This topic is concerned with the mathematics of shape and space, both 2-dimensional and 3-dimensional.

The main setting for much of the work is the home and, with that link, it would be possible for many of the tasks to be completed outside the classroom, if suitable. If that is not possible or desirable, then the buildings and rooms within the school can serve almost as well.

Some information about sizes and processes needs to be found out in some places. In cases where this is likely to present problems for the pupils, teachers might find it useful to structure some of work more tightly and have a prepared list of relevant data.

The unit is most closely related to the Attainment Target **Shape, Space and Measures**, bringing in other topics from the Programmes of Study as they are needed to work on that Attainment Target. In particular, the complete unit will provide opportunities to cover and assess the *Yearly Teaching Programmes* in the National Numeracy Framework as given in the chart below

Topic	Sheet number	National Numeracy Framework reference
Introduction	**0**	
Finding shapes	**1**	3/D2
Finding sizes	**2**	3/D1 and 4/D1
Planning a layout	**3**	6/A3 and D2
Making a drawing	**4**	5/A1 and 6/A3 and D2
Making a model	**5**	6/D2
Decorating	**6**	6/D1 and C3
Covering the floor	**7**	5/D1
Finding the space	**8**	6/C3 and D1
The cost of it	**9**	6/C3
Plan of a room	**10**	
Solutions		

Buildings are made up of shapes.
Look around you.

> **Activity 1**
>
> *What shapes can you see?*
> *Can you name all of them?*
> *Which shapes do you see most of?*

Can you see any unusual shapes?
If you see one you cannot name, try to describe it.

Perhaps you need to look not just at the building but also the furniture and other objects in the building.

When you describe a building you might talk about *angles*.

One of the most common is the *right angle*.

> **Activity 2**
>
> *List **ten** places where a right angle can be found.*
>
> *Make a small drawing of each and label it to show what makes the right angle.*

Wall

Floor
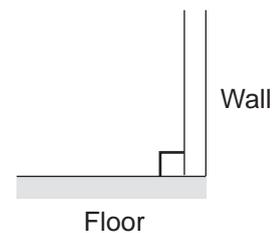
Can you find an angle that is not a right angle?

> **Activity 3**
>
> *Describe how you could move something to change a right angle into a non-right angle.*

As you walk through a building, going from one room to another, you usually need to turn several corners, each of which is a right angle.
Walk from one room to another making a record of the corners you turn.

Remember, sometimes you will be turning left, sometimes right.
Your record might look like this

$$\text{Room A} \rightarrow R \rightarrow L \rightarrow R \rightarrow R \rightarrow L \rightarrow \text{Room B}$$

> **Activity 4**
>
> *Ask someone to try and work out in which direction you must be facing, relative to your start, when you step into Room B.*


It is useful to be able to estimate sizes and distances by looking at them.

How well can you do this?

Activity 1

Estimate the length, width and height of the room. How far is it from you to the door … the window … the nearest corner … the furthest corner?

Write down your estimates.

Activity 2

Try estimating some smaller measurements such as the length, width and height of a table, the lengths of a pen, a pencil, your feet, your fingers...
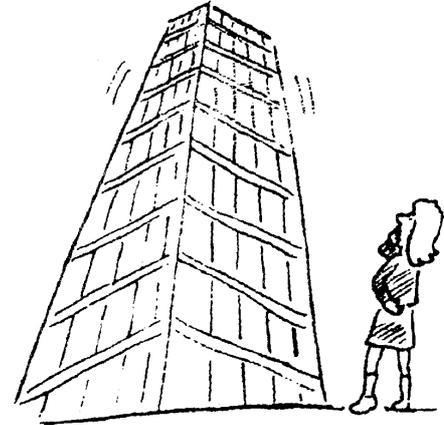
Practise outside as you walk along.

How tall is that building? How far is it to the end of the road? How big is that lorry?

How will you know how accurate you are?

Activity 3

Use a ruler or tape measure to measure some of the distances you have estimated. See how close you were.

It is a help to your estimating if you know the sizes of a few things with which you are familiar.

