

Grades 9-12 (AS)

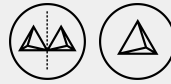
Duration: 30 min

Tools: one Logifaces Set / group

Group work

Keywords: Transformations, Rotation around a line, Reflection in a plane, Translation

533 - Relocating Blocks in GeoGebra



MATHS / TRANSFORMATIONS



LOGIFACES
METHODOLOGY
Erasmus+

TEACHER
Logifaces

2019-1-HU01-KA201-0612722019-1

DESCRIPTION

Students' task is to start with a Logifaces block drawn in GeoGebra and move it by transformations to another given target location. See exercises [526 - Calculate the Coordinates](#) and [529 - Coordinates of a Rotated Block](#) for the particular coordinates and [527 - Coordinates in GeoGebra](#) for the drawings in GeoGebra.

LEVEL 1 See the pairs in the table below.

block	Start	Target location I.	Target location II.
111	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 1), (4, 0, 1), (2, 2√3, 1)	(0, 0, 0), (4, 0, 0), (4, 1, 0), (0, 1, 0), (2, 0, 2√3), (2, 1, 2√3)	(0, 0, 0), (1, 0, 0), (1, 4, 0), (0, 4, 0), (0, 2, 2√3), (1, 2, 2√3)
222	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 2), (4, 0, 2), (2, 2√3, 2)	(0, 0, 0), (4, 0, 0), (4, 2, 0), (0, 2, 0), (2, 0, 2√3), (2, 2, 2√3)	(0, 0, 0), (2, 0, 0), (2, 4, 0), (0, 4, 0), (0, 2, 2√3), (2, 2, 2√3)
333	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 3), (4, 0, 3), (2, 2√3, 3)	(0, 0, 0), (4, 0, 0), (4, 3, 0), (0, 3, 0), (2, 0, 2√3), (2, 3, 2√3)	(0, 0, 0), (3, 0, 0), (3, 4, 0), (0, 4, 0), (0, 2, 2√3), (3, 2, 2√3)

LEVEL 2 See the pairs in the table below. In the last two lines, the start and the target II. blocks are not the same, they are the reflected images of each other.

Block	Start	Target location I.	Target location II.
112	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 1), (4, 0, 1), (2, 2√3, 2)	(0, 0, 0), (4, 0, 0), (2, 0, 2√3), (0, 1, 0), (4, 1, 0), (2, 2, 2√3)	(0, 0, 0), (0, 4, 0), (0, 2, 2√3), (1, 0, 0), (1, 4, 0), (2, 2, 2√3)
122	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 1), (4, 0, 2), (2, 2√3, 2)	(0, 0, 0), (4, 0, 0), (2, 0, 2√3), (0, 1, 0), (4, 2, 0), (2, 2, 2√3)	(0, 0, 0), (0, 4, 0), (0, 2, 2√3), (1, 0, 0), (2, 4, 0), (2, 2, 2√3)
223	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 2), (4, 0, 2), (2, 2√3, 3)	(0, 0, 0), (4, 0, 0), (2, 0, 2√3), (0, 2, 0), (4, 2, 0), (2, 3, 2√3)	(0, 0, 0), (0, 4, 0), (0, 2, 2√3), (2, 0, 0), (2, 4, 0), (3, 2, 2√3)
233	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 2), (4, 0, 3), (2, 2√3, 3)	(0, 0, 0), (4, 0, 0), (2, 0, 2√3), (0, 2, 0), (4, 3, 0), (2, 3, 2√3)	(0, 0, 0), (0, 4, 0), (0, 2, 2√3), (2, 0, 0), (3, 4, 0), (3, 2, 2√3)
113	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 1), (4, 0, 1), (2, 2√3, 3)	(0, 0, 0), (4, 0, 0), (2, 0, 2√3), (0, 1, 0), (4, 1, 0), (2, 3, 2√3)	(0, 0, 0), (0, 4, 0), (0, 2, 2√3), (1, 0, 0), (1, 4, 0), (3, 2, 2√3)
133	(0, 0, 0), (4, 0, 0), (2, 2√3, 0), (0, 0, 1), (4, 0, 3), (2, 2√3, 3)	(0, 0, 0), (4, 0, 0), (2, 0, 2√3), (0, 1, 0), (4, 3, 0), (2, 3, 2√3)	(0, 0, 0), (0, 4, 0), (0, 2, 2√3), (1, 0, 0), (3, 4, 0), (3, 2, 2√3)

