



## Developing **number**

Optional Skills Assessment Materials

# Clocks



# Optional Skills Assessment Materials

## Developing number

|                            |                                                                                                                                                                                                                                                                                                                  |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Audience</b>            | Teachers at Key Stage 2, in particular those with Year 5 classes; local authorities; tutors in initial teacher training; and others with an interest in education.                                                                                                                                               |
| <b>Overview</b>            | These new materials support learning, teaching and assessment of learners' skills in Year 5. They are designed to assist schools in implementing the revised school curriculum and its frameworks.                                                                                                               |
| <b>Action required</b>     | Schools' senior managers and local authority advisers are requested to raise awareness of these new materials within their schools, and to encourage teachers to use the materials to support their focus on developing learners' skills.                                                                        |
| <b>Further information</b> | Enquiries about this document should be directed to:<br>Curriculum and Assessment Division<br>Department for Children, Education, Lifelong Learning and Skills<br>Welsh Assembly Government<br>Cathays Park<br>Cardiff<br>CF10 3NQ<br>Tel: 0800 083 6003<br>e-mail: C&A3-14.C&A3-14@wales.gsi.gov.uk             |
| <b>Additional copies</b>   | Can be obtained from:<br>Tel: 0845 603 1108 (English medium)<br>0870 242 3206 (Welsh medium)<br>Fax: 01767 375920<br>e-mail: dcells1@prolog.uk.com<br><br>Or by visiting the Welsh Assembly Government's website<br><a href="http://www.wales.gov.uk/educationandskills">www.wales.gov.uk/educationandskills</a> |
| <b>Related documents</b>   | <i>Optional Skills Assessment Materials for Year 5 – An overview;</i><br><i>Optional Skills Assessment Materials: Developing communication;</i><br><i>Optional Skills Assessment Materials: Developing thinking</i><br>(Welsh Assembly Government, 2009)<br><br>These materials are also available in Welsh.     |



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### Overview

Two related activities based around a central theme of clocks are provided:

- **Activity 1: Circular clocks**
- **Activity 2: Novelty clocks**

In Activity 1, learners begin by identifying similarities and differences amongst a collection of clock faces. Learners are then asked to position missing numerals on a circular clock face. Finally, learners construct a circular clock face of specified diameter and show, as accurately as they can, the position of each of the numerals.

In Activity 2, learners discuss four unusual clock designs before completing one or more tasks, exploring ways in which numerals can be positioned around a variety of differently shaped clock faces. These tasks extend those presented in the previous activity, allowing learners to adapt the necessary skills for use in related, but unfamiliar, contexts.

These activities are not timed assessment tasks, so you should feel free to adapt the materials provided to suit the needs of your learners.

The timings given at the beginning of each activity are suggestions. Some activities may take less time, while others may take considerably more. This will depend on the routes learners take and their interest in the activity itself.



### Learner groupings

To promote collaborative learning, most activities are best undertaken by groups or pairs of learners who should be encouraged to share and discuss their ideas. At appropriate times, these groups could come together to present and compare their findings and the methods they use.

At other times, you may wish learners to work individually to provide evidence of their knowledge and skills. Consequently, the worksheets that accompany the activities can be used with groups, pairs or individuals as you consider appropriate.

## Links to the skills framework

As learners engage with these materials, they will generate evidence that contributes to their individual skills profile.

The 'Developing number across the curriculum' section of the skills framework has three main elements: **Use mathematical information**, **Calculate** and **Interpret and present findings**, with each of these sub-divided into a further two or three strands. These strands are referred to as 'principles' in the skills framework and are shown below.

### Use mathematical information

- Using numbers
- Measuring
- Gathering information

### Calculate

- Using the number system
- Using a variety of methods

### Interpret and present findings

- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

Each principle contains six cells that correspond to stages in the development of the related skill. For example, the six cells identified in the **Measuring** principle are shown below.

|                                                                          |                                                            |                                                                                                                              |                                                                                                                                                                                                                  |                                                                            |                                                                                                                 |
|--------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Compare two or more objects by direct comparison of physical properties. | Measure and compare length and mass; order events in time. | Choose and use everyday units of measure and familiar measuring equipment; read scales to an appropriate degree of accuracy. | Use more precise measuring equipment with finer calibrations. Make reasonable estimates of a range of measures in everyday situations. Use correct units for compound measures such as volume, density or speed. | Read scales on a range of measuring equipment to given levels of accuracy. | Make accurate and reliable observations choosing suitable equipment; measure in a variety of appropriate units. |
|--------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|

Evidence generated by the activities can be linked with cells to provide an indication of an individual learner's progress in the related skill area.

However, when doing this you should bear in mind the following points:

- The evidence generated by the activities will be a small part of the overall evidence that is available to you.
- Much evidence will be generated during other day-to-day learning and teaching; significant elements of this should also contribute to the learner's skills profile.
- The evidence generated by any activity is likely to contribute to a variety of principles and cells.

This final point is of particular importance when you review the **What to look for** section included with each of the activities.

These sections are designed to make evidence gathering more manageable by deliberately focusing on just two or three of the eight principles. However, this means that only some of the evidence that emerges is being considered.

As your familiarity with each of the activities increases, you may find that you are able to incorporate more of the available evidence into a variety of other principles and/or cells.

# Links to the curriculum

### Design and technology

#### Skills: Designing

1. use a range of information sources to generate ideas for products
2. investigate how existing products look and function as a source of ideas for their own products

### Mathematics

#### Skills: 1. Solve mathematical problems

- appreciate the continuous nature of measures, and that measurement is approximate; estimate measures, and measure to an appropriate degree of accuracy in a range of contexts

### Art and design

#### Skills: Understanding

3. evaluate the methods and results of their own work and that of their fellow pupils through discussion, reading, writing and reflection

### PSE

#### Skills: Developing thinking

- form personal opinions and make informed decisions
- use appropriate techniques for personal reflection

### PSE

#### Skills: Developing communication

- express their views and ideas confidently through a range of appropriate methods

### PSE

#### Skills: Working with others

- work cooperatively to solve problems

### English (Oracy)

#### Skills:

3. communicate clearly and confidently, expressing opinions, adapting talk to audience and purpose, using appropriate gesture, intonation and register in order to engage the listener
4. develop their awareness of the social conventions of conversation and discussion

# Activity 1: Circular clocks



## Links to the skills framework

In order to make evidence gathering more manageable, it is suggested that you concentrate initially on each of the principles shown as a main focus in the table below.

### Use mathematical information

- Using numbers
- Measuring
- Gathering information

### Calculate

- Using the number system
- Using a variety of methods

### Interpret and present findings

- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

#### Key

- Main focus    ● Incidental focus
- No intentional focus

The **What to look for** section at the end of this activity provides an indication of some of the evidence that you might expect and the cells with which this evidence might be matched. However, it is important to appreciate that a range of other evidence may also be generated and that this may be more validly associated with other principles and/or cells.

## Context

In this activity, learners compare a collection of circular clock faces before completing one or two tasks, exploring ways in which numerals can be accurately positioned around circular clock faces.

The tasks provide opportunities for learners to demonstrate their measuring skills and to talk about and explain the methods they use. Allow approximately 30 to 40 minutes for each task and 20 minutes for the introduction.

Both tasks are presented in worksheet format. Although essentially the same skills are required in each task, Worksheet 2 is more demanding than Worksheet 1. Consequently, you will need to decide whether both tasks are appropriate for all of your learners.

Although learners complete individual worksheets, they should be encouraged to work together, discussing appropriate strategies, describing the skills they use and evaluating outcomes against their agreed criteria.

## Resources

One resource sheet and two related worksheets are provided.

Each group of learners will need a copy of the resource sheet, while each learner will require a copy of the worksheet(s) relating to the task(s) they attempt.

In addition, you will need to provide learners with a range of measuring instruments, including protractors/angle measurers, pairs of compasses and rulers.

## Activity 1 | Circular clocks

### Developing the activity (part 1)

- Display the resource sheet on the whiteboard and/or distribute a copy to each group of learners.
- Stimulate whole-class discussion and thinking by asking questions such as:
  - What do you think this activity is all about?
  - How might you use this sheet?
  - What kind of information does the sheet give?
  - If you were asked to design a clock, how might this sheet help you?
  - What do you think makes a 'good' clock?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- After the general introduction, ask learners to work in groups identifying similarities and differences in the clocks shown.
- To provide some structure, you could suggest that each pair of learners selects two different clocks and identifies one way in which they are similar and one way in which they are different.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for groups to engage with the task, before bringing them together to share and compare their ideas.
- Selecting particular learners to report back will provide further opportunities for you to gather specific evidence about individuals.
- Following the reporting back session, you may wish to allow further time for learners to follow up the ideas discussed.



## Some examples of classroom practice

In one school, the teacher reduced the size of the resource sheet so that learners could record similarities and differences alongside the illustration. After the general introduction, individual learners were given a copy of the reduced sheet and asked to record their ideas.

