



The Mathematics Department

7

Data Handling

and Statistics

Name:

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The Mean

In the qualifying games for Euro 2016, Wales' football team scored the following number of goals.

2, 0, 2, 0, 3,
1, 1, 0, 0, 2.

Which number would best describe the number of goals scored by Wales per game? When we are looking for a number of this type, we are looking for an **average** for the data. An average is a number which attempts to represent the typical or middle value of the data. The **mean** is an example of an average.



Calculating the Mean

In order to calculate the mean of a set of data:

- (1) Find the **total** of all the data items.
- (2) **Divide** by the number of data items.



For the data about Wales' goals, the total of all the data items would be

$$2 + 0 + 2 + 0 + 3 + 1 + 1 + 0 + 0 + 2 = 11.$$

It follows that the mean is $11 \div 10 = 1.1$. This means that, on average, Wales scored around 1 goal per game.

Exercise 1

Find the mean number of goals scored by the following football teams during the first games of the new football season.

(a) Arsenal	5,	0,	2,	0,	4.
(b) Chelsea	0,	2,	1,	2,	3.
(c) Everton	2,	1,	1,	2,	0.
(d) Liverpool	2,	3,	0,	2,	1.
(e) Manchester United	3,	2,	3,	4,	0.
(f) Tottenham Hotspur	2,	0,	0,	4,	1.

Exercise 2

In Exercise 1, which team has the **largest** mean number of goals?

Exercise 3

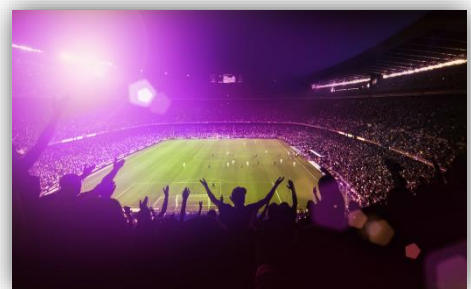
Sara asked her friends how much pocket money they received. She wrote down their responses:

£1, £3, £2, £5, £2, £10, £8, £7.

What is the **mean amount** of pocket money?

5

Skill

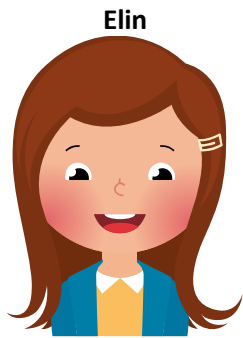


Exercise 4

Here is some information about five children.

5

Applying



Elin
Height: 132cm
Weight: 45kg
Shoe size: 3



Hari
Height: 148cm
Weight: 50kg
Shoe size: 5



Catrin
Height: 136cm
Weight: 39kg
Shoe size: 4



Siôn
Height: 150cm
Weight: 49kg
Shoe size: 5



Esyllt
Height: 150cm
Weight: 52kg
Shoe size: 6

- What is the mean height of these children?
- Which children are taller than the mean height?
- What is the mean weight of these children?
- Which children are lighter than the mean weight?
- What is the mean shoe size of these children?
- Can you buy shoes of mean shoe size?

**Exercise 5**

Here is some information about four babies.

**Carwyn**

Weight: 8kg

Height: 69cm

Bethan

Weight: 5kg

Height: 70cm

Eryl

Weight: 7kg

Height: 75cm

Osian

Weight: 9kg

Height: 77cm

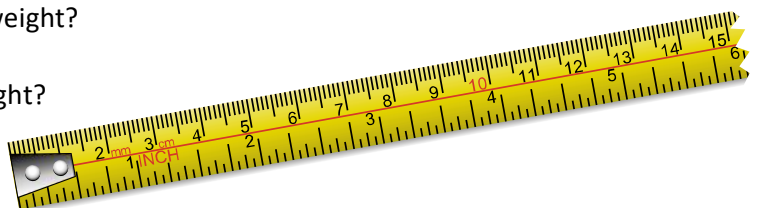
- What is the mean weight of these 4 babies?
- Which of the babies are heavier than the mean weight?
- What is the mean height of these 4 babies?
- Which of the babies are taller than the mean height?

Exercise 6

Here is the weekly shopping cost of 15 families.

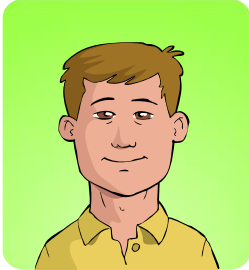
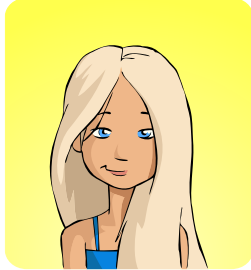
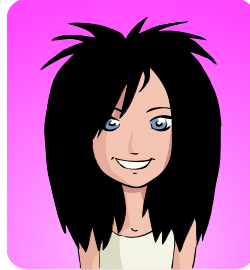
£75 £86 £83 £62 £86 £78 £64 £94 £101 £79 £91 £71 £59 £91 £95

Find the **mean amount** spent, per week, by these families.



Exercise 7

Here is some information about ten adults.

Sophie  Age: 32 Height: 154cm Number of brothers: 2	David  Age: 38 Height: 163cm Number of brothers: 1	Jessica  Age: 18 Height: 145cm Number of brothers: 3	Ben  Age: 24 Height: 165cm Number of brothers: 0	Ffion  Age: 26 Height: 150cm Number of brothers: 1
Jack  Age: 74 Height: 149cm Number of brothers: 1	Jane  Age: 34 Height: 165cm Number of brothers: 0	Iwan  Age: 30 Height: 155cm Number of brothers: 2	Sara  Age: 44 Height: 139cm Number of brothers: 1	Jeff  Age: 48 Height: 153cm Number of brothers: 0

- What is the mean age of these 10 people?
- Who is older than the mean age?
- What is the mean height of these 10 people?
- Who is shorter than the mean height?
- What is the mean number of brothers of these 10 people?
- How many people have less brothers than the mean amount?
- What is the mean age of the males?
- What is the mean age of the females?
- On average, who is older: the males or the females?
- On average, who is taller: the males or the females?

**Exercise 8**

Dafydd asked his friends how much money they had in their pockets. He wrote down their responses:

99p, 50p, 25p, 12p, 52p, 32p, 90p, 80p.

What is the **mean** of this data?

**Exercise 9**

Here are the times, in seconds, that the females in 7C took to run a 100m race.

14.1, 15.3, 15.5, 15.6, 15.0, 14.7, 13.9, 16.1, 15.8, 14.5, 15.7, 14.6, 16.3, 15.7.

- Find the **mean time taken** to complete the race.
- How many females were **faster** than the mean time?

Calculating the mean from a table

Sometimes, when we have a lot of data, it is easier (and quicker) to use a table to present the data.

Example

The following table shows the shoe size of the learners in 7R.

Shoe size	Number of children
3	4
4	5
5	10
6	9
7	2



In order to calculate the mean shoe size for 7R, we first need to find the **total of all the data values**. To do this, we must consider each row in the table in turn. The first row tells us that four pupils in 7R have a shoe size of 3. The total of the shoe sizes of these four pupils would be $3 + 3 + 3 + 3$, or 3×4 . The other rows of the table would also lead to multiplication sums, as shown below.

Shoe size	Number of children	Multiplication
3	4	$3 \times 4 = 12$
4	5	$4 \times 5 = 20$
5	10	$5 \times 10 = 50$
6	9	$6 \times 9 = 54$
7	2	$7 \times 2 = 14$
Total	30	150



The total of all the data values would be the total of the final column, namely $12 + 20 + 50 + 54 + 14 = 150$.

To find the mean, we must divide this total by the **number of data items**. In this example, the number of data items is the number of pupils in 7R, which is the total of the second column of the table.

$$4 + 5 + 10 + 9 + 2 = 30.$$

It follows that the mean shoe size for 7R is $150 \div 30 = 5$.

Exercise 10

100 packets of Smarties are chosen randomly. The following table shows the number of Smarties in each tube.

Number of Smarties in a tube	Number of tubes
35	14
36	24
37	26
38	20
39	16

Find the mean number of Smarties in a tube.

Challenge!

Today, the first 30 customers visiting a shop spent a mean total of £4 each. After the next 50 customers had visited the shop, the mean had risen to £6. What was the mean total spent by these 50 customers?



Exercise 11

The following table shows the number of M&Ms in several big packets of M&Ms.

