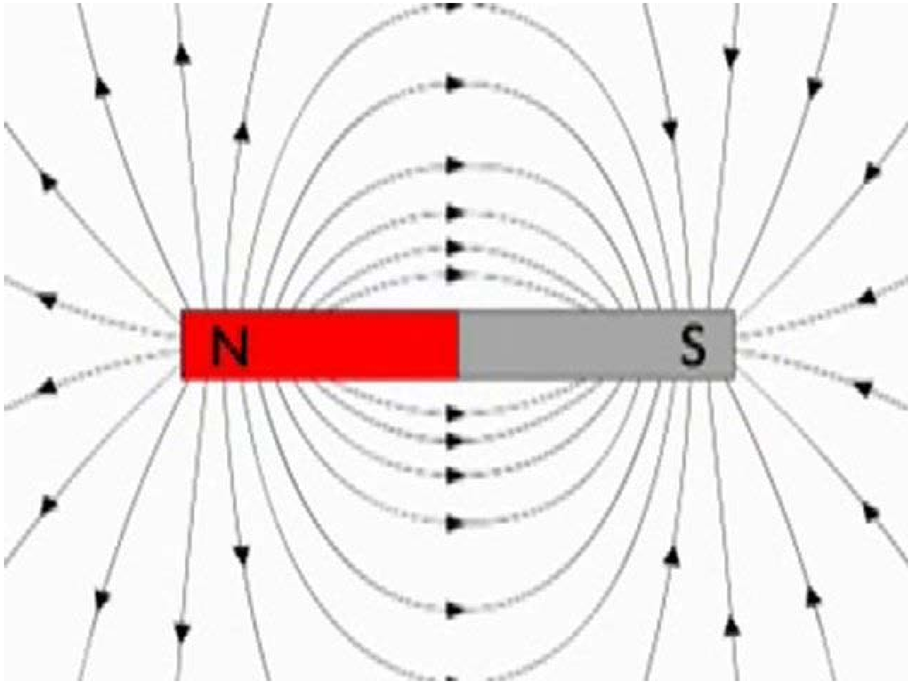
a place of mind
FACULTY OF EDUCATION
Department of
Curriculum and Pedagogy

Physics
Magnetism

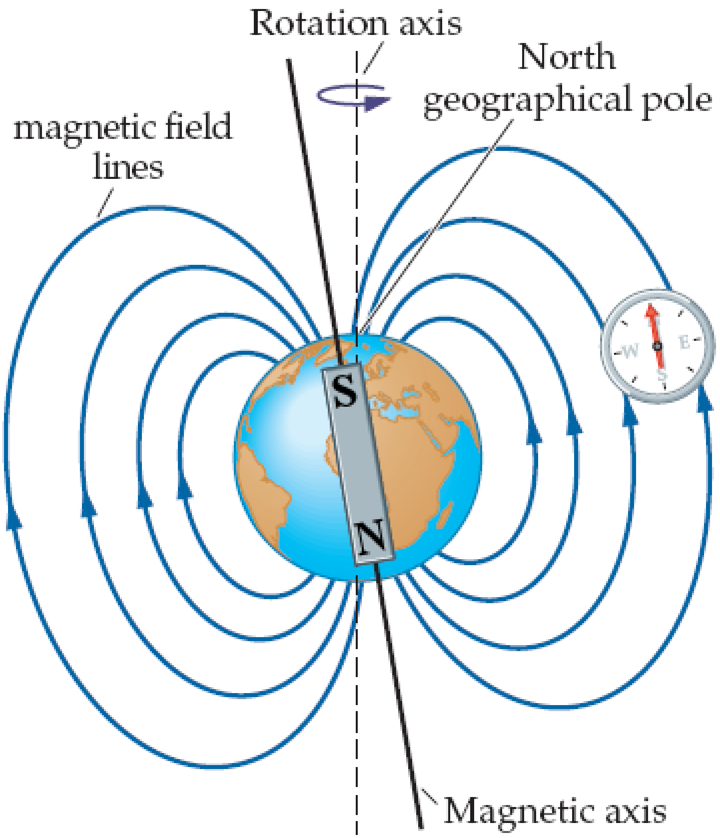
Science and Mathematics
Education Research Group