Clocks
Activity 1: Circular clocks
Resource sheet



**Similarity and differences**

- Difference**  
2 clocks have Roman numerals
- Same**  
Most of them are brown, black and white
- Same**  
They are all circles
- Similarity**  
They all have hands. Some with 2 and some with 3
- Difference**  
One of the clocks has a 24 hour face
- Difference**  
One clock is missing certain numbers
- Same**  
3 clocks have no numbers

In another school, the teacher asked learners to work in pairs. Each pair was asked to select two clocks and state one way in which these clocks were similar and one way in which they were different. Although there was no written outcome, there was much useful discussion and some interesting comparisons.

Clocks 1 and 7 both have numbers, but clock 1 has a frame and 7 doesn't.

Clocks 2 and 6 have Roman numerals. Clock 2 is bigger than clock 6.

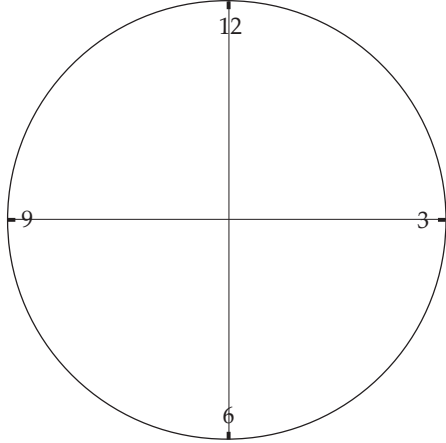
4 and 5 are both modern designs. 5 has numbers and 4 doesn't.

## Activity 1 | Circular clocks

### Developing the activity (part 2)

- Distribute a copy of Worksheet 1 to each learner and explain that they are to show the positions of the missing numerals as accurately as possible.
- Allow learners to work in groups and/or discuss possible methods with a partner. However, each learner will need to complete a separate worksheet in order to demonstrate their measuring skills.
- Allow learners to select appropriate instruments from a range of resources. This will provide evidence of their ability to choose and use appropriate instruments for the task in hand.
- Explain that when the clock face is complete, learners should record the time it shows at the bottom of the page. You may wish to suggest that learners record this time in a variety of ways, e.g. quarter past 2, 2:15p.m. and 14:15.
- Before moving on, bring learners together to share and compare their work.
- While reporting back, encourage learners to suggest success criteria for the task and to use these to evaluate their work.

An overlay can be prepared (see page 16) to check the accuracy of learners' completed clocks. However, the primary purpose of this activity is to provide opportunities for learners' to use their measuring skills. Consequently, even if a completed clock is not correct, it is still possible for a learner to demonstrate much positive attainment, for example, by choosing and using appropriate measuring instruments, by measuring distances accurately and/or by reading scales and constructing angles.

| Clocks                                                                              | Activity 1: Circular clocks | Worksheet 1 |
|-------------------------------------------------------------------------------------|-----------------------------|-------------|
| <b>Name:</b> .....                                                                  |                             |             |
| Complete the clock face as accurately as you can.                                   |                             |             |
|  |                             |             |
| The time on my clock is .....                                                       |                             |             |

## Some examples of classroom practice

In an attempt to position the numerals 1 and 2 correctly, Amanda drew a chord joining 12 and 3 and divided this line into three equal parts. Although this is an incorrect method, it provides evidence of Amanda's ability to measure length and to carry out an appropriate calculation.

In order to position the numerals 1 and 2 correctly, Amanda should have used the arc of the circle joining 12 and 3 and not the chord. To find the length of the arc, Amanda could have overlayed it with string (or cotton), before straightening the string out and measuring it with a ruler (approximately 9.4cm). Dividing this length by 3 and then mapping out the appropriate distance along the arc (again using string) will give the approximate positions of the numerals.

A more conventional method for achieving the correct result is to divide the right angle between the lines joining the numerals 3 and 12 into three equal parts. A protractor can then be used to measure the relevant angles of  $30^\circ$  and position the numerals accurately.

| Clocks                                            | Activity 1: Circular clocks | Worksheet 1 |
|---------------------------------------------------|-----------------------------|-------------|
| Name: <u>Amanda</u>                               |                             |             |
| Complete the clock face as accurately as you can. |                             |             |
|                                                   |                             |             |
| The time on my clock is _____                     |                             |             |

| Clocks                                            | Activity 1: Circular clocks | Worksheet 1 |
|---------------------------------------------------|-----------------------------|-------------|
| Name: <u>Brandon</u>                              |                             |             |
| Complete the clock face as accurately as you can. |                             |             |
|                                                   |                             |             |
| The time on my clock is <u>7:30</u>               |                             |             |

In order to find the position of the numerals 1 and 2, Brandon chose to use a protractor. However, his attempts at measuring angles of  $30^\circ$  are only accurate to about  $\pm 5^\circ$ . Having positioned 1 and 2, Brandon realised that he could position 7 and 8 by drawing the appropriate diameters of the circle.

To position the remaining numerals, Brandon repeated the process. This time the angles he measured are much more accurate. Later, when evaluating his own work, Brandon said, 'I think it's good that I put in the minute marks. I think the hands are right because I put a line in the middle between 7 and 8 to show half past 7. Next time, I'll make the hour hand smaller'.

When it was pointed out that the minute marks were not accurate, Brandon agreed, saying that the distances involved were small and so he thought it was, 'OK to judge where they should go'.

## Activity 1 | Circular clocks

- Next, distribute a copy of Worksheet 2 to each learner for whom you consider it to be appropriate.
- The task presented on this worksheet is similar to the previous one, but is more demanding, since learners must construct their own circular clock face as well as positioning all the numerals.
- Before learners begin to construct their clocks, ask them to use their experience of completing Worksheet 1 to identify success criteria for this new task. You may wish to list these on the whiteboard for reference.
- Encourage learners to construct their clocks, keeping these success criteria in mind.
- Careful observation of learners as they work will provide opportunities for gathering evidence, e.g. do learners:
  - select appropriate measuring instruments for the task?
  - use the instruments with appropriate accuracy?
  - appreciate that they must set their compasses to 6cm in order to draw a circle of diameter 12cm?
  - recognise that once they have positioned one of the numerals (e.g. the 2), the position of a second numeral (in this case, the 8) can be determined by drawing a diameter of the circle that joins the two numerals?
- Finally, bring learners back together to share and compare their work. As before, encourage learners to evaluate their own work and the work of others using the agreed success criteria.



## An example of classroom practice

Before the learners began Worksheet 2, they reflected upon their earlier work, identifying possible success criteria against which to evaluate the new task.

The numbers should be in the right place.

There should be marks to show the exact position of the numbers.

There should be a big hand and a smaller hand.

The clock should be drawn accurately.

It should show the correct time and look good.

Jac's method of construction is representative of the approach adopted by most learners. Jac began by using a pair of compasses to construct a circle of diameter 12cm. He then used a ruler to gauge the position of the horizontal diameter and drew in this line. Jac then used a protractor to construct the line at right angles to this diameter and marked the positions of numerals 3, 6, 9 and 12. Finally, Jac measured successive angles of  $30^\circ$  in order to position the remaining numerals.

To complete the clock face, Jac added hands of an appropriate length and recorded the time he had shown in two ways.

Jac's self evaluation included:

- 'I've drawn an accurate clock.'
- 'I've shown where the numbers go.'
- 'You can read the time easily.'
- 'To make it clearer, I could rub out some of the lines.'

Other learners suggested that Jac's clock could be improved by showing the minute marks and by adjusting the hour hand so that it pointed three-quarters of the way between 11 and 12.

| Clocks                                                                               | Activity 1: Circular clocks | Worksheet 2 |
|--------------------------------------------------------------------------------------|-----------------------------|-------------|
| Name: <u>Jac</u>                                                                     |                             |             |
| Draw a circular clock face that has a diameter of 12cm.                              |                             |             |
| Show the position of each number as accurately as you can.                           |                             |             |
| Discuss your ideas with a partner before you begin.                                  |                             |             |
|  |                             |             |
| The time on my clock is <u>quarter to twelve 11:45</u>                               |                             |             |

## Activity 1 | Circular clocks

### What to look for

#### Comparing data

When comparing clocks, are learners able to:

- match two or more clocks with the same characteristic and/or sort the clocks according to a given criterion, e.g. identify all those clocks with Roman numerals (Cell 1)
- sort the clocks using one or more of their own criteria (Cell 2)?

#### Measuring

When comparing clocks, positioning numerals and/or completing clock faces, are learners able to:

- make direct comparisons of the physical properties of two or more clocks, e.g. by shape, size or design (Cell 1)
- demonstrate their ability to measure and compare length, e.g. by measuring the length of a chord of a circle or by using string to help measure the arc of a circle (Cell 2)
- choose appropriate instruments for the task and use these to an appropriate degree of accuracy, e.g. by using a protractor to measure and construct angles of  $30^\circ$  to an accuracy of  $\pm 3^\circ$ , or by using a pair of compasses to draw a circle (Cell 3)?

#### Talking about and explaining work

When comparing clocks, completing clock faces and/or reporting back, are learners able to:

- talk about the numbers they have encountered within the context of the activity, e.g. 'One is opposite seven', 'Two is opposite eight', etc. (Cell 1)
- use the language of number, shape and comparatives, e.g. 'All the clocks are circular; all have hands' or 'Some clocks use Roman numerals, some use numbers, some use dots and some do not mark time intervals at all' (Cell 2)
- use the language of position, movement and measures to explain the methods used, evaluating the outcomes of their own work and those of others in a constructive manner (Cell 3)?