Number of M&Ms in a big packet	Number of big packets
96	2
97	13
98	8
99	17

- (a) Calculate the mean number of M&Ms in a big packet.
 (b) How many packets contained more than the mean value?
 (c) How many packets contained less than the mean value?

**Exercise 12**

A dice is thrown 100 times.

The scores are listed in the following table.

Score	Number of times the dice was thrown
1	14
2	17
3	16
4	18
5	17
6	18



Calculate the mean score.

Exercise 13

On a golf course, the hole shown on the right is called a Par 3. This means that the majority of the players are expected to complete the hole in three shots.

The table below shows the number of shots taken by some players in completing the hole.

Number of shots	Number of people
1	1
2	18
3	30
4	26
5	25

- (a) Calculate the mean number of shots needed to complete the hole.
 (b) In your opinion, should this hole be called a Par 3?
 Explain your answer.

**Challenge!**

The mean age of a pop group with 3 members is 21. What will be the mean age of the group if a new, 25-year-old member joins the group?



5

Applying

Test 1:	42	55	47	61	59	71	49	53	65	61
Test 2:	54	49	63	63	58	48	68	61	48	58

(b) In 8 games, the netball team of Ysgol y Creuddyn scored the following number of goals:

In 6 games the netball team of Ysgol John Bright scored the following number of goals:

Morris:	81	76	79	85	89	78	74	83	74	87
Parry:	79	88	87	76	91	73	74	76		

(d) The teachers in the physical education department measure, in seconds, the times taken by the football and rugby teams to complete a 100m race.

The rugby team: 12, 13, 14, 11, 12, 14, 15, 13, 15, 14, 11, 16, 14, 15, 13.

Challenge! 



Evaluation

Key Words	Further Questions	What went well?	To reach my target level I will...
			<div> <div>My Level</div> <div>My Target</div> </div>

The Range



Arwyn and Megan travel to school on different school buses. Over a period of a fortnight, Arwyn and Megan wrote down the times the buses arrived to take them to school.

Arwyn's Bus

08:13 08:16 08:14 08:15 08:14
08:15 08:14 08:17 08:14 08:15

Megan's Bus

08:29 08:27 08:33 08:28 08:28
08:33 08:26 08:31 08:34 08:30



Looking at the above times, can you tell which bus is **most reliable**?

Measures of Spread

In order to discuss which bus is most reliable, we need to measure the **spread** of the data. A data set has **low data spread** if the data values are all close to each other. We could depend on a bus with low data spread to reach the bus stop at the same time each day, or close to this time. A bus with **high data spread** wouldn't be as reliable.

The Range

The **range** is one measure of data spread. To calculate the range for a specific data set, find the **difference** between the greatest data item and the least data item. Usually, this means **taking away the least number from the greatest number**.

Arwyn and Megan

For Arwyn's bus, the latest time is 08:17, and the earliest time is 08:13. The difference between these two times is 4 minutes, so the range for Arwyn's bus is 4 minutes.

For Megan's bus, the latest time is 08:34, and the earliest time is 08:26. The difference between these two times is 8 minutes, so the range for Megan's bus is 8 minutes.

Because the range of Megan's bus is more than the range of Arwyn's bus, we can say that the **data spread** of Megan's bus is higher, and so Megan's bus is **less reliable** than Arwyn's bus.

Exercise 15

Find the range of the following data sets.

- (a) 4 8 9 10 11 15 16
(b) 1 2 4 8 16 17 19 22
(c) 10,800 15,000 15,500 18,300 21,300
(d) 2.8 3.1 4.9 8.6 14.3 21.6
(e) 7.2 1.3 8.4 2.1 3.6 4.7 9.3 8.4
(f) 5 4 0 2 4
(g) 150 150 141 137 146
(h) 70 69 69 51 80

5

Skill

Exercise 16

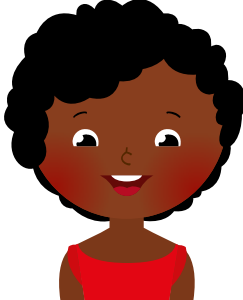
- (a) The range of a data set is 16. If the largest data value is 26, what is the **smallest** data value?
- (b) Peter collected data from 10 of his friends concerning the weekly pocket money they received. He forgot to write down the final value in his list.

£1 £1.20 £1.15 £1.25 £1 £1.40 £1.90 70c 90c

He remembered that the range of values was £1.40. What could be the **final** data value?

Exercise 17

Here is some information about five children.

Huw	Erin	William	Lili	Iestyn
				
Height: 150cm Weight: 52kg Shoe size: 4	Height: 158cm Weight: 52kg Shoe size: 6	Height: 150cm Weight: 50kg Shoe size: 5	Height: 149cm Weight: 46kg Shoe size: 4	Height: 146cm Weight: 45kg Shoe size: 3

- (a) Who is the tallest pupil?
- (b) Who is the shortest pupil?
- (c) What is the range of the heights of the pupils?
- (d) What is the range of the weights of the pupils?
- (e) What is the range of the shoe sizes of the pupils?

Exercise 18

Alys and Hywel travel to school on different school buses. Over a period of a fortnight, Alys and Hywel wrote down the times the buses arrived to take them to school.

Alys' Bus

08:25 08:27 08:24 08:29 08:31
08:30 08:25 08:32 08:26 08:26

Hywel's Bus

08:09 08:14 08:11 08:12 08:10
08:10 08:09 08:12 08:13 08:10

- (a) What is the range of Alys' times?
- (b) What is the range of Hywel's times?
- (c) In your opinion, which bus is most reliable? Explain your answer.

5

Applying



Exercise 19

Two groups of 6 people took part in a quiz.

(a) The 6 members of group A had the following scores.

52 29 78 56 24 37

What was the range of group A's scores?

(b) The scores for the 6 members of group B are shown in the following table.

Score	Number of people
22	2
25	2
26	1
28	1



Which group had the biggest range for their scores? You must give a reason for your answer.

Exercise 20 (Revision)

Here are the ages (in years) of 8 members of an evening class:

36 28 45 24 31 34 27 47

- Find the range of the ages of the members of the evening class.
- What was the range of the ages exactly one year ago? Give a reason for your answer.
- Find the mean age of the members of the evening class.
- What was the mean age of the ages exactly one year ago? Give a reason for your answer.
- A new, 40-year-old member joins the evening class. Without doing any further calculations, state
 - Will the range of the evening class increase, decrease or stay the same?
 - Will the mean of the evening class increase, decrease or stay the same?

Evaluation

Key Words	Further Questions	What went well?	To reach my target level I will...
			My Level ☐ My Target ☐

Bar Charts

We use bar charts to display data. The type of bar chart depends on the type of data that has been collected.

Types of Data

It is possible to place data into two categories: **qualitative** and **quantitative**.

Qualitative Data	Quantitative Data
Deals with descriptions . Data that can be observed but not measured. <i>Examples:</i> Method of travelling to school; eye colour; favourite pet; mobile phone manufacturer.	Deals with numbers . Data that can be measured. <i>Examples:</i> The height of a person; temperature; number of brothers; time to complete a race.

Exercise 21

State whether the following data is **qualitative** or **quantitative**.

- (a) Favourite board game (e.g. Monopoly; Scrabble).
- (b) The weight of a cake.
- (c) The name of your dentist.
- (d) The number of learners in your registration class.
- (e) The daily rainfall in Llandudno.
- (f) The day of the week (e.g. Monday) that you were born on.



4

Skill

Quantitative Data

It is possible to place quantitative data into two categories: discrete and continuous.

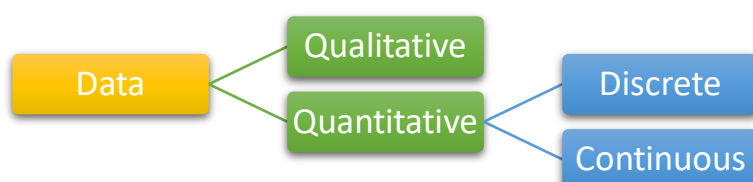
Discrete Data	Continuous Data
Only takes specific values . <i>Examples:</i> Shoe size; number of songs on an album; the salary of a nurse; number of sisters.	Takes any values within a specific range. <i>Examples:</i> Length of your foot; the temperature at midday; the time taken to cycle from Rhyl to Abergel.

Exercise 22

State whether the following quantitative data is **discrete** or **continuous**.

- (a) Population of the United Kingdom.
- (b) The length of your thumb.
- (c) The age of women when they marry.
- (d) The amount of money earnt for babysitting one night.
- (e) The number of cars on sale at a showroom.
- (f) The weight of the letters in a postman's sack.

