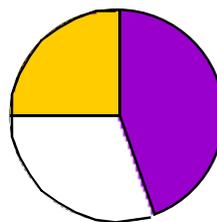


Pie Charts



A **pie chart** shows how something is divided into parts - it is a good way of showing the **proportion** (or fraction) of the data that is in each category.

To draw a pie chart:

1. **Find the total** number of items.
2. **Find how many degrees represent each item** by dividing 360° by the total.
Put this value into your calculator's memory so that you can recall it when needed.
3. **Calculate the angle for each category** by multiplying the number of degrees per item by the number of items in the category.
4. **Check** the angles add up to 360° .
5. **Write a title** to say what information the pie chart gives.
6. **Draw a circle** and **divide it into sectors** using the angles you have found.
7. **Include a key** to show what each sector represents or **label** each sector of the pie chart.

Work through this example:

A shop sells different sizes of gloves.
The table shows the percentage of gloves sold in a year that were each size.

Size	% of gloves sold
Small	14%
Medium	40%
Large	35%
Extra Large	11%

As the values are percentages, the total must be 100% (but check to make sure).

Each % will be represented by:

$$\frac{360^\circ}{100} = 3.6^\circ$$

The table shows how to find the first angle.

Size	% of gloves sold	Angle (nearest $^\circ$)
Small	14%	$14 \times 3.6 = 50^\circ$
Medium	40%	
Large	35%	
Extra Large	11%	
Total	100%	

Use your calculator to check this angle, then work out the others.

Check that the total angle is 360°

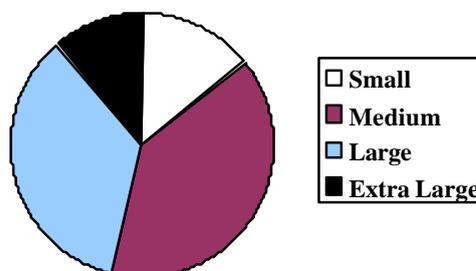
The pie chart is shown here – check that its angles agree with those you have found.

Note

Sometimes rounding the angles leads to a total angle of more or less than 360° .

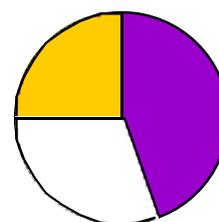
If this happens, adjust the angle of the largest sector so that the total is correct eg if the total comes to 361° , take 1° away from the largest angle.

Glove sizes sold in a shop



Pie Charts

Worksheet



- 1 The table shows the number of students in a class who achieved each grade.

Grade	Number of students
Distinction	5
Merit	8
Pass	9
Fail	2

- a Use this data to draw a pie chart.
 b According to your chart which grade had
 i the largest proportion of students
 ii the smallest proportion?

- 2 The table shows the results of a survey in which people who moved house were asked to give the main reason.

Reason	%
Needed different size of house	19
Personal (eg marriage, divorce)	34
To move to a better area	9
Job-related reason	12
Other	26

- a Use this data to draw a pie chart.
 b Describe briefly what your pie chart shows.

- 3 The table gives the population of different regions of the world in 2001.

Region	Population (millions)
Asia	3721
Africa	813
Europe	726
Latin America	527
North America	317
Oceania	31

- a Draw a pie chart.
 b Describe briefly what your pie chart shows.

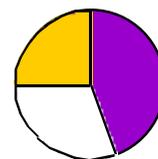
- 4 The table below gives the population and area of each country in the UK in 2001.

Country	Area (000 km ²)	Population (millions)
England	130.4	49.2
Northern Ireland	13.6	1.7
Scotland	78.1	5.1
Wales	20.8	2.9

- a Use the area data to draw a pie chart.
 b Use the population data to draw a pie chart.
 c Explain what your charts show.



Comparative Pie Charts



When you wish to draw pie charts from different quantities of data, the size of the pie charts should reflect the quantities of data represented.

If the first pie chart represents a total of n_1 items and the second represents a total of n_2 items, then the areas of the pies should be proportional to these totals.

