

## D2 DATA HANDLING 2

### A/W 6.1 TO BE SUPPLIED

*This unit will show you how to:*

- Use two-way tables and frequency tables
- Draw pictograms, bar charts and pie charts
- Draw line graphs and frequency polygons
- Draw stem-and-leaf diagrams

**Before you start:**

You should know how to ...	Check in D2
<p>1. Work with percentages For example, to find</p> <p>12% of 60</p> <p>↓ ↓ ↓</p> $\frac{12}{100} \times 60 = 0.12 \times 60 = 7.2$	<p>1. (a) Find 8% of 360. (b) Express 45 as a percentage of 360.</p>
<p>2. Simplify ratios For example, simplify 6 : 15</p> <p>÷3 ( 6 : 15 ) ÷3</p> <p>2 : 5</p>	<p>2. Express the ratio 4 : 8 : 12 in its simplest form.</p>

## 2.1 Two-way tables

A two-way table is a way of linking two pieces of information. The rows show one piece of information and the columns show the other.

### Example 1

The following two-way table describes the audience at a cinema.

	Children	Adults
Male	42	27
Female	69	96

Use the table to find

- (a) how many children were at the cinema
- (b) how many females were at the cinema.
- (c) What was the total audience at the cinema?

(a) Children are represented in the first column:

$$42 + 69 = 111$$

(b) Females are represented in the second row:

$$69 + 96 = 165$$

(c) Add up all sections of the two-way table:

$$42 + 27 + 69 + 96 = 234$$

### Example 2

A survey was conducted on how people travelled to a local supermarket.

195 people were asked and 47 of them were men.

139 people travelled by car and 21 travelled by bus.

Fill in the missing numbers represented by a, b, c and d.

(a) 139 travelled by car, so the missing number is  
 $139 - 31 = 108$

(b) There are 47 men in the survey.  
 So far there are  $31 + 12 = 43$  in the table.  
 So the missing number is 4

*Method of travel*

	Car	Bus	Walk
Men	31	b	12
Women	a	c	d

(c) Look at the bus column.  
 4 was found for the top number.  
 21 travelled by bus.  
 $21 - 4 = 17$

(d) There are  $195 - 47 = 148$  women.  
 $148 - 108 - 17 = 23$

The completed table now becomes:

*Method of travel*

	<b>Car</b>	<b>Bus</b>	<b>Walk</b>
<b>Men</b>	31	4	12
<b>Women</b>	108	17	23

The figures in the table can now be added to check that the total is 195 people.

**Exercise 2A**

1. Kingswood School has an Activities Afternoon for Year 9 pupils. The pupils have two separate sessions and they must choose one activity for each session. The first session has Model-making or Cookery whilst the second session has Athletics or Tennis. The table shows the pupil choices.

	<b>Athletics</b>	<b>Tennis</b>
<b>Model-making</b>	49	21
<b>Cookery</b>	36	43

Use the table to find how many pupils

- (a) chose Athletics
  - (b) chose Tennis
  - (c) there are in Year 9.
2. The table gives the examination level achieved by a number of Mathematics students at Year 9 (Key Stage 3) and then their GCSE grade in Year 11.

		<b>GCSE Grade</b>						
		<b>F</b>	<b>E</b>	<b>D</b>	<b>C</b>	<b>B</b>	<b>A</b>	<b>A*</b>
<b>Key Stage 3 Level</b>	<b>4</b>	1	3	1				
	<b>5</b>		4	29	2			
	<b>6</b>			15	48	4		
	<b>7</b>				36	12	7	
	<b>8</b>						3	2

- (a) How many students achieved an A\* grade?
- (b) How many students achieved a grade C or better in GCSE?

- (c) At Key Stage 3, the average level is a 5 or a 6. How many students achieved an average Key Stage 3 result?
- (d) What was the total number of students included for these results?

3. Pupils in Years 9, 10 and 11 took part in a sponsored walk. A total of 315 pupils took part and 138 were girls. Of these, 75 girls in Year 9 and 15 girls in Year 11 took part.

There was a total of 147 pupils in Year 9 and 111 pupils in Year 10 taking part.

- (a) Copy the table and fill in the missing numbers of pupils.

	<b>Year 9</b>	<b>Year 10</b>	<b>Year 11</b>
<b>Boys</b>			
<b>Girls</b>			

- (b) Use your table to write down the number of
- (i) boys taking part for Year 9
- (ii) girls taking part for Year 10.

4. 450 television executives attended a conference. All those attending completed a questionnaire. The executives were asked whether they were from BBC, ITV, or an independent company. They were also asked how they travelled to the conference, using one of car, train or coach. The total number of executives travelling by train was 82. Out of the total of 83 executives who travelled by coach, 4 were from the BBC. Out of 141 executives from ITV, 89 travelled by car and 36 by train. Out of 196 executives from independent companies, 105 travelled by car.

Design a table to show this data and complete all the entries in your table.

- (a) How many executives were from the BBC and travelled by car?
- (b) How many executives attended from the BBC?
5. The table shows the amount of money earned by employees at a local factory, according to their age group. Each age group has the same number of employees. Write down how many employees

		Age in years		
		Up to and including 20	21–45	Over 45
Wage per week	Up to £120	54	38	4
	£121–£350	18	27	–
	Over £350	3	–	42

- are in the age group ‘up to and including 20’
- work at this factory
- are in the age group ‘21–45 years’ and earn over £350
- are over 45 years old and earn between £121 and £350
- earn between £121 and £350
- are 45 or less and earn over £350.

## 2.2 Tally charts and frequency tables

**Tally charts** provide an effective format for recording original, or **raw**, data.

Suppose you asked 25 pupils in a class to choose their favourite sport from a list. The tally chart might look like this.

Favourite sport	Tally	Frequency
Rugby		2
Swimming		7
Soccer		12
Tennis		3
Orienteering		1

This means 2

When the tally marks are complete, they are counted and the value is recorded in the column headed ‘frequency’

This means 7

Tally charts allow you to show frequencies, or amounts.

Frequencies can be shown in a **frequency table** (like for favourite sport), in a diagram or just in a list.

However you display frequencies, it is known as a **frequency distribution**.

It is often helpful to combine the raw data into a more compact form.

The table records how many pupils in a form group buy a school dinner.

Number of pupils in a form group buying a school dinner	Frequency (or number in class)
0–4	1
5–9	3
10–14	5
15–19	13
20–24	14
25–29	4

This is an example of a **grouped frequency table**. The categories have been merged together into **classes**, or **intervals**.

### Exercise 2B

1. The number of runs scored from each ball during the first 10 overs of a cricket match is listed below.

0,0,0,1,2,3    4,0,1,1,2,0    0,0,0,1,3,4    0,1,3,4,1,0    0,0,1,1,0,1  
 0,0,1,1,2,6    0,1,1,4,6,4    0,1,1,2,1,0    0,0,0,1,1,1    0,6,6,4,3,1

Use a tally chart to obtain a frequency table for the data.

2. The following marks were obtained by pupils in a test.

90 16 22 35 68 19 42 28 19 83  
 61 42 60 18 26 58 82 42 77 59  
 57 63 43 7 35 71 19 18 62 50  
 47 68 75 67 58 69 43 37 35 48  
 59 63 51 43 62 12 19 72 81 34

Use intervals 0–9, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, 80–89, 90–99 to record the data in a frequency distribution using a tally chart.

3. The heights (in centimetres) of 20 children are listed below.

127 111 119 136 125 120 158  
 117 145 147 148 128 142 151  
 149 138 127 146 113 129

Use intervals 110–119 cm, 120–129 cm, 130–139 cm, 140–149 cm, 150–159 cm to draw a tally chart and obtain the frequency table for the data.

#### Hint:

The first column should be headed 'number of runs'.

4. The numbers of caravans parked on a holiday site in Cornwall was recorded over a four-week period in August. The numbers are given in the table.

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
<b>Week 1</b>	12	6	10	22	46	45	38
<b>Week 2</b>	17	7	15	24	41	48	29
<b>Week 3</b>	14	4	17	20	31	46	21
<b>Week 4</b>	15	8	29	32	35	21	41

Choose suitable intervals 0–9, 10–19, etc. to draw a tally chart and obtain the frequency table for the data.

5. Passengers getting onto a local bus during its journey were recorded in one of four categories: woman (W), man (M), boy (B) or girl (G). The results for the information collected are as follows.

M W W W B G M G G B W M  
 M W M W B M W W W W M W  
 B G W M B W W M W M B G

Draw a tally chart to show this information and obtain the frequency distribution for the data.

6. During the first morning of a sale a shoe shop sold the following sizes of shoes.

7 2  $2\frac{1}{2}$  6 6 7 7 8 10  $10\frac{1}{2}$   
 $6\frac{1}{2}$  11 9  $7\frac{1}{2}$  6  $6\frac{1}{2}$   $5\frac{1}{2}$  4 7 7  
 $5\frac{1}{2}$  6 7  $7\frac{1}{2}$  8  $10\frac{1}{2}$  7 7 6  $6\frac{1}{2}$   
 7 8  $8\frac{1}{2}$   $7\frac{1}{2}$  6 5  $5\frac{1}{2}$  5 4  $6\frac{1}{2}$   
 10 8 6  $4\frac{1}{2}$  4 5 6 6 7  $8\frac{1}{2}$

Draw a tally chart to show this data and obtain the frequency distribution for the data.