Summary



Drawing a Bar Chart

We can draw a **bar chart** for the following types of data.

- Qualitative data.
- Discrete quantitative data that is not grouped.



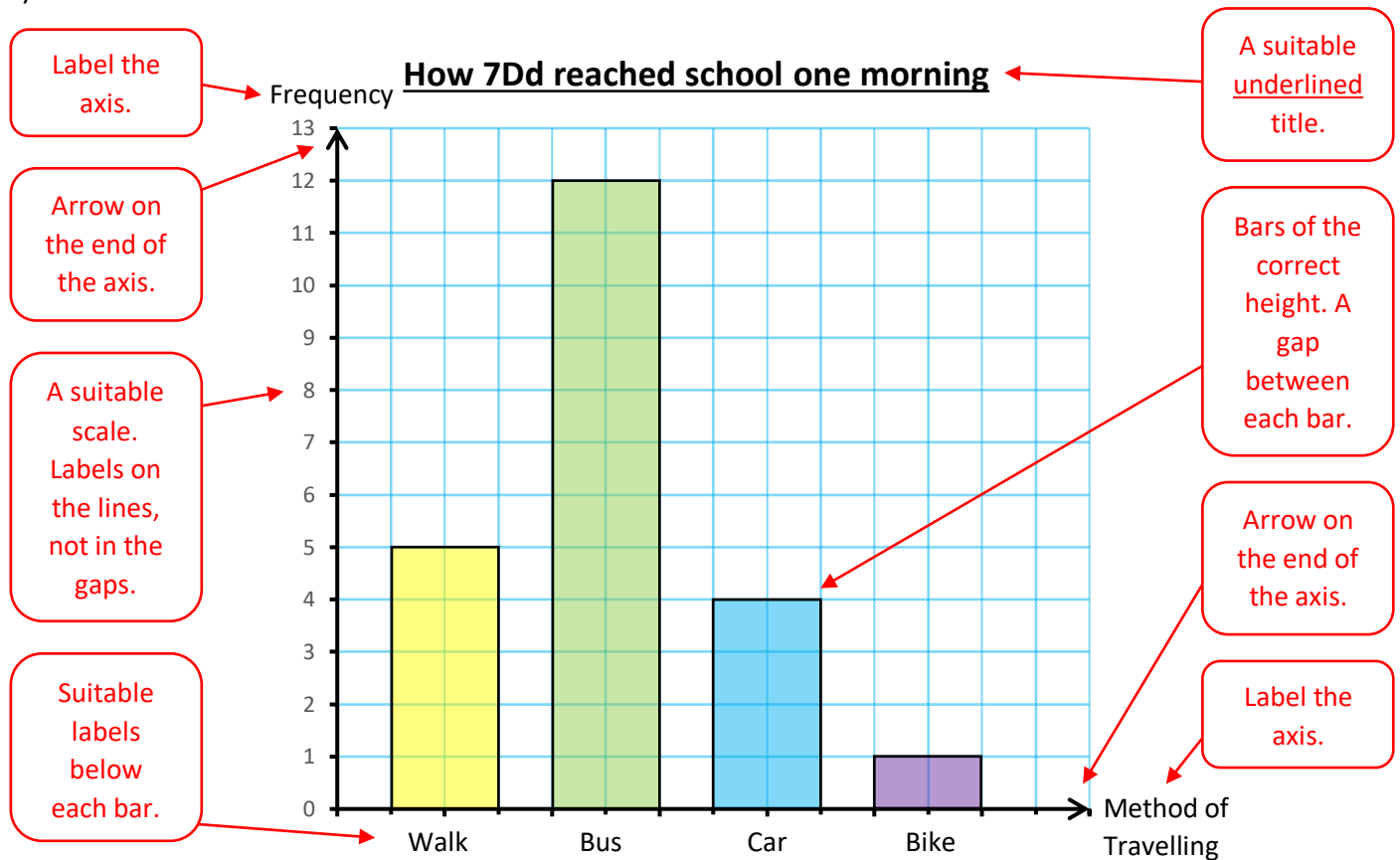
We need to include a **gap** between each bar in a bar chart.

Example

Dylan asked each member of 7Dd how they got to school one morning. Here are the results:

Walk 5 Bus 12 Car 4 Bike 1

Dylan drew a bar chart for the data.



Exercise 23

On a piece of squared paper, draw a **bar chart** for the following sets of data.

(a) Number of hours of sunshine in Colwyn Bay during one week.

Monday: 3 hours Tuesday: 4 hours Wednesday: 4 hours Thursday: 3 hours
Friday: 8 hours Saturday: 7 hours Sunday: 6 hours

(b) 7C's favourite pet.

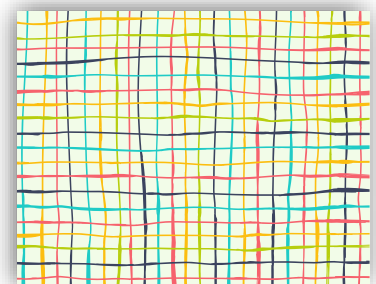
Dog: 8 Cat: 7 Rabbit: 4 Guinea Pig: 2 Snake: 1

(c) 7R's eye colour.

Blue: 6 Brown: 15 Green: 2

(d) The number of brothers of each member of 7E.

No brothers: 5 One brother: 10 Two brothers: 7 Three brothers: 2



3

Skill

Drawing a Frequency Diagram

We can draw a frequency diagram for the following types of data.

- Discrete quantitative data that has been grouped.
- Continuous quantitative data.



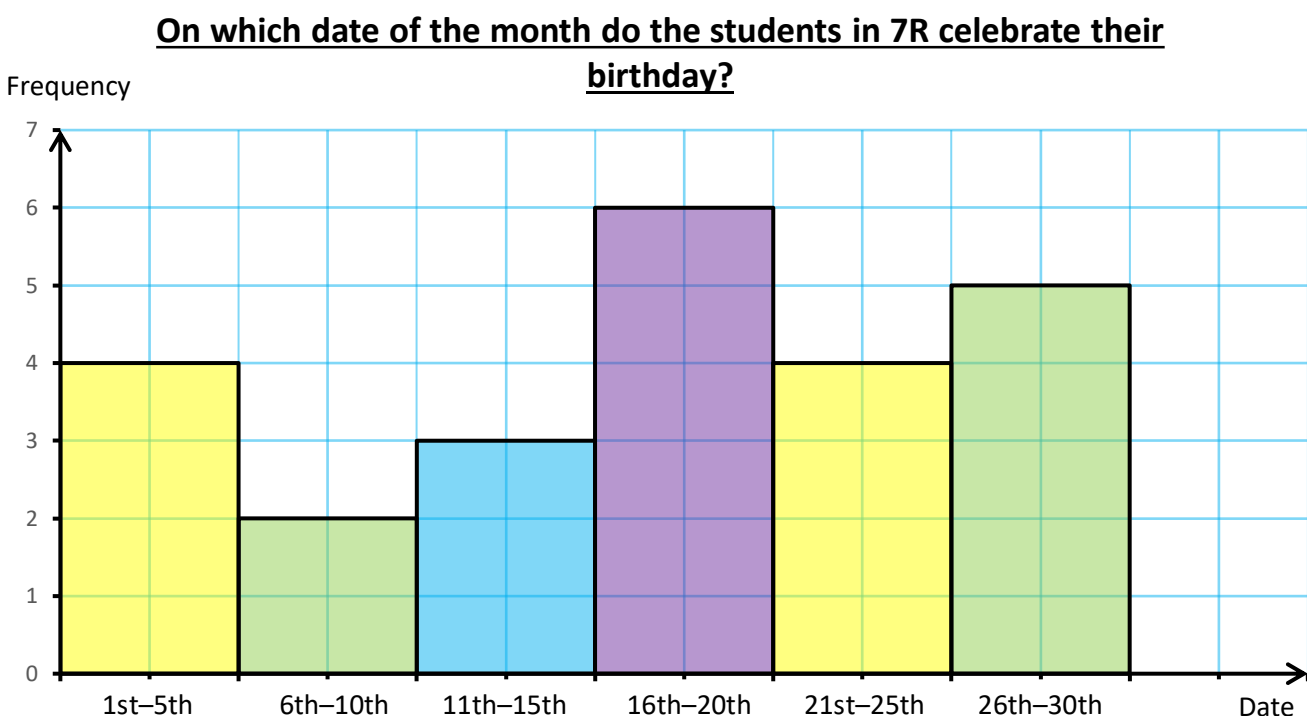
There are no gaps between the bars in a frequency diagram, but the **width** of each bar must be **equal**.