This gives:

$$\frac{\pi r_2^2}{\pi r_1^2} = \frac{n_2}{n_1} \quad \text{so} \quad \frac{r_2}{r_1} = \sqrt{\frac{n_2}{n_1}} \quad \text{and} \quad r_2 = r_1 \sqrt{\frac{n_2}{n_1}}$$

so the radius of the second pie should be $\sqrt{\frac{n_2}{n_1}}$ times the radius of the first pie.

Work through this example:

The table gives the number of male and female officers in different ranks of the police force in England and Wales in 2002.

Rank	Number of Officers	
	Female	Male
Constable	20 137	79 351
Sergeant	1 953	16 621
Inspector & Higher Ranks	695	8 511
Total	22 785	104 483

If pie charts are used to illustrate this data, the radius of the pie chart for male officers should be $\sqrt{\frac{104\,483}{22\,785}} = \sqrt{4.5856} = 2.14$ times that for female officers.

The angle for each female officer is $\frac{360^\circ}{22\,785} = 0.0158^\circ$ (to 3sf)

Check this on your calculator then multiply by the number of female officers in each rank to check the angles given in the table below.

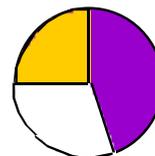
Rank	Number of Officers	
	Female	Male
Constable	318°	
Sergeant	31°	
Inspector & Higher Ranks	11°	
Total	360°	

Complete the table to give angles for each rank for male officers.

Draw pie charts to illustrate the data – remember that the radius of the circle representing the male officers should be 2.14 times that for the female officers.



Comparative Pie Charts



Worksheet

- 1 The number of households in Great Britain increased from 18.6 million in 1971 to 24.4 million in 2002. The table below shows how the percentage of households of different sizes changed over this period.

Household Size	Percentage in 1971	Percentage in 2002
One person	18	29
Two people	32	34
Three people	19	16
Four people	17	14
Five people	8	5
Six or more people	6	2

Draw pie charts for 1971 and 2002 and describe the similarities and differences.

- 2 The table below shows the proportion of the male and female population in the UK of different marital status in 1971 and 2000. The male population increased from 27.2 to 28.8 million and the female population from 28.8 to 30.2 million over this period.

Marital Status	Percentage in 1971		Percentage in 2000	
	M	F	M	F
Single	24	19	34	26
Married	71	65	54	52
Widowed	4	15	4	13
Divorced	1	1	8	9

- a Draw pie charts for the males and females for each of 1971 and 2000.
 b Describe the similarities and differences.
- 3 The table below gives estimates of the air pollutants from different sources in the UK in 2000.

Source	Carbon Monoxide	Sulphur Dioxide	Nitrogen Oxides
Road Transport	69%	1%	42%
Industry & Power	14%	90%	36%
Other	17%	9%	22%
Total (thousand tonnes)	4171	1165	1512

- a Draw pie charts for each pollutant.
 b Write a paragraph describing what your charts show.



Teacher Notes

Units Foundation Level, *Making sense of data*
 Intermediate Level, *Handling and interpreting data*
 Advanced Level, *Using and applying statistics*.

Skills used in this activity:

- drawing pie charts by hand (or in Excel)

Preparation

Students need to know how to use a protractor to draw angles.

Notes

- Students studying *Making sense of data* need only work through the first 2 pages.
- Students studying *Handling and interpreting data* are likely to need to work through all of this activity.
- Students studying *Using and applying statistics* will probably already know how to draw simple pie charts. They may only need to work through pages 3 to 5.

Angles for pie charts**Page 1**

Size	Angle (nearest °)
Small	$14 \times 3.6 = 50^\circ$
Medium	$40 \times 3.6 = 144^\circ$
Large	$35 \times 3.6 = 126^\circ$
Extra Large	$11 \times 3.6 = 40^\circ$
Total	360°

Page 2

1 a

Grade	Angle
Distinction	75°
Merit	120°
Pass	135°
Fail	30°

b i Pass
 ii Fail

2 a

Reason	Angle
Needed different size of house	68°
Personal (eg marriage, divorce)	123°
To move to a better area	32°
Job-related reason	43°
Other	94°

3 a

Region	Angle
Asia	217°
Africa	48°
Europe	43°
Latin America	31°
North America	19°
Oceania	2°