## 2.3 Pictograms

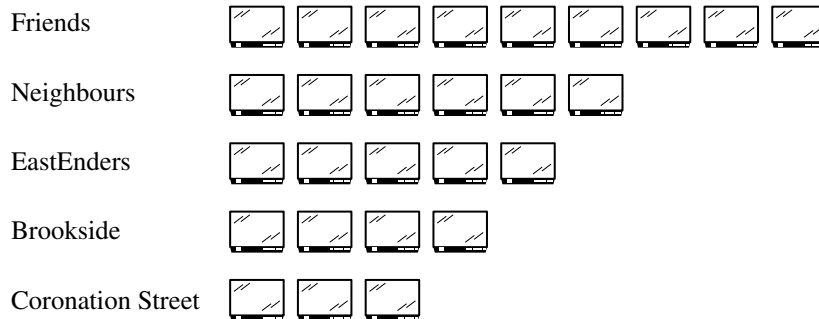
Pictograms are diagrams in the form of pictures, and they are used to present information. Each picture or symbol is used to represent a number of items.



Use the diagram to answer these questions.

- (a) How many copies of the Forest News were sold during the week?
- (b) Estimate how many copies of the South Coast Echo were sold.

2. The pictogram shows the result of a survey of Year 9 pupils to find which was the most popular TV programme.



- (a) Fifteen students chose Coronation Street. How many pupils chose Friends?
- (b) How many students were included in the survey?

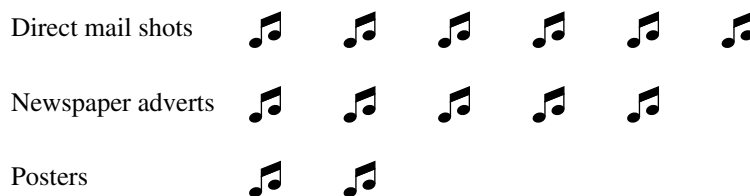
3. Draw a pictogram to illustrate the following data for the makes of a number of cars passing a junction.

Vauxhall	15	Rover	20	Toyota	5
Peugeot	12	Ford	28	Citroen	10

**Hint:**

Choose a car symbol to represent 5 cars. For Peugeot and Ford you will need to draw fractions of a symbol.

4. The pictogram shows the expenditure of a music company in advertising a concert.



The company spent £80 on posters.

- (a) How much was spent on direct mail shots?
- (b) Each direct mail shot cost an average of 80p. How many mail shots did they use?

5. Draw a pictogram to illustrate the following data, which was recorded when a Year 11 class was asked to state their most popular sport.

Football	15
Tennis	8
Hockey	2
Basketball	4
Cricket	2

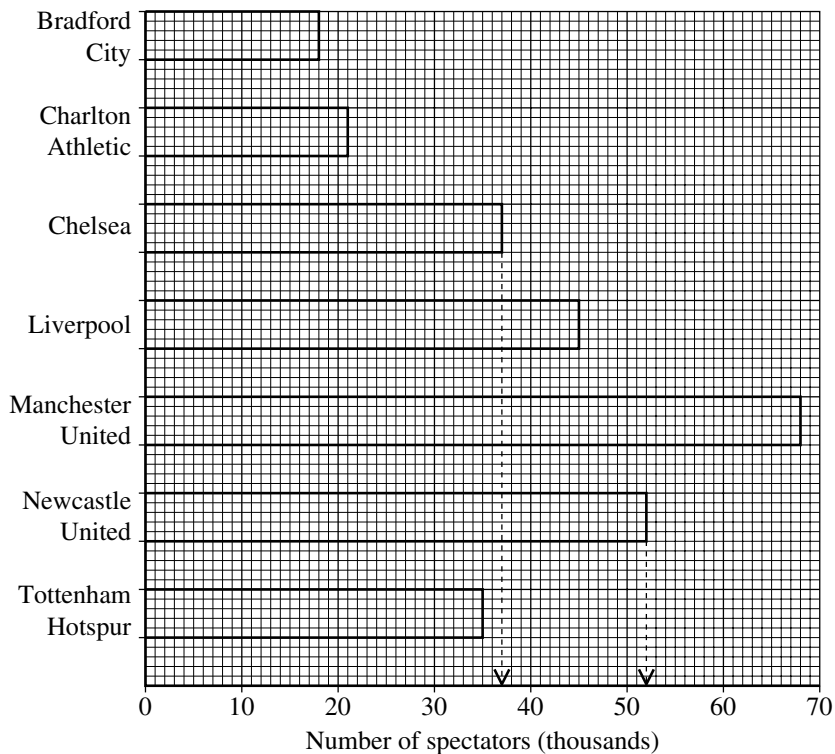
## 2.4 Bar charts

Bar charts show information in a graphical form by the use of bars or columns.

The height or length of the column corresponds to the frequency. Bar charts can be drawn either horizontally or vertically.

### Example 1

The numbers of spectators attending Premier league football matches over one weekend in the 2000–2001 season were recorded. The bar chart shows this information.



- (a) Which football match had 37 000 spectators?  
 (b) How many spectators watched the Newcastle United match?

- (a) Chelsea had 37 000 spectators.  
 (b) The arrow drawn from the Newcastle United bar shows that the crowd was approximately 52 000.

### Sectional bar charts

If data has been subdivided into two or more parts, you can use a **sectional bar chart**.

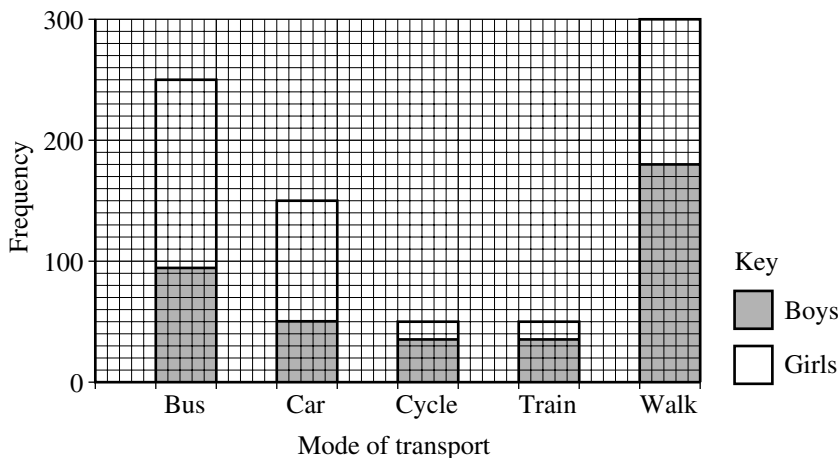
Sectional bar charts are also known as **component bar charts**.

### Example 2

A survey was carried out to discover how the 800 pupils in a school travelled to school.

Method of transport	Boys	Girls
Bus	95	155
Car	52	98
Cycle	35	15
Train	32	18
Walk	185	115

Show the data by means of a sectional bar chart.



This diagram shows the number of boys and girls in each category together with the totals.

### Dual bar charts

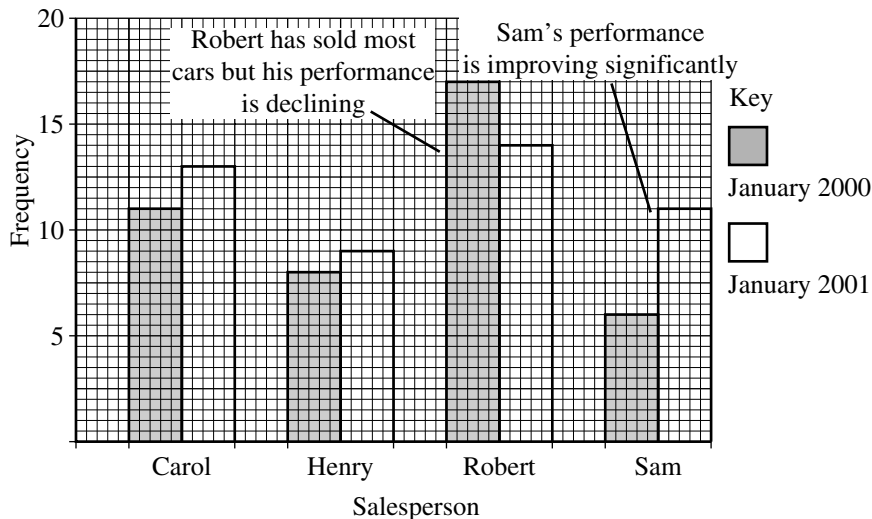
When two different sets of information are given on the same topic, but the **total** is not meaningful, you can use a **dual bar chart**.

#### Example 3

The numbers of cars sold by four sales people working in a garage in January 2000 and January 2001 are given in the table.