For instance, if you wanted to estimate the height of a tree or tall building, you could first estimate how many people would fit beside it when balanced one on top of the other. Then, if a person is about 'so high' the tree is about 'so high' times the number of people.
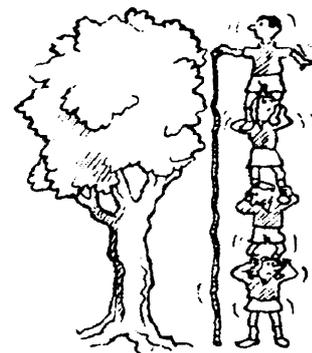
Activity 4

Make a list of familiar things and measure them.

Try doing some more estimating.

Write a description of how you made your estimates using sizes from your 'familiar things' list.

You will need sheet Home : 10 *Plan of a room.*

When planning how furniture will fit into a room, it is a good idea to make a drawing of the room first and some shapes to show the furniture.
Then the shapes can be moved around to see how it all fits in – or doesn't!

Decide on the sort of room you wish to furnish: lounge, dining-room, bedroom, etc.
Use sheet Home 10 : *Plan of a room* as your plan.

Activity 1

On the plan shown on Sheet 10, squares have been drawn to allow sizes to be measured.

A length of 10 squares represents 1 metre.

What size do you think the room is?

What size does the edge of just one square represent?

Your furniture will need to be the correct size to match your room. That means using the squares to measure it.

Activity 2

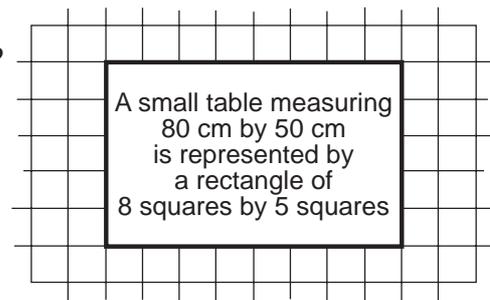*What sizes of rectangles (by squares) would be needed to show the following pieces of furniture?*

bed (1.5 by 2 metres)

sideboard (1.5 by 0.5 metres)

sink unit (2.5 by 0.5 metres)

easy chair (60 cm by 80 cm)

A small table measuring 80 cm by 50 cm is represented by a rectangle of 8 squares by 5 squares

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Activity 3

List the furniture you would like to have in the room you are planning.
Find out the sizes of what you want – or make an estimate of them.
You might find it easier to work to the nearest 10 cm.
Cut out rectangles of the correct size (by squares) to represent your furniture – card is best – and label them.

Find the best arrangement you can and, when you are satisfied, stick them on to the plan.

Often a drawing is needed of a room or building to help in planning the work which has to be done.

For this all the measurements need to be made first.

They can be written on a rough drawing to start.

From these measurements a *scale drawing* can be made.

A scale drawing is a drawing where every measurement is made smaller in the same way by using the same *scale* on all measurements.

A good scale to use for the room above would be 1 cm to represent 50 cm. This is the same as 2 cm to represent 1 metre.
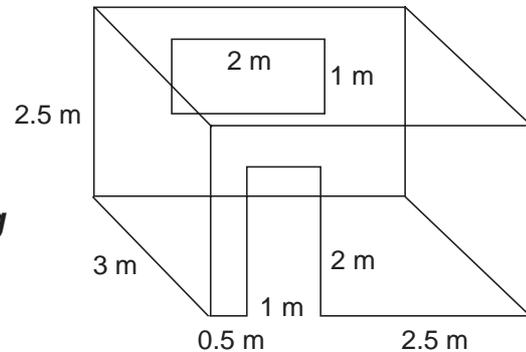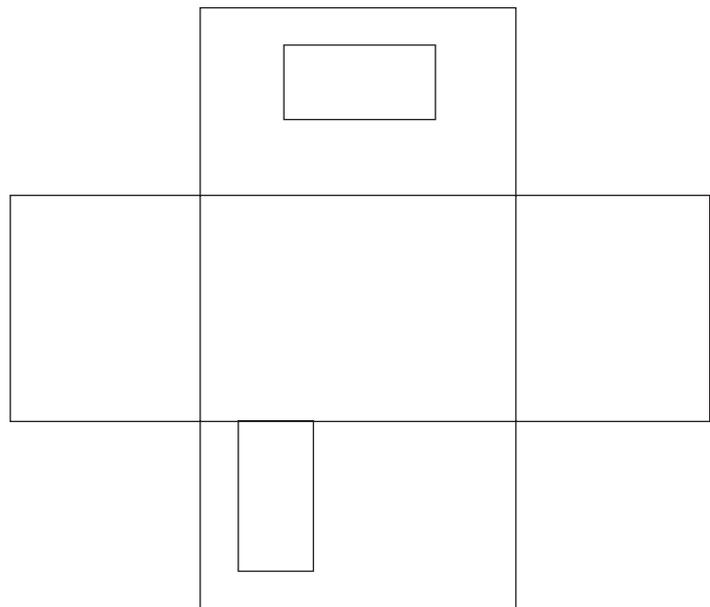
Activity 1