Supported by UBC Teaching and Learning Enhancement Fund 2012-2015

Magnetism



http://www.dailymotion.com/video/xdchzo_magnetism_tech



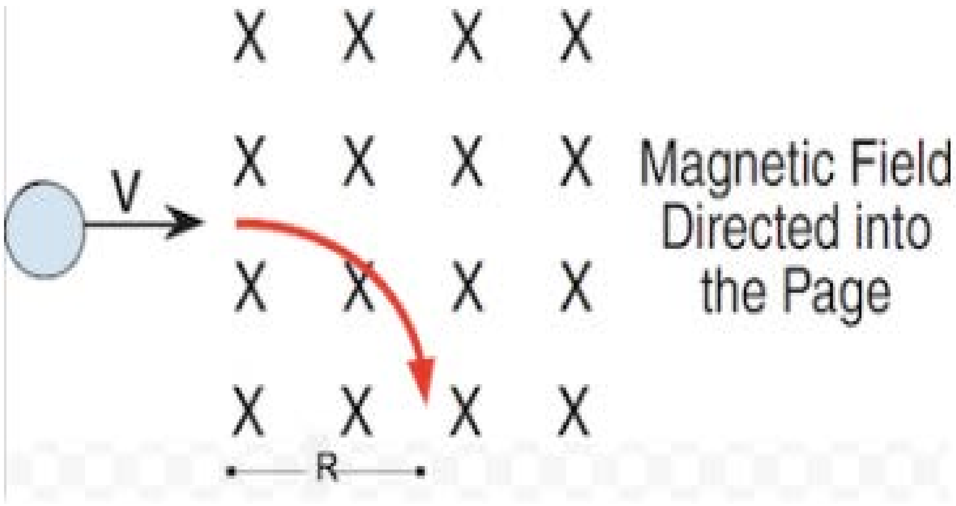
http://stemwigmore.ninja/y8-magnetism.php

Magnetism

The following questions have been compiled from a collection of questions submitted on PeerWise (https://peerwise.cs.auckland.ac.nz/) by teacher candidates as part of the EDCP 357 physics methods courses at UBC.

Magnetism Problems I

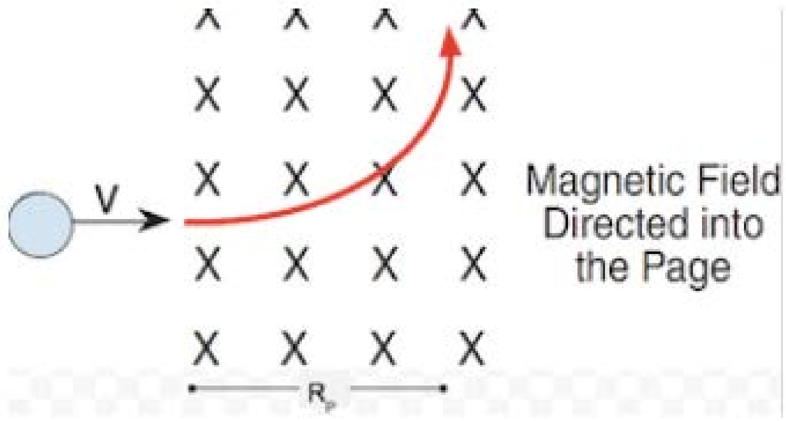
An electron's trajectory upon entering a uniform magnetic field is as shown (by the red arrow) in the diagram. Which of the following could be a proton's trajectory upon entering an identical magnetic field with the same velocity?