Example

Siwan asked each member of 7R which date of the month their birthday fell on. She received the following responses.

1st–5th: 4 6th–10th: 2 11th–15th: 3 16th–20th: 6 21st–25th: 4 26th–30th: 5

Siwan drew the following frequency diagram to show the data.



Exercise 24

On a piece of squared paper, draw a **frequency diagram** for the following sets of data.

(a) The number of books the pupils in 7E have bought during the past year.

Zero to four books: 12 Five to nine books: 5 Ten to fourteen books: 6 Fifteen to nineteen books: 1

(b) The number of minutes the dentist spends with each patient.

1–5 minutes: 2 6–10 minutes: 4 11–15 minutes: 9 16–20 minutes: 5
 21–25 minutes: 3 26–30 minutes: 3 31–35 minutes: 0 36–40 minutes: 1

(c) The number of days the pupils in 7C were absent from school last term.

0–4 days: 11 5–9 days: 8 10–14 days: 6 15–19 days: 0 20–24 days: 5

(d) Number of words in each sentence during the first 50 sentences of a book.

1–10 words: 2 11–20 words: 9 21–30 words: 14 31–40 words: 7
 41–50 words: 4 51–60 words: 8 61–70 words: 6



Grouping Discrete Data

In Exercise 24, we saw that we must use grouped data in order to draw a frequency diagram. We must use a **frequency table** to group data that is not yet grouped.

Example

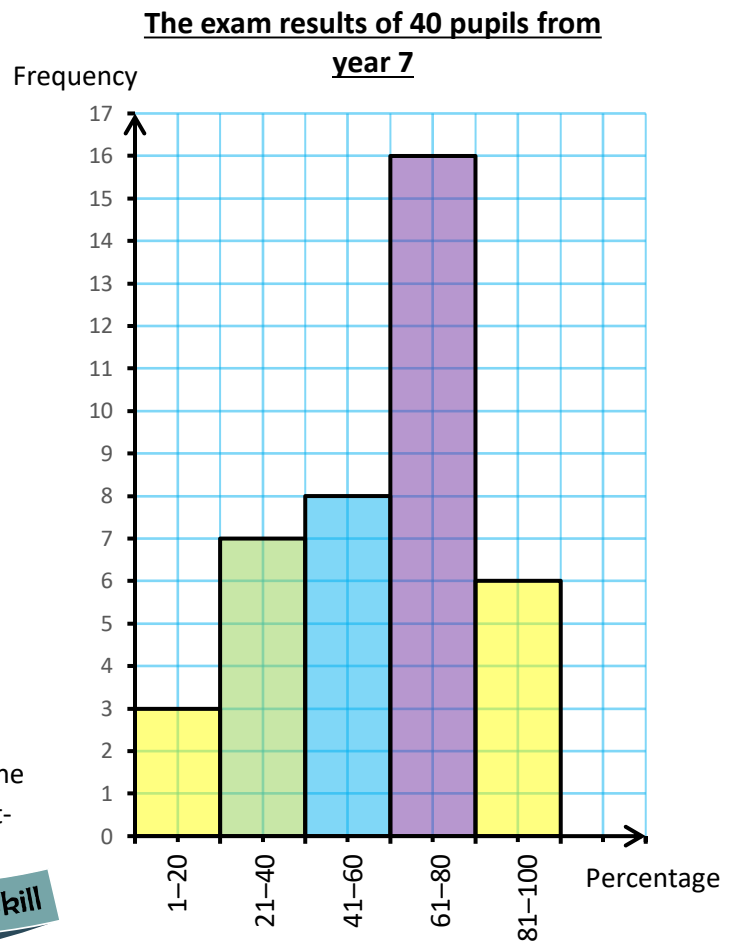
Here are the exam percentages of 40 pupils in year 7.

56	14	61	67	90	38	47	67
72	75	80	41	21	54	92	44
68	85	43	71	69	19	39	64
83	80	65	42	20	35	27	81
70	75	39	36	71	88	50	79

Let us group this data using the groups
1–20, 21–40, 41–60, 61–80, 81–100.

Group	Tally Marks	Frequency
1–20		3
21–40		7
41–60		8
61–80		16
81–100		6
Total		40

After forming the above frequency table, we can now draw the frequency diagram for the data. This can be seen on the right-hand side of this page.



Exercise 25

6

Skill

(a) Here are the times taken by the pupils in 7E to come to school today, correct to the nearest minute.

15	5	8	22	12	10	30	25	27	22	35	8	18	17	22
15	44	35	45	55	12	28	35	48	48	30	40	19	25	50

Draw a **frequency table** for the data, using the groups 1–10, 11–20, 21–30 up to 51–60.

Draw a **frequency diagram** to show the data.

(b) A class measured the arm span of each pupil. Here are the results, to the nearest cm.

132	129	147	127	128	124	134	139	138	136	144
143	133	141	139	130	142	143	140	137	148	136
146	151	123	131	135	135	130	140	138	133	



Draw a **frequency table** for the data, using the groups 120–124, 125–129, 130–134 up to 150–154.

Draw a **frequency diagram** to show the data.

(c) 7C decided to see how good they were at estimating the length of a minute. Here are the results, correct to the nearest second.

72	70	52	48	52	48	63	71	63	70	61	62	59	62	50
64	46	65	69	65	58	64	61	48	63	68	67	73	55	51

Draw a **frequency table** for the data, using the groups 46–50, 51–55, 56–60 up to 71–75.

Draw a **frequency diagram** to show the data.

Grouped Continuous Data

The following frequency table shows the length of the right thumb of the students of a class.

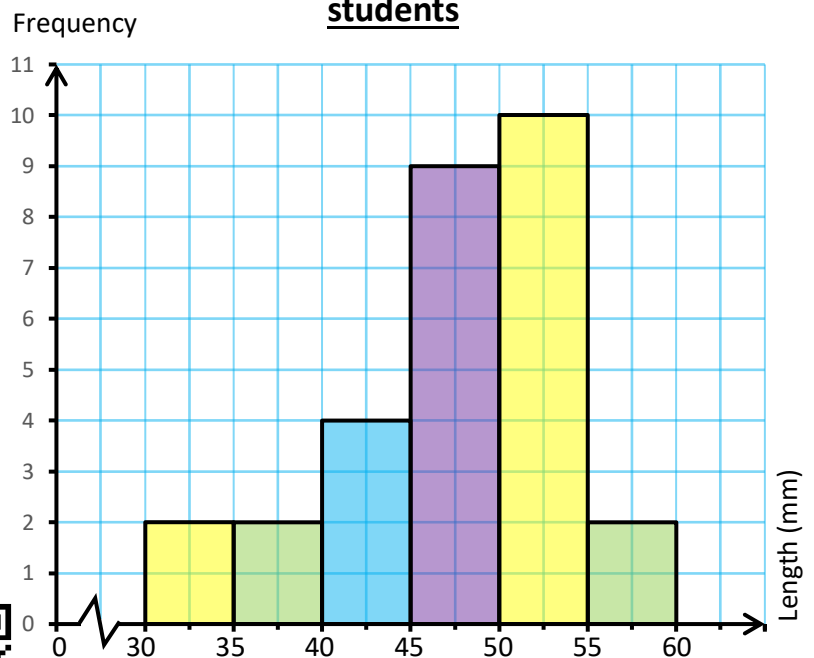
Class interval (l mm)	Frequency
$30 \leq l < 35$	2
$35 \leq l < 40$	2
$40 \leq l < 45$	4
$45 \leq l < 50$	9
$50 \leq l < 55$	10
$55 \leq l < 60$	2

We read $30 \leq l < 35$ as " l is at least 30 but is less than 35" or " l lies between 30 and 35, but can be equal to 30".

The above information is shown in the frequency diagram on the right. Notice the jump in the graph between 0 and 30.



The length of the right thumb of some students

**Exercise 26**

Draw **frequency diagrams** for the following sets of data.

- (a) How much weight the members of a weight loss club lost in 6 months. (b) The height of 60 pupils.

- (c) The noise of 60 items of electrical equipment.

