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ELEMENTAR POLYHEDRONS

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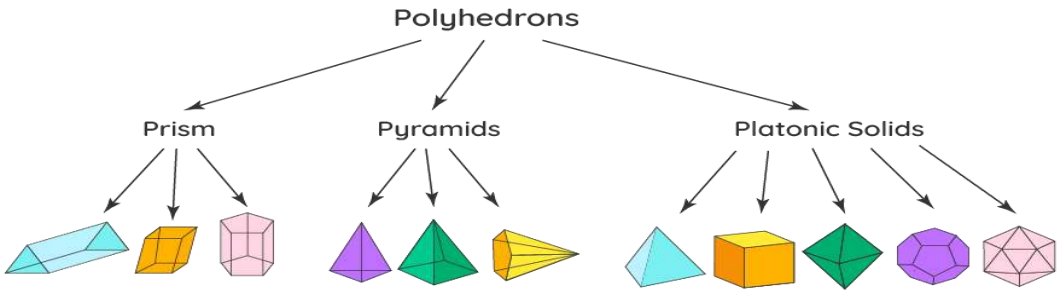
A B S T R A C T	K E Y W O R D S
This article explores the need to introduce more concepts into the school geometry course and polyhedral and development of polyhedral.	Polyhedral , convex polyhedral, flexible polyhedral.

A polyhedron is a 3D shape that has flat faces, straight edges, and sharp vertices (corners). The word "polyhedron" is derived from a Greek word, where 'poly' means "many" and hedron means "surface".Thus, when many flat surfaces are joined together they form a polyhedron. These shapes have names according to their faces that are usually polygons. The most common names are cubes, hexahedrons, etc. Let us learn more about the types of polyhedrons and solve a few examples to understand the shape better.

Polyhedron Definition A polyhedron is a three-dimensional solid made up of polygons. It has flat faces, straight edges, and vertices. For example, a cube, prism, or pyramid are polyhedrons. Cones, spheres, and cylinders are non-polyhedrons because their sides are not polygons and they have curved surfaces. The plural of a polyhedron is also known as polyhedra. They are classified as prisms, pyramids, and platonic solids. For example, triangular prism, square prism, rectangular pyramid, square pyramid, and cube (platonic solid) are polyhedrons. Observe the following figure which shows the different kinds of polyhedrons.

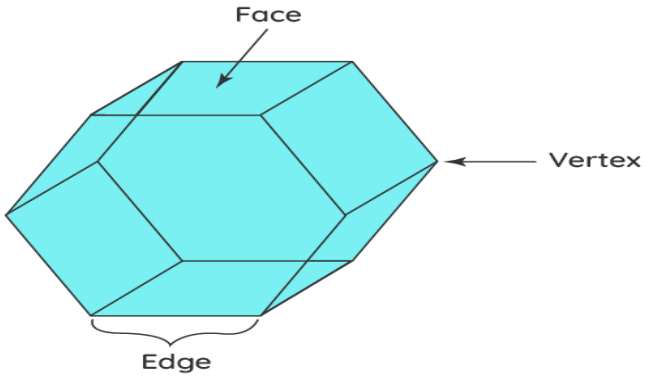


Parts of a Polyhedron

The dimensions of a polyhedron are classified as faces, edges, and vertices.

- Face: The flat surface of a polyhedron is termed as its face.
- Edge: The two faces meet at a line called the edge.
- Vertices: The point of intersection of two edges is a vertex.

Observe the following figure which shows the face, vertex, and edges of a shape.