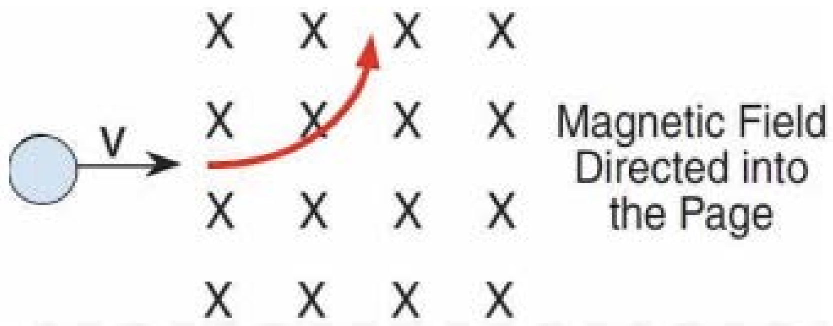
Magnetism Problems I (cont.)

A.

C.



B.



D. None of the options

Solution

Answer: C

Justification: Note that the proton and electron are under identical conditions (magnetic field, initial velocity, magnitude of charge), except for the sign of their charge and their mass. Since the electron is deflected downward, then the proton would be deflected upward. Now, we need to determine the radius of the proton's trajectory relative to the radius of the electron's trajectory.

Since the mass of a proton is larger than the mass of an electron (almost 2000x larger), the radius of proton's trajectory will be much larger than the electron's trajectory radius.

Thus, **C** is the correct answer. More details in the next slide.

Solution continued

More details: We know that a charged particle in a magnetic field travels in circular motion, i.e. $F = \frac{m\,v^2}{R}$. We also know the Lorentz Force acting on a particle, $F = B\,q\,v$, when the magnetic field is perpendicular to the velocity of the particle. In our case, the only force acting on the proton is the magnetic force, which is responsible for the centripetal force experienced by the proton.

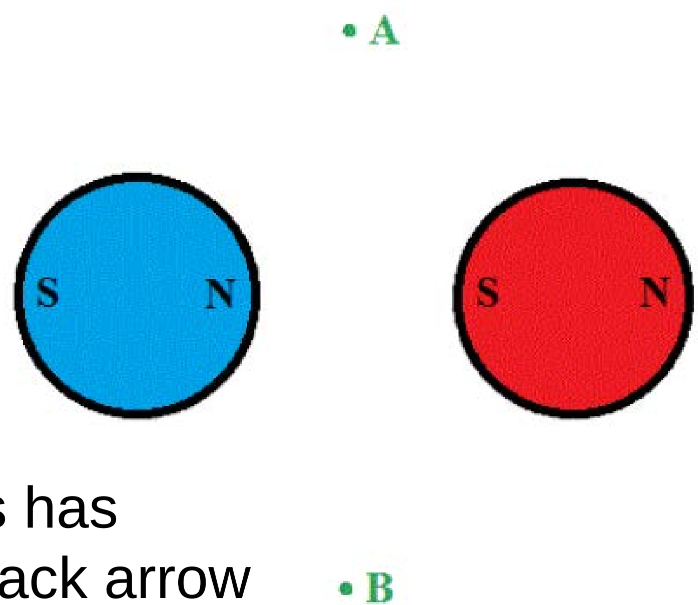
Thus, $F = \frac{m\,v^2}{R} = B\,q\,v \;\rightarrow\; \frac{m\,v}{R} = B\,q \rightarrow \;\; R = \frac{m\,v}{B\,q}$

Since, $v_{proton} = \; v_{electron}$ and $|\,q_{proton}| = |\,q_{electron}\,|$, then after simplification, $\frac{R_{proton}}{R_{electron}} = \frac{m_{proton}}{m_{electron}} > 1 \;\;\rightarrow\;\; R_{proton} > R_{electron}$.

Thus, **C** is the correct answer.

Magnetism Problems II

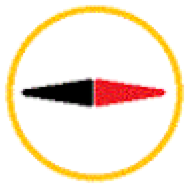
Below is a diagram of 2 circular magnets with North and South poles labelled. If you placed two compasses at points A and B, how would they look like?



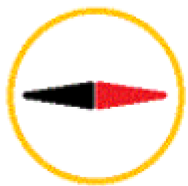
Note: The red arrow on the compass has a "North“ magnetization, while the black arrow has a "South" magnetization.

