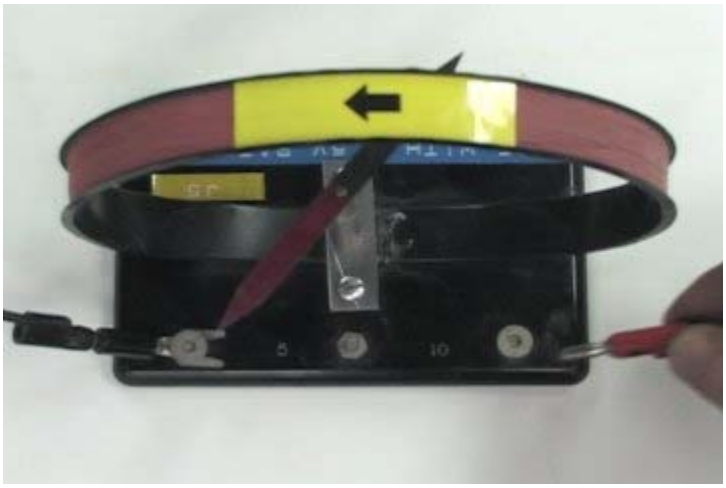
Answer #329

The answer is (b): the compass needle will point in the downward direction in the picture, as seen in an mpeg video by clicking your mouse on the photograph below.



Using the right hand rule, the red end of the coil will point in the direction of the field, which will be top-to-bottom in the picture. The magnetic field of the coil is considerably larger than that of the component of the earth's field in the north direction, so it will be the dominant magnetic field when the current is on.

Using the Biot-Savart law, the axial magnetic field of the 10-turn coil with radius of 7 cm carrying 10 amperes of current can be calculated:

$$B = \mu_o I / 2R,$$

and is approximately 10 gauss, about a factor of 10 greater than the magnetic field of the earth (about 1 gauss). Therefore, the compass needle will move to align itself with the magnetic field of the coil rather than that of the earth.

Question of the Week

Outreach Index Page

Lecture-Demonstration Home Page

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