1



2



3



4



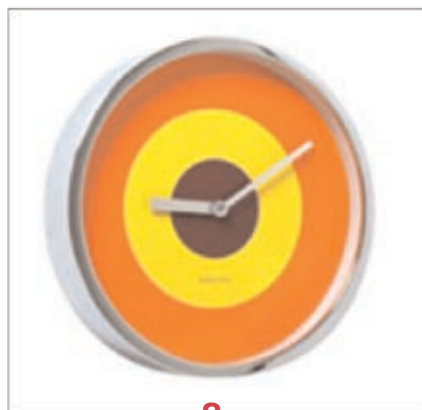
5



6



7



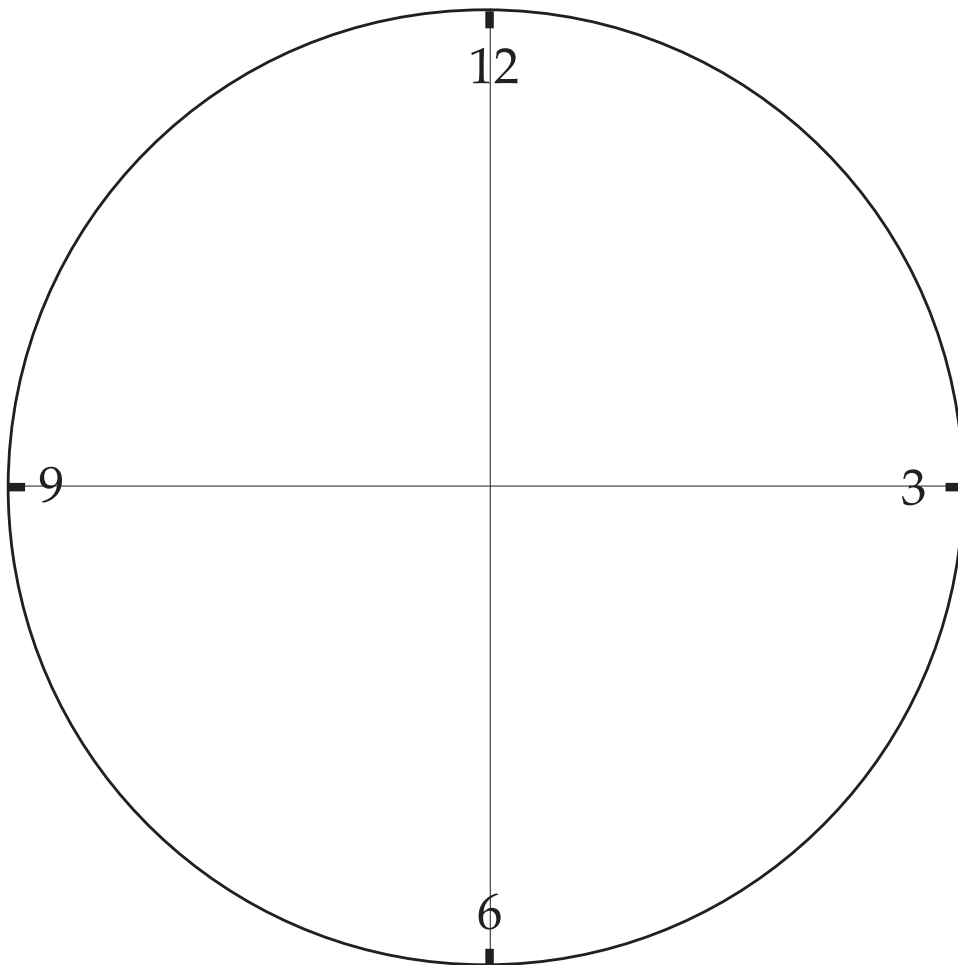
8



9

Name: .....

Complete the clock face as accurately as you can.



The time on my clock is .....

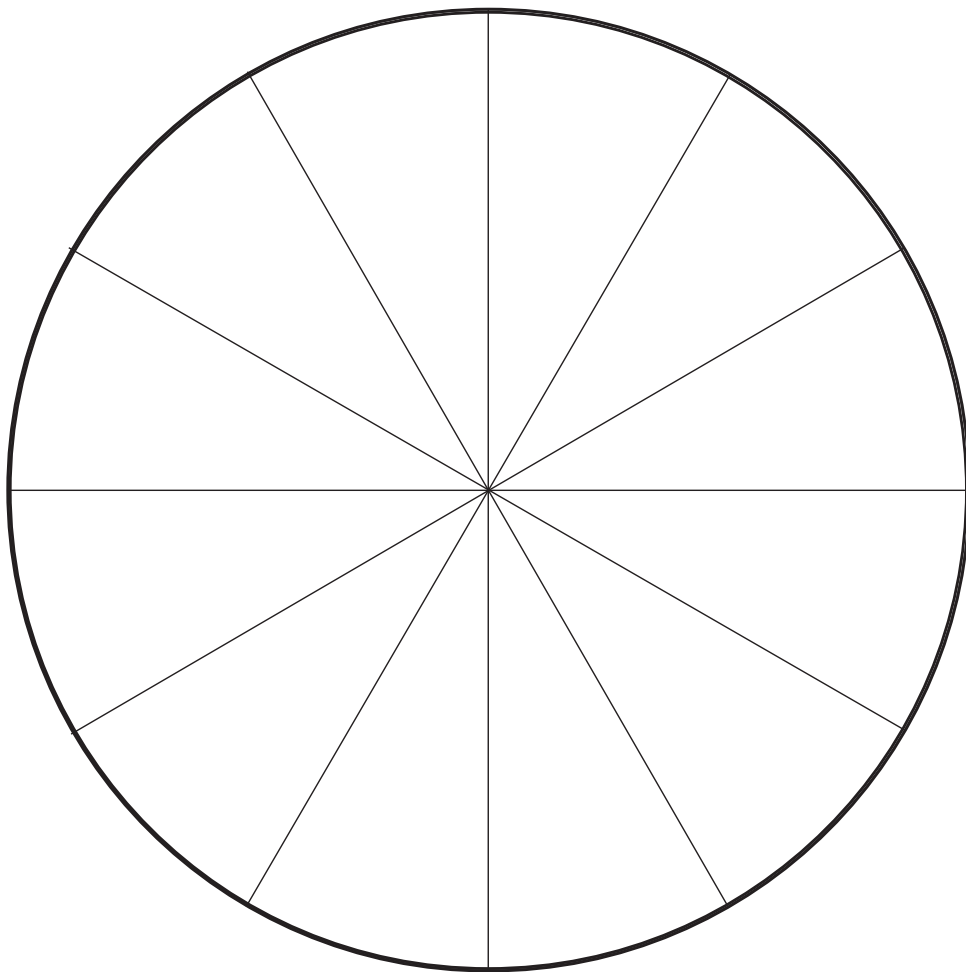
**Name:** .....

Draw a circular clock face that has a diameter of 12cm.

Show the position of each number as accurately as you can.

Discuss your ideas with a partner before you begin.

The time on my clock is .....



Photocopying this diagram onto an acetate sheet will produce an overlay that can be used to check the accuracy of learners' clock faces. Alternatively, print the relevant page from the CD-ROM and use this to produce the acetate.

## Activity 2: Novelty clocks



### Links to the skills framework

In order to make evidence gathering more manageable, it is suggested that you concentrate initially on each of the principles shown as a main focus in the table below.

#### Use mathematical information

- Using numbers
- Measuring
- Gathering information

#### Calculate

- Using the number system
- Using a variety of methods

#### Interpret and present findings

- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

#### Key

- Main focus    ● Incidental focus
- No intentional focus

The **What to look for** section at the end of this activity provides an indication of some of the evidence that you might expect and the cells with which this evidence might be matched. However, it is important to appreciate that a range of other evidence may also be generated and that this may be more validly associated with other principles and/or cells.

### Context

In this activity, learners discuss four unusual clock designs before completing one or more tasks, exploring ways in which numerals can be positioned around a variety of differently shaped clock faces. These tasks extend those presented in the previous activity, allowing learners to adapt the necessary skills for use in related, but unfamiliar, contexts. Allow approximately 30 to 35 minutes for each task and 15 minutes for the introduction.

The tasks are presented in worksheet format in order to allow individual learners to demonstrate their measuring skills. Although essentially the same skills are required throughout, the tasks become progressively more demanding. Consequently, you will need to decide which of the tasks are appropriate for your learners.

Although learners complete individual worksheets, they should be encouraged to work together, discussing appropriate strategies, describing the skills they use and evaluating outcomes against agreed criteria.

### Resources

One resource sheet and five related worksheets are provided.

Each group of learners will need a copy of the resource sheet, while each learner will require a copy of the worksheet(s) relating to the task(s) they attempt.

In addition, you will need to provide learners with a range of measuring instruments, including protractors/angle measurers, pairs of compasses and rulers.