Using the scale described above, the rectangle showing the floor would need to be 8 cm by 6 cm on the drawing.

Change all the other sizes on the rough drawing into the sizes needed for the scale drawing.

Use them to make a scale drawing. Your scale drawing will look like the one on the right but will be larger.

Activity 2

*Choose a room and make a rough drawing of it with all the measurements.*

It might be best to work to the nearest 10 cm.

Make a scale drawing of your room using the same scale as before.

Corus   **© CIMT, University of Exeter**

A model is much better than simple drawings to show other people just what something is going to look like.

Making a simple model is not at all difficult.

In fact, with the scale drawing from the previous sheet you are more than half way there.
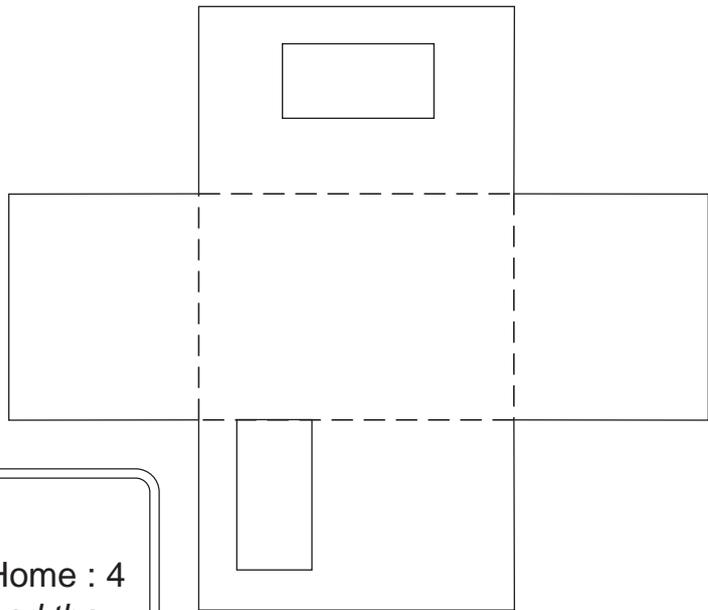
Activity 1

Copy the scale drawing from sheet Home : 4 *on to a piece of card. Cut it out around the outside edge.*

*The shape you now have is called the **net** of the model.*

Score it lightly on the dotted lines, fold up the walls and you have a model of the room.

To keep the walls in place you could use sticky tape, or else leave some extra card on the ends of the walls to make tabs which can be glued to the other walls. The window could be cut out. The door could be cut along three edges so it stayed hinged on one edge and looked like a door.

Activity 2

To complete the model, try making a roof to go on top.

The roof should not be fixed. It should be possible to lift it off so people can look inside.

*You could make the roof by sticking together four separate pieces of card, but try to do it with one piece of card by working out the **net** you need.*

Perhaps you could make models of some of the furniture to go into the room.

Remember they must be the correct size.

Corus

Many walls in houses are covered with wallpaper.

Wallpaper is supplied in rolls. Each roll is 50 cm (half a metre) wide.

The paper when unrolled is 10 metres long.

> ### Activity
>
> *Can you work out how many rolls of wallpaper are needed to cover the walls of the room on Sheet* Home : 4*?*

DIY shops have charts to help work it out. Here is one for you to use.