123	$(0, 0, 0), (4, 0, 0), (2, 2\sqrt{3}, 0), (0, 0, 1), (4, 0, 2), (2, 2\sqrt{3}, 3)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 2, 0), (2, 3, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (2, 4, 0), (3, 2, 2\sqrt{3})$
132	$(0, 0, 0), (4, 0, 0), (2, 2\sqrt{3}, 0), (0, 0, 1), (4, 0, 3), (2, 2\sqrt{3}, 2)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 3, 0), (2, 2, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (3, 4, 0), (2, 2, 2\sqrt{3})$

LEVEL 3 This table shows the coordinates of the top vertices of the starting locations and the coordinates of all vertices of the target location. The base vertices of the starting location have the coordinates $(0, 0, 0), (4, 0, 0), (2, 2\sqrt{3}, 0)$ in each case.

Block	Starting top coordinates	Starting top coordinates	Target location I.	Target location II.
112	$(0, 0, 1), (4, 0, 2), (2, 2\sqrt{3}, 1)$	$(0, 0, 2), (4, 0, 1), (2, 2\sqrt{3}, 1)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 1, 0), (2, 2, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (1, 4, 0), (2, 2, 2\sqrt{3})$
122	$(0, 0, 2), (4, 0, 2), (2, 2\sqrt{3}, 1)$	$(0, 0, 2), (4, 0, 1), (2, 2\sqrt{3}, 2)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 2, 0), (2, 2, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (2, 4, 0), (2, 2, 2\sqrt{3})$
223	$(0, 0, 2), (4, 0, 3), (2, 2\sqrt{3}, 2)$	$(0, 0, 3), (4, 0, 2), (2, 2\sqrt{3}, 2)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 2, 0), (4, 2, 0), (2, 3, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (2, 0, 0), (2, 4, 0), (3, 2, 2\sqrt{3})$
233	$(0, 0, 3), (4, 0, 3), (2, 2\sqrt{3}, 2)$	$(0, 0, 3), (4, 0, 2), (2, 2\sqrt{3}, 3)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 2, 0), (4, 3, 0), (2, 3, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (2, 0, 0), (3, 4, 0), (3, 2, 2\sqrt{3})$
113	$(0, 0, 1), (4, 0, 3), (2, 2\sqrt{3}, 1)$	$(0, 0, 3), (4, 0, 1), (2, 2\sqrt{3}, 1)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 1, 0), (2, 3, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (1, 4, 0), (3, 2, 2\sqrt{3})$
133	$(0, 0, 3), (4, 0, 3), (2, 2\sqrt{3}, 1)$	$(0, 0, 3), (4, 0, 1), (2, 2\sqrt{3}, 3)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 3, 0), (2, 3, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (3, 4, 0), (3, 2, 2\sqrt{3})$
123	$(0, 0, 2), (4, 0, 3), (2, 2\sqrt{3}, 1)$	$(0, 0, 3), (4, 0, 1), (2, 2\sqrt{3}, 2)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 2, 0), (2, 3, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (2, 4, 0), (3, 2, 2\sqrt{3})$
132	$(0, 0, 3), (4, 0, 2), (2, 2\sqrt{3}, 1)$	$(0, 0, 2), (4, 0, 1), (2, 2\sqrt{3}, 3)$	$(0, 0, 0), (4, 0, 0), (2, 0, 2\sqrt{3}), (0, 1, 0), (4, 3, 0), (2, 2, 2\sqrt{3})$	$(0, 0, 0), (0, 4, 0), (0, 2, 2\sqrt{3}), (1, 0, 0), (3, 4, 0), (2, 2, 2\sqrt{3})$

