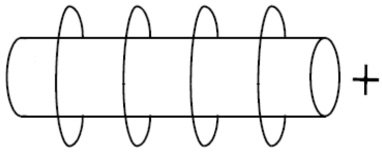
Questions:

A current-carrying wire coiled around a core will create a magnetic field resembling that of a bar magnet, with distinct north and south poles at the ends of the coil. To determine which end of the coil is which, curl your right fingers around the coil so that they follow the direction of **conventional current**. Your thumb will point to the coil's north pole.



Use the Wire Rule and Coil Rule to answer the following questions.

7. A wire is shown with a radial magnetic field emanating from it. If the right end is positive, does the magnetic flux along the front side of the wire point upwards or downwards?



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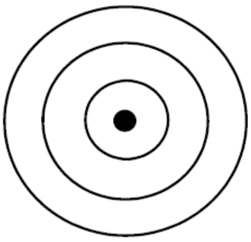

8. A wire is shown to the left in cross-section with its radial field around it. If the conventional current flows out of the page (as shown by the dot in the centre of the wire), is the field clockwise or anticlockwise?

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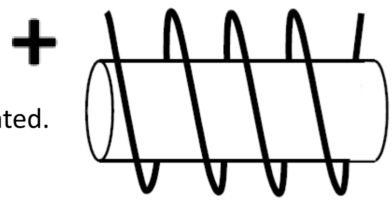

9. A coil wrapped around a core is shown to the right, with the left end of the coil positive and the wire wrapped around it as indicated. Which end of the coil is the north pole?

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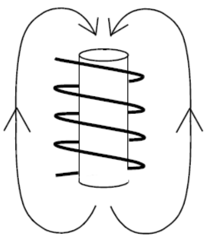

10. A coil is wrapped around a core as shown on the diagram on the left, with its lines of flux. Which end is positive?

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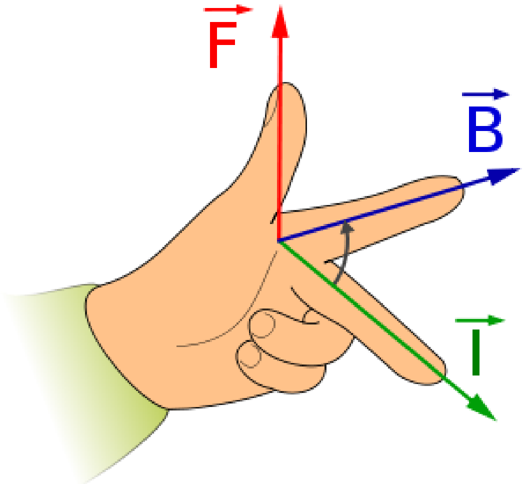
Left Hand Rule (Motor Rule or Fleming's Left Hand Rule)

A charged particle moving perpendicularly through a magnetic field will experience a force that is perpendicular to both its velocity and the field. The same effect can also push a current-carrying wire. This is called a **deflecting force**.



What does the thumb stand for?

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What does the first finger stand for?

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What does the second finger stand for?

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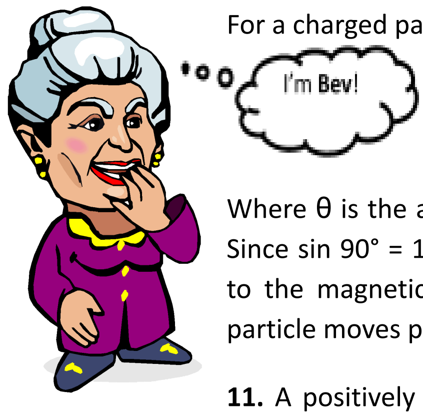
Motor Rule for Charged Particles

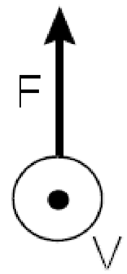


For a charged particle moving through a magnetic field:

$$F = Bevsin\theta$$

Where θ is the angle between the velocity vector and the magnetic field vector. Since sin 90° = 1, the force, F, is greatest when the particle moves perpendicular to the magnetic field lines. But since sin 0° = 0, the force disappears if the particle moves parallel to the magnetic field.

11. A positively charged particle is moving through a uniform magnetic field with a velocity, v, directed out of the page and experiences a force as shown on the diagram on the right. What is the direction of the magnetic field, B?