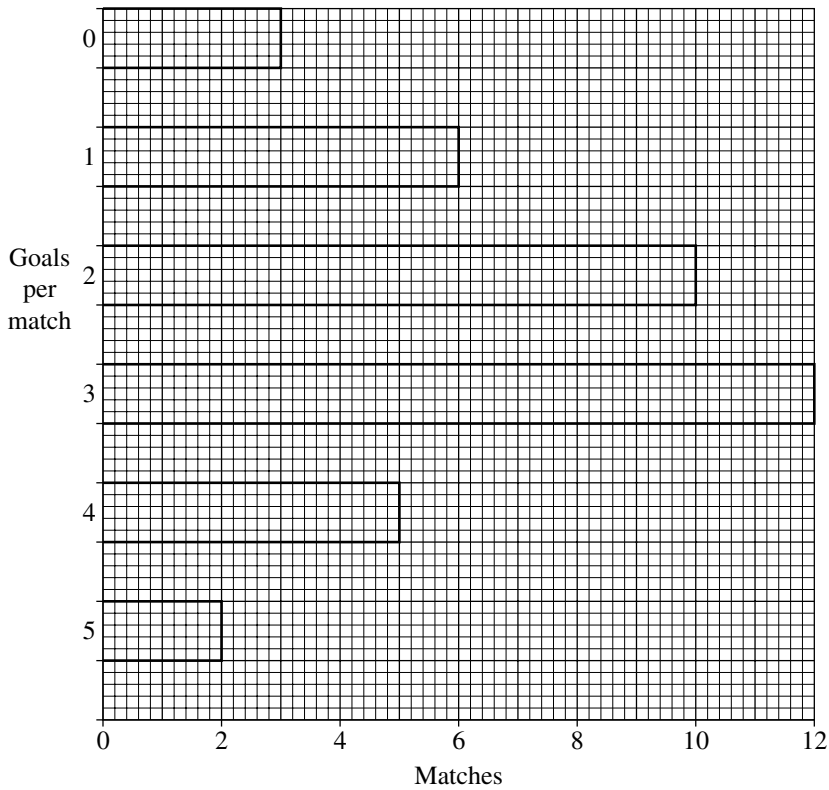
Salesperson	January 2000	January 2001
Carol	11	13
Henry	8	9
Robert	17	14
Sam	6	11

Represent this data by means of a dual bar chart.

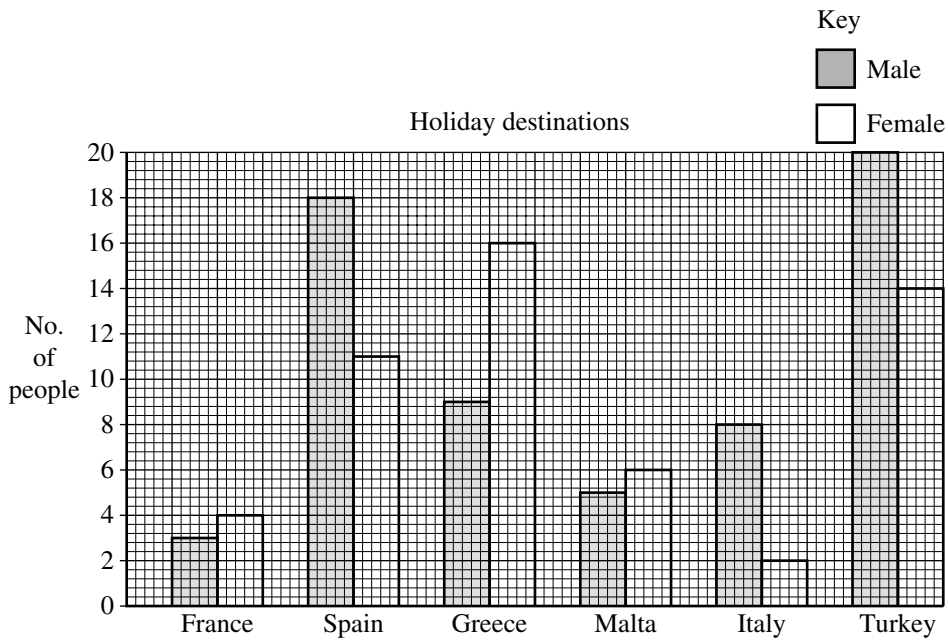


#### Exercise 2D

- The bar chart shows the number of goals scored in football matches in a Sunday league.
  - What number of goals was scored most often in one of these football matches?
  - In how many matches were 4 goals scored?
  - In how many matches were less than 3 goals scored?
  - What was the total number of matches taking place in this Sunday league?



2. The bar chart shows the holiday destinations of a number of people entering an airport during a 30-minute survey.



- (a) Which holiday destination is the most popular for females?
- (b) Which holiday destination is the least popular for males?
- (c) How many males were questioned for the survey?
- (d) What was the total number of people involved in the survey?
- (e) Which is the most popular holiday destination from this survey?

3. On a walk through a wood, the following types of trees were seen:

Oak	65	Chestnut	49
Beech	23	Birch	21
Sycamore	42	Ash	15

Draw a suitable bar chart to illustrate this data.

4. Thirty people noted the television channel they were watching at 7.30 pm on two successive Saturday nights.

Channel	First Saturday	Second Saturday
BBC1	10	5
BBC2	3	1
ITV	11	14
Channel 4	2	2
Channel 5	1	4
Satellite	3	4

Draw a suitable bar chart to illustrate this data.

5. A group of 30 pupils were asked how often they had been swimming last month.

The data was recorded as shown in the table.

No. of times	Boys	Girls
0	5	2
1	6	4
2	1	4
3–5	1	5
Over 5	0	1

Represent this data by means of a bar chart.

## 2.5 Pie charts

### Drawing pie charts

Pie charts are used commonly for displaying qualitative data. In a pie chart, a circular 'pie' is divided into sectors, and each sector is proportional to the size of the class it represents.

To remind yourself what qualitative data means, look back at page 000.

### Example

One evening, 120 people bought the following food from a take-away shop.

Type of take-away	Number of people
Fish and chips	58
Burger and chips	22
Pizza	31
Chinese	9
Total	120

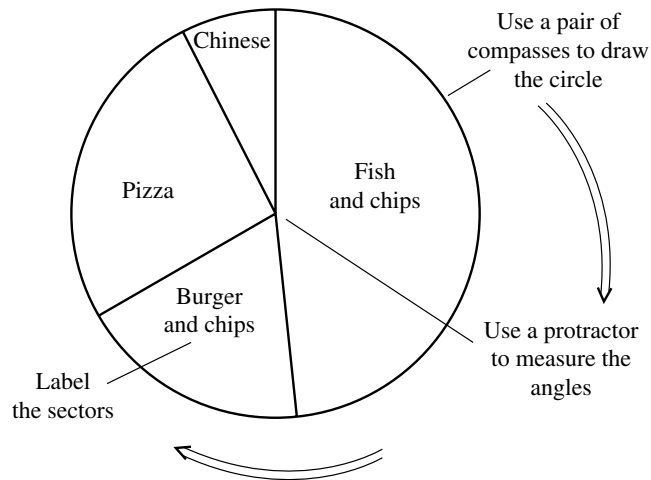
Represent this data by means of a pie chart.

- First calculate the angle which represents each person.  
The complete pie chart is a circle, which contains  $360^\circ$ .  
Hence 120 people are represented by  $360^\circ$ .  
1 person is represented by  $360^\circ \div 120 = 3^\circ$ .  
Thus the angle of the pie chart which represents 1 person is  $3^\circ$ .
- Then calculate the angles for each sector.  
There were 31 people buying pizza.  
Each person is represented by  $3^\circ$ .  
So the pizza sector is represented by  $31 \times 3^\circ = 93^\circ$ .

Similarly for the other categories:

Type of take-away	Angle in pie chart
Fish and chips	$58 \times 3^\circ = 174^\circ$
Burger and chips	$22 \times 3^\circ = 66^\circ$
Pizza	$31 \times 3^\circ = 93^\circ$
Chinese	$9 \times 3^\circ = 27^\circ$
Total	$360^\circ$

- Now draw the pie chart.



### Exercise 2E

1. A box of 60 coloured pencils contains the following number of pencils of each colour.

Colour	Blue	Yellow	Red	Green	Black	Brown
No. of pencils	12	22	5	7	8	6

- (a) What angles in a pie chart would you use to represent each pencil colour?
  - (b) Draw a pie chart to represent the data.
2. During December, 1800 new cars were sold in a town. 750 were sold by Ford, 800 by Vauxhall and 250 by Rover.
    - (a) What angles in a pie chart would you use to represent each make of car?
    - (b) Draw a pie chart to represent the data.
  3. Marion spends her day as shown in the table.

Sleeping	8 hours
Eating	2 hours
Working	9 hours
Watching TV	2 hours
Driving	3 hours

- (a) Calculate the angle of each sector of a pie chart representing this data.
- (b) Draw the pie chart.