## Activity 2 | Novelty clocks

### Developing the activity (part 1)

- Display the resource sheet on the whiteboard and/or distribute a copy to each group of learners.
- Stimulate whole-class discussion and thinking by asking questions such as:
  - In what ways are these clocks different from those you considered in Activity 1?
  - What do you like/dislike about these clocks?
  - What other shapes might be used as clock faces?
  - If you were asked to design a clock, how might this sheet help you?
  - What do you think makes a 'good' clock?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- After the general introduction, distribute a copy of Worksheet 1 to each learner. Explain that they are to complete the clock face, showing the positions of the missing numerals and the hands, and record the time.
- Asking learners to record the time on this clock face (and on subsequent worksheets) is intended to focus attention on the length of the clock hands, which should not extend beyond the edge of the clock face as they rotate. This is an issue that learners may discuss during the reporting back session.
- Before moving on, bring learners together to share and compare their clock faces.
- While reporting back, learners should be encouraged to evaluate their clock faces using their own success criteria.



## Some examples of classroom practice – Worksheet 1

Abdi was able to position the numerals accurately on the clock face using a correct strategy. This strategy involved joining the two pairs of given numerals (4 to 10 and 2 to 8) to produce two diameters whose point of intersection gives the centre of the truncated circle.

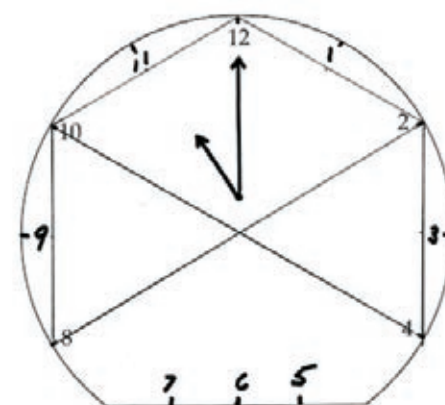
Abdi then used one of these diameters as a reference point to measure successive angles of  $30^\circ$  and position each of the other numerals accurately.

During the reporting back session, it was noted that:

- the hands of Abdi's clock face were almost equal in length
- the hands were too long to allow them to rotate fully.

Learners agreed that these were important considerations that should be reflected in their list of success criteria.

| Clocks                                                                              | Activity 2: Novelty clocks | Worksheet 1 |
|-------------------------------------------------------------------------------------|----------------------------|-------------|
| Name: <u>Abdi</u>                                                                   |                            |             |
| Complete this clock face by adding the missing numbers and the hands.               |                            |             |
| Think carefully about where to put the numbers and the length of the hands.         |                            |             |
|  |                            |             |
| The time on my clock is <u>10 to 1 (12:50)</u>                                      |                            |             |

| Clocks                                                                              | Activity 2: Novelty clocks | Worksheet 1 |
|-------------------------------------------------------------------------------------|----------------------------|-------------|
| Name: <u>Elizabeth</u>                                                              |                            |             |
| Complete this clock face by adding the missing numbers and the hands.               |                            |             |
| Think carefully about where to put the numbers and the length of the hands.         |                            |             |
|  |                            |             |
| The time on my clock is <u>11:00 a.m.</u>                                           |                            |             |

Elizabeth also began by constructing two diameters of the truncated circle. She then drew the chord joining the numeral 10 to the numeral 12 and, by measuring half way along this line, identified the approximate position of the numeral 11. Elizabeth repeated this procedure to identify correctly the approximate positions of the numerals 1, 3 and 9.

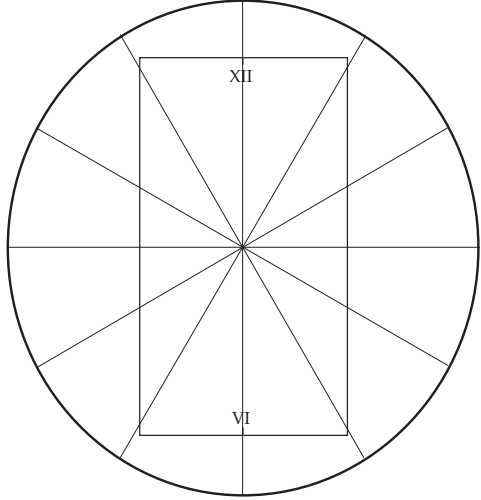
However, the strategy adopted for the final step in her construction, which involved measuring the base of the truncated circle and dividing by 4, is flawed and, although it provides further evidence of measuring skills, it leads to the incorrect positioning of the numerals 5 and 7.

Interestingly, Elizabeth decided to 'centre' the hands of her clock approximately halfway down the truncated clock face and not at the point of intersection of the two diameters, as should be the case.

## Activity 2 | Novelty clocks

### Developing the activity (part 2)

- The activity can be developed further using one or more of the additional worksheets provided.
- Worksheets 2, 3 and 4 offer similar, although increasingly more demanding, challenges. It is recommended that you work through each of these worksheets yourself, before deciding which ones are appropriate for your learners.
- Worksheet 5 provides opportunities for learners to use the skills they have gained to design their own clock. Learners who need additional support with this task could be given a photocopy of the overlay on which to create their design.
- A general method for positioning the numerals around any clock face involves superimposing a circle.
- For example, one way of dealing with the rectangular clock face shown on Worksheet 2 is to find its midpoint and then construct a circle about that point (see diagram opposite).
- Drawing radii to identify where the numerals would be placed on the circle (as in Activity 1) also provides an indication of their positions on the rectangle.
- Alternative methods are, of course, possible and learners should be allowed to explore these, rather than being directed towards one particular solution.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- When learners have had adequate time to complete a worksheet, bring them together to share, compare and evaluate their work.
- Encouraging learners to reflect on how they solved a particular problem will help them to adapt this solution for use in other contexts.

| Clocks                                                                              | Activity 2: Novelty clocks | Worksheet 2 |
|-------------------------------------------------------------------------------------|----------------------------|-------------|
| <b>Name:</b> .....                                                                  |                            |             |
| Complete this clock face as accurately as you can.                                  |                            |             |
|  |                            |             |
| The time on my clock is .....                                                       |                            |             |

# Some examples of classroom practice – Worksheet 2

Cerys decided that she would begin by finding the centre of the clock face. She did this by drawing the vertical line joining the two given numerals and then measured it to find its midpoint. Cerys then used her protractor to help construct a horizontal line through the midpoint, before marking the positions of the numerals III and IX. Finally, Cerys used the horizontal line as a reference point for measuring successive angles of  $30^\circ$  in order to position the remaining numerals.

Although Cerys has not drawn a circle, its use is implicit in her work. The lines she has drawn are actually radii of any circle centred at the midpoint of the clock face. The points at which these radii meet the edges of the rectangular clock face determine the position of the numerals. This means that the numerals are positioned unequally along each vertical edge of the rectangle, although overall the clock face is symmetrical.

Luke used a similar method to Cerys in order to identify the midpoint of the rectangle and the positions of the numerals III and IX. However, Luke has not appreciated the rotational nature of the movement of the clock hands. Consequently, he has not used angular measure, but has attempted to place the remaining numerals at equal distances along the two vertical edges of the clock face.

Although the numerals are written, no actual marks have been made to indicate their exact position. This means that, except for the identification of the midpoint, there is little evidence on which to base an assessment of Luke's measuring skills.

The lack of marks to indicate the positions of the numerals was also noted by Luke's classmates during their evaluation of his work. It was agreed that this made it difficult 'to tell the time' and that one of the success criteria should be that these marks are clearly shown and should be in the direction the clock hands point when indicating the time (see Cerys's clock above).

| Clocks                                                | Activity 2: Novelty clocks | Worksheet 2 |
|-------------------------------------------------------|----------------------------|-------------|
| Name: <u>Cerys</u>                                    |                            |             |
| Complete this clock face as accurately as you can.    |                            |             |
|                                                       |                            |             |
| The time on my clock is <u>4:55 or 5 minutes to 5</u> |                            |             |

| Clocks                                             | Activity 2: Novelty clocks | Worksheet 2 |
|----------------------------------------------------|----------------------------|-------------|
| Name: <u>Luke</u>                                  |                            |             |
| Complete this clock face as accurately as you can. |                            |             |
|                                                    |                            |             |
| The time on my clock is <u>3:00</u>                |                            |             |

## Activity 2 | Novelty clocks

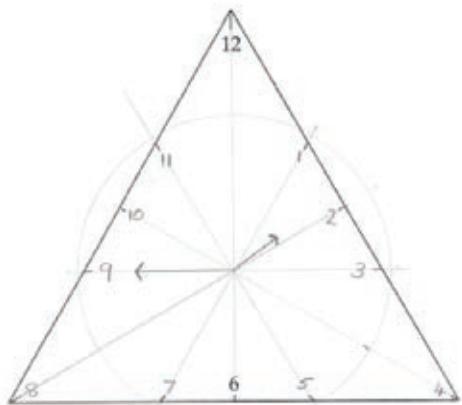
### Some examples of classroom practice – Worksheet 3

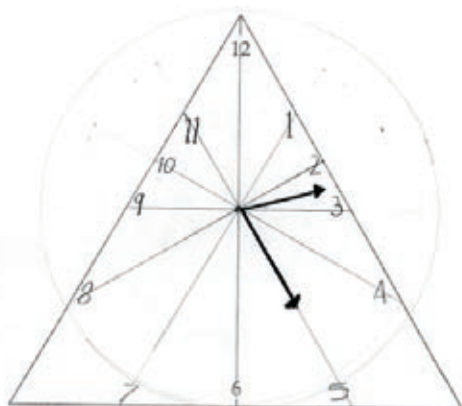
Rhys has provided an impressive solution.