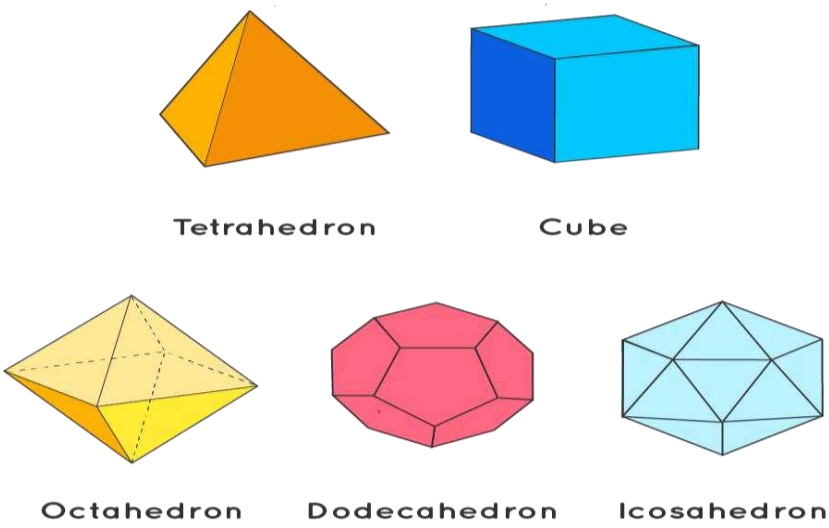
Types of Polyhedron

Polyhedra are mainly divided into two types – regular polyhedron and irregular polyhedron.

A regular polyhedron is also called a platonic solid whose faces are regular polygons and are congruent to each other. In a regular polyhedron, all the polyhedral angles are equal. There are five regular polyhedrons. The following is the list of five regular polyhedrons.

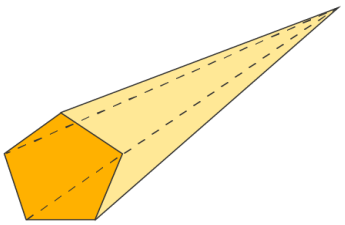
- **Tetrahedron:** A tetrahedron has 4 faces, 6 edges, and 4 vertices (corners); and the shape of each face is an equilateral triangle.
- **Cube:** A cube has 6 faces, 12 edges, and 8 vertices; and the shape of each face is a square.
- **Regular Octahedron:** A regular octahedron has 8 faces, 12 edges, and 6 vertices; and the shape of each face is an equilateral triangle.
- **Regular** Dodecahedron: A regular dodecahedron has 12 faces, 30 edges, 20 vertices; and the shape of each face is a regular pentagon.
- **Regular Icosahedron**: A Regular icosahedron has 20 faces, 30 edges, and 12 vertices; and the shape of each face is an equilateral triangle.

Observe the following figure which shows the various types of regular polyhedrons.



Regular Polyhedron

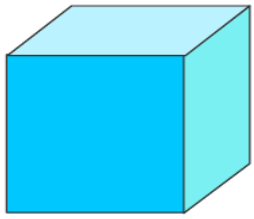
A polyhedron with irregular polygonal faces that are not congruent to each other, and in which the polyhedral angles are not equal is called an irregular polyhedron.



Irregular Polyhedron

Convex Polyhedron

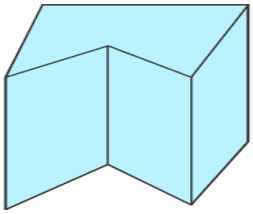
A convex polyhedron is just like a convex polygon. If a line segment joining any two points on the surface of a polyhedron entirely lies inside the polyhedron, it is called a convex polyhedron.



Convex Polyhedron

Concave Polyhedron

A concave polyhedron is quite similar to a concave polygon. If a line segment joining any two points on the surface of a polyhedron goes outside the polyhedron, it is called a concave polyhedron.



Concave Polyhedron

Polyhedron Formula

There is a relationship between the number of faces, edges, and vertices in a polyhedron. We can represent this relationship as a math formula known as the Euler's Formula. Euler's Formula ⇒ F + V - E = 2, where, F = number of faces, V = number of vertices, and E = number of edges

By using the Euler's Formula we can easily find the missing part of a polyhedron. We can also verify if a polyhedron with the given number of parts exists or not. For example, a cube has 6 faces, 8 vertices (corner points) and 12 edges. Let us check whether a cube is a polyhedron or not by using Euler's formula. F = 6, V = 8, E = 12

Euler's Formula ⇒ F + V - E = 2 where, F = number of faces; V = number of vertices; E = number of edges

Substituting the values in the formula: 6 + 8 - 12 = 2 ⇒ 2 = 2. Hence proved, cube is a polyhedron.