4. The numbers of pets kept by pupils in a Year 9 tutor group are shown in the table.

Type of pet	Dog	Cat	Goldfish	Hamster	Bird	Other	None
Number	15	16	10	5	4	1	3

- (a) Calculate the angle of each sector of a pie chart representing this data.  
 (b) Draw the pie chart.
5. Bill earns £150 per week. He divides his money up as follows:

Rent	£35	Travel	£10	Clothes	£25
Food	£45	Savings	£20	Entertainment	£15

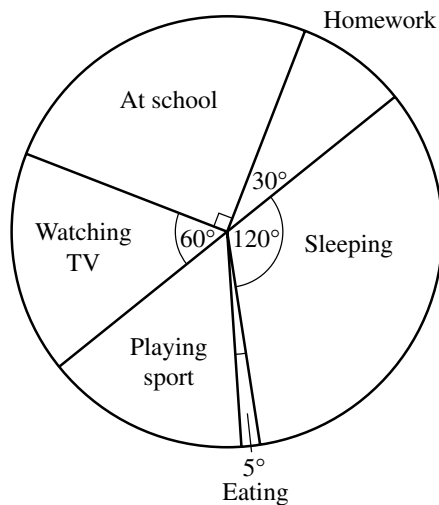
Draw a pie chart to show how Bill divides up his earnings.

## 2.6 Interpreting pie charts

You should now know how to construct pie charts; you also need to know how to interpret them.

### Example

This pie chart shows how Mark spent his time during one 24-hour period.



- (a) How long did Mark spend sleeping?  
 (b) How many hours did Mark spend in total playing sport and watching TV?

- (a)  $120^\circ$  represents the time Mark spent sleeping.

$360^\circ$  represents 24 hours,

so  $1^\circ$  represents  $\frac{24}{360}$  hours,

$\therefore 120^\circ$  represents  $\frac{24}{360} \times 120$  hours.

Hence Mark spent 8 hours sleeping.

- (b) First find the angle that represents playing sport:

The sum of the other sectors angles =  $60^\circ + 90^\circ + 30^\circ + 120^\circ + 15^\circ = 215^\circ$ .

The angle representing playing sport is  $360^\circ - 215^\circ = 45^\circ$ .

$\therefore$  The total angle for playing sport and watching TV is  $60^\circ + 45^\circ = 105^\circ$ .

Now find the time taken for playing sport and watching TV:

$1^\circ$  represents  $\frac{24}{360}$  hours.

Time spent playing sport and watching TV =  $\frac{24}{360} \times 105$  hours.

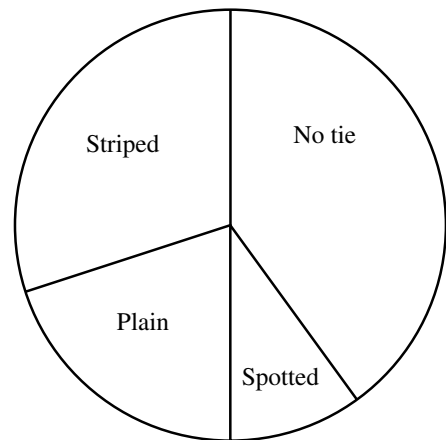
$\therefore$  Mark spent 7 hours watching TV and playing sport.

This is an example of the **unitary method**; you find out what 1 degree equals, and then scale it up to the required amount.

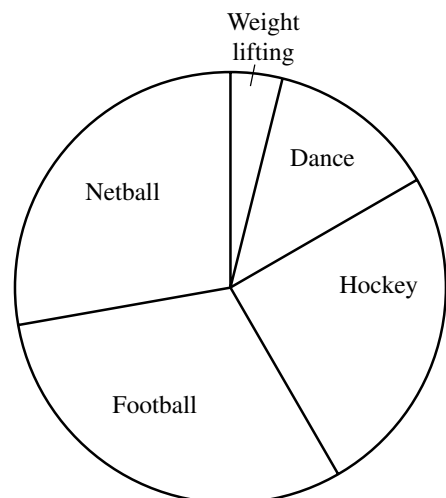
### Exercise 2F

1. The pie chart shows the results from asking forty men about the style of tie they would prefer to wear.

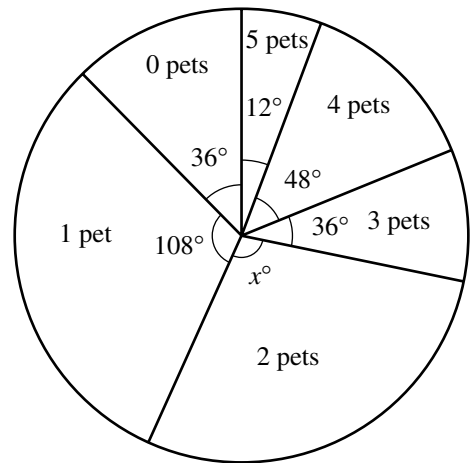
- (a) Measure the angles of each sector of the pie chart. Write down your angles for each style of tie preferred.
- (b) How many degrees in the pie chart represent the response from one man?
- (c) How many men prefer
- striped ties
  - not to wear a tie at all?



2. The pie chart shows the different activities taken by a Year 11 group during their sports afternoon. Netball was chosen by 50 pupils.
- (a) How many degrees are there in each sector of the pie chart? Write down your measurements, stating the angle for each activity.
- (b) How many students chose Dance?
- (c) How many students in total chose Hockey, Netball and Football?

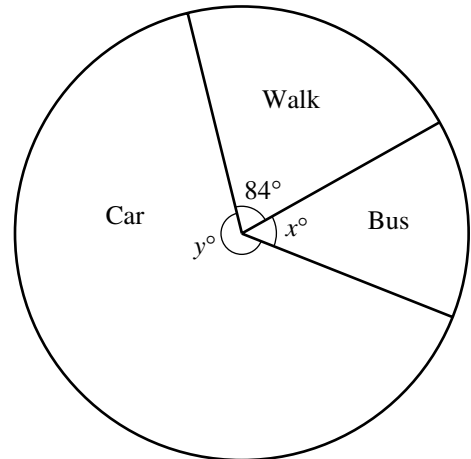


3. A class of 30 pupils drew a pie chart showing the number of pets they each have.
- How many pupils have 4 pets?
  - Calculate the size of the angle marked  $x$ .
  - How many pets do these 30 students have in total?



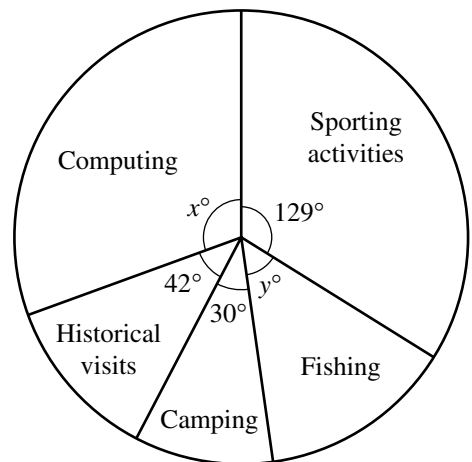
Not drawn to scale

4. In a survey on travel to school, 150 pupils travelled by car, bus or walked. 35 pupils walked to school. If 20 pupils travelled to school by bus and 95 pupils travelled by car, calculate the angles  $x$  and  $y$ .



Not drawn to scale

5. A Year 7 group consisting of 240 pupils selected one activity each for their final week of the summer term. The choices were camping, fishing, computing, historical visits or sporting activities. The pie chart illustrates the choices made by all the pupils. The total number of pupils who chose sporting activities and fishing was exactly equal to the total number of pupils choosing camping, historical visits and computing.
- Calculate the angles  $x$  and  $y$ .
  - How many pupils chose each individual activity?



## 2.7 Line graphs

You can often use a line graph to display continuous variables, such as length or time.

### Example

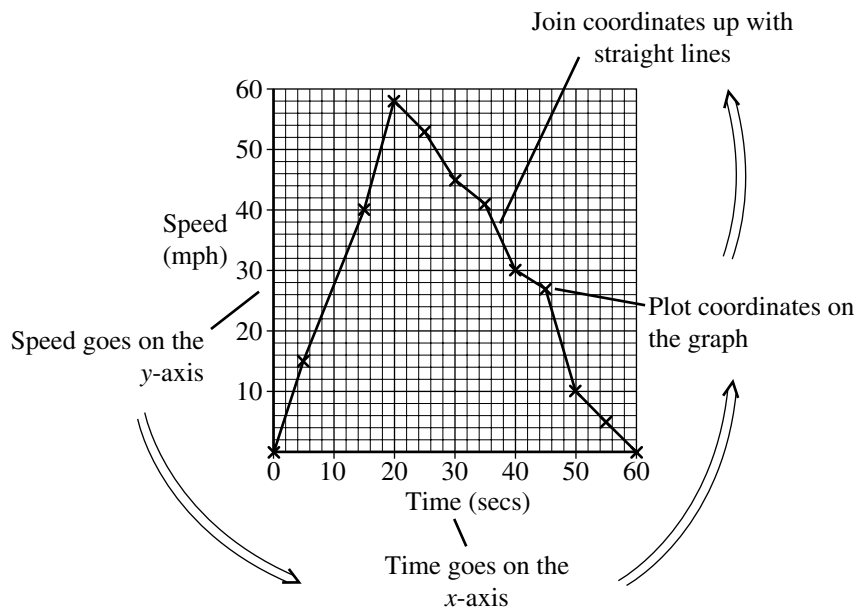
The speed of a car was recorded every 5 seconds as it travelled between two sets of traffic lights.