Magnetism Problems II (cont.)

A.

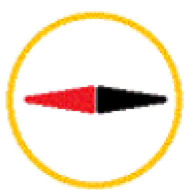


A)

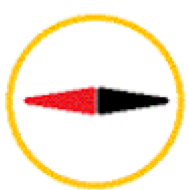


B)

B.

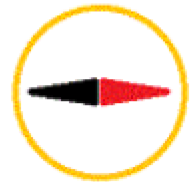


A)

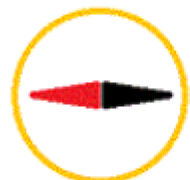


B)

C.

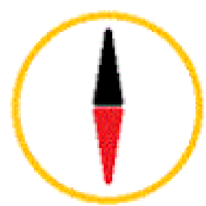


A)

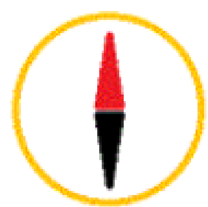


B)

D.

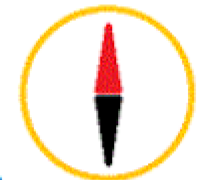


A)

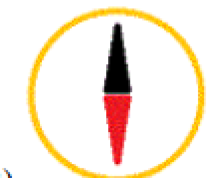


B)

E.



A)

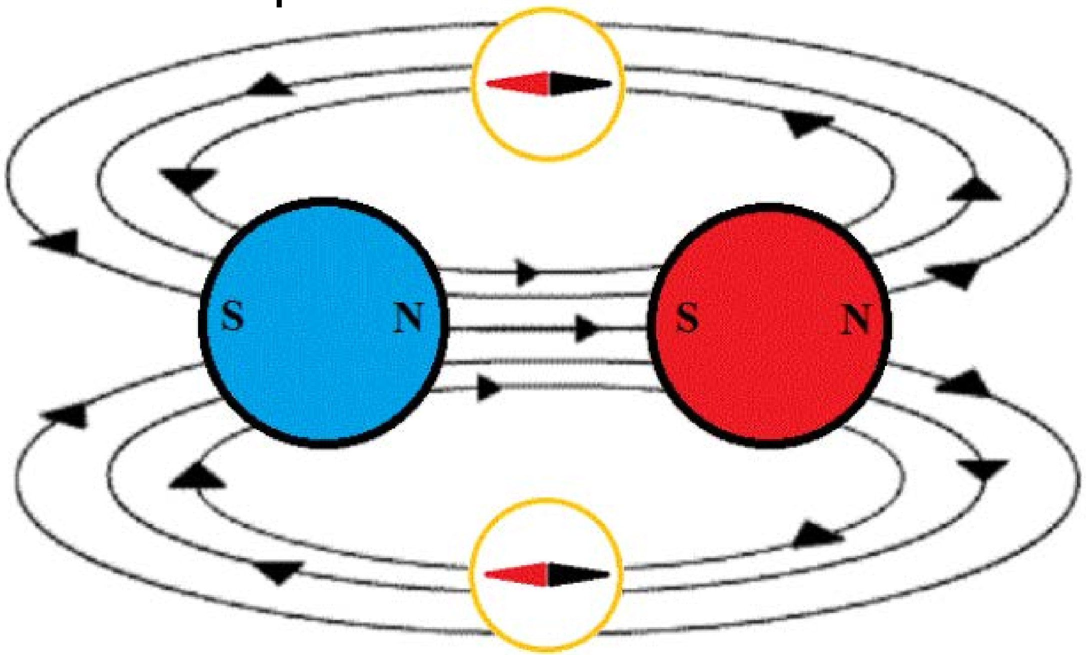


B)