After discussion with the teacher and his group members, Rhys decided he would find the 'centre' (centroid) of the triangle by joining each of its vertices to the midpoint of the opposite side of the triangle. This, he said, would show him where to put the hands of the clock. However, having found the 'centre', Rhys realised that if he drew a circle about this point, 'It will be just like putting numbers round an ordinary clock'.

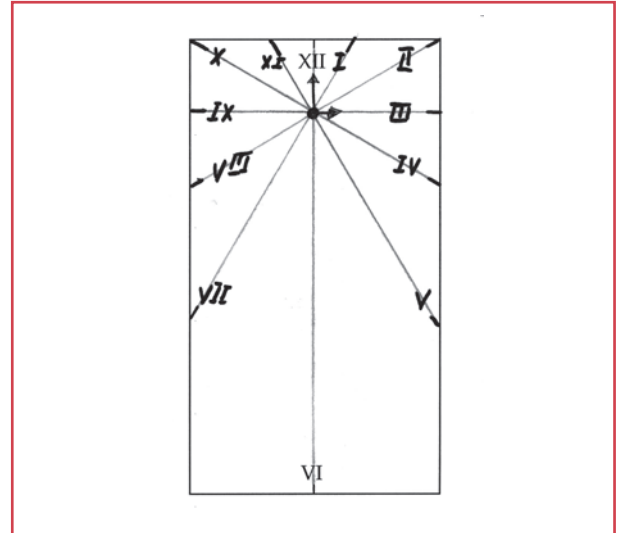
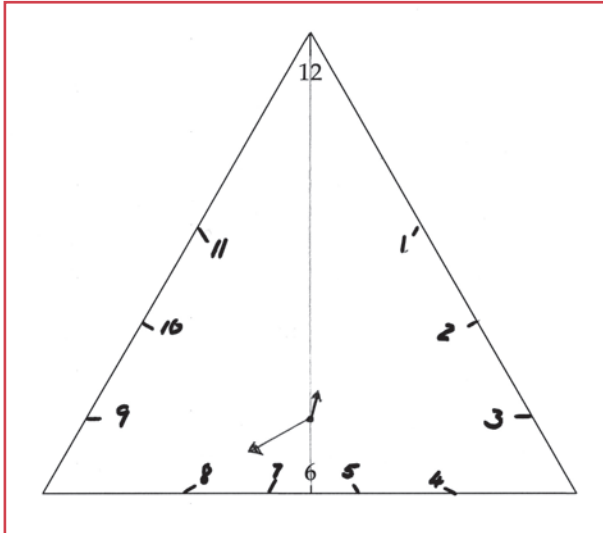
As well as writing in the numerals, Rhys has shown clearly the position on the clock face to which the hands would need to point in order to indicate the time. The hands themselves are of an appropriate length and will remain within the triangular frame as they rotate. These features all take account of the success criteria agreed by learners when considering earlier worksheets.

Lauren provided a similar solution, but did not use the centroid of the triangle as the centre of her circle. In this instance, the midpoint of the vertical line joining the numerals 6 and 12 has been used, which has resulted in the numerals being placed in different positions to Rhys's numerals. However, the method used is equally appropriate.

| Clocks                                                                             | Activity 2: Novelty clocks | Worksheet 3 |
|------------------------------------------------------------------------------------|----------------------------|-------------|
| Name: <u>Rhys</u>                                                                  |                            |             |
| Complete this clock face as accurately as you can.                                 |                            |             |
|  |                            |             |
| The time on my clock is <u>Quarter to two</u> or <u>1:45</u>                       |                            |             |

| Clocks                                                                               | Activity 2: Novelty clocks | Worksheet 3 |
|--------------------------------------------------------------------------------------|----------------------------|-------------|
| Name: <u>Lauren</u>                                                                  |                            |             |
| Complete this clock face as accurately as you can.                                   |                            |             |
|  |                            |             |
| The time on my clock is <u>25 past 2 (2:25)</u>                                      |                            |             |

In fact, any point on the vertical line joining the numerals 6 and 12 can be chosen as the centre of the circle and any sized circle can be used. Different centres will, of course, lead to different distributions of the numerals, but the clocks themselves will all be functional. These comments also apply to the rectangular clock face shown on Worksheet 2 and an example of each is shown below.



Finally, Honor's work is typical of those learners who fail to recognise the need to place numerals in a circular configuration.

| Clocks                                                                              | Activity 2: Novelty clocks | Worksheet 3 |
|-------------------------------------------------------------------------------------|----------------------------|-------------|
| <p>Name: <u>Honor</u></p> <p>Complete this clock face as accurately as you can.</p> |                            |             |
|                                                                                     |                            |             |
| <p>The time on my clock is <u>4 o'clock</u></p>                                     |                            |             |

Honor has simply placed numerals at equal distances along each side of the triangle. As in similar cases, this provides evidence of her ability to measure linear distances, but does not result in a clock face that can be used to read time.

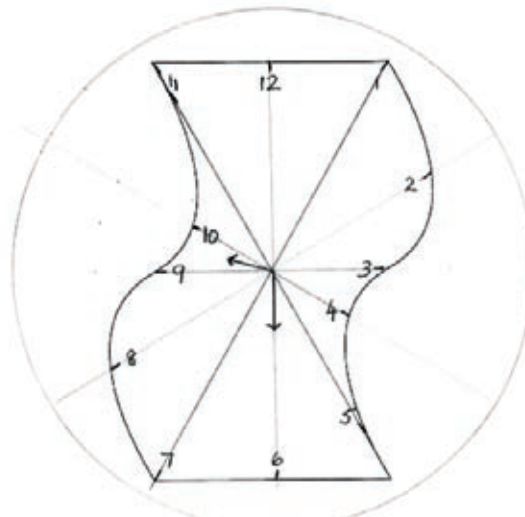
## Activity 2 | Novelty clocks

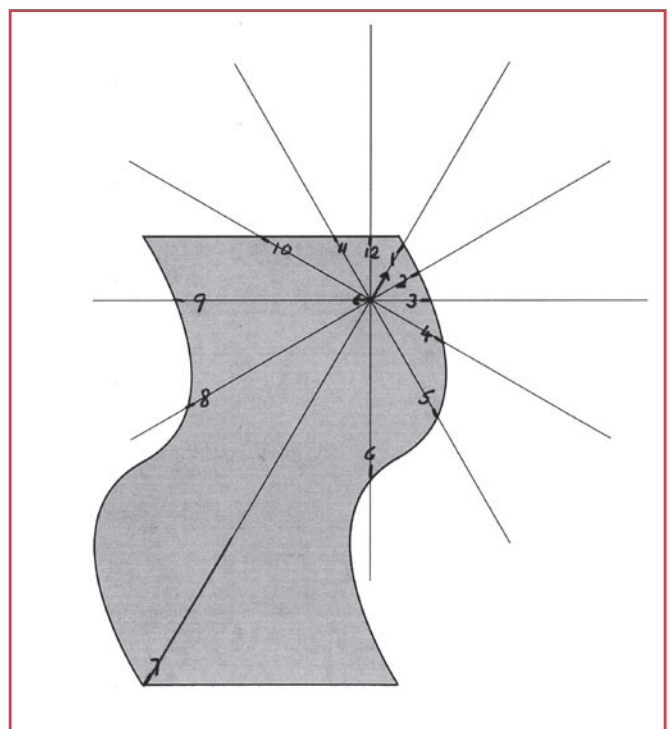
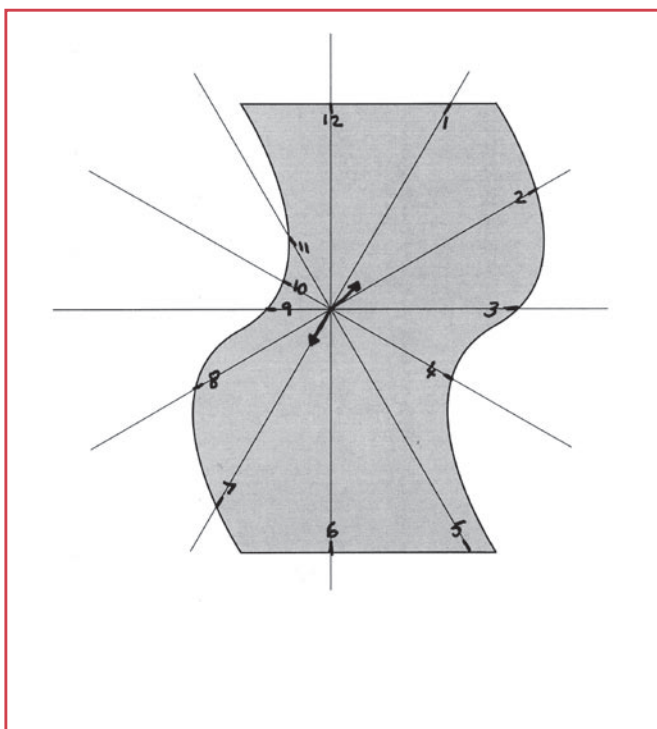
### Some examples of classroom practice – Worksheet 4

Katie began by positioning the numerals 12 and 6 at the midpoints of the top and bottom edges of the clock face. She then drew the vertical line joining the two points and found the centre of the clock face by measuring halfway along this line. Katie used a pair of compasses to construct a circle about this point and then a protractor to find the position of the remaining numerals.

