

Unit 1: Working like a physicist

1.1 Area of regular shapes

We are learning how to:

- formulate a simple working definition for the term 'area'
- use appropriate units for area
- calculate the area of regular shapes

A grid is a set of squares, like a sheet of graph paper. In Fig 1.1.1 each of the small squares measures 1 cm by 1 cm.

The **area** of a flat shape is the space contained within its boundaries. The area contained by a square of sides of 1 cm is called a square centimetre or a **centimetre squared**. It has the symbol cm^2 .

The area of a square or a rectangle can be found by placing it on a similar grid and counting how many squares it covers.

A square of sides 4 cm covers 16 squares on the grid. Its area must be 16 cm^2 .

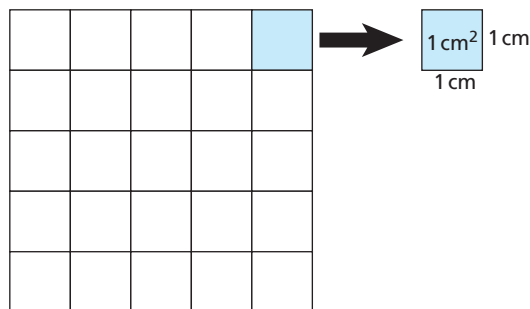


FIG 1.1.1 A square marked in centimetres

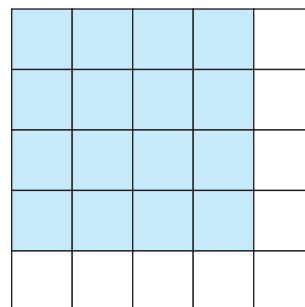


FIG 1.1.2 Area of a square of sides 4 cm

Composite shapes

The area of a composite shape can be found by cutting it into pieces and placing those pieces on a 1 cm^2 grid.

In Fig 1.1.3 the parts of the letter 'E' form a rectangle 5 cm long by 2 cm wide. The parts cover $10 \times 1 \text{ cm}^2$, so the area of the letter must be 10 cm^2 .

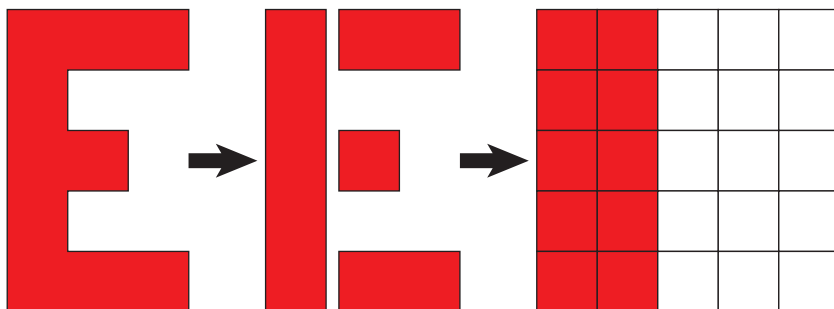


FIG 1.1.3 The parts of the shape cover $10 \times 1 \text{ cm}^2$

Finding the area of a shape by placing it on a grid works fine, but is of limited use. How could you use it to find the area of a large shape like a football pitch?

Formulae for calculating area

Table 1.1 shows information about the areas of the shapes opposite. Can you see a pattern between length, width and area?

The area of a square or a rectangle is equal to the product of the sides. In a square the length and width are equal, so:

The area of a rectangle is equal to the product of the length and the width:

Notice that area is always measured in units squared. The unit of area depends on the unit used for the dimensions of the shape. We express small areas in cm^2 and larger areas in m^2 .

area of square = length^2

area of rectangle
= $\text{length} \times \text{width}$

Length	Width	Area
1 cm	1 cm	1 cm^2
4 cm	4 cm	16 cm^2
5 cm	3 cm	15 cm^2
5 cm	2 cm	10 cm^2

TABLE 1.1.1

Interesting fact

Very large areas, like the area of a country, are expressed in kilometres squared. The area of Jamaica is $10\,991 \text{ km}^2$.

Key terms

area the region bound by the edges of a flat shape

centimetre squared (cm^2)
and metre squared (m^2)
units of area

Activity 1.1.1

Finding the area of surfaces in the classroom

You should work with another student on this activity. Make sure that each of you has an opportunity to measure and to record. Here is what you need:

- metre rule or measure tape.

Here is what you should do:

1. Measure the length and width of some square or rectangular surfaces in your classroom. These might be shapes like the top of your desk, the front of your textbook, the chalkboard, etc. Measure small surfaces in centimetres and large surfaces in metres.
2. Record your measurements in a table.
3. Calculate the area of each surface, including the unit.

Check your understanding

1. Remember to include the correct unit with each of your answers.
 - a) Calculate the area of squares that have sides of the following length:
 - i) 15 cm
 - ii) 5 m
 - iii) 2.5 cm.
 - b) Calculate the area of rectangles that have sides of the following lengths:
 - i) 18 cm and 12 cm
 - iii) 5 m and 3.5 m.
2. A house brick has sides of 23 cm, 11 cm and 7.5 cm. Calculate the areas of the three sides of the brick you can see in the picture.

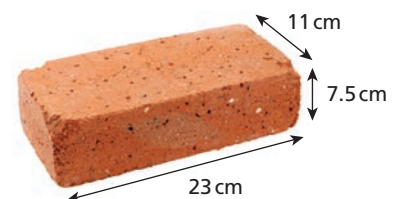


FIG 1.1.4

1.2 Area of irregular shapes

We are learning how to:

- use appropriate units for area
- estimate the area of irregular shapes

The areas of shapes can be compared by investigating whether shapes cover each other or not. Fig 1.2.1 shows a circle, a square and a triangle.

