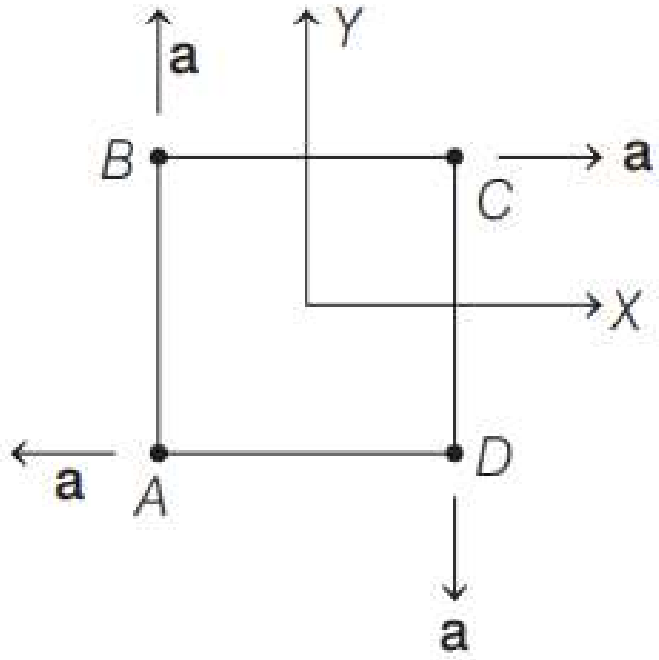
Four particles A, B, C and D with masses $m_A = m$, $m_B = 2m$, $m_C = 3m$ and $m_D = 4m$ are at the corners of a square. They have accelerations of equal magnitude with directions as shown. The acceleration of the centre of mass of the particles (in ms^{-2}) is **(2019 Main, 8 April I)**



(a) $\frac{a}{5}(\hat{\mathbf{i}} - \hat{\mathbf{j}})$ (b) $a(\hat{\mathbf{i}} + \hat{\mathbf{j}})$ (c) zero (d) $\frac{a}{5}(\hat{\mathbf{i}} + \hat{\mathbf{j}})$

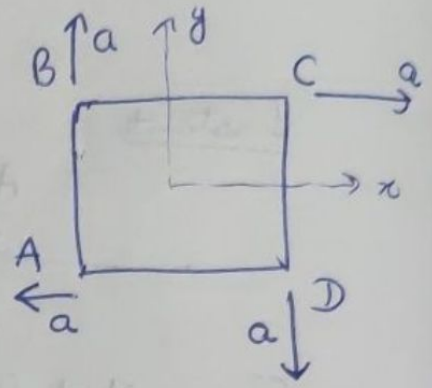
Solution

$$\vec{a}_{com} = \frac{m_1\vec{a}_1 + m_2\vec{a}_2 + m_3\vec{a}_3 + m_4\vec{a}_4}{m_1 + m_2 + m_3 + m_4}$$

$m_1 \rightarrow A$
$m_2 \rightarrow B$
$m_3 \rightarrow C$
$m_4 \rightarrow D$

$\Rightarrow$

$a_1 = -a\hat{i}$
$a_2 = a\hat{j}$
$a_3 = a\hat{i}$
$a_4 = -a\hat{j}$



$$\vec{a}_{com} = \frac{-ma\hat{i} + 2ma\hat{j} + 3ma\hat{i} - 4ma\hat{j}}{10m}$$

$$= \frac{2ma\hat{i} - 2ma\hat{j}}{10m}$$

$$= \frac{a}{5}(\hat{i} - \hat{j})$$

A option, Correct