# THE AREA OF THE PARALLELOGRAM

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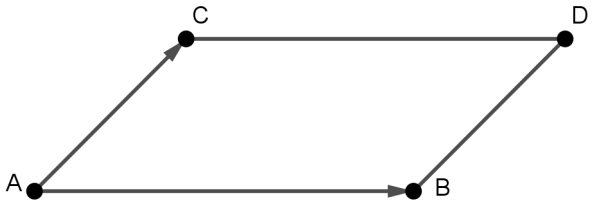
Let be $A(2,0,0); B(0,1,0); C(1,2,2)$.
Find the area of the parallelogram builded on $\overrightarrow{AB}$ and $\overrightarrow{AC}$.




$$\overrightarrow{AB} = (x_B - x_A)\,\overrightarrow{i} + (y_B - y_A)\,\overrightarrow{j} + (z_B - z_A)\,\overrightarrow{k}$$
$$\overrightarrow{AB} = (0-2)\,\overrightarrow{i} + (1-0)\,\overrightarrow{j} + (0-0)\,\overrightarrow{k} = -2\,\overrightarrow{i} + \overrightarrow{j}$$
$$\overrightarrow{AC} = (x_C - x_A)\,\overrightarrow{i} + (y_c - y_A)\,\overrightarrow{j} + (z_C - z_A)\,\overrightarrow{k}$$
$$\overrightarrow{AC} = (1-2)\,\overrightarrow{i} + (2-0)\,\overrightarrow{j} + (2-0)\,\overrightarrow{k} = -\overrightarrow{i} + 2\,\overrightarrow{j} + 2\,\overrightarrow{k}$$
$$\overrightarrow{AB} \times \overrightarrow{AC} = \begin{vmatrix} \overrightarrow{i} & \overrightarrow{j} & \overrightarrow{k} \\ -2 & 1 & 0 \\ -1 & 2 & 2 \end{vmatrix} =$$
$$= 2\,\overrightarrow{i} - 4\,\overrightarrow{k} + \overrightarrow{k} + 4\,\overrightarrow{j} = 2\,\overrightarrow{i} + 4\,\overrightarrow{j} - 3\,\overrightarrow{k}$$
$$\text{Area } (ABCD) = |\overrightarrow{AB} \times \overrightarrow{AC}| = \sqrt{2^2 + 4^2 + (-3)^2} = \sqrt{29}$$

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