The triangle fits inside the circle and the circle fits inside the square.

So the areas of these shapes, from smallest to largest, is: triangle, circle, square.

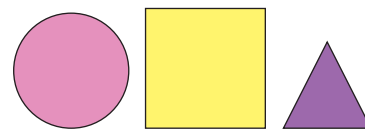


FIG 1.2.1 Three shapes

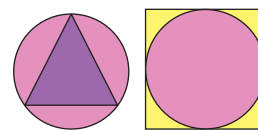


FIG 1.2.2 The triangle fits inside the circle, and the circle fits inside the square

Estimating the area

The area of a shape can be **estimated** by finding out how many squares of a 1 cm^2 grid it covers even when the sides are not whole numbers. The rectangle in Fig 1.2.3 has sides of 4.0 cm and 2.5 cm.

The rectangle covers some whole squares and some half squares. There are:

- 8 squares which are all covered
- 4 squares which are half covered.

The estimated area of this rectangle is $8 + 4 \times 0.5 = 10.0 \text{ cm}^2$. You can compare this with the value obtained using the formula given in the previous topic:

$$\text{area of rectangle} = 4.0 \times 2.5 = 10.0 \text{ cm}^2$$

When an area cannot be calculated using a formula, it has to be estimated. In Fig 1.2.4 the oval covers the squares of the grid by different amounts.

The area is estimated by counting up those squares that are at least half covered by the shape. This leads to an over-estimate of the area but this is compensated for by ignoring the squares that are less than half covered.

Using this method, an estimate for the area of the oval is:

8 whole squares covered + 12 squares that are about half covered or more
= 20 squares

Since each square represents 1 cm^2 , this represents an area of 20 cm^2 .

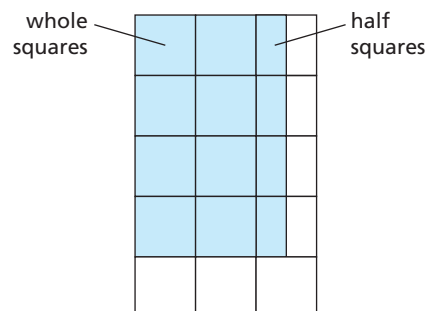


FIG 1.2.3 Area of a rectangle of sides 4.0 cm and 2.5 cm

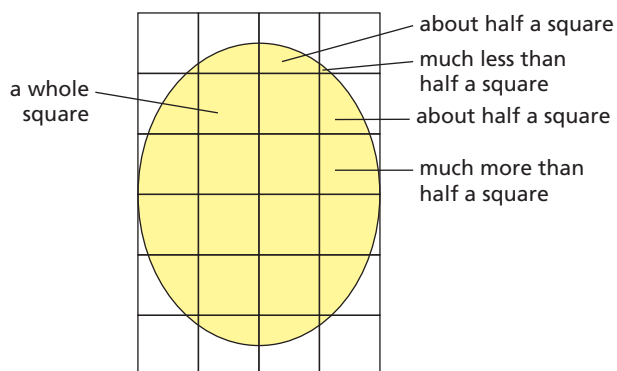


FIG 1.2.4 Area of an oval shape

Activity 1.2.1

1.2

Estimating the area of an irregular shape

Here is what you need:

- ruler 30 cm
- sheet of plain paper
- irregular shape cut in card.

Here is what you should do:

1. Draw a grid 10 cm by 10 cm on the plain paper using a pencil and ruler.
2. Place the irregular shape onto the grid and draw round it.
3. Count the number of squares that are at least half covered by the outline of the shape. You might find it helpful to shade each part as you add it, so that none are missed or counted twice.
4. Write down your estimate of the area of the shape.

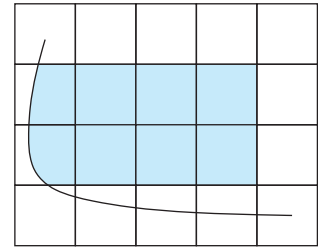


FIG 1.2.5 An irregular shape on a grid

Check your understanding

1. A student drew around an irregular shape that had been placed on a 1 cm² grid.

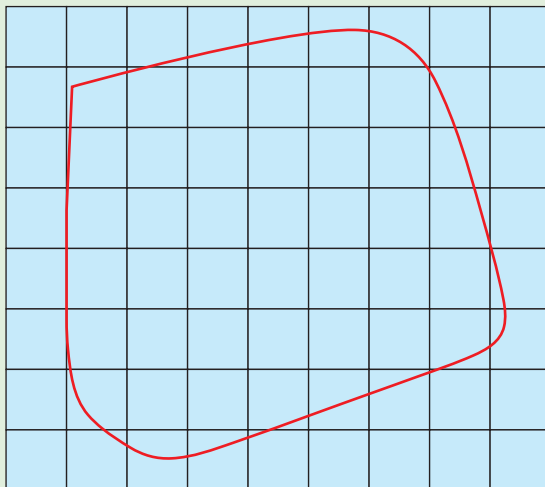


FIG 1.2.6 The student's irregular shape

Estimate the area of this shape using the method described above.

Key terms

irregular shape has sides and angles of different sizes or lacks symmetry

estimate an approximate amount