<b>Time (secs)</b>	0	5	10	15	20	25	30	35	40	45	50	55	60
<b>Speed (mph)</b>	0	15.1	27.2	41.1	58.3	52.7	45.1	40.9	30.5	20.7	10.5	5.3	0

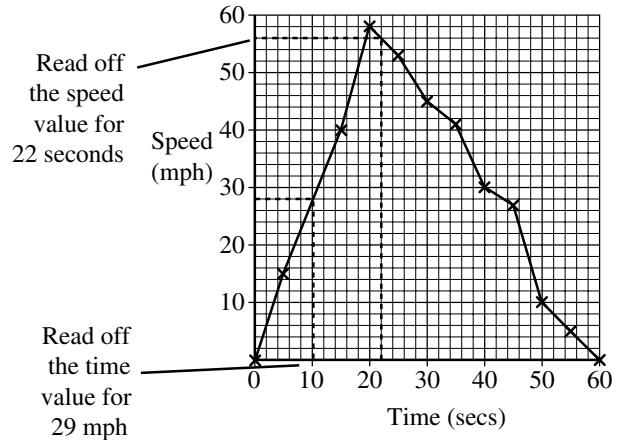
- (a) Represent this data by means of a line graph.  
 (b) Use your graph to estimate  
 (i) the speed of the car after 22 seconds  
 (ii) the time when the speed of the car was 29 mph.

- (a) Take each pair of values in the table as coordinates:  
 (0, 0), (5, 15.1), (10, 27.2), and so on.

Plot a graph on graph paper like this:



- (b) (i) After 22 seconds the speed is roughly 55 mph.  
 (ii) The speed is 29 mph after roughly 11 seconds.

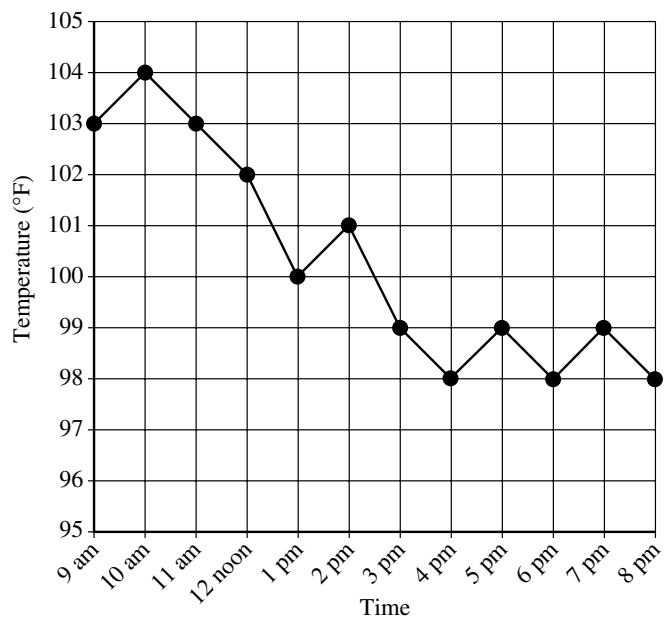


### Exercise 2G

1. A retailer of mobile phones recorded their sales figures at the end of each month for a nine-month period. The sales figures are given in the table.

	1999							2000	
Month	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Phone sales	1200	1050	900	1120	1150	1230	1700	1240	970

- (a) Draw a line graph to illustrate the given data.  
 (b) Consider the trend and comment on any fluctuations in the sales patterns, suggesting reasons why they may happen at those times.
2. A nurse records the temperature, hourly, for a patient admitted to a hospital ward. The graph shows the temperatures recorded.
- (a) The patient was given drugs on entry to the hospital ward. How long did it take before the drugs began to lower the temperature of the patient?  
 (b) By how many degrees did the temperature fall and how long did it take before the temperature began to rise again?

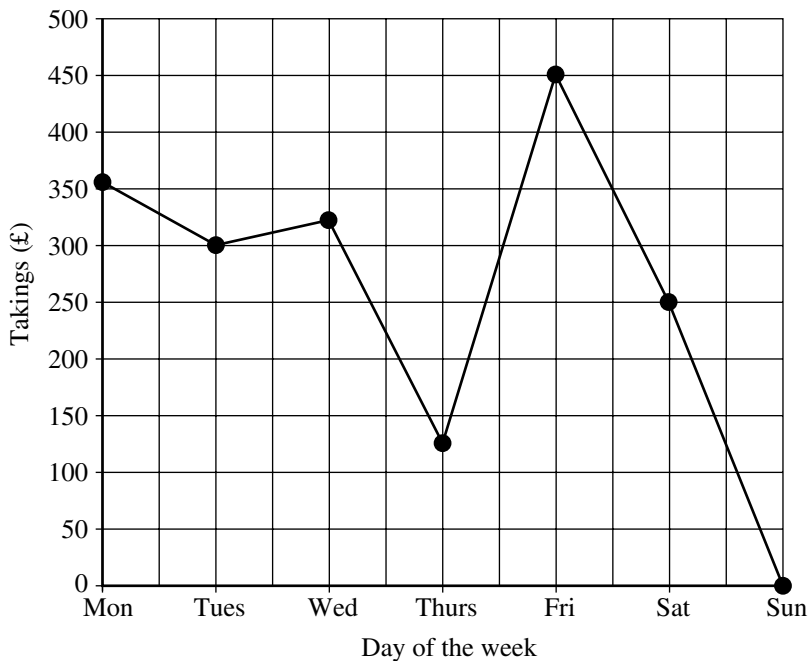


- (c) The normal body temperature is 98.4 °F. How long did it take before the patient's temperature returned to normal?
- (d) Is it possible to estimate the temperature at 1.30 pm? Justify your answer.

3. The table gives the monthly rainfall amounts for one year.

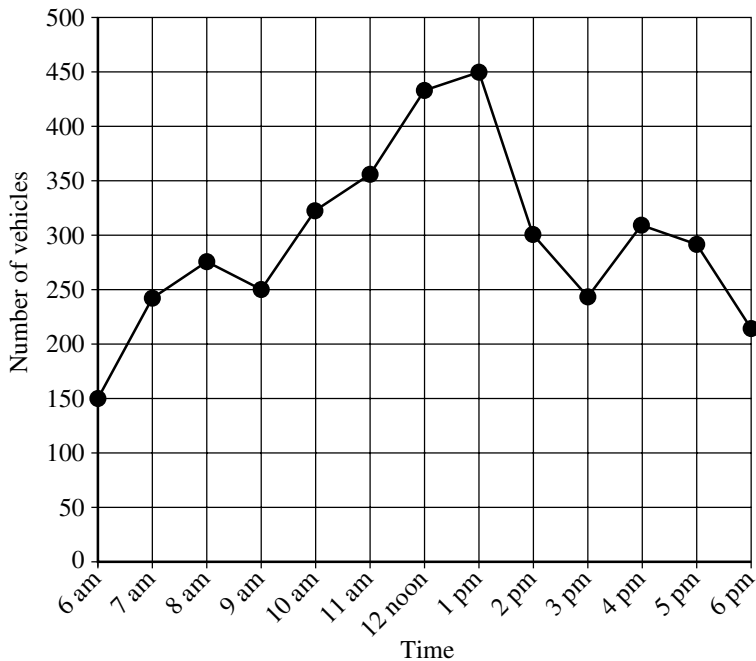
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (cm)	8.2	9.4	4.6	4.4	3.3	2.4	2.2	0.8	3.9	5.7	9.9	12.4

- (a) Draw a line graph to illustrate the monthly rainfall.
  - (b) Comment on any trends that you notice.
4. The daily takings for stamp sales for one week, at a village post office, are shown on the graph.



- (a) On which day was the post office closed?
- (b) On which day do you think the post office was only open in the morning?
- (c) On which days were the stamp sales greater than those for Wednesday?

5. The number of vehicles using a motorway service area was recorded at the end of each hour during one day. The results are shown on the graph.



- (a) What was the largest number of vehicles recorded using the service area and when did this occur?
- (b) How many times were more than 300 vehicles recorded?
- (c) Comment on the trend for the number of vehicles stopping at this service area.
- (d) Is it possible to use this graph to estimate the number of vehicles at the service area at 10.30 am on this day? Justify your answer.
6. Robert records the maximum and minimum outdoor temperatures every day for two weeks over the Christmas holiday period. The table gives his recorded temperatures.

	First week							Second week						
Day	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon
Max. temp. (°C)	14	18	13	14	8	10	15	19	18	12	11	10	7	9
Min. temp. (°C)	4	5	0	-1	-4	1	3	5	4	-1	-3	-6	-5	-1

- (a) On the same axes, draw line graphs to illustrate both the maximum and minimum temperatures recorded over these two weeks.
- (b) On which day did the greatest difference between the maximum and minimum temperatures occur?  
How can you tell this by inspection of your graph?
- (c) On which day was the difference between the maximum and minimum temperatures the least?

7. A water company needs to replace a supply pipe and has a work gang digging out the trench to re-lay this pipe. The length of trench dug out is recorded hourly from the 6 am start time, as shown in the table.

Time	6 am	7 am	8 am	9 am	10 am	11 am	12 noon	1 pm	2 pm	3 pm	4 pm	5 pm
Trench length (m)	0	3	7	11	16	18	24	24	28	33	37	45

- (a) Draw a line graph to represent this data.
- (b) Use your graph to estimate the length of the trench at  
(i) 8.30 am                      (ii) 2.15 pm
- (c) Explain fully what you think happened between 12 pm and 1 pm.
8. Jenny has a savings account with the school bank. The amount of money recorded in her account each week for the autumn term is given in the table.

