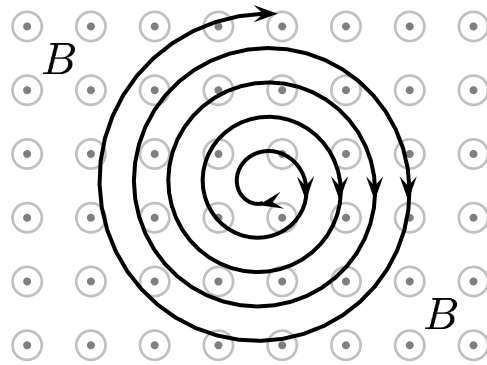


A uniform magnetic field is directed out of the page. A charged particle moves in the plane of the page following a clockwise spiral of increasing radius as shown.



A reasonable explanation is

- A) the charge is positive and speeding up.
- B) the charge is positive and slowing down.
- C) the charge is negative and speeding up.
- D) the charge is negative and slowing down.

We know that when a charged particle move in a uniform magnetic field with a constant speed, it undergoes a circular motion with the centripetal force provided by the magnetic force, namely

$$m \frac{v^2}{r} = q v B ,$$

so we know that the radius is in fact proportional to the speed,

$$r = \frac{m}{q B} v .$$

Since in this problem the particle follows a spiral of increasing radius, we can judge that it is speeding up.

The magnetic force  $\vec{F} = q \vec{v} \times \vec{B}$  must be in the direction for the centripetal force  $-\hat{r}$  (pointed inward) of this particle in counter-clockwise circular motion. Since  $\vec{v} \times \vec{B}$  is in the negative  $\hat{r}$  direction, the particle has a positive charge.

Answer A.

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