		Perimeter of room in metres													
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Height of room in metres	2.0	5	6	6	6	7	7	8	8	8	9	9	10	10	10	11
	2.1	5	6	6	7	7	7	8	8	9	9	9	10	10	11	11
	2.2	6	6	6	7	7	8	8	9	9	9	10	10	11	11	12
	2.3	6	6	7	7	8	8	9	9	9	10	10	11	11	12	12
	2.4	6	7	7	8	8	8	9	9	10	10	11	11	12	12	13
	2.5	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13
	2.6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14
	2.7	7	7	8	8	9	9	10	11	11	12	12	13	13	14	14
	2.8	7	8	8	9	9	10	10	11	11	12	13	13	14	14	15
	2.9	7	8	8	9	10	10	11	11	12	12	13	14	14	15	15
	3.0	8	8	9	9	10	10	11	12	12	13	13	14	15	15	16

You need to know the **height** and **perimeter** of the room.

The perimeter is the distance all the way around the walls of the room or around the edge of the floor.

For a rectangle, it can be found from

$$\text{perimeter} = (\text{length} + \text{width}) \times 2 \quad \text{or} \quad \boxed{P = 2(L + W)}$$
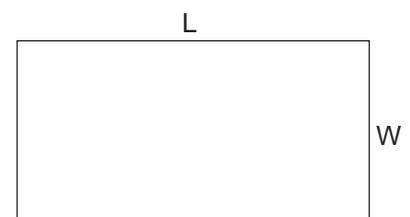
Problems

1. Use the chart to find how many rolls are needed for the following rooms

    (i)   length = 3 m, width = 3 m, height = 2 m

    (ii)   length = 5 m, width = 5 m, height = 2.5 m

    (iii) length = 3.5 m, width = 4 m, height = 2.2 m

2. Can you suggest the sizes of a room which needs 16 rolls of wallpaper?

Floors can be covered in several different ways.

The material used might be wood, cork, vinyl or carpet.

It might be put down as one complete piece, in several strips, in the form of square tiles or as rectangular blocks.
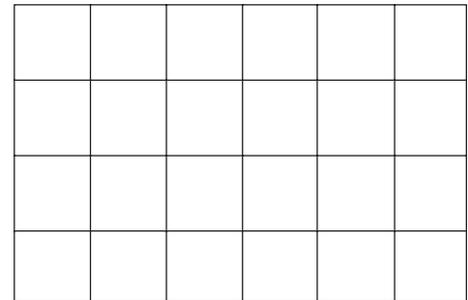

Activity

Find and describe as many different examples as you can of ways in which a floor has been covered.

Problems

1. The drawing on the right shows a scale drawing of a floor covered with carpet squares.

   Each carpet square measures 50 cm by 50 cm.

   What must be the size of the floor?

2. Another rectangular floor measures 4 metres by 3 metres. How many carpet tiles (50 cm by 50 cm) will be needed?

3. How many carpet tiles are needed for a floor 4.5 metres by 2.5 metres?

4. Another floor measures 5 metres by 3.7 metres. What problem would you have in covering that floor with 50 cm by 50 cm carpet squares?

   How might you deal with that problem?

   How many carpet squares would you need?

5. Using the same size of carpet squares, suggest the most practical way you could cover these two floors. How many tiles would you need?

   (i) 4.2 metres by 3.8 metres   (ii) 4.9 metres by 3.3 metres

6. Vinyl floor covering can be bought in 30 cm by 30 cm squares.

   Work out how many squares are needed, and describe (draw) the best way of using them for each of these floor sizes.

   (i) 2.4 metres by 3.3 metres   (ii) 3.6 metres by 2.8 metres

   (iii) 3.5 metres by 3.7 metres   (iv) 4.4 metres by 3.8 metres

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Sometimes you need to know how much space there is in a room; not just the space to put things on the floor (that is, the **area**) but the total space in the whole room – that is, the **volume**.

It is necessary when working out how much heating is needed, and also in connection with renting buildings and obtaining planning permission for alterations and extensions.

The volume of a room is found by working out

volume of room = area of floor × height of room

In most cases the floor is a rectangle and it is easy to find the area.

