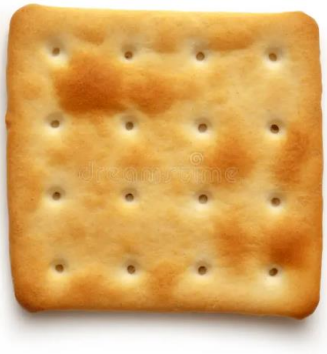
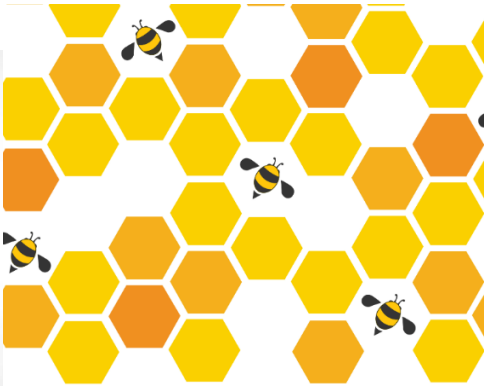
REGULAR POLYGON

What is a Regular Polygon?

A **regular polygon** is a polygon where:

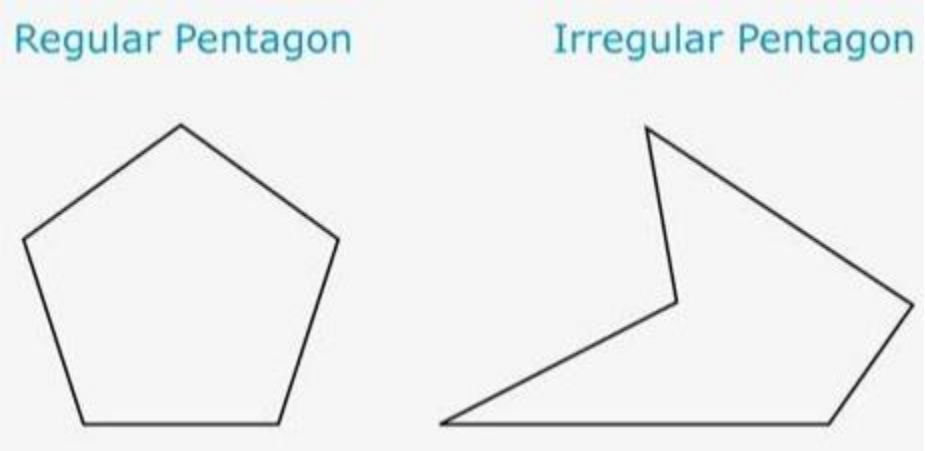
- All sides have the same length.
- All interior angles are equal.





Examples of regular polygons:

- An **equilateral triangle** (3 sides, each the same length).
- A **square** (4 sides, each the same length).
- A **regular pentagon** (5 sides, each the same length).
- A **regular hexagon** (6 sides, each the same length).



Area of a Regular Polygon

The area of a regular polygon can be calculated using a formula that depends on the number of sides and the length of each side.

There are two primary ways to calculate the area of a regular polygon:

1. Using the apothem (the perpendicular distance from the center to the midpoint of a side).
2. Using the side length and the number of sides directly.

Formula for the Area of a Regular Polygon

For a regular polygon with **n sides**, each of length **s**, the formula for the area **A** is:

$$A = \frac{1}{2} \times n \times s \times a$$

Where:

- **n** is the number of sides of the polygon.
- **s** is the length of each side.
- **a** is the **apothem** (the distance from the center of the polygon to the midpoint of any side).

Steps to Calculate the Area Using the Apothem

1. **Find the apothem (a)**:
    a. The apothem can sometimes be found directly, or you can use trigonometric formulas depending on the type of regular polygon.
    b. For regular polygons like a square or hexagon, the apothem can be calculated using specific formulas related to the side length.

2. **Substitute values into the area formula**:
    a. Plug the number of sides, the side length, and the apothem into the formula.

Example 1: Area of a Regular Hexagon

Let's calculate the area of a **regular hexagon** (6 sides), where each side has a length of 10 units.

Step-by-step solution:

1. **Number of sides (n)**: 6
2. **Side length (s)**: 10 units
3. **Apothem (a)**: For a regular hexagon, the apothem can be calculated as:

$$a = \frac{s}{2\tan(\frac{180^\circ}{n})}$$

Substituting the known values for a hexagon ($n = 6$ and $s = 10$):

$$a = \frac{10}{2 \times \tan(\frac{180^\circ}{6})} = \frac{10}{2 \times \tan(30^\circ)} \approx \frac{10}{2 \times 0.577} \approx \frac{10}{1.154} \approx 8.66 \text{ units}$$

4. **Apply the formula:**

$$A = \frac{1}{2} \times 6 \times 10 \times 8.66 \approx 260 \text{ square units}$$

Important Points to Remember:

- **Regular polygons** have all sides and angles equal.
- The area depends on either the **apothem** or the side length and the number of sides.
- For regular polygons, the apothem is crucial in finding the area, and you may need to use trigonometric functions to calculate it.
- **Different regular polygons** will have different methods for calculating the apothem (like for a square, equilateral triangle, or regular hexagon), but the formulas for the area will follow similar principles.

A **regular polygon** is a polygon where all sides and angles are equal.
The **area of a regular polygon** can be found using the formula involving the **apothem** or a formula involving the **side length** and the **number of sides**.

Trigonometry plays a key role in calculating the apothem and, consequently, the area for most regular polygons.