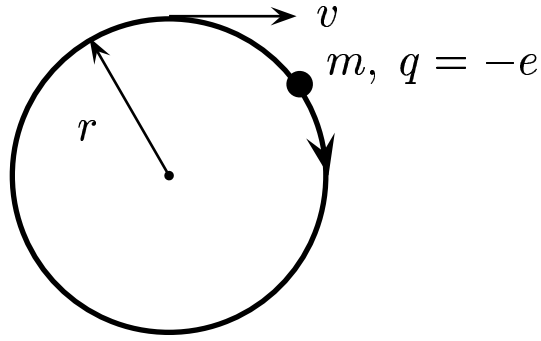


Consider an atom, where an electron is orbiting along a circular orbit with radius  $r$ , in a clockwise manner. The orbital speed is  $v$ . The electron has a mass  $m$ , and a charge “ $e$ ”.



Denote  $\vec{\mu}_{\text{orb}}$  to be the corresponding magnetic dipole moment vector. Find  $\vec{\mu}_{\text{orb}}$ .

- A)  $\|\vec{\mu}_{\text{orb}}\| = e v r$  and its direction is  $\odot$  (out of).  
 B)  $\|\vec{\mu}_{\text{orb}}\| = \frac{e v r}{2}$  and its direction is  $\odot$  (out of).  
 C)  $\|\vec{\mu}_{\text{orb}}\| = e v r$  and its direction is  $\otimes$  (into).  
 D)  $\|\vec{\mu}_{\text{orb}}\| = \frac{e v r}{2}$  and its direction is  $\otimes$  (into).
- 

By inspection, there is a counterclockwise current. The loop-magnet identity implies that  $\vec{\mu}_{\text{orb}}$  is *out of* the paper.

For a circular orbit, the area is  $A = \pi r^2$ , or  $\|\vec{\mu}_{\text{orb}}\| = I A = \left(\frac{e v}{2 \pi r}\right) \pi r^2 = \frac{e v r}{2}$ .

Answer **B**.