

The figure above shows three magnetic field lines in space. The three arrows show the direction that a compass needle will point in the magnetic north direction. The X-axis lies along the west-east direction with east towards the right. The Y-axis lies along the geographic north-south direction with north at the top.

**Problem 1** – Describe what happens to the compass needle as a spacecraft moves from point  $(+6.2, 0)$  to  $(+6.2, +5.0)$  to  $(+6.2, +8.0)$ .

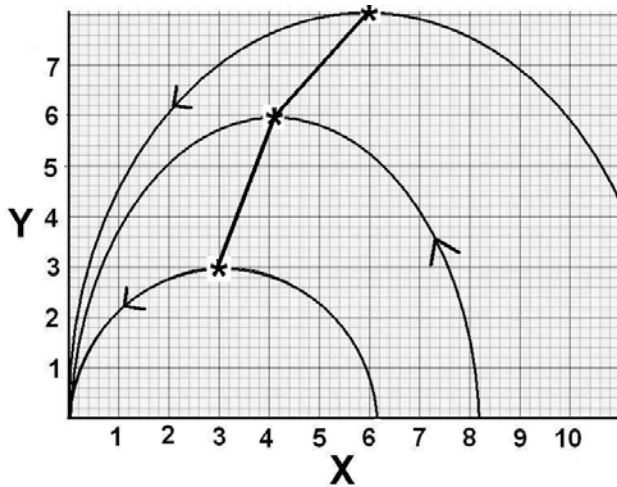
**Problem 2** - Draw a possible spacecraft path so that the compass needle always points to geographic west in the figure.

**Problem 3** – A satellite is launched from point  $(+1.0, +2.0)$  and travels horizontally to point  $(+10.0, +2.0)$ . Plot a graph that shows how its instruments will record the direction changes of the magnetic field as it travels. At what location is the magnetic field pointed due-west? (Note: You may approximate angle measurements by interpolation as needed.)

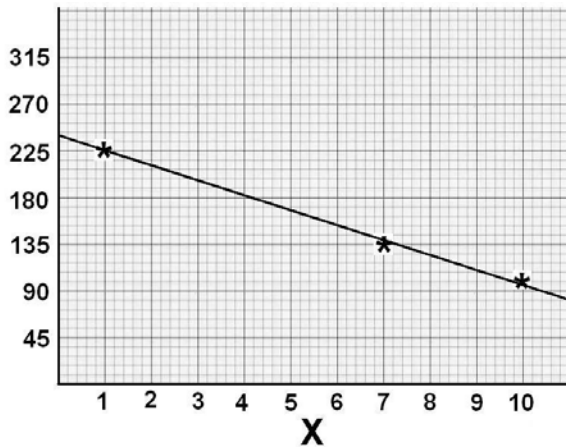
**Problem 1** – Describe what happens to the compass needle as a spacecraft moves from point  $(+6.2, 0)$  to  $(+6.2, +5.0)$  to  $(+6.2, +8.0)$ .

Answer: First the compass needle points vertically due-North, then it points 45degrees west of north, then it points due-west!

**Problem 2** - Draw a possible spacecraft path so that the compass needle always points to geographic west in the figure.



**Problem 3** – A satellite is launched from point  $(+1.0, +4.0)$  and travels horizontally to point  $(+10.0, +4.0)$ . Plot a graph that shows how its instruments will record the direction changes of the magnetic field as it travels. At what location is the magnetic field pointed due-west? (Note: You may approximate angle measurements by interpolation as needed.)



To point due-west, the angle must be 180 degrees. From the graph this happens when the satellite is close to  $x=+4.0$ , so its coordinate on its path is  $(+4.0, +4.0)$