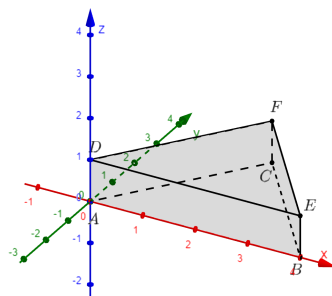
SOLUTIONS / EXAMPLES

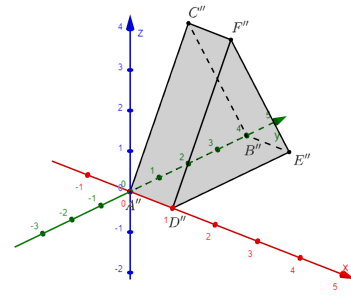
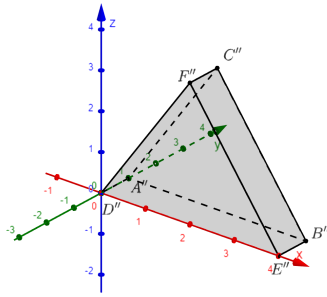
We show one example for each level using one block. The solutions for the other blocks are similar. Note that there are many other solutions for the example blocks as well.

Note on the use of GeoGebra:

In GeoGebra, it is impossible yet to rotate or translate a truncated prism as a whole. Instead, one can divide the truncated prism in Levels 2 and 3 into a regular prism and a pyramid (see exercise [527 - Coordinates in GeoGebra](#)) and perform the transformations on these two polyhedra separately

LEVEL 1 Start: block 111 with vertices $(0, 0, 0), (4, 0, 0), (2, 2\sqrt{3}, 0), (0, 0, 1), (4, 0, 1), (2, 2\sqrt{3}, 1)$





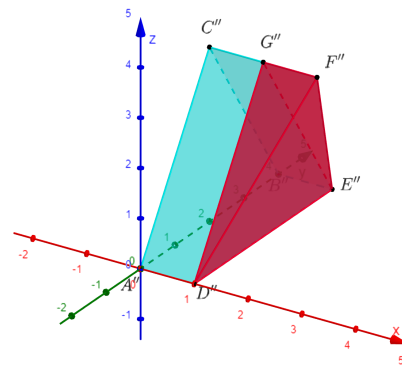
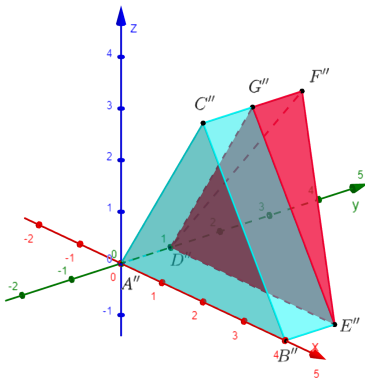
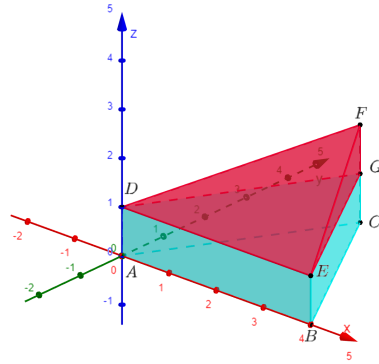
Target I: block 111 with vertices
 $(0, 0, 0)$, $(4, 0, 0)$, $(4, 1, 0)$,
 $(0, 1, 0)$, $(2, 0, 2\sqrt{3})$, $(2, 1, 2\sqrt{3})$

Target II: block 111 with vertices
 $(0, 0, 0)$, $(1, 0, 0)$, $(1, 4, 0)$,
 $(0, 4, 0)$, $(0, 2, 2\sqrt{3})$, $(1, 2, 2\sqrt{3})$

1. Rotation around the x-axis by 90°
2. Translation by the vector $\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

1. Rotation around the x-axis by 90°
2. Rotation around the z-axis by 90°

LEVEL 2 Start: block 112 with top vertices $(0, 0, 1)$, $(4, 0, 1)$, $(2, 2\sqrt{3}, 2)$



