Intuitively we expect the centripetal force should depend on $r$, $m$, and $v$, and only on these variables.

**Assume:** The form of the force to be $F = k m^x r^y v^z$, where $k$ is dimensionless.

![Diagram of a point mass $m$ moving in a plane with coordinates $x$, $y$, and $z$.]

Determine expressions for $x$, $y$, and $z$ in the function $F = k m^x r^y v^z$.

A) $x = 1$, $y - z = 1$, $z = -2$

B) $x = 1$, $y + z = 1$, $z = 2$

C) $x = 1$, $y + z = 1$, $z = -2$

D) $x = 2$, $y + z = 2$, $z = -2$

E) $x = 1$, $y + z = 2$, $z = 2$
\[ [F] = [m \, a] = M \frac{L}{T^2} = M L T^{-2}, \]

\[ [k \, \text{m}^x \, \text{r}^y \, \text{v}^z] = M^{x} L^{y} \frac{L^{z}}{T^{z}} = M^{x} L^{y+z} T^{-z} \]

Therefore \( M L T^{-2} = M^{x} L^{y+z} T^{-z} \)

By equating powers of \( M \), \( L \), and \( T \), we have \( x = 1 \), \( y + z = 1 \), and \( z = 2 \). Or, substituting \( z = 2 \) into \( y + z = 1 \), we have \( y = -1 \).
That is, \( x = 1 \), \( y = -1 \), and \( z = 2 \), and the equation for \( F \) is

\[ F = m^{1} \frac{v^{2}}{r^{1}} = m \frac{v^{2}}{r}, \]

as expected. \( F = m^{1} \frac{v^{2}}{r^{1}} = m \frac{v^{2}}{r} \) is commonly called the centripetal force.

Answer B.

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