Activity

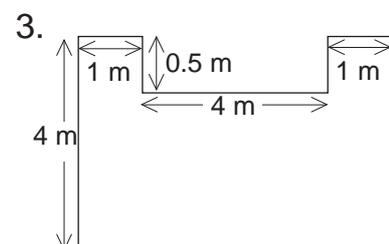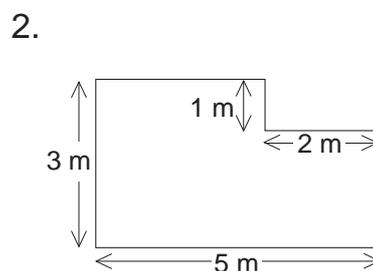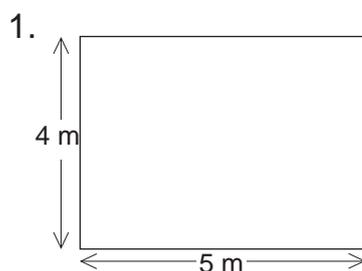*Calculate the volume of the room shown on sheet Home : 4.*

Sometimes it is more difficult, perhaps because the room is L-shaped or the chimney breast sticks out into the room.

Usually these awkward cases can be worked out by dividing the room up into smaller rectangles, finding the area of each of these, and adding them together.

Problems

Work out the areas of these floors. All the sizes are in metres.

1.

4 m

5 m

2.

3 m

1 m

2 m

5 m

3.

1 m   0.5 m   1 m

4 m

4 m

4. The height of the room for each of the floors is 3 metres.

Calculate the volume of each room.

**Caution: Take care with areas and volumes to use
the same units with all measurements.**

It is easy to make a list of what you want to furnish a room and it is not too difficult to make plans of where things will go.

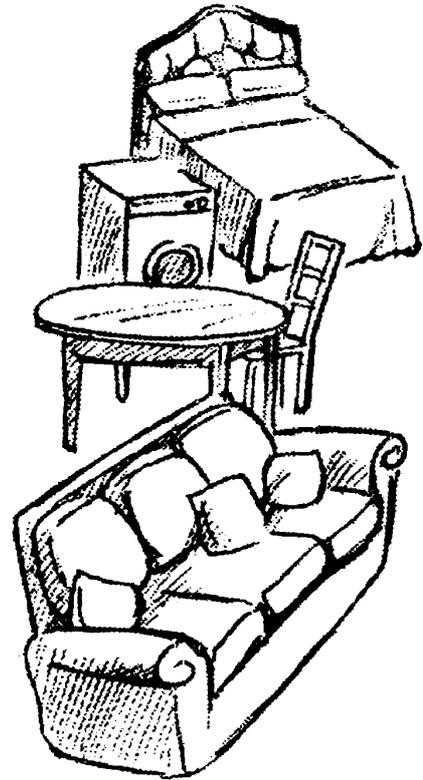But – can you afford everything on your list?

What will it all cost?

Have you any idea how much you will have to spend to buy all the items you have chosen?

For instance, what might you have to pay for a new:

    bed   dining-table

    washing machine   3-piece suite?

It might be helpful to estimate a range of prices:

    "From £…………to £…………"

Activity 1

Make a list of the items you choose for your room.

Find out, from catalogues or shops, their cost.

Make sure the prices include VAT.

Find the total cost.

Activity 2

Find out all you can about different methods of paying for the items.