Solution

Answer: B

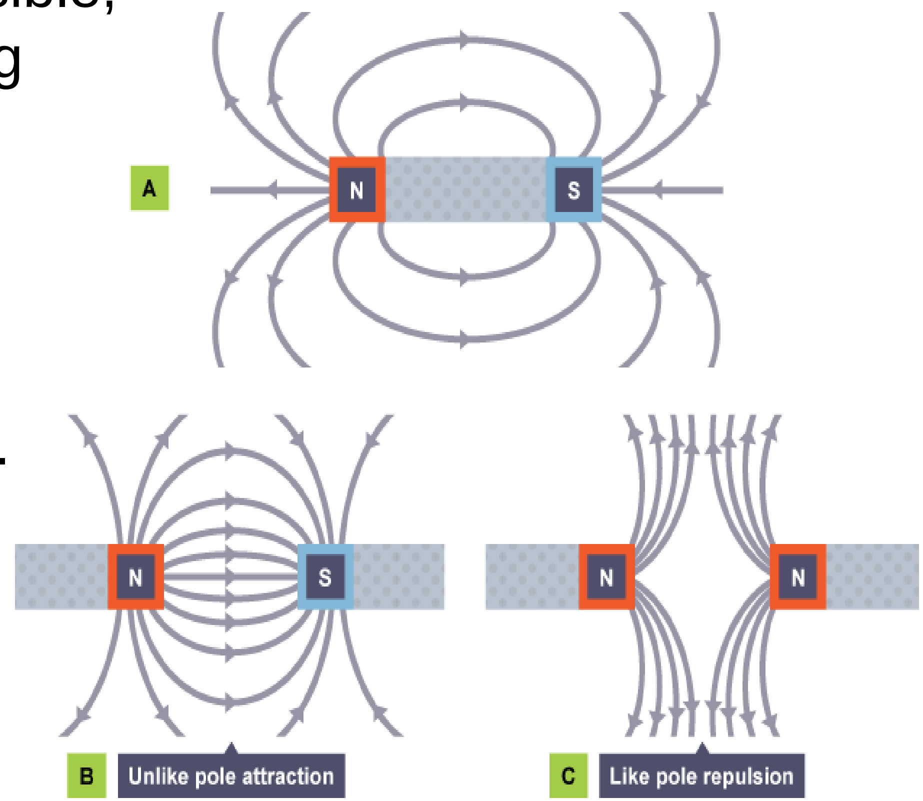
Justification: Since the compass' red arrows have a "North" magnetization, they align themselves with the magnetic field and point toward the South pole. This looks like the following:



Thus, **B** is the correct answer.

Solution continued

Note, magnetic field lines are invisible, however we can detect them using iron filings or compasses. Simple drawings can be used to show magnetic field lines. In general,

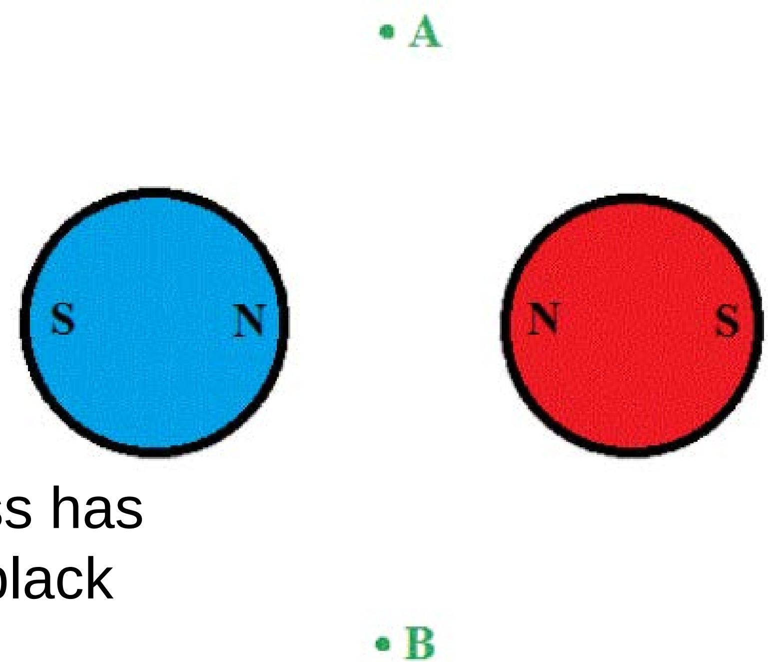


http://www.bbc.co.uk/education/guides/zxxbkqt/revision/2

- Arrows are used to show the direction of magnetic field lines.
- Magnetic field lines emerge out of N (north pole) and go into S (south pole).
- Magnetic field lines are concentrated at the poles, indicating the strength of the field at the poles.