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Account total (£)	20	25	32	36	45	62	32	39	45	50	56	68	73	44	20	20

- (a) Draw a line graph to represent the data.
- (b) Comment on any trends that you notice in how Jenny uses her savings account.
- (c) Explain what happened between week 6 and week 7.

9. A supermarket sells petrol. The volume of unleaded petrol in the storage tanks is recorded hourly during opening hours on one day and is shown in the table.

Time	8 am	9 am	10 am	11 am	12 noon	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm
Volume (1000's litres)	3.2	2.5	1.9	9.3	8.9	8.6	8.2	8.1	7.9	7.5	5.4	4.5

- (a) Draw a line graph to represent the data.  
 (b) What happened between 10 am and 11 am?  
 Give a reason to explain your answer.  
 (c) Between which times was most petrol sold?  
 Give a reason why you think this happened between these times.

## 2.8 Frequency polygons

A frequency polygon is a line graph which shows the shape of a grouped frequency distribution. It is constructed like a bar chart, but instead of drawing bars you plot points and join them up with straight lines.

- For grouped data the coordinates are plotted at the midpoint of each class interval.

### Example 1

The speeds of 100 cars passing beneath a motorway bridge, after 3 pm on a weekday, were checked. The results were recorded in a table.

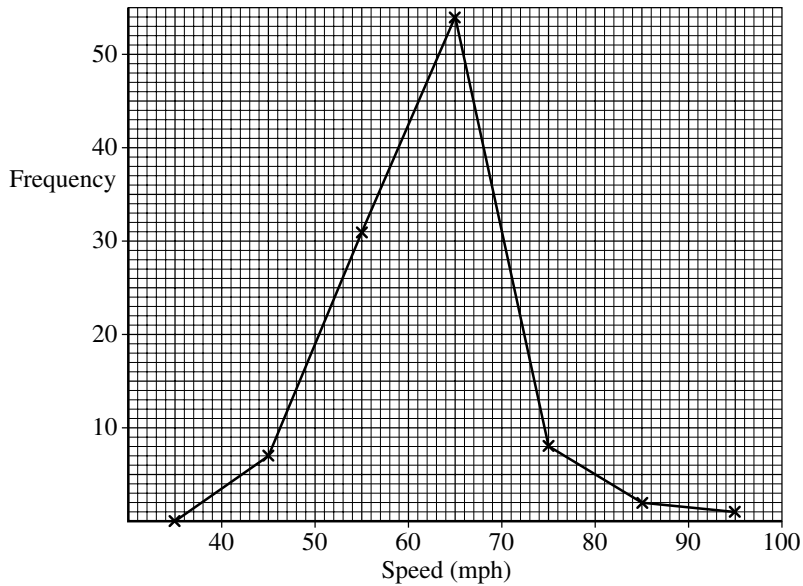
Represent this data by means of a frequency polygon.

Speed in mph ( $S$ )	$0 \leq S < 40$	$40 \leq S < 50$	$50 \leq S < 60$	$60 \leq S < 70$	$70 \leq S < 80$	$80 \leq S < 90$	$90 \leq S < 100$
Frequency	0	7	31	54	5	2	1

Plot coordinates using midpoints as shown

(20,0)    (45,7)    (55,31)    (65,54)    (75,5)    (85,2)    (95,1)

Plot the frequency polygon on graph paper.

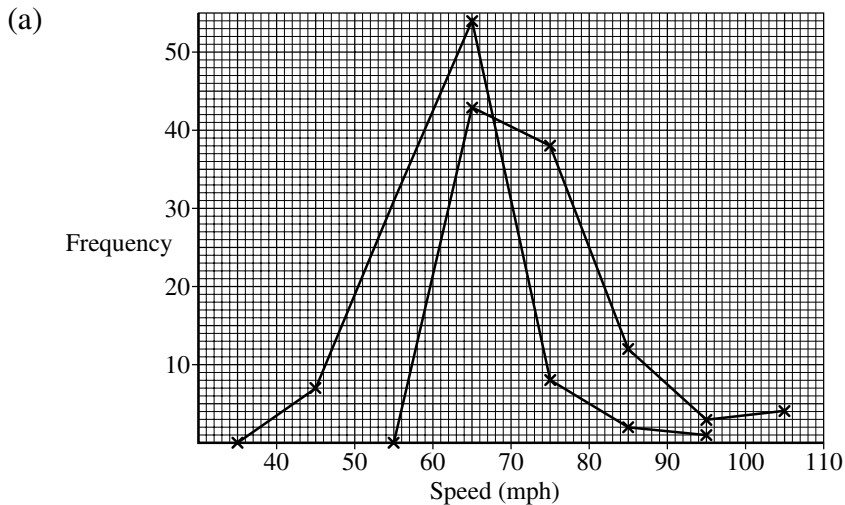


**Example 2**

Data was similarly collected for the first 100 cars passing the bridge after midnight on a weekday.

Speed in mph ( $S$ )	$0 \leq S < 60$	$60 \leq S < 70$	$70 \leq S < 80$	$80 \leq S < 90$	$90 \leq S < 100$	$100 \leq S < 110$
Frequency	0	43	38	12	3	4

- (a) Draw the frequency polygon for this data on the same axes as the frequency polygon in Example 1.
- (b) Compare the two distributions.



- (b) The second frequency polygon drawn is to the right of the first. The speed of cars after midnight was higher than the speed of the cars after 3 pm.

### Exercise 2H

1. Fifty pupils were asked how many magazines they had bought last week. The responses are given in the table.

Number of magazines	Number of pupils
0	3
1	1
2	2
3	5
4	21
5	12
6	5
7	0
8	1

Show this data by means of a frequency polygon.

2. Over a period of three months, the number of people who ate in a restaurant in Benidorm was recorded on a daily basis.

Number of people	Number of days
0–10	4
11–20	11
21–30	33
31–40	31
41–50	17
51–60	2

Draw a frequency polygon to show this data.

3. The heights of sixty roses in a flower garden were measured in centimetres as:

25, 37, 11, 18, 29, 42, 38, 25, 26, 31, 17, 28, 35, 34, 37,  
28, 12, 44, 38, 26, 25, 21, 31, 33, 29, 41, 32, 29, 32, 37,  
21, 27, 35, 28, 12, 42, 38, 37, 12, 31, 25, 29, 36, 37, 28,  
31, 41, 11, 27, 29, 17, 28, 35, 15, 37, 28, 26, 29, 38, 30.

Construct a frequency table using class intervals of 10–15, 16–20, 21–25, 26–30, 31–35, 36–40 and 41–45 centimetres.

Show the data as a frequency polygon.

4. The number of hours that two groups of people watched television in one week was recorded.

Number of hours (to the nearest hour)	Number of people in Group A	Number of people in Group B
0–4	3	4
5–9	7	5
10–14	21	14
15–19	11	15
20–24	5	11
25–29	2	1
30–34	1	0

Draw two frequency polygons to show this data, using the same axes and comment on your results.

5. The weights of two groups of people were recorded.

Weight (kg)	40–50	50–60	60–70	70–80	80–90	90–100
Group A (no. of people)	1	8	27	11	2	1
Group B (no. of people)	1	5	15	24	4	1

Draw the frequency polygons to show this data, using the same axes.

What can you deduce from these polygons?

6. Cara finds the number of letters per word in the first 100 words on page 6 of two newspapers. Cara's results are given in the table.

No. of letters	1	2	3	4	5	6	7	8	9	10	11	12
<b>Paper A</b>	1	1	8	15	20	24	18	7	0	3	2	1
<b>Paper B</b>	1	2	17	34	31	11	3	1	0	0	0	0

Draw the frequency polygons to show this data, using the same axes.  
One of the papers is a tabloid, the other is a broadsheet. Which paper is which?

## 2.9 Stem-and-leaf diagrams

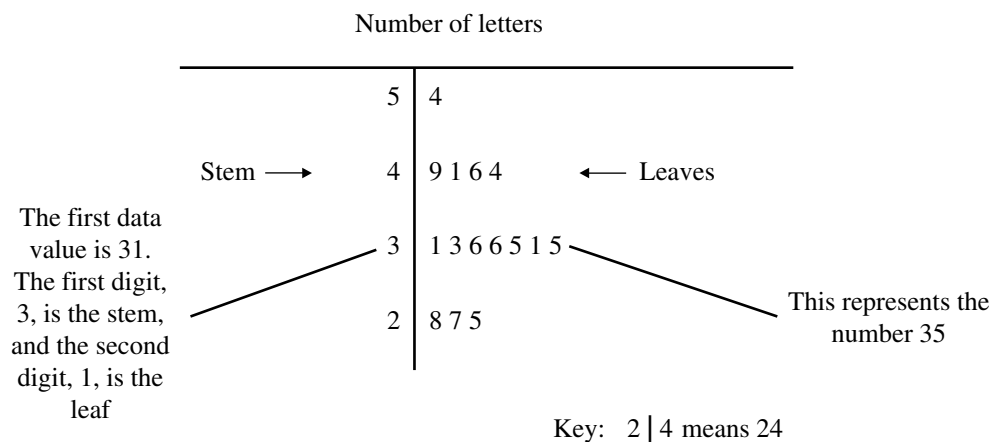
Stem-and-leaf diagrams are useful for ordering raw numerical data without losing any information.

