

Grades 5-8 (AS), 9-12 (AS)

Duration: 30-45 min

Tools: one Logifaces set / group

Group work

Keywords: Faces of 3D solids

310 - How many Faces



MATHS / SEQUENCES



LOGIFACES
METHODOLOGY
Erasmus+

TEACHER
Logifaces

2019-1-HU01-KA201-0612722019-1

DESCRIPTION

Warm-up question: How many faces does a block have?

LEVEL 1 Build a solid using 2 blocks, where two sides of the blocks have to fit completely. How many faces can this new solid have?

The union of two faces of different blocks is considered as one face of the new solid if the two faces of the blocks have a common edge and lie in the same plane.

LEVEL 2 Build a solid using 2 blocks. How many faces can this new solid have if there are no building constraints given?

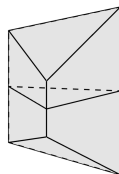
LEVEL 3 How many faces can a solid built from 2 blocks have minimum and maximum?. What is your explanation? What is the answer for the same questions when two sides of the blocks have to fit completely?

SOLUTIONS / EXAMPLES

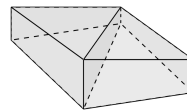
One block has 5 faces.

LEVEL 1 When two sides of the blocks have to fit completely, the solid can have 5, 6, 7 or 8 faces. See the table below for examples.

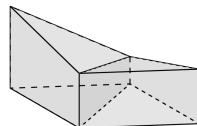
EXAMPLES



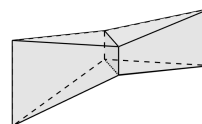
number of faces: 5
blocks used in the example: 123, 132
Any two blocks fitted together by their base faces have 5 faces altogether.



number of faces: 6
blocks used in the example:
123, 132 fit by the vertical faces 31 and 13



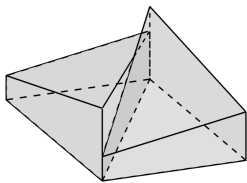
number of faces: 7
blocks used in the example: 122, 132



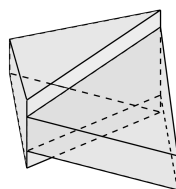
number of faces: 8
blocks used in the example: 112, 113

LEVEL 2 When there are no building constraints using two blocks, then it is possible to build solids with 9, 10, 11, 12, 13, 14, 15 or 16 faces in addition to the examples mentioned in Level 1. See the table below for examples.

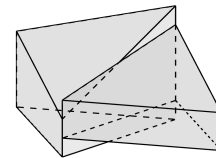
EXAMPLES



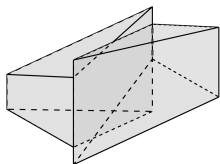
number of faces: 9
blocks used in the example:
123, 132



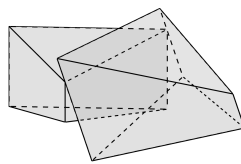
number of faces: 10
blocks used in the example:
112, 123



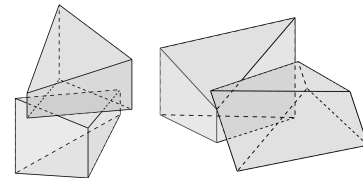
number of faces: 11
blocks used in the example:
132, 112



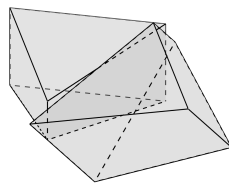
number of faces: 12
blocks used in the example:
123, 123



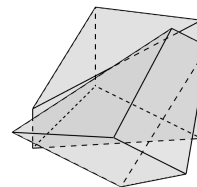
number of faces: 13
blocks used in the example:
123, 122



number of faces: 14
blocks used in the example:
123, 123 or 132, 132



number of faces: 15
blocks used in the example:
132, 122



number of faces: 16
blocks used in the example:
133, 132

LEVEL 3 The minimum number of faces that a solid can have when it's built from two blocks is 5. It's true in both cases, when two sides have to fit completely and when a solid can be built without constraints.

The first example shows that a solid can have 5 faces. The reason that a new solid cannot have fewer faces is that one block has 5 faces and that can not decrease when two convex polyhedra are fitted together. (Note that this claim is not true in the case of non-convex polyhedra.)

The maximum number of faces that a solid can have when two sides of the blocks have to fit completely is 8. The reason for this is that the two blocks have 10 faces altogether, but two faces disappear when they are fitted together completely.

The maximum number of faces that a solid can have when it's built from two blocks without constraints is 16. The reason for this is that when a solid is built from two convex polyhedra, only one face of each polyhedron is joined to the other. The two blocks have ten faces altogether, and when two quadrilateral faces are fitted together it can create 4 new faces for both blocks. (See the example above). Therefore the initial 10 faces are decreased by 2 because they are fitted together but 2×4 new faces are created, giving a total of 16 faces.

PRIOR KNOWLEDGE

Face of a polyhedron

RECOMMENDATIONS / COMMENTS

Level 1 is recommended for any age group. Levels 2 and 3 are recommended for students of grades 9-12.