Weight (w kg)	Frequency
$0 \leq w < 6$	4
$6 \leq w < 12$	11
$12 \leq w < 18$	12
$18 \leq w < 24$	7
$24 \leq w < 30$	3

Height (h cm)	Frequency
$168 \leq h < 172$	2
$172 \leq h < 176$	6
$176 \leq h < 180$	17
$180 \leq h < 184$	22
$184 \leq h < 188$	10
$188 \leq h < 192$	3

Noise (n db)	Frequency
$15 \leq n < 20$	4
$20 \leq n < 25$	12
$25 \leq n < 30$	15
$30 \leq n < 35$	6
$35 \leq n < 40$	8
$40 \leq n < 45$	3
$45 \leq n < 50$	12

Exercise 27

The following figures give the time, correct to the nearest minute, taken by 50 cross-country runners to complete a race.

30	37	43	55	52	47	49	36	44	40
41	49	52	53	39	41	46	42	50	49
39	53	54	57	43	59	34	38	40	42
48	53	50	52	37	36	45	53	48	42
52	39	41	46	50	52	38	58	57	46

Time (t minutes)	Tally Marks	Frequency
$30 \leq t < 35$		
$35 \leq t < 40$		
$40 \leq t < 45$		
$45 \leq t < 50$		
$50 \leq t < 55$		
$55 \leq t < 60$		



- (a) Complete the frequency table for the data. (Remember that 35 minutes would appear in the class $35 \leq t < 40$, not $30 \leq t < 35$.)

- (b) Draw a **frequency diagram** for the data.

Exercise 28

The following data gives the weights of books on a shelf in a library, in grams.

742 241 332 478 1245 832 746 291 160 635 1042 368 760 590
 748 800 564 1340 824 683 174 960 236 746 328 387 823 894

(a) Complete a **frequency table** for the data. (Use the following classes for the weight, w :

$0 \leq w < 200$, $200 \leq w < 400$, $400 \leq w < 600$, ..., $1200 \leq w < 1400$.)

(b) Draw a **frequency diagram** for the data.

Exercise 29

The following data shows the hand width of several 13-year-old girls, in mm.

171 182 202 164 198 211 164 173 177 173 192 205 232 223
 189 186 191 194 197 205 231 207 169 173 184 209 176 181

Draw a **frequency diagram** for the data. (You will need to complete a suitable **frequency table** first.)

Challenge!

What is wrong with the following frequency table, which shows the length of leaves that fell from a tree one morning? What would you have to do to create a frequency diagram for the data?

Length (l cm)	Tally Marks	Frequency
$0 \leq l < 5$		7
$5 \leq l < 10$		11
$10 \leq l < 20$		9
$20 \leq l < 25$		3
$25 \leq l < 30$		8

**Interpreting Charts****Exercise 30**

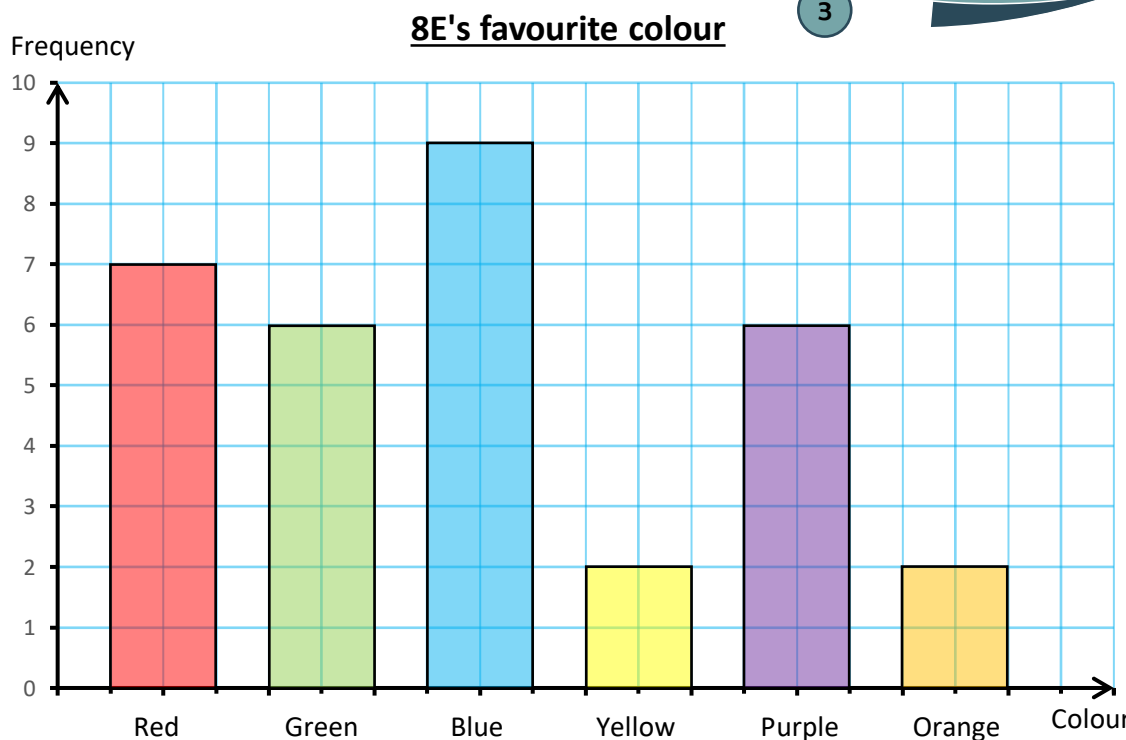
(a) How many pupils chose **red**?

(b) How many pupils chose **yellow**?

(c) Which colour was the **most popular**?

(d) How many pupils are in class 8E?

(e) How many pupils in 8E did **not** like purple?



3

Applying

Exercise 31

6

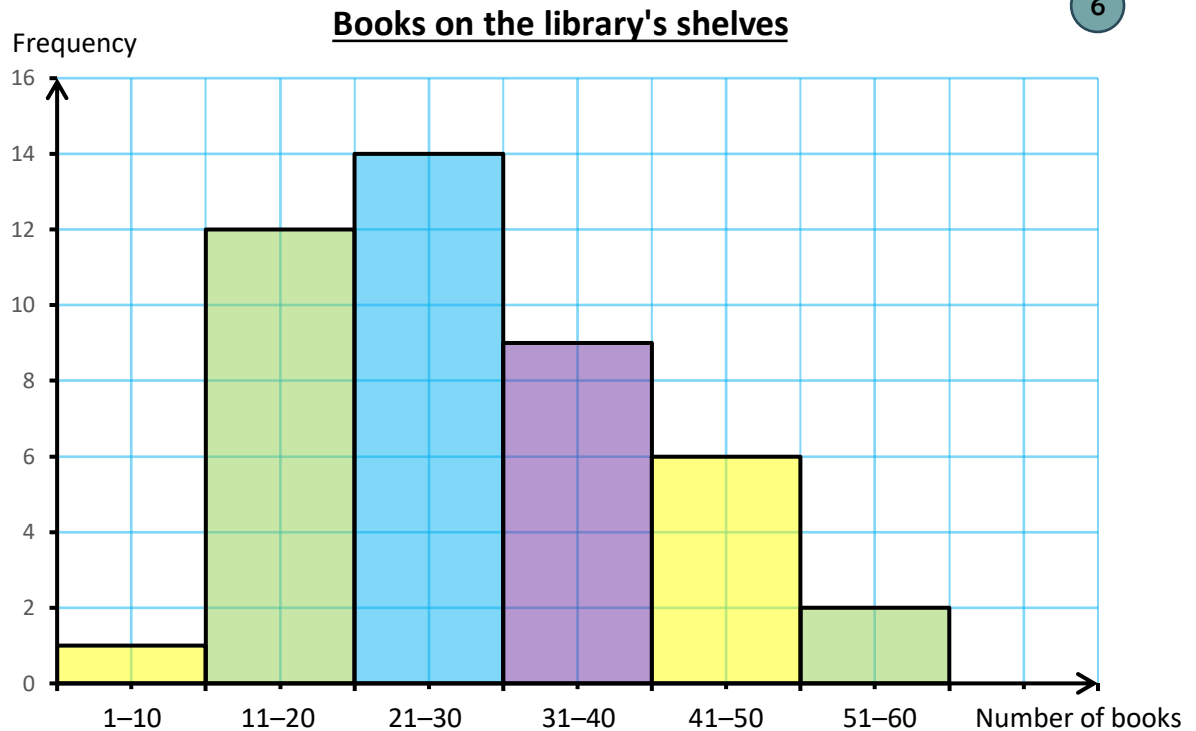
(a) How many shelves contain between **11 and 20** books?