Katie has recalled the success criteria that learners agreed earlier. She has ensured that the hands of the clock do not extend beyond the clock face as they rotate, and has used appropriately angled markers to indicate the positions of the numerals.

Katie's method has involved using the centre of the clock face as the centre of her circle. However, it is interesting to note that Katie could have used any point on the clock face for this purpose. Photocopying Worksheet 4 and positioning a prepared overlay (see page 35) at a variety of different points, (see examples below) provides an effective way of allowing learners to explore this phenomenon.

| Clocks                                                                              | Activity 2: Novelty clocks | Worksheet 4 |
|-------------------------------------------------------------------------------------|----------------------------|-------------|
| Name: <u>Katie</u>                                                                  |                            |             |
| Complete this unusual clock face as accurately as you can.                          |                            |             |
|  |                            |             |
| The time on my clock is <u>9:30</u>                                                 |                            |             |



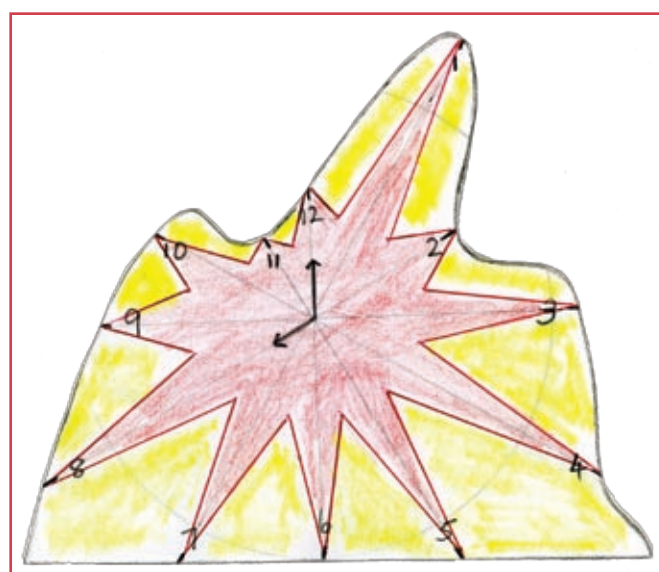
## An example of classroom practice – adapting Worksheet 5

In one school, the teacher decided to use Worksheet 5 as the basis of a design and technology project. The purpose of the task was to offer learners the opportunity to use the skills and knowledge they had developed by completing the various clock faces, to design their own clock faces. Prior to the introduction of this task, the teacher encouraged learners to research clock designs by using the internet, inspecting catalogues and studying clocks in their homes.

The teacher introduced the task by asking the learners to consider a number of questions:

- Who are you designing your clock for?
- Where would you want to see it used – a kitchen, a bedroom, a shop, a school, a café, an office, or somewhere else?
- What design features do you think you would like to include?
- Are you going to use numerals or symbols of some kind?
- Is your design likely to be adventurous or more conventional?
- How will you evaluate your design?

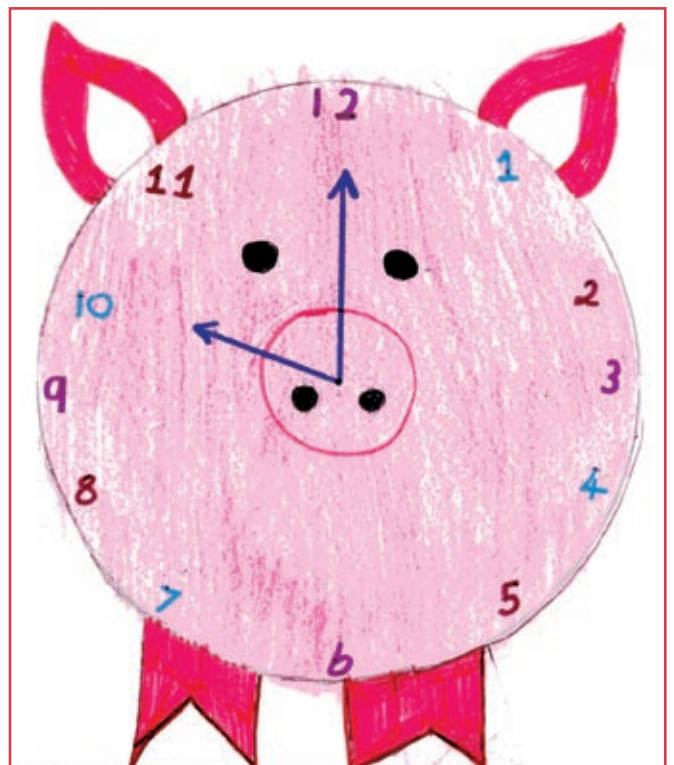
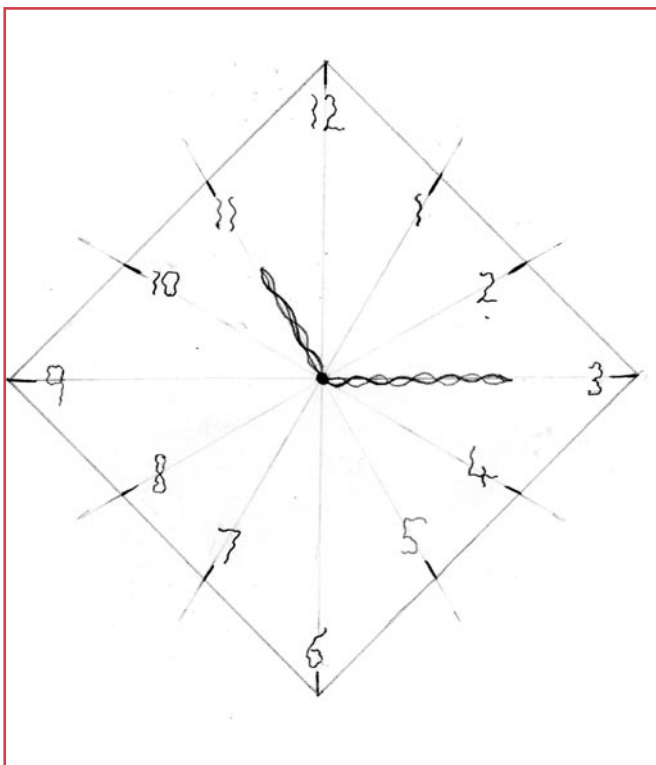
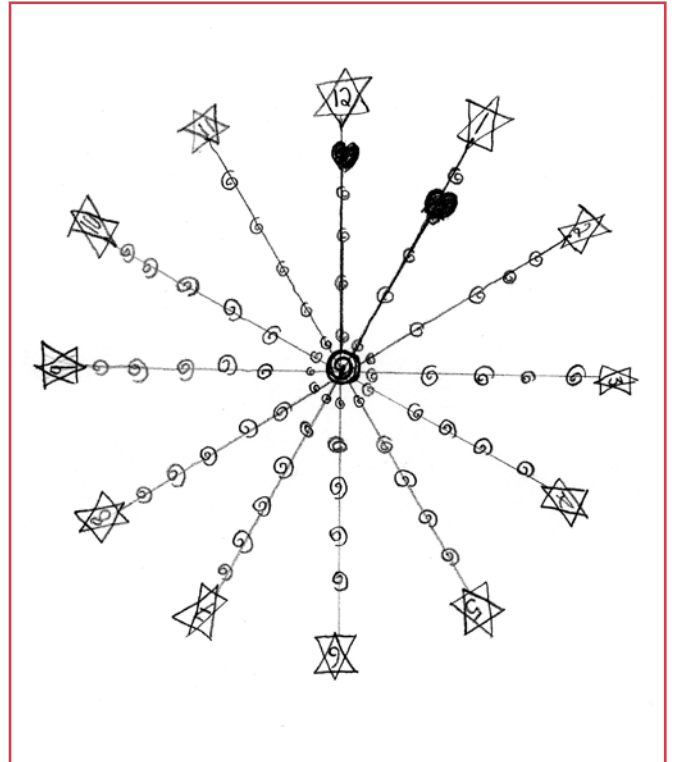
To ensure that the task was inclusive, the teacher produced a template similar to the overlay. This template was photocopied and made available to those learners requiring particular support. The illustration opposite shows how one learner used the template to produce a particularly attractive design, which he has cut out and coloured.