4 a, b

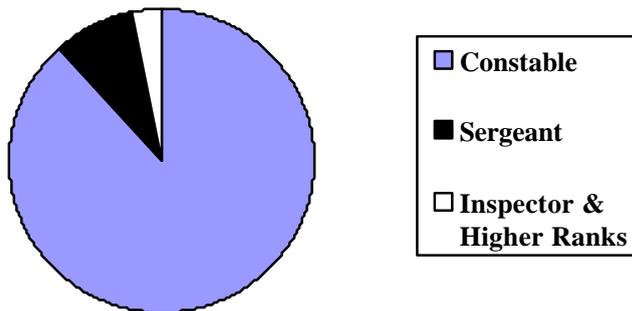
Country	Area angles	Population angles
England	193°	301°
Northern Ireland	20°	10°
Scotland	116°	31°
Wales	31°	18°



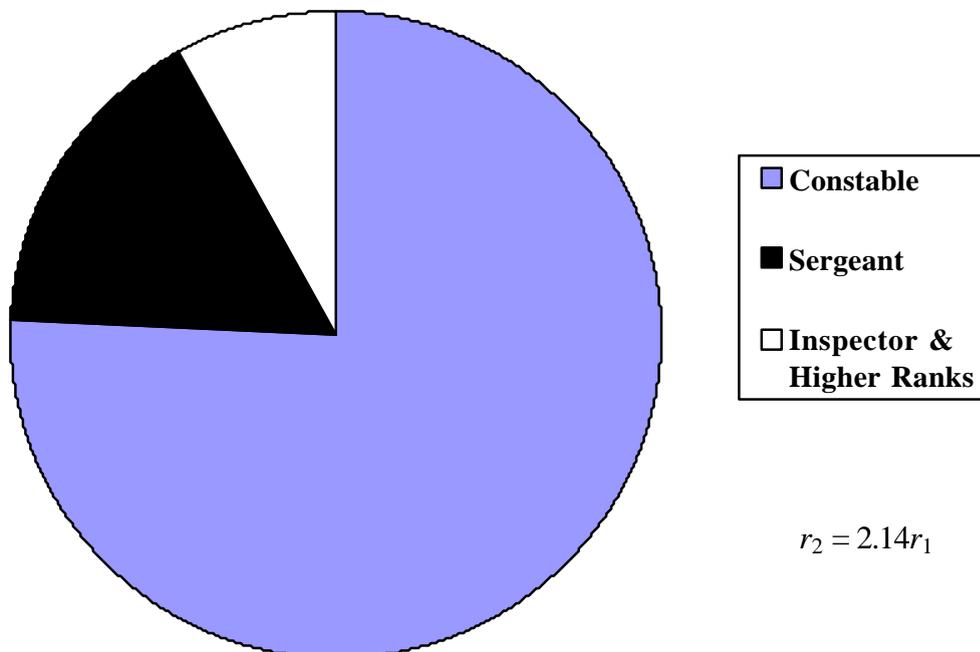
Page 3

Rank	Number of Officers	
	Female	Male
Constable	318°	274°
Sergeant	31°	57°
Inspector & Higher Ranks	11°	29°
Total	360°	360°

Ranks of female police officers in England and Wales in 2002



Ranks of male police officers in England and Wales in 2002



$$r_2 = 2.14r_1$$



Page 4

1

Household Size	Angles for 1971	Angles for 2002
One person	65°	104°
Two people	115°	123°
Three people	68°	58°
Four people	61°	50°
Five people	29°	18°
Six or more people	22°	7°

$$r_2 = 1.15r_1$$

2

Marital Status	Angles for 1971		Angles for 2000	
	M	F	M	F
Single	86°	68°	122°	94°
Married	256°	234°	195°	187°
Widowed	14°	54°	14°	47°
Divorced	4°	4°	29°	32°

$$r_2 = 1.03r_1$$

$$r_3 = 1.03r_1$$

$$r_4 = 1.05r_1$$

(very little difference)

3

Source	Carbon Monoxide	Sulphur Dioxide	Nitrogen Oxides
Road Transport	249°	4°	151°
Industry & Power	50°	324°	130°
Other	61°	32°	79°

$$r_2 = 0.528r_1, r_3 = 0.602r_1$$