(b) How many shelves contain between **31 and 40** books?

(c) How many shelves contain **more than 30** books?

(d) **How many shelves** are there in total in the library?

(e) Based on this information, can you state how many shelves in the library contain **exactly 20 books**? Explain your answer.

**Exercise 32**

5

(a) How many pupils got **7 marks**?

(b) How many pupils got **less than 5 marks**?

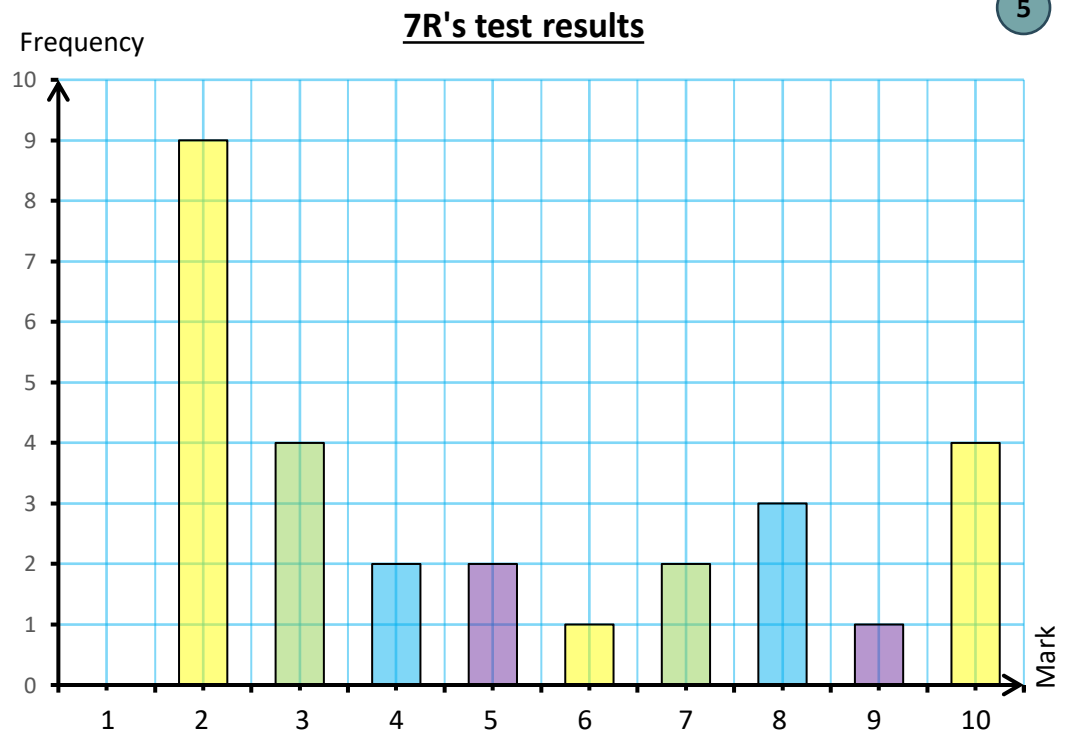
(c) How many pupils got **more than 6 marks**?

(d) **How many pupils** are there in the class?

(e) What was the **total** of the class' marks?

(f) What was the **mean** of the class' marks?

(g) What was the mark **3 of the pupils** got?

**Exercise 33**

6

(a) What **type of data** is shown in Exercises 30, 31 and 32?

(b) Were the graphs in Exercises 30–32 **bar charts** or **frequency diagrams**?

Exercise 34

6

The length of the phone calls in an office one afternoon

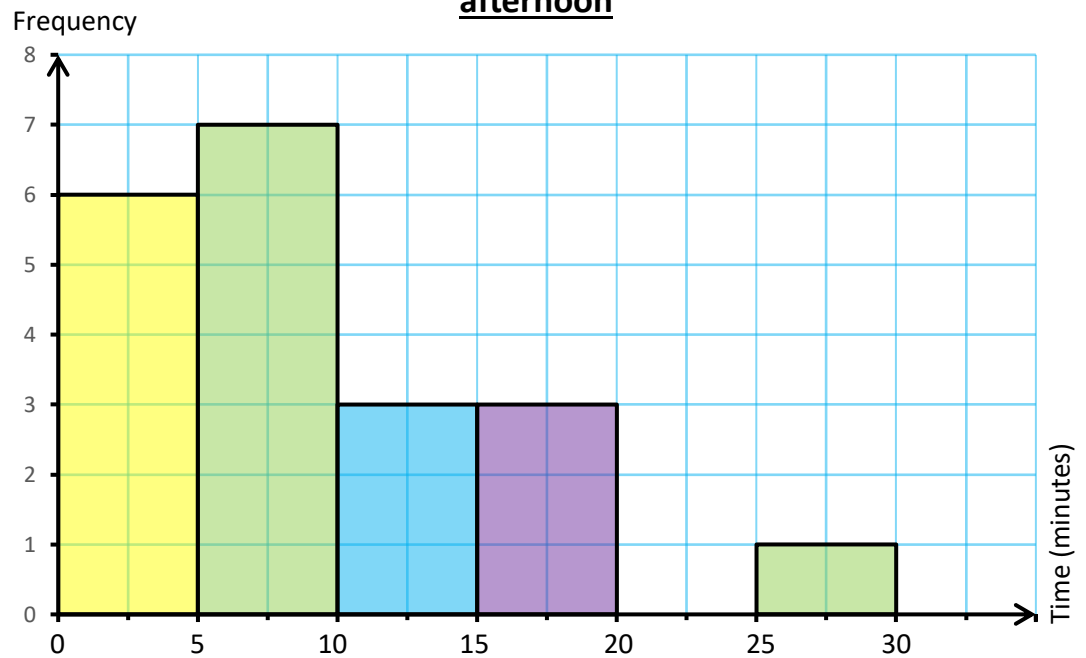
(a) How many phone calls lasted between **10 and 15** minutes?

(b) How many phone calls lasted **at least 15** minutes?

(c) How many phone calls were there **in total** during the afternoon?

(d) What **type** of data is shown here?

(e) Alwen phoned the office during the afternoon. The length of her phone call was 590 seconds. Which bar in the frequency diagram shows this phone call?



Exercise 35 (Revision)

The following list shows the **number of complete games** a squad of football players played during one season.

16 10 9 3 21 30 4 12 0 36 20 14 12 5 16
 0 5 6 14 23 0 0 18 1 38 15 18 3 12 16

(a) What **type** of data is this?

(b) Draw a **frequency table** for the data, using the groups 0–4, 5–9, 10–14 up to 35–39.

(c) Draw a **frequency diagram** for the data.

(d) How many players played more than 25 complete games during the season?

(e) How many players played less than 10 complete games during the season?

Did you know?

The first person to draw a bar chart was William Playfair, in 1786, to show Scottish exports.

Evaluation

Key Words	Further Questions	What went well?	To reach my target level I will...
			My Level ☐ My Target ☐

Mean of Grouped Data

In the previous chapter, we used a **frequency table** to group data into equal classes. Given a table of this sort, is it possible to calculate the **mean** of the original data?

Example

The following table shows the number of music albums the pupils of 10R have bought during November.

Number of albums	Frequency
0–4	11
5–9	8
10–14	5
15–19	1



What is the **mean number** of music albums the pupils of 10R have bought during November? Without access to the original data (*before it is grouped*), it is **impossible to state** what is the exact mean, because the frequency table does not give us complete data. For example, the table notes that one person has bought between 15 and 19 albums, but how many exactly? It could be 15, but it could also be 16, 17, 18 or 19. Without this information, we cannot calculate the mean exactly. We can, however, **estimate** the mean using the frequency table, by using the following method.

(1) Find the **mid-point** of each class by adding the two numbers that form the class and halving. For example, the numbers 5 and 9 form the class 5–9. By adding these numbers, we obtain 14. Half of 14 is 7, so the mid-point of the class 5–9 is 7.

Number of albums	Mid-point	Frequency
0–4	2	11
5–9	7	8
10–14	12	5
15–19	17	1

(2) Because the mid-point of each class gives a single value that **represents** the class, we can now use the method from page **Error! Bookmark not defined.** to estimate the mean from the table.

To begin, **multiply** each mid-point by the frequency of the class.

Number of albums	Mid-point	Frequency	Multiplication
0–4	2	11	$2 \times 11 = 22$
5–9	7	8	$7 \times 8 = 56$
10–14	12	5	$12 \times 5 = 60$
15–19	17	1	$17 \times 1 = 17$

(3) Find the **total** of the final two columns.