### Example

At the morning post collection, the numbers of letters in 15 post boxes were recorded as:

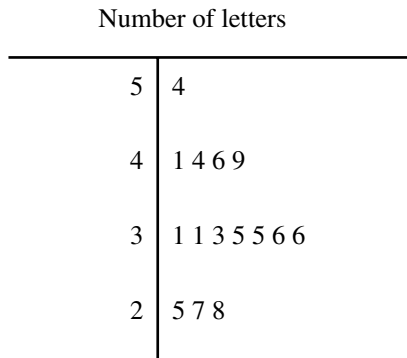
31, 49, 28, 33, 36, 41, 46, 36, 35, 27, 31, 35, 44, 25, 54.

Draw a stem-and-leaf diagram to show this data.



As the numbers in the leaves are not in numerical order, this is an **unordered stem-and-leaf diagram**.

Redrawing it with the leaves in numerical order gives:



Key: 2 | 4 means 24

This is known as an **ordered stem-and-leaf diagram**.

- A stem-and-leaf diagram needs a heading and a key.

### Exercise 21

1. The numbers of passengers on a small 72-seater aeroplane in its 20 short flights on one day were recorded as:

33, 37, 41, 45, 61, 72, 68, 72, 65, 61,  
65, 39, 41, 48, 53, 54, 57, 49, 41, 31.

Draw a stem-and-leaf diagram to show this data.

2. The numbers of supporters of a football club who travelled on Byron's coaches to away matches were:

84, 76, 92, 41, 62, 71, 59, 63, 70, 81,  
74, 65, 67, 58, 49, 63, 71, 49, 54, 61.

Draw a stem-and-leaf diagram to show this data.

3. The numbers of tourists travelling on a pleasure boat in the Solent on 14 days in August were:

71, 49, 82, 61, 91, 85, 89, 74, 92, 75, 64, 48, 52, 57.

Draw a stem-and-leaf diagram to show this data.

4. The weights of packets, in kg, received by a small company were recorded as:

2.1, 4.8, 7.1, 5.2, 2.7, 3.5, 3.6, 4.1, 5.3, 4.7,  
3.8, 2.7, 2.8, 4.7, 3.9, 6.2, 5.3, 6.8, 4.8.

Using a key 4 | 3 to mean 4.3, draw a stem-and-leaf diagram to show this data.

5. Alan tested a machine to check that it delivered the correct weight of sweets. He took a sample of 25 packets and weighed them.

The weights in grams of each packet are:

239, 255, 249, 239, 237, 240, 248,  
 240, 245, 244, 245, 238, 232, 237,  
 251, 241, 246, 235, 250, 236, 234,  
 237, 245, 247, 241

- (a) Using a key  $23 \mid 9$  to mean 239, draw a stem-and-leaf diagram to show this data.
- (b) The machine is set to weigh sweets to an average weight of 240 grams and is allowed to vary between 235 and 245 grams. What conclusion should Alan make from his test on this weighing machine?

## 2.10 Back-to-back stem-and-leaf diagrams

You can compare two similar sets of data using a **back-to-back stem-and-leaf diagram**.

### Example

The ages in years of holidaymakers in two small hotels were:

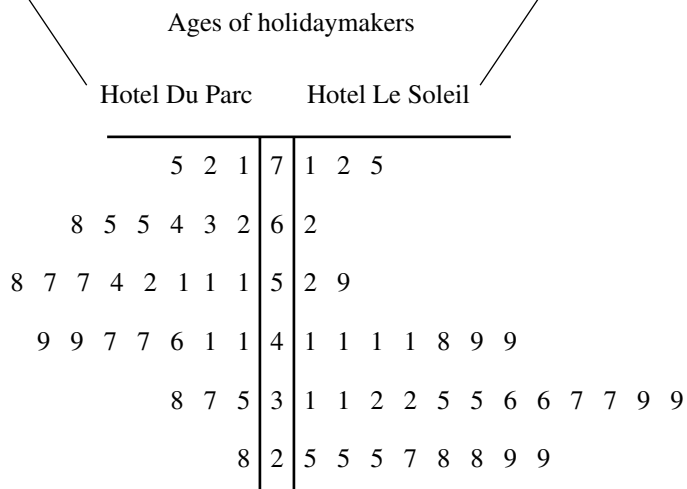
Hotel Du Parc: 37, 28, 41, 71, 62, 47, 54, 49,  
 63, 41, 38, 75, 51, 49, 47, 65,  
 58, 57, 51, 68, 72, 35, 51, 46,  
 52, 57, 64, 65

Hotel Le Soleil: 52, 49, 75, 35, 36, 49, 25, 29,  
 31, 37, 28, 39, 62, 41, 25, 28,  
 32, 71, 36, 39, 29, 41, 31, 32,  
 35, 41, 59, 48, 72, 27, 41, 37,  
 25

- (a) Show this information in a back-to-back stem-and-leaf diagram.
- (b) Compare the two age distributions.

- (a) Hotel du Parc is shown on the left in order **away** from the stem

Hotel Le Soleil is shown on the right of the stem



Key: 2 | 4 means 24

**Hint:**

You will probably need to draw an unordered diagram first.

- (b) From this diagram you can see at a glance that the guests at the Hotel Le Soleil tend to be younger than those at the Hotel Du Parc.

**Exercise 2J**

1. The sales of a bottle of coke in two small convenience stores were recorded over a ten-day period.

For 'Open All Hours' the sales were

7, 19, 15, 22, 14, 16, 17, 19, 21, 9.

For 'Pricetrim' the sales were

17, 11, 15, 23, 14, 18, 19, 9, 21, 8.

Show this data by means of a back-to-back stem-and-leaf diagram.

2. The numbers of cars passing a counter on a road in the New Forest per half-hour period from 8 am until 8 pm on a particular Monday and Saturday in June were:

Monday: 44, 39, 31, 21, 19, 17, 25, 15, 29, 27, 24, 15,  
13, 17, 19, 28, 34, 32, 29, 34, 33, 21, 15, 11

Saturday: 3, 4, 11, 31, 42, 47, 51, 49, 56, 51, 67, 71, 49,  
53, 51, 69, 51, 42, 41, 39, 28, 31, 29, 25

Draw a back-to-back stem-and-leaf diagram to show this data.

3. The numbers of passengers in an aeroplane in the Caribbean on 15 short flights on a Wednesday and a Sunday were recorded:

Wednesday: 8, 12, 15, 21, 17, 19, 23, 31, 31, 28, 15, 11, 16, 9, 6

Sunday: 19, 28, 27, 29, 28, 30, 30, 31, 29, 24, 21, 25, 17, 15, 12

- (a) Draw a back-to-back stem-and-leaf diagram to show this data.  
(b) What conclusions can you draw from this diagram?

4. During October the numbers of hours of sunshine recorded each day in two resorts, one in Portugal and the other in the South of England, were:

Portugal: 8·1, 7·9, 6·7, 5·4, 4·9, 5·2, 4·1, 3·1, 1·9, 6·9,  
9·2, 8·7, 8·5, 9·2, 8·7, 7·4, 5·2, 4·1, 1·1, 4·2,  
1·5, 7·2, 8·4, 7·9, 8·3, 9·2, 9·1, 8·9, 8·8, 7·1, 8·2

England: 5·8, 4·7, 3·3, 3·2, 3·7, 3·8, 3·9, 0·1, 0·2, 0·1,  
1·1, 2·3, 3·7, 3·5, 3·6, 3·3, 4·1, 8·1, 7·1, 3·9,  
4·5, 4·7, 3·9, 4·8, 2·1, 1·7, 1·5, 1·9, 4·9, 2·8, 2·9

- (a) Using a key  $4 \mid 3$  to mean 4·3, draw a back-to-back stem-and-leaf diagram to show this data.  
(b) What conclusion can you draw from the diagram?

5. The numbers of male and female customers in 'Le Bistro' restaurant were recorded for a three-week period:

Male: 21, 15, 17, 19, 35, 42, 51, 34, 47, 25, 31, 25,  
17, 21, 29, 38, 52, 47, 8, 38, 28

Female: 24, 17, 19, 31, 21, 12, 8, 25, 19, 34, 15, 21,  
11, 32, 24, 17, 12, 21, 38, 17, 31

- (a) Draw a back-to-back stem-and-leaf diagram to show this data.  
(b) Use your evidence from (a) to compare the male and female numbers using this restaurant.

## Summary

You can use a two-way table.

2. You can complete a tally chart.

3. You can draw a pictogram.

4. You can draw a bar chart.

5. You recognise the difference between dual bar charts and sectional bar charts.

6. You can draw a pie chart.

## Check out D2

1. In one year group, the number of pupils with cats and dogs was recorded.

	No. of pupils with cats	No. of pupils with dogs
<b>Girls</b>	17	8
<b>Boys</b>	5	19

How many boys had dogs?

2. The numbers of people waiting at twenty bus stops were:

6, 9, 4, 7, 8, 9, 7, 8, 4, 6, 3, 6, 4, 8, 6, 6, 4, 3, 4, 5.