Magnetism Problems III

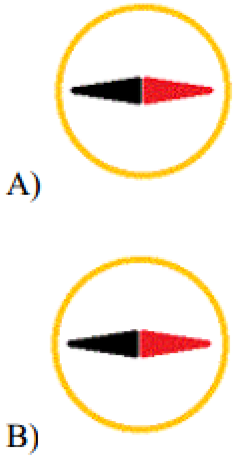
Below is a diagram of 2 circular magnets with North and South poles labelled. If you placed two compasses at points A and B, how would they look like?



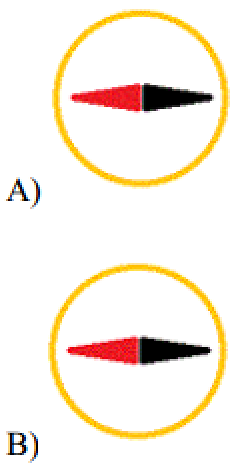
Note: The red arrow on the compass has a "North“ magnetization, while the black arrow has a "South" magnetization.

Magnetism Problems III (cont.)

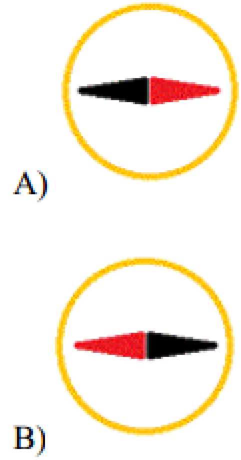
A.



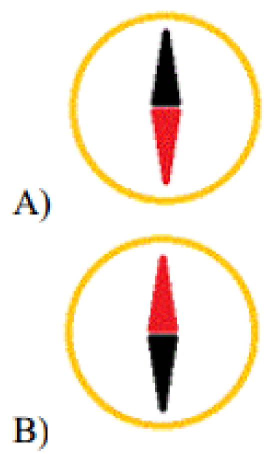
B.



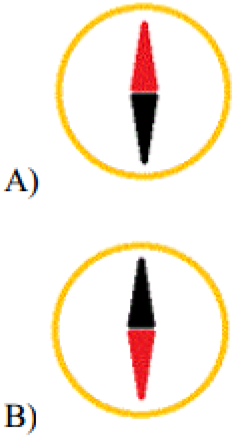
C.



D.



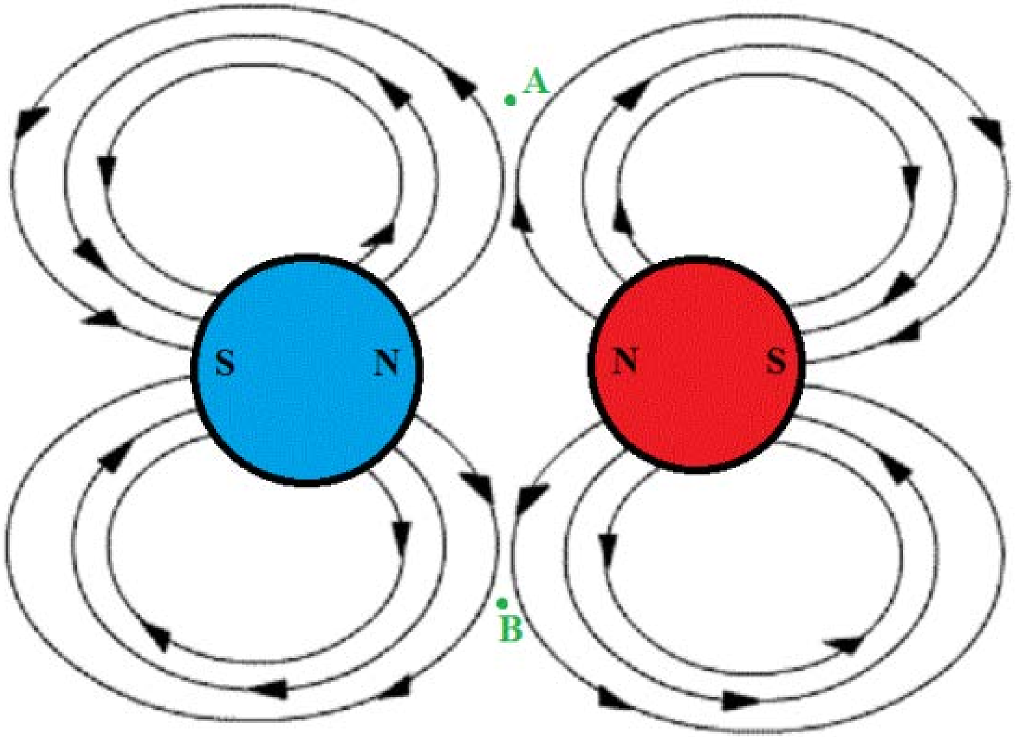
E.



