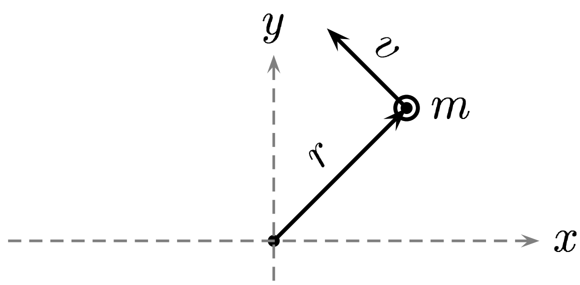
Intuitively we expect the centripetal force should depend on r, m, and v, and only on these variables.

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



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

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

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

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

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

E) $x = 1\,, \quad y + z = 2\,, \quad z = 2$

$$[\mathrm{F}] = [\mathrm{m\,a}] = \mathrm{M}\,\frac{\mathrm{L}}{\mathrm{T}^2} = \mathrm{M\,L\,T^{-2}}\,,$$

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

Therefore $\mathrm{M\,L\,T^{-2}} = \mathrm{M^x\,L^{y+z}\,T^{-z}}$
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**.