Number of albums	Mid-point	Frequency	Multiplication
0–4	2	11	$2 \times 11 = 22$
5–9	7	8	$7 \times 8 = 56$
10–14	12	5	$12 \times 5 = 60$
15–19	17	1	$17 \times 1 = 17$
Total		25	155

(4) Divide the total of the 'multiplication' column by the total of the 'frequency' column:
 $155 \div 25 = 6.2$. This is the estimate for the mean of this set of data.



Exercise 36Find an **estimate** for the mean of the following data sets.

7

Skill

(a)

Number of cars sold in a day	Number of days
0–4	18
5–9	11
10–14	6
15–19	4
20–24	1

(b)

Number of flowers per m ²	Number of square metres
0–14	43
15–29	21
30–44	13
45–59	2
60–74	1

(c)

Height of a horse chestnut tree, in metres	Frequency
0–3	13
4–7	17
8–11	9
12–15	4
16–19	5
20–23	0
24–27	2

(d)

Number of books sold in a week	Frequency
100–124	1
125–149	9
150–174	8
175–199	5
200–224	2

(e)

Number of customers in a café	Frequency
70–74	3
75–79	21
80–84	30
85–89	28
90–94	14
95–99	4

(f)

Number of sweets in a jar	Frequency
300–324	4
325–349	15
350–374	27
375–399	63
400–424	74
425–449	32
450–474	11
475–499	2



The Range

Let us consider again the data about music from page 20.

Number of albums	Mid-point	Frequency
0–4	2	11
5–9	7	8
10–14	12	5
15–19	17	1

Is it possible to find the **range** of the data set using the above table? As with the mean, it is not possible to calculate the range exactly, as the table does not tell us the maximum and minimum data values. The best we can do is to state that the least value is *between 0 and 4*; and that the greatest value is *between 15 and 19*. We must use the **mid-point** of the classes to find an **estimate** for the range, by taking away the lower mid-point from the higher mid-point. For this data, our estimate for the range is $17 - 2 = 15$.



7

Exercise 37

Find an **estimate for the range** of the data sets from Exercise 36.

Continuous Grouped Data

The methods of estimating the mean and range also work with continuous data that is grouped.

Example

A golfer hits 40 golf balls using one of his clubs. He records the distance that each ball has travelled. The following frequency table shows his results.

Distance travelled, d , in yards	Frequency
$75 \leq d < 80$	4
$80 \leq d < 85$	13
$85 \leq d < 90$	17
$90 \leq d < 95$	6

We can find an estimate for the **mean** of this data by finding the class mid-points; multiplying by the frequency; and finding the total of the final two columns.

Distance travelled, d , in yards	Mid-point	Frequency	Multiplication
$75 \leq d < 80$	77.5	4	$77.5 \times 4 = 310$
$80 \leq d < 85$	82.5	13	$82.5 \times 13 = 1072.5$
$85 \leq d < 90$	87.5	17	$87.5 \times 17 = 1487.5$
$90 \leq d < 95$	92.5	6	$92.5 \times 6 = 555$
Total		40	3425

The estimate for the **mean** is $3425 \div 40 = 85.625$ yards.

The estimate for the **range** is $92.5 - 77.5 = 15$ yards.



Exercise 38

7

Find an estimate for the **mean** and **range** of each of the following data sets.

(a)

The length of the cars, l , that are parked in a supermarket car park, in metres	Frequency
$3 \leq l < 4$	34
$4 \leq l < 5$	41
$5 \leq l < 6$	5

(b)

The time, t , taken to complete a race, in minutes	Frequency
$20 \leq t < 25$	5
$25 \leq t < 30$	11
$30 \leq t < 35$	19
$35 \leq t < 40$	12
$40 \leq t < 45$	3

(c)

The head circumference, c , of people in a factory	Frequency
$50 \leq c < 54$	10
$54 \leq c < 58$	31
$58 \leq c < 62$	16
$62 \leq c < 66$	3

(d)

The thickness, t , of books in a library, in mm	Frequency
$0 \leq t < 10$	5
$10 \leq t < 20$	16
$20 \leq t < 30$	41
$30 \leq t < 40$	32
$40 \leq t < 50$	6

(e)

The length of phone calls, l , in minutes	Frequency
$0 \leq l < 5$	32
$5 \leq l < 10$	42
$10 \leq l < 15$	24
$15 \leq l < 20$	12
$20 \leq l < 25$	7
$25 \leq l < 30$	2



Exercise 39

Over a period of 50 days, Bethan and Lowri recorded how many minutes per day they spent on their mobile phones. The data is given in the following frequency tables.

Bethan's time, t , in minutes	Frequency
$0 \leq t < 30$	14
$30 \leq t < 60$	17
$60 \leq t < 90$	10
$90 \leq t < 120$	9
$120 \leq t < 150$	0
$150 \leq t < 180$	0

Lowri's time, t , in minutes	Frequency
$0 \leq t < 30$	23
$30 \leq t < 60$	14
$60 \leq t < 90$	5
$90 \leq t < 120$	3
$120 \leq t < 150$	2
$150 \leq t < 180$	3

Applying

7

- (a) Calculate an estimate for **Bethan's mean time** and **Lowri's mean time**.
 (b) Calculate an estimate for **Bethan's range** and **Lowri's range**.
 (c) Who would you say uses their mobile phone **the most**? Explain your answer.
 (d) Who would you say is **most consistent** in using their mobile phone? Explain your answer.

Exercise 40 (Revision)

7

The height of 25 Year 7 learners was measured. The results are given below, correct to the nearest inch.

57	53	59	62	61
66	51	58	59	62
60	62	54	64	59
58	62	64	53	67
61	63	57	48	60

- Calculate the **mean height** of the learners.
- Calculate the **range** of the heights.
- What **type** of data is this?
- Complete the following **frequency table** in order to group the data.

Height, h , in inches	Tally Marks	Frequency
$45 \leq h < 50$		
$50 \leq h < 55$		
$55 \leq h < 60$		
$60 \leq h < 65$		
$65 \leq h < 70$		

- (e) Draw a **frequency diagram** for the data.
- (f) Use the frequency table to find an **estimate for the mean and range**.
- (g) How close were your estimates to the true values?

Challenge!

Repeat the above exercise using the heights of the learners in your class.



Evaluation

Key Words	Further Questions	What went well?	To reach my target level I will...
			<div> <div>My Level</div> <div>My Target</div> </div>

Pie Charts

It is possible to display data by dividing a circle into **sectors** of appropriate sizes. We form a **pie chart** by doing this.

Example

Here is the weather for the 30 days in June.

<i>Rainy days</i>	4
<i>Cloudy days</i>	8
<i>Sunny days</i>	18

In order to draw a pie chart for this data, we need to start by dividing 360° (which is the angle around a point in the centre of a circle) by 30 (which is the number of data items).

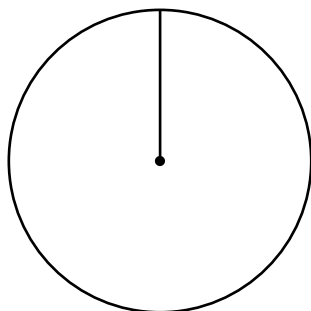
$$360^\circ \div 30 = 12^\circ$$

Next, we multiply the 12° (which is the angle for one day) by the number of days for a particular type of weather.

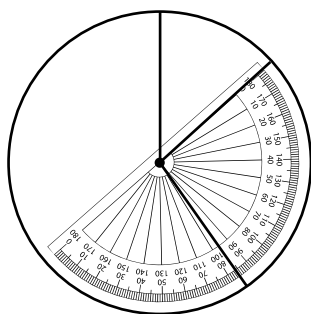
<i>Rainy days</i>	$4 \times 12^\circ = 48^\circ$
<i>Cloudy days</i>	$8 \times 12^\circ = 96^\circ$
<i>Sunny days</i>	$18 \times 12^\circ = 216^\circ$

To finish, we construct the pie chart itself.

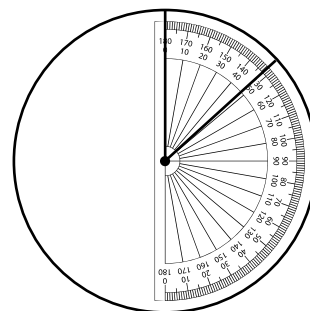
- (a) Draw a **circle** using a compass. Mark the centre of the circle with a **dot**. Draw a **vertical line** from the centre of the circle to the top of the circle.