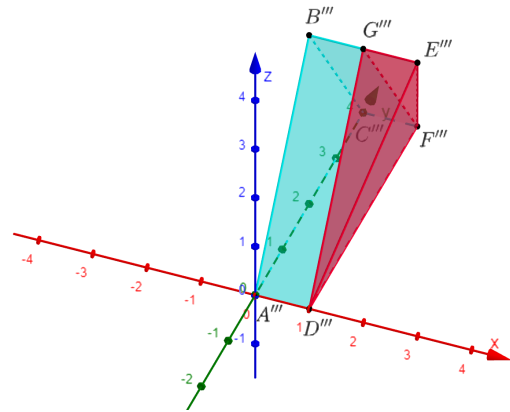
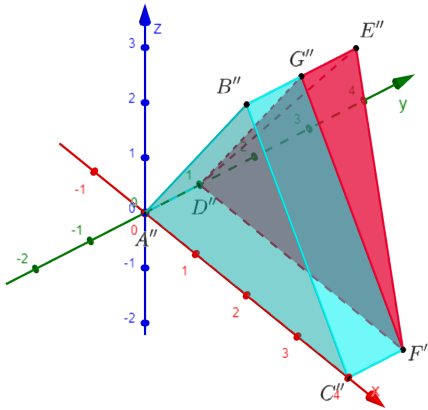
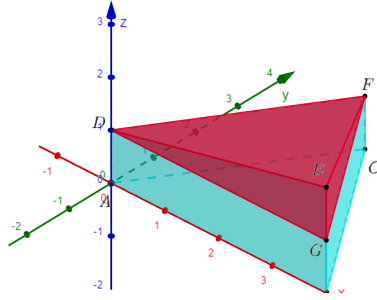
Target I: block 112 with vertices
 $(0, 0, 0)$, $(4, 0, 0)$, $(2, 0, 2\sqrt{3})$,
 $(0, 1, 0)$, $(4, 1, 0)$, $(2, 2, 2\sqrt{3})$

Target II: block 112 with vertices
 $(0, 0, 0)$, $(0, 4, 0)$, $(0, 2, 2\sqrt{3})$,
 $(1, 0, 0)$, $(1, 4, 0)$, $(2, 2, 2\sqrt{3})$

1. Rotation around the x-axis by 90°
2. Reflection in the xz-plane

1. Rotation around the x-axis by 90°
2. Rotation around the z-axis by 90°

LEVEL 3: Start: block 112 with top vertices $(0, 0, 1)$, $(4, 0, 2)$, $(2, 2\sqrt{3}, 1)$



Target I: block 112 with vertices

$(0, 0, 0)$, $(4, 0, 0)$, $(2, 0, 2\sqrt{3})$,
 $(0, 1, 0)$, $(4, 1, 0)$, $(2, 2, 2\sqrt{3})$

1. Rotation around the z-axis by -60°
2. Rotation around the x-axis by -90°

Target II: block 112 with vertices

$(0, 0, 0)$, $(0, 4, 0)$, $(0, 2, 2\sqrt{3})$,
 $(1, 0, 0)$, $(1, 4, 0)$, $(2, 2, 2\sqrt{3})$

1. Rotation around the z-axis by 30°
2. Rotation around the y-axis by -90°
3. Reflection in the yz-plane

PRIOR KNOWLEDGE

Reflection in a plane, Rotation around an axis, Transformations in GeoGebra

RECOMMENDATIONS / COMMENTS

Exercises [526 - Calculate the Coordinates](#), [527 - Coordinates in GeoGebra](#) and [529 - Coordinates of a Rotated Block](#) are recommended before this exercise.

Exercise [532 - Rotating Blocks in GeoGebra](#) is an easier exercise to practise 3-dimensional transformations that are just generalisations of transformations of a plane.

Exercise [534 - Upside down Blocks in GeoGebra](#) is recommended after this exercise as an advanced level exercise to practise more difficult transformations.