C2 *Solids* Introduction

Learning objectives

The work in this unit is focused on the important practical topic of solids (sometimes referred to as 3D, that is, three-dimensional, shapes). After completing Unit C2 you should be able to

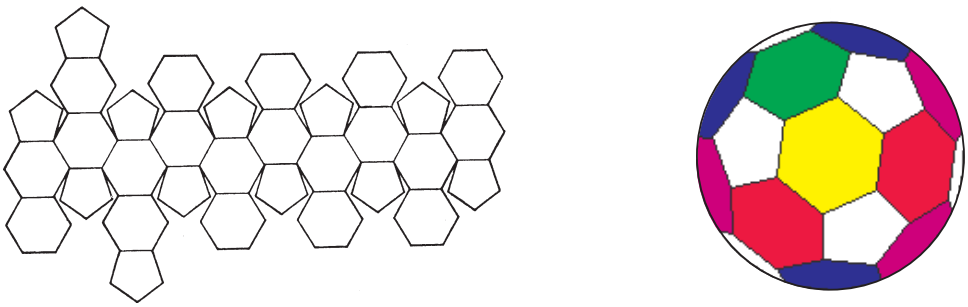
- use a 2D net to construct a 3D shape
- name the common 3D shapes
- design a net for a given 3D shape
- determine the plan and elevations (front and side) for a given 3D shape
- use isometric paper to illustrate 3D shapes.

Introduction

The word 'net' as used in, for example, 'fishing-net', is very old, but its use in mathematics to describe the flat shape which we can fold up to make a polyhedron is much more recent. The first use of 'net' with this meaning appears to have been in 1855 when one writer explained:

> "A drawing of the faces of a solid, arranged so that the model may be folded up from a single piece of cardboard, is called a net."

The reason for this choice of word becomes clear when looking at one of the more complex nets for polyhedra with a large number of faces, such as this one for a truncated icosahedron (or buckyball).



Net for a truncated icosahedron (32 faces) also known as a buckyball

A buckyball has 32 faces, that is, 20 hexagons and 12 pentagons. It is named after Richard Buckmaster Fuller, who invented the geodesic dome. If you look at a football, you will see that it is not really a polyhedron with flat faces. It is made of leather which stretches slightly, so when it is stuffed or blown up, the centres of each face bulge out slightly. This makes a better sphere.

Instructions for building a buckyball are given at

http://199.6.131.12/en/scictr/lab/buckyball/index.htm

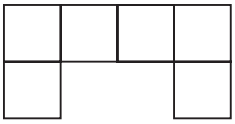
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Key points and principles

- There are many ways that nets can be constructed for the same solid.
- A plan and two elevations (front and back) provide a way of defining a 3D shape (solid).
- A box is a cuboid, but a cuboid is a cube only when all its sides are square.
- You need a net of 6 identical squares to make the net of a cube, but not all nets of 6 identical squares will make a cube.

  For example, the net shown here will not make a cube.



Facts to remember

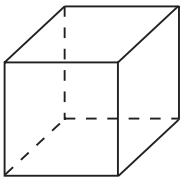
- Names of common 3D shapes.

  For example: sphere, cube, cuboid, cylinder, pyramid, prism, tetrahedron, octahedron

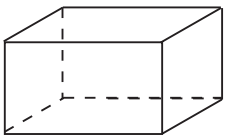
- Plans and elevations are used to define a 3D shape.

Glossary of terms

Cube all side lengths equal (square faces) and all angles right angles



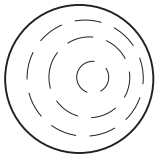
Cuboid faces a combination of rectangles (opposite faces equal) and all angles right angles



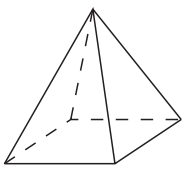
Cylinder has a circular cross-section throughout



Sphere all points on the surface are equidistant from the centre



Pyramid all slant edges from the base meet at a vertex

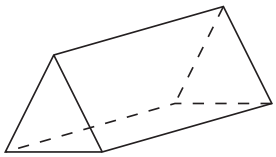


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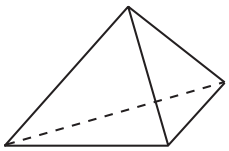
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Prism cross-section remains the same throughout

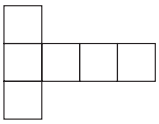
Note: a cube is a square-based prism with all sides equal.



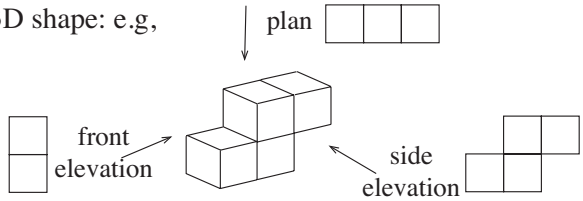
Tetrahedron all faces are triangles



Octahedron solid shape with eight faces

Net of a 3D shape can be cut and folded to form the 3D shape: e.g.  is a net for a cube.

Plans and elevations (front and side) define the 3D shape: e.g,



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