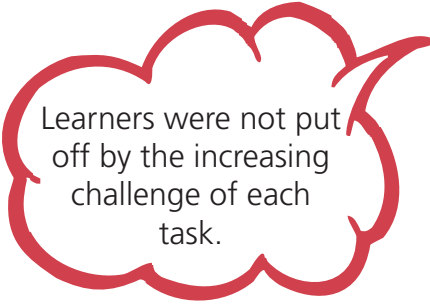
## Activity 2 | Novelty clocks

When all the clocks were complete, the learners were asked to display them so that they could be evaluated.

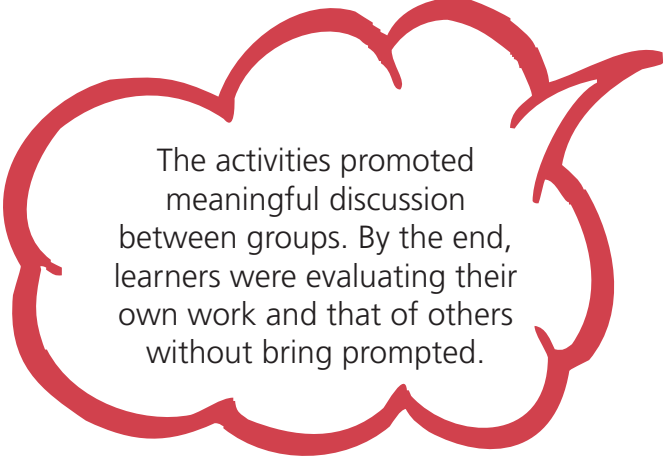
Some of the clocks that the learners produced are shown below. Although there are varying degrees of success in relation to the accuracy achieved, each of the learners concerned was able to demonstrate their ability to use number, thinking and communication skills while engaging with the task.



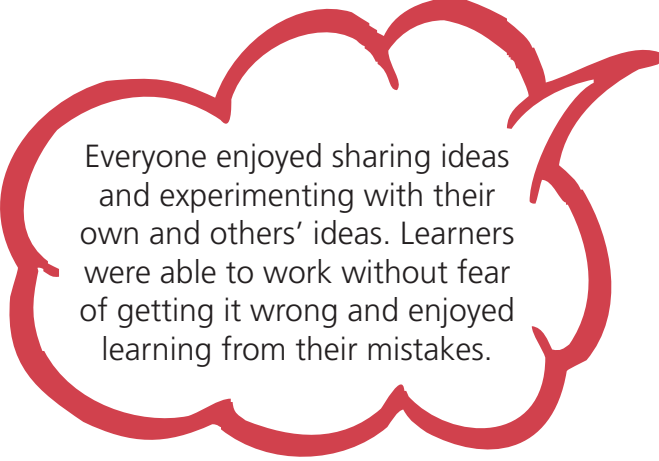
## What some teachers said about the activity



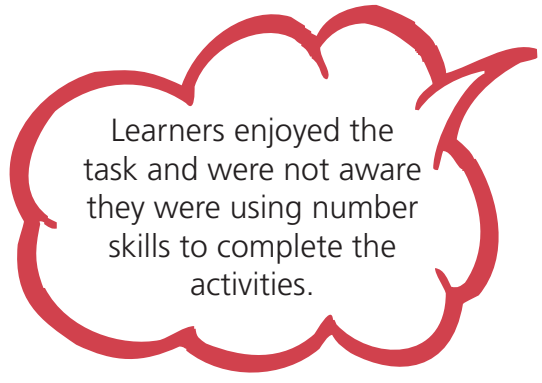
Learners were not put off by the increasing challenge of each task.



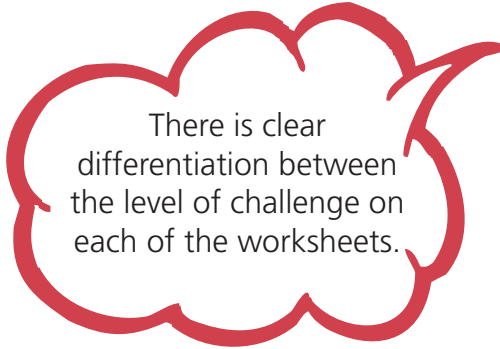
The activities promoted meaningful discussion between groups. By the end, learners were evaluating their own work and that of others without being prompted.



Everyone enjoyed sharing ideas and experimenting with their own and others' ideas. Learners were able to work without fear of getting it wrong and enjoyed learning from their mistakes.



Learners enjoyed the task and were not aware they were using number skills to complete the activities.



There is clear differentiation between the level of challenge on each of the worksheets.



At all times learners were fully engaged.

### What to look for

#### Measuring

When comparing clocks, positioning numerals and/or completing clock faces, are learners able to:

- make direct comparisons of the physical properties of two or more clocks, e.g. by shape, size or design (Cell 1)
- measure and compare linear distances, e.g. the length of a chord, the diameters of a circle, the sides of a rectangle or triangle (Cell 2)
- choose appropriate instruments for the task and use these to an appropriate degree of accuracy, e.g. by using a protractor to measure and construct angles to an accuracy of  $\pm 3^\circ$  (Cell 3)?

#### Talking about and explaining work

When comparing clocks, completing clock faces and/or reporting back, are learners able to:

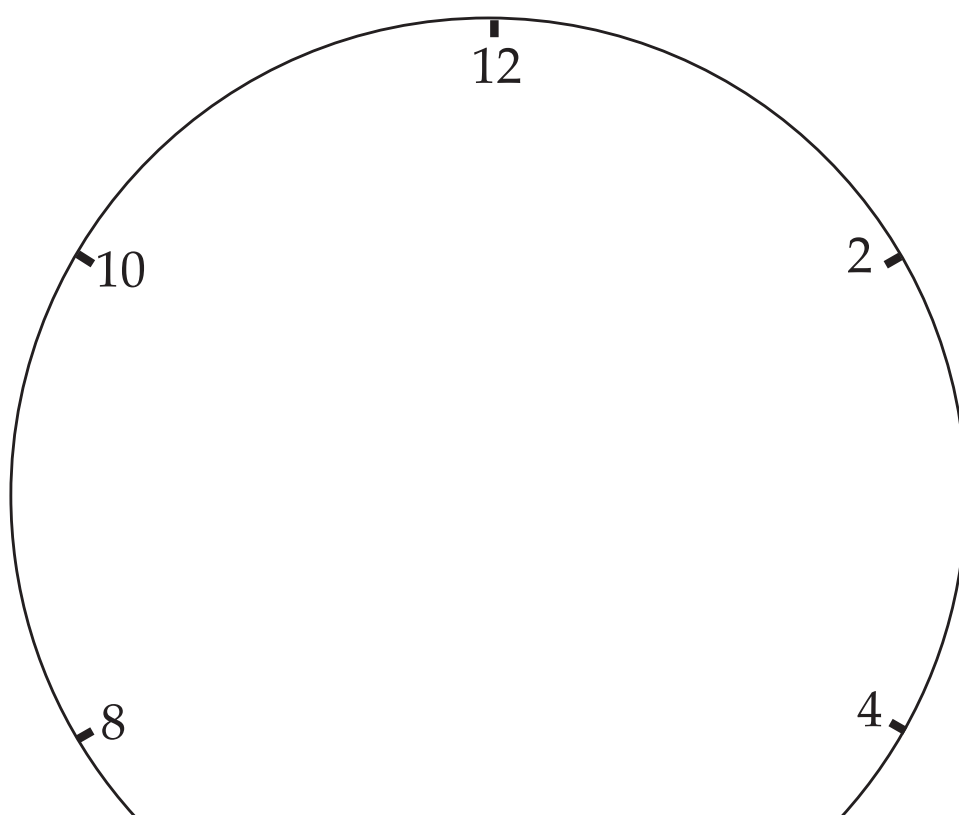
- talk about what they have done, referring to some of the numbers they have encountered (Cell 1)
- use the language of number, shape and comparatives, e.g. when comparing the clock faces they have produced (Cell 2)
- use the language of position, movement and measures to explain the methods used, evaluating the outcomes of their own work and those of others in a constructive manner (Cell 3)?



**Name:** .....

Complete this clock face by adding the missing numbers and the hands.

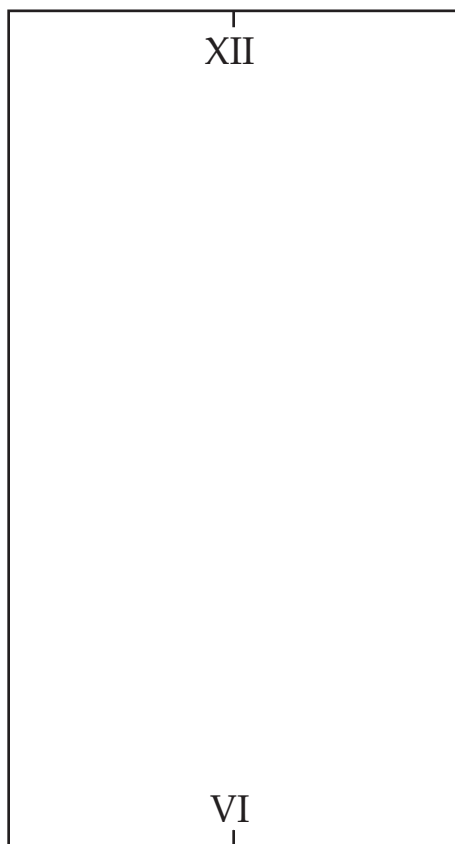
Think carefully about where to put the numbers and the length of the hands.