Polyhedron Examples

Example 1: An eight-faced polyhedron has 12 edges. How many vertices does it have?

Solution: Given, number of faces (F) = 8; edges (E) = 12 and vertices (V) = ?

Let us apply the Euler's formula.

F + V - E = 2

8 + V - 12 = 2

V - 4 = 2

V = 2 + 4
V = 6
Therefore, the polyhedron has 6 vertices.
Example 2: The number of dimensions of a polyhedron are given as follows: edges (E) = 4, faces (F) = 6, and vertices (V) = 8. Check and tell if a polyhedron with these dimensions exists?
Solution: We can use the Euler's formula and apply these values: E = 4, F = 6, and V = 8
F + V - E = 2
6 + 8 - 4 = 14 - 4 = 10
These values do not satisfy the Euler's formula, therefore, a polyhedron with the above number of dimensions does not exist.
Example 3: A polyhedron has 14 vertices and 20 edges. How many faces does it have?
Solution: We can use the Euler's formula to find the faces.
F + V - E = 2
Where F = Faces, V = Vertices and E = Edges
Given, V = 14 and E = 20
F + 14 - 20 = 2
F - 6 = 2
F = 6 + 2 = 8
Therefore, the polyhedron has 8 faces.

References

1. A.Ortiqboyev, E.Qurbonov, K.Axadova “Ko’pyoqli sirtlar geometriyasi” o’quv qo’llanma. Toshkent, Sahhof. 2022 y. 166 b.
2. Abdusaidov, Sadriddin, and Jahongir G'afforov. "KO’PYOQLAR VA ULARNING CHIZMALARI." Журнал математики и информатики 2.2 (2022).
3. Abdusaidov, Sadriddin, and Jaxongir G'afforov. "EGILUVCHI KO’P YOQLAR." Журнал математики и информатики 2.2 (2022).
4. Abriyev, N. T. "TEKISLIKDA KILLING VEKTOR MAYDONLAR GEOMETRIYASI." Eurasian Journal of Mathematical Theory and Computer Sciences 3.1 (2023): 101-105.
5. Uzoqboyev Azizbek, Sarvar Abdullayev, and Nematillo Abriyev. "ROBOTOTEXNIK MEXANIZMLARNING MAXSUSLIKLARINI IZLASHDA MATRITSAVIY USULNING QO’LLANISHI." Eurasian Journal of Mathematical Theory and Computer Sciences 3.1 (2023): 92-100.
6. Abriyev, N. T. "TEKISLIKDA KILLING VEKTOR MAYDONLAR GEOMETRIYASI." Eurasian Journal of Mathematical Theory and Computer Sciences 3.1 (2023): 101-105.
7. Turaev, U., K. Ostanov, and N. Abriyev. "USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN MATHEMATICS LESSONS AS A MEANS OF STUDENTS'CREATIVE THINKING DEVELOPMENT." Science and innovation 1.A6 (2022): 437-447.
8. Abriyev, Nematillo. "FAZODA HARAKATLAR GRUPPASI." Scienceweb academic papers collection (2022).
9. A. A. Gaifullin, Sabitov polynomials for volumes of polyhedra in dimension 4, arxiv: 1108.6014, 2011.
10. Ахадова, К. С. "О ГРУППЕ ИЗОМЕТРИЙ СЛОЕНОГО МНОГООБРАЗИЯ." Естественные и технические науки 1 (2014): 14-17.
11. Axadova, K. “Изометрические отображения слоеных многообразий”. O‘ZBEKISTON RESPUBLIKASI FANLAR AKADEMIYASI MIRZO ULUG‘BEK NOMIDAGI O‘ZBEKISTON MILLIY UNIVERSITETI QOSHIDAGI MATEMATIKA INSTITUTI, 2015.
12. Ахадова, К. С. "О ГРУППЕ ИЗОМЕТРИЙ СЛОЕНОГО МНОГООБРАЗИЯ." Естественные и технические науки 1 (2014): 14-17.
13. Akhadova, K. S. "PROBLEMS OF DEVELOPING MATHEMATICAL COMPETENCIES OF FUTURE ENGINEERS." Academic research in educational sciences 3.3 (2022): 316-323.