Activity 3

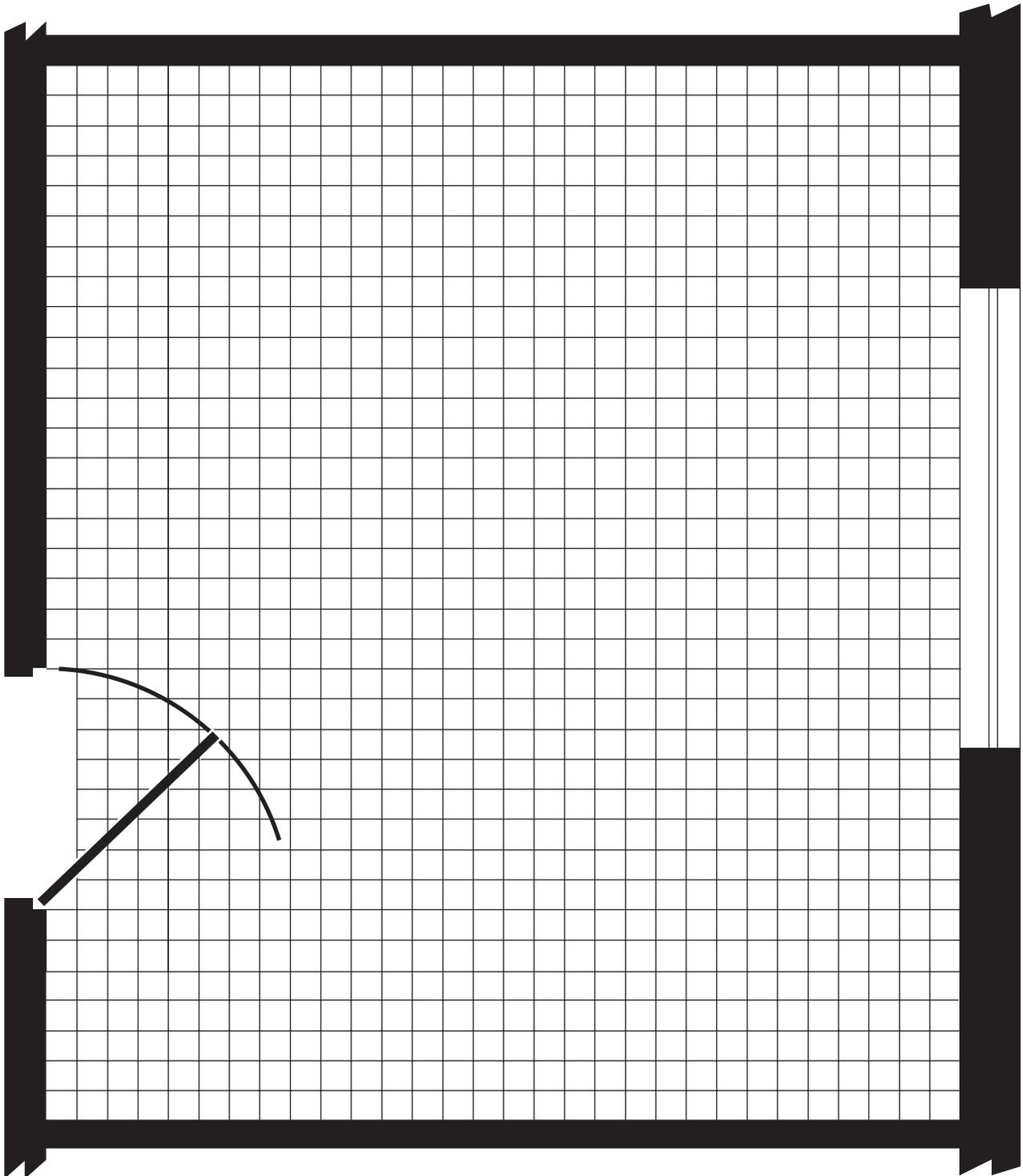*For the room shown on sheet Home : 4*

OR

for your own chosen room:

calculate the total cost of the wallpaper.

Also calculate the cost of covering the floor with a material of your choice.

You might wish to compare costs of covering the floor with different materials and in different ways.

Sheet 3	**Activity 2**	15×20, 15×5, 25×5, 6×8

Sheet 4	**Activity 1**	**1.** side wall 6 cm × 5 cm, front wall 8 cm × 5 cm window 4 cm × 2 cm, door 4 cm × 2 cm

Sheet 6   **Activity**   7 rolls

                Problems   **1. (i)** 5   **(ii)** 10   **(iii)** 7

                          2. Height = 3.0 m and perimeter = 26 m, giving many possibilities (e.g. 6 × 7, 4 × 9)

Sheet 7   **Problems**

1. 2 m × 3 m

2. 48

3. 45

4. 80 (cutting 10)

5. (i) 64   **(ii)** 70

6. (i) 88   **(ii)** 112   **(iii)** 144 **(iv)** 195

Sheet 8   **Activity** 30 m^3

                Problems

1. 20 m^2

2. 13 m^2

3. 22 m^2

4. 60 m^3, 39 m^3, 66 m^3