The time on my clock is .....

**Name:** .....

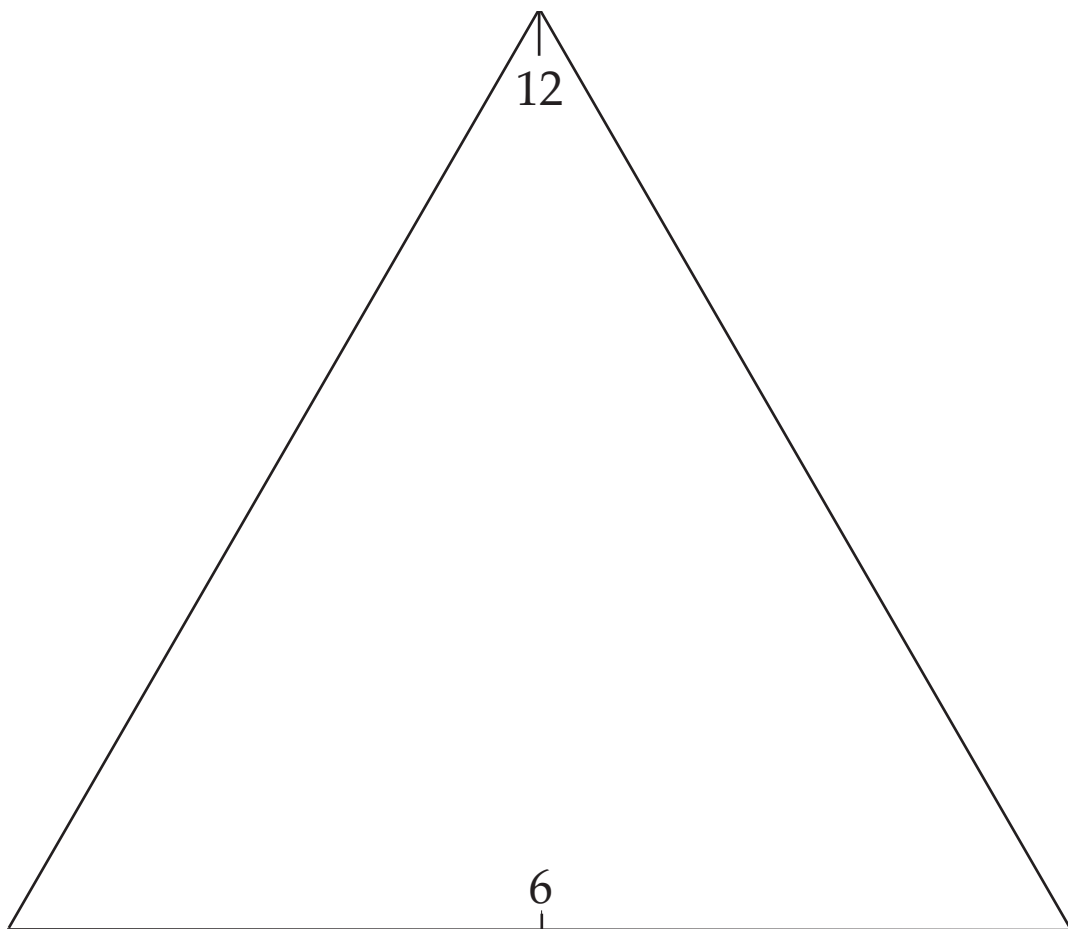
Complete this clock face as accurately as you can.



The time on my clock is .....

Name: .....

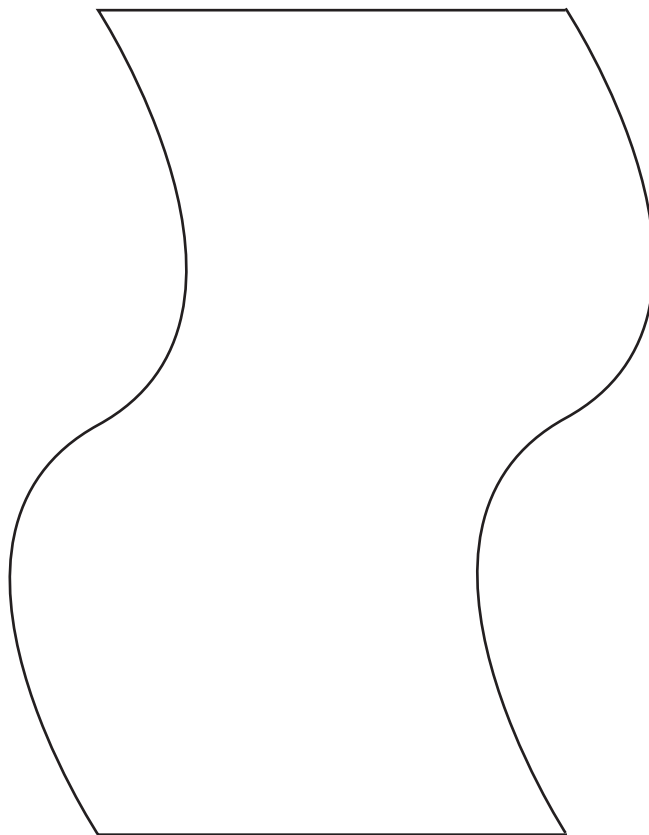
Complete this clock face as accurately as you can.



The time on my clock is .....

**Name:** .....

Complete this unusual clock face as accurately as you can.



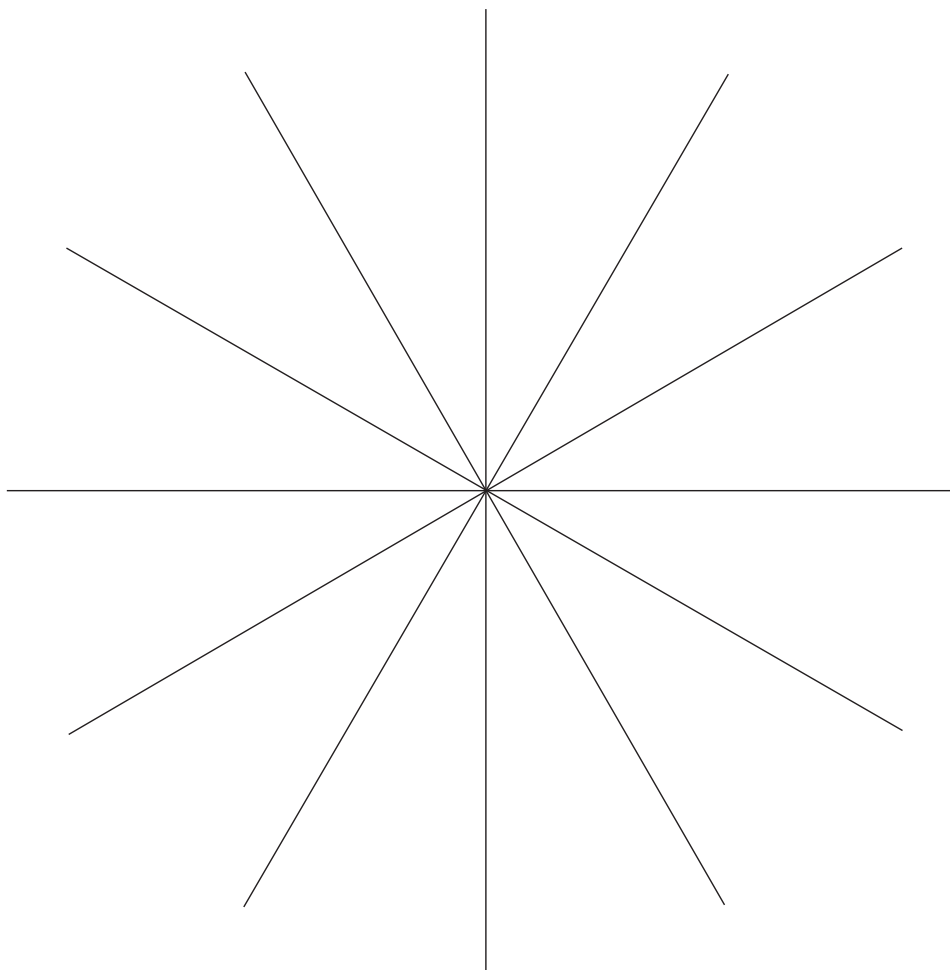
The time on my clock is .....

**Name:** .....

Design your own modern clock face.

Discuss your design ideas with a partner before you begin.

The time on my clock is .....



Photocopying this diagram onto an acetate sheet will produce an overlay that can be used to check the accuracy of learners' clock faces. Alternatively, print the relevant page from the CD-ROM and use this to produce the acetate.





