Magnetic Fields

The aim of this lab is to draw the magnetic-field lines for magnets in several configurations. The measuring instrument for doing this is a compass, which is attracted to the magnetic S pole of any magnet.

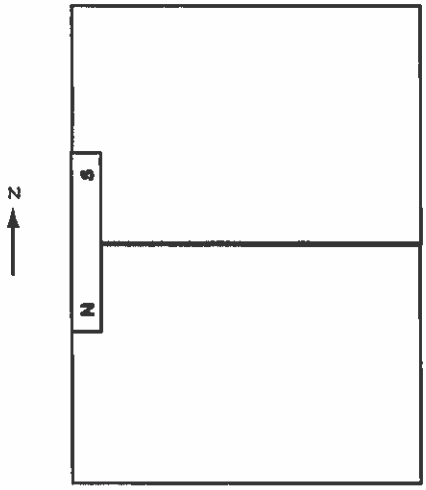
Checking the labeling of the bar magnets and the compasses.

Magnets, including the ones used for the needles in compasses, can sometimes get reversed in polarity so that the N label should read S. You should first check that the compass is correctly pointing to north by orienting yourself and using your knowledge of the local geography. Using a correctly-labeled compass, you can then check the other magnets being used. The N end of the compass needle will be attracted towards the S pole of other magnets. Avoid dragging your compass directly across the surface of the bar magnets, since this could cause reversal of the compass poles.

Tracing magnetic field lines on paper:

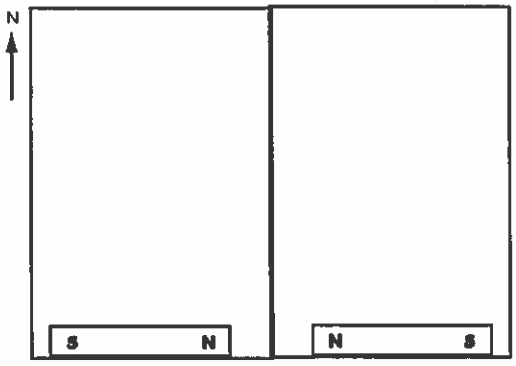
1. Place the magnets on the page as instructed and trace their outlines. Indicate the N and S pole labels on the page for each magnet.
2. On each page, indicate the geographic north direction with an arrow and an "N" in one corner. You must orient your page as shown on the diagram. Remember that the compass must be far from any of the magnets to correctly get magnetic north.
3. To plot the magnetic field direction at a point, put the center of the compass over that point. Mark the page lightly at the two ends of the needle, or make a mental note of the direction. Then lift the compass up and draw a short arrow in the correct direction at the original point.
4. Before drawing anything, get a general idea of the field lines by moving the compass about on the page. When you move the compass along a magnetic field line, the compass needle will ride along in the direction of motion, i.e. the needle will be tangent to the line at all times. This will take some practice.
5. When you seem to have found a complete line, pick a few points along it and find the magnetic field directions. Then carefully sketch the field line by drawing a smooth curve for which each arrow is a tangent vector. The line does not have to pass through each arrow. Do not create additional curves simply to hit an arrow that is to the one side.
6. Each magnetic-field line must have arrows to indicate the direction of the magnetic field at any point on the line.
7. Where the magnetic field is strong, the needle will hold steady; where the field is weak, the compass needle will swing back and forth before settling. There may be points where the Earth's field is equal and opposite to the bar-magnet field, giving a net field of zero. At such points the needle may rotate and not choose any direction at all.
8. Magnetic-field lines never cross each other, since this implies conflicting needle directions at the intersection.

1. Single Bar Magnet

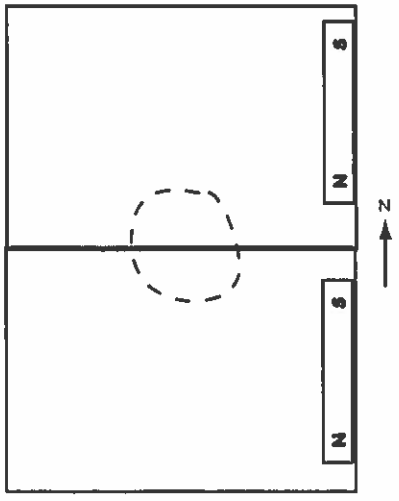


For each case, make sure your page is turned into the given alignment with the N direction.

2. Two bar magnets, like poles facing each other



3. Two bar magnets, opposite poles facing each other



Avoid the part in the dashed circle until you have done the rest of the plot first.