Solution

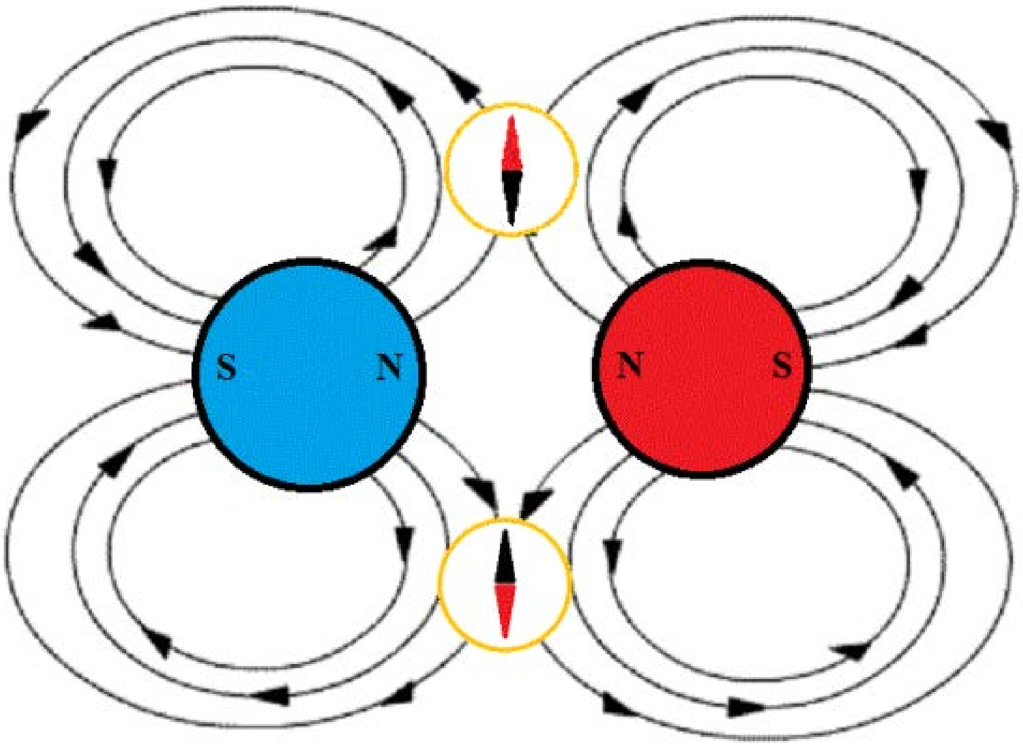
Answer: E

Justification: Magnetic field lines are drawn from North to South, so the magnetic field diagram for this arrangement will look like:



Solution continued

Since the compass' red arrows have a "North" magnetization, they align themselves with the magnetic field and point toward the South pole. This looks like the following:



Thus, **E** is the correct answer.