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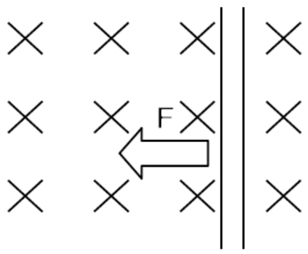

12. A wire is immersed in a magnetic field that points into the page. Which direction must the conventional current flow through the wire to cause the wire to be deflected to the left as shown in the diagram?

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13. What is the direction of the force on the current-carrying wire in the magnetic field shown in the diagram? Conventional current flow is into the page.

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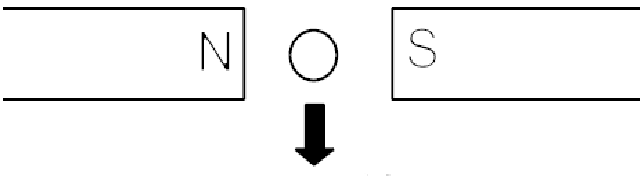

14. The current flowing in the wire shown to the left creates a downward force on the wire. Show the direction of the conventional current flow. (Use a dot for out of the page and an X for into the page).

15. A proton in the solar wind travels perpendicularly at $3.00 \times 10^5 ms^{-1}$ across the Earth's magnetic field lines. The field at that location is 0.0000100T.

Proton Charge = $+1.6 \times 10^{-19}$ C **Proton Mass = 1.67×10^{-27} kg**

Use the motor rule equation for a particle to determine the magnitude of the force on the particle.

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The motor rule predicts that this force will act as a centripetal force, causing the proton to have circular motion. Calculate the radius of the circle it begins to make.

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16. A neutron and an electron are shot between the poles of a U magnet which generates a uniform magnetic field across their paths of magnitude 0.600T.

One of the particles flies straight through the magnet's field lines without any deflection. Is that particle the neutron or the electron? Briefly explain how you know this.

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The other particle is deflected by a force of 4.00×10^{-15}N. Determine the speed at which the particle was moving through the magnetic field.

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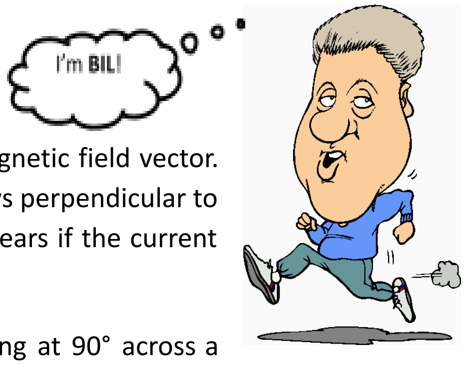
Motors and Current-Carrying Wires

For a current-carrying wire in a magnetic field:



$$F = BILsin\theta$$

Where θ is the angle between the velocity vector and the magnetic field vector. Since sin 90° = 1, the force, F, is greatest when the current flows perpendicular to the magnetic field lines. But since sin 0° = 0, the force disappears if the current flows parallel to the magnetic field.

17. A simple motor consists of a straight wire 0.500m long lying at 90° across a uniform magnetic field of 0.300T. The motor will be used to accelerate a 5.00 gram mass at $3.00ms^{-2}$. What is the smallest current that could be used?

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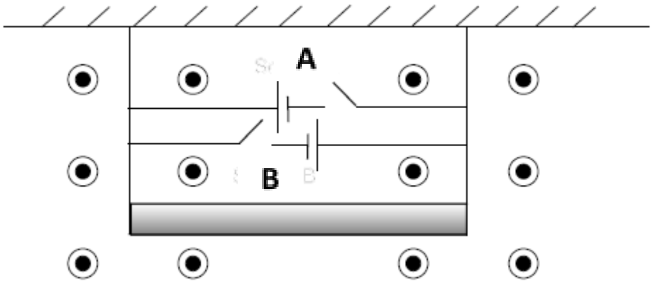
18. A conductor of mass 40.0 grams per metre is hung by two wires in a magnetic field of strength 3.60T directed out of the page as shown.



Which source, A or B, should be switched on so that the magnetic field will deflect the wire upward, helping balance the conductor's weight? Explain your answer.

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How much current from the source would be needed so that the conductor would levitate, reducing the tension in the wires to zero?

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THE END