

Construction of the C₆₀ Fullerene Model

Student Handout

Purpose

To construct a paper model of a C₆₀ molecule.

Introduction

In the past decades, scientists discovered that other forms of carbon exist besides that of the diamond, graphite and amorphous carbon allotropes. These forms of carbon are collectively known as the Fullerenes or Buckyballs, after Buckminster Fuller, who invented the geodesic dome, which has a similar structure. The most investigated fullerene is the C₆₀ molecule. It has the same shape as a soccer ball. The formal name for this shape is *truncated icosahedron*. It has 32 faces, of which 20 are regular hexagons and 12 are regular pentagons. These faces come together at 60 points, or vertices. There is a carbon atom at each of these vertices.

Three scientists spent much time in investigating C₆₀ and its related fullerenes. They were awarded the Nobel Prize in Chemistry in 1996. The discovery of the fullerenes paved the way for nanotechnology in which scientists actively engaged in various ways of joining molecules together to produce useful new materials other than the familiar plastics.

Materials and Tools

Templates I and II, a pair of scissors, adhesive tape

Tasks

1. Use a pair of scissors to cut out the shapes of template I. With the help of adhesive tape, join the two strips together to form a chain of 10 hexagons (Fig. 1). Stick the head and tail of the chain together to form a ring (Fig. 2).

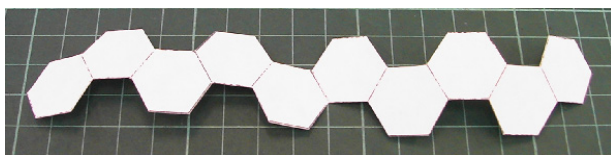


Fig. 1: Chain of 10 hexagons

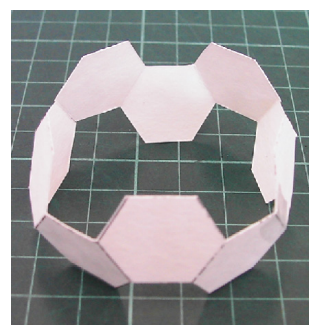


Fig. 2: A ring of 10 hexagons

2. Cut out the two shapes of template II. Complete two shapes each of which looks like Fig. 3.

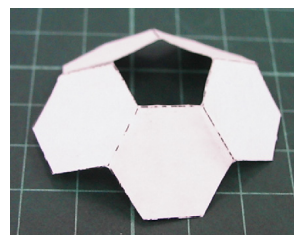


Fig. 3

3. Create a hemisphere-like shape by joining the ring constructed in step (1) to one of the shape cut out in step (2) (see Fig. 4).

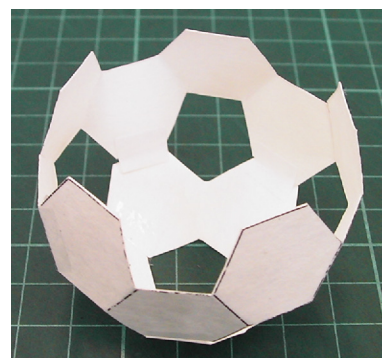


Fig. 4

4. Complete the model by joining in the remaining shape cut out in step (2) to the hemisphere.

Questions for Discussions

1. Describe in detail the appearance of the assembled sphere.

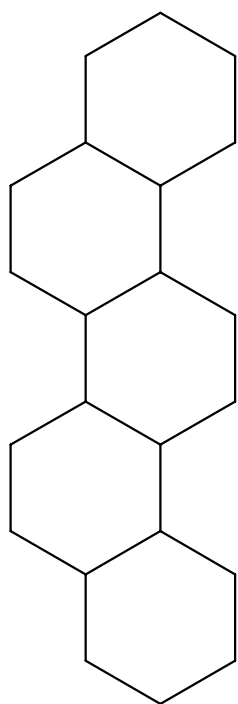
2. Explain why the sphere cannot be constructed entirely with hexagonal rings.

3. Does fullerene conduct electricity? Suggest an explanation in terms of the hybridization state of the carbon atoms.

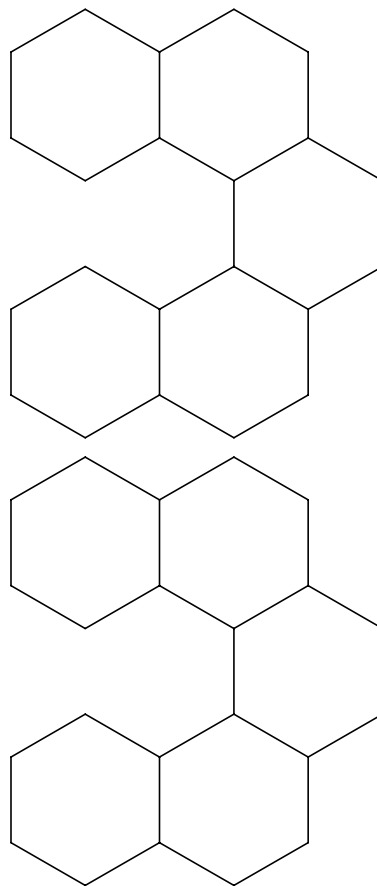
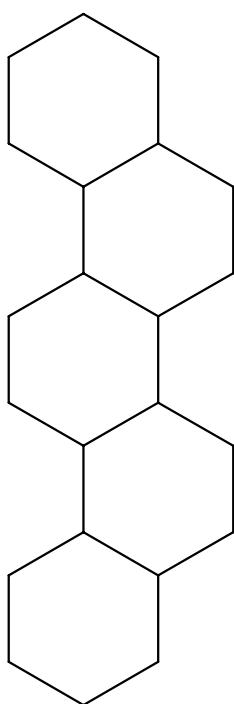
4. Based on the constructed model of C_{60} , suggest shapes of other fullerenes with more than 60 carbon atoms.

5. Suggest some applications of the fullerenes to illustrate its importance.

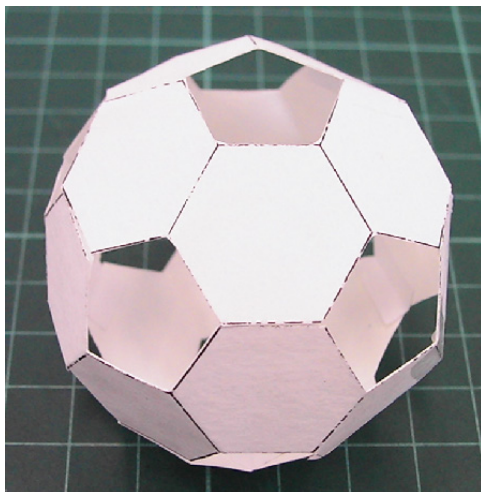
Paper Model of Buckyball



Template I



Template II



A finished model of Buckminsterfullerene, C₆₀