Record this data in a tally chart.

3. The numbers of sweets eaten by six friends were:

John 25, Sharon 15, Ahmed 20, Chloe 30, Emma 25 and Andy 10.

Record this data as a pictogram.

4. Record the data shown in the tally chart in question 2 in a bar chart.

5. At 7 pm one evening all thirty pupils in a tutor group recorded which TV channel they were watching.

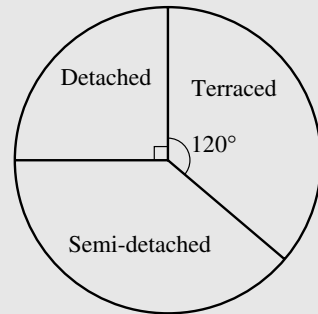
	BBC1	BBC2	ITV	Ch 4	Other
<b>Boys</b>	4	1	6	3	4
<b>Girls</b>	5	2	3	1	1

Record this data by means of a sectional bar chart.

6. Record in a pie chart the data shown in the tally chart in question 2.

7. You can interpret pictograms, bar charts and pie charts.


7. (a) The pie chart shows the number of houses of different types on a housing estate.



- (i) What type of house is most common?  
 (ii) There are 180 houses on the estate. How many are detached?
- (b) The pictogram shows the method by which a class arrive at school.

Walk 

Cycle 

Bus 

Key:  represents 4 pupils

Show this information by means of a bar chart.

8. You can draw a line graph.

8. The monthly rainfall in a town was recorded over 10 months. In centimetres this was:

<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>
11.2	8.4	7.8	5.7	2.9
<b>June</b>	<b>July</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>
3.1	1.1	0.8	4.7	11.2

Represent the data on a line graph.

9. You can draw a frequency polygon.

9. The number of letters which a postman delivered to 300 homes were recorded.

Number of letters	Number of homes
0	17
1	41
2	67
3	76
4	45
5	31
6	15
7	7
8	1

Draw the frequency polygon for this data.

10. You can draw a stem-and-leaf diagram.

10. The weights of fish (in pounds) caught in a lake in one day were:

7.4, 8.2, 4.3, 5.4, 6.7, 7.2, 7.5, 8.1, 8.9, 6.7, 4.7, 3.8.

Using a key  $3 \mid 4$  to represent 3.4, show this data on a stem-and-leaf diagram.

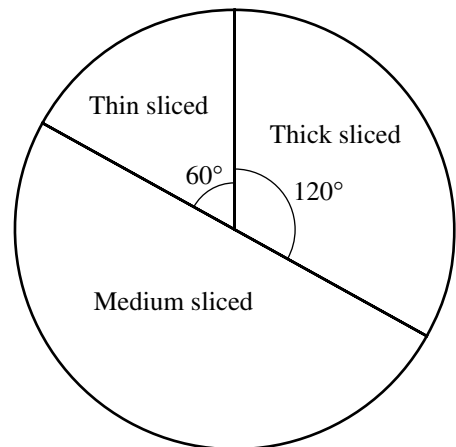
## Revision exercise D2

1. The pie chart shows information about the loaves of sliced bread sold by a supermarket one day.

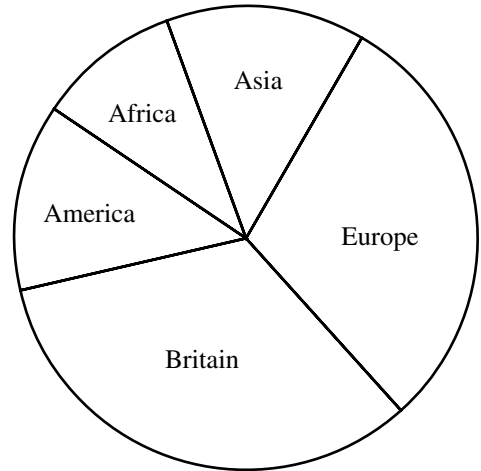
- (a) The supermarket sold 150 medium sliced loaves.  
How many thick sliced loaves were sold?

The supermarket sells both sliced bread and unsliced bread.

- (b) Three quarters of the loaves of bread sold that day were sliced.  
How many loaves of bread were sold altogether that day?



2. The pie chart shows information from a survey about the holiday destinations of a number of people.



- (a) (i) Which holiday destination is the mode?  
 (ii) America is the holiday destination of 24 people.  
 How many people go to Africa?

In another survey it was found that America is the holiday destination of 21 people out of 180 people asked.

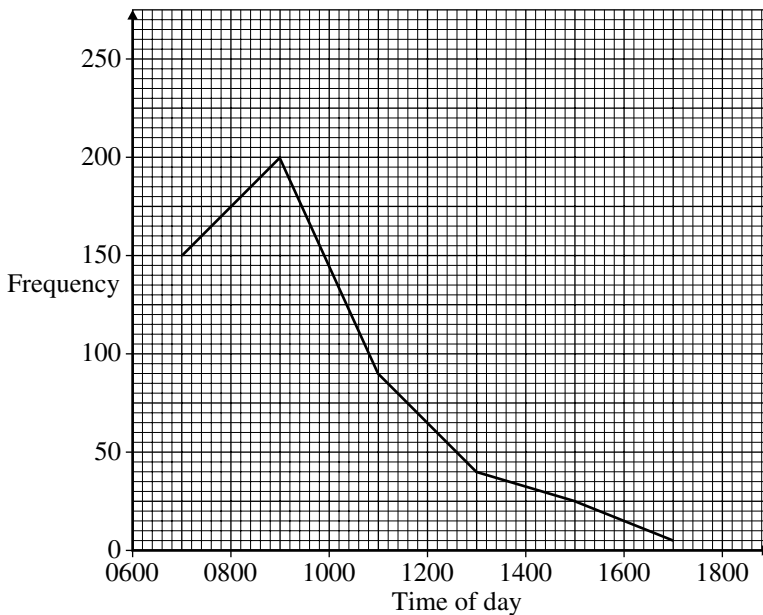
- (b) What percentage of all the people asked in these two surveys gave America as their holiday destination?

3. One Saturday a newsagent sells the following:

National daily newspapers	510
Echo	360
Magazines and comics	210

- (a) Draw a clearly labelled pie chart to represent these sales.

The frequency polygon shows the sales of national daily newspapers.



- (b) (i) How many of these papers were sold between 1000 and 1400?

The table shows the sales of the Echo.

Time of day	0600–	0800–	1000–	1200–	1400–	1600–1800
Frequency	0	0	0	20	125	215

- (ii) On a copy of the diagram on page 00 draw a frequency polygon to show the sales of the Echo.
- (iii) Compare and comment on the sales of these two types of paper.
4. The two-way table shows the number of visits made by students to dentists and to doctors.

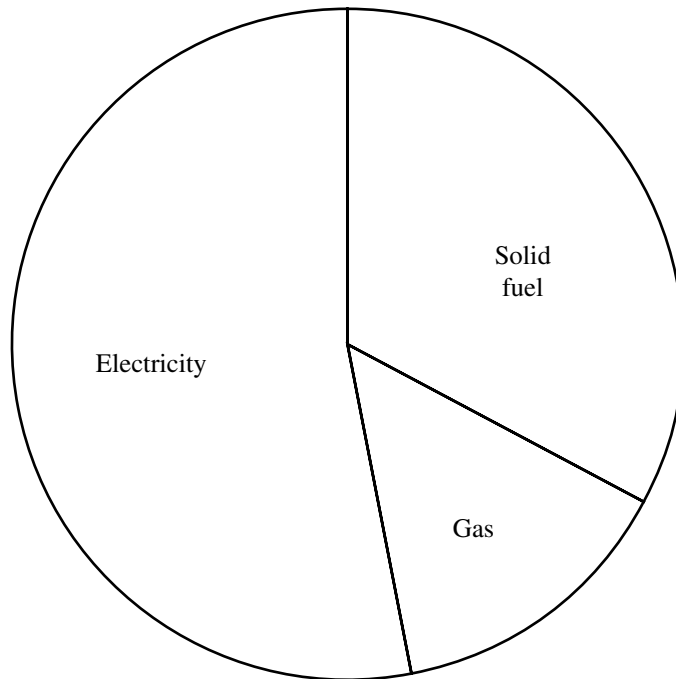
		Number of visits made to the doctor			
		0	1	2	3
Number of visits made to the dentist	0	24	10	2	1
	1	8	5	3	1
	2	10	7	0	0
	3	5	3	1	0

- (a) How many students did not visit the doctor?
- (b) How many students visited the dentist exactly 3 times?
- (c) How many students made more visits to the doctor than they made to the dentist?
5. (a) The table shows the fuels used for heating in all the houses in a large town.

Fuel	Number of houses (in 1000's)
Solid fuel	8
Electricity	42
Gas	70
Total	120

Draw a clearly labelled pie chart to represent this information.

- (b) This pie chart shows the fuels used for heating in all the houses in a small village.



- (i) What fraction of these houses use gas?
- (ii) Solid fuel is used in 24 houses.  
How many houses are in the village?
- (c) Use the information from these two pie charts to say which fuel is most likely to be the mode.  
Give a reason for your answer.