- (c) Draw the next angle (96°) using a protractor.

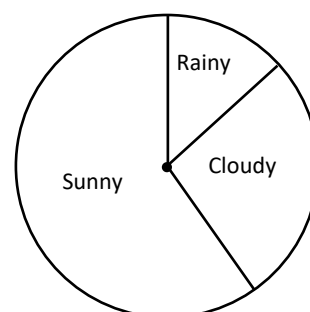


- (b) Measure the first angle (48°) using a protractor. Mark the angle using a pencil before drawing a straight line **from the centre of the circle to your mark**.



- (d) Label the sectors and add a suitable title to the pie chart.

June's weather



Exercise 41

Draw a **pie chart** for the following sets of data.

(a) 8C's favourite fruit.

<i>Apple</i> : 10	<i>Banana</i> : 8
<i>Orange</i> : 4	<i>Strawberry</i> : 2

(b) Year 9's holiday destinations, for last summer.

<i>Europe</i> : 40	<i>Britain</i> : 70
<i>U.S.A.</i> : 10	

(c) Tomos' typical day (24 hours).

<i>Sleeping</i> : 8 hours	<i>Eating</i> : 1 hour
<i>Working</i> : 8 hours	<i>Leisure</i> : 6 hours
<i>Travelling</i> : 1 hour	

(d) The foods that were eaten in a hotel.

<i>Beef</i> : 7	<i>Lamb</i> : 26
<i>Chicken</i> : 18	<i>Vegetarian</i> : 5
<i>Fish</i> : 14	<i>Duck</i> : 2

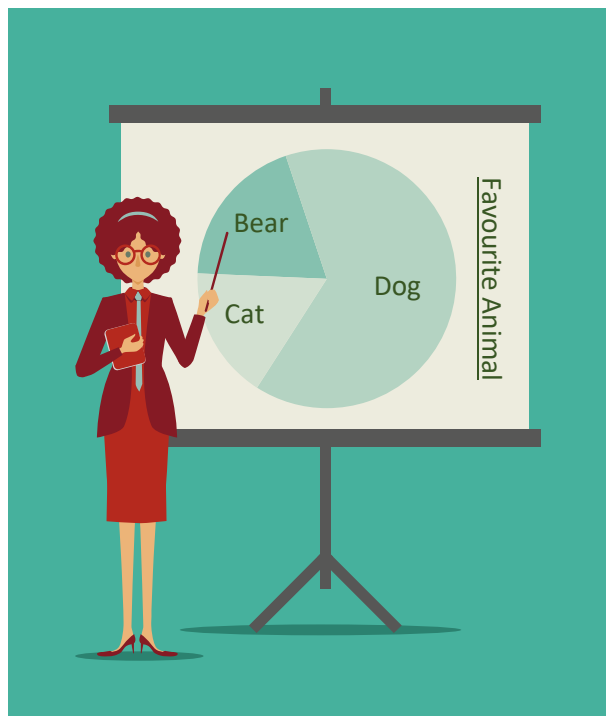
(e) Methods of heating a house.

<i>Coal</i> : 7	<i>Electricity</i> : 9
<i>Gas</i> : 11	<i>Oil</i> : 3



6

Skill



(f) How do the pupils of Ysgol y Creuddyn reach school?

<i>Bus</i> : 500	<i>Car</i> : 150
<i>Bike</i> : 50	<i>Walk</i> : 100

(g) The votes in a recent election.

<i>Conservatives</i> : 13,000	<i>Labour</i> : 9,000
<i>Plaid Cymru</i> : 7,000	<i>UKIP</i> : 4,000
<i>Liberal Democrats</i> : 3,000	

(h) The colour of the cars in a car park.

<i>Red</i> : 8	<i>Blue</i> : 4
<i>Green</i> : 5	<i>Yellow</i> : 7

(i) 8E's favourite sport.

<i>Football</i> : 13	<i>Rugby</i> : 5
<i>Golf</i> : 2	<i>Other</i> : 3

(j) How many sisters do the learners of 9E have?

<i>None</i> : 7	<i>One</i> : 12
<i>Two</i> : 4	<i>Three</i> : 3

**Exercise 42**

What **type** of data is given in the questions of Exercise 41?

4

Interpreting Pie Charts

Exercise 43

5

Applying

(a) The pie chart shows how 7C come to school.

(i) What is the **most popular method** of coming to school?

8 of the pupils come by car.

(ii) How many pupils come by **bus**?

(iii) How many pupils **walk** to school?



(b) Paul has drawn a pie chart. It shows when pupils like to complete their homework.

(i) Which time is the **most popular**?

(ii) What **fraction** of the pupils like to complete their homework after supper?

There were 20 pupils in the survey.

(iii) How many pupils like to complete their homework **before** supper?

(iv) How many pupils chose **dinner time**?

(c) Siân asked her class, 9C, what type of **bike** they had. There are 32 pupils in Siân's class.

(i) What is the **most popular** bike?

(ii) How many pupils **do not** have a bike?

(iii) Complete the following table.

Bike	Mountain	Racing	Normal	No Bike
Number of pupils				

(d) This pie chart shows the **favourite colour** of 40 boys.

(i) Which **fraction** liked **red**?

(ii) How many boys liked **red**?

(iii) Which fraction liked **blue**?

(iv) How many boys liked **blue**?

(v) How many boys did **not** choose green?

(e) Siôn spends 4 hours on different activities at night.

How much time is spent on

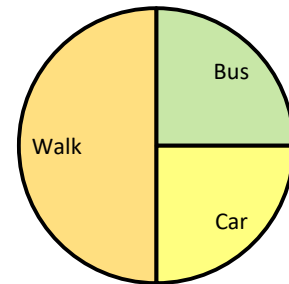
(i) **sports**;

(ii) watching **television**;

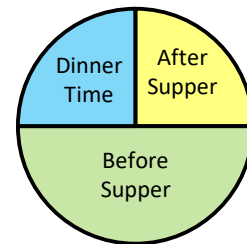
(iii) **reading**;

(iv) **homework**?

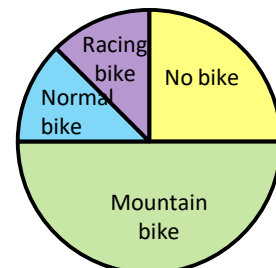
How do 7C come to school?



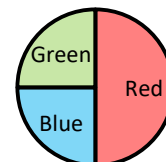
Favourite time for doing homework



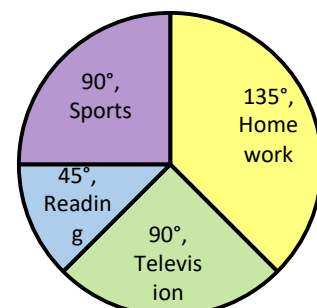
The type of bike that the pupils of Siân's class have



40 boys' favourite colour



Siôn's Activities



6

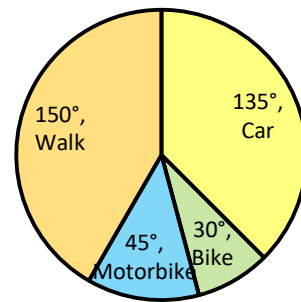
Exercise 44

(a) This pie chart shows how 24 people travelled to town.

Find how many people

- (i) **walked** to town;
- (ii) came in a **car**;
- (iii) came on a **motorbike**;
- (iv) came on a **bike**.

How did 24 people travel to town?



(b) Llinos surveyed 210 pupils in years 7 and 8.

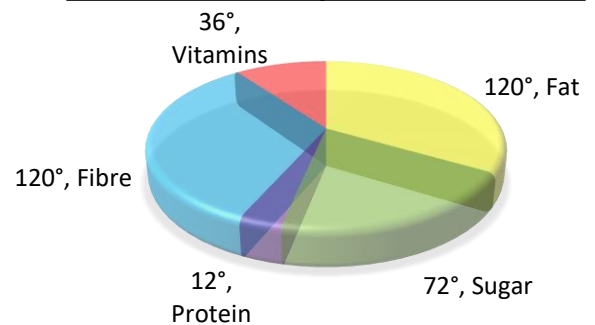
She asked the pupils which of the following, in their opinion, was most important in their diet.

Fat; Sugar; Protein; Fibre; Vitamins.

The pie chart shows her results.

How many pupils are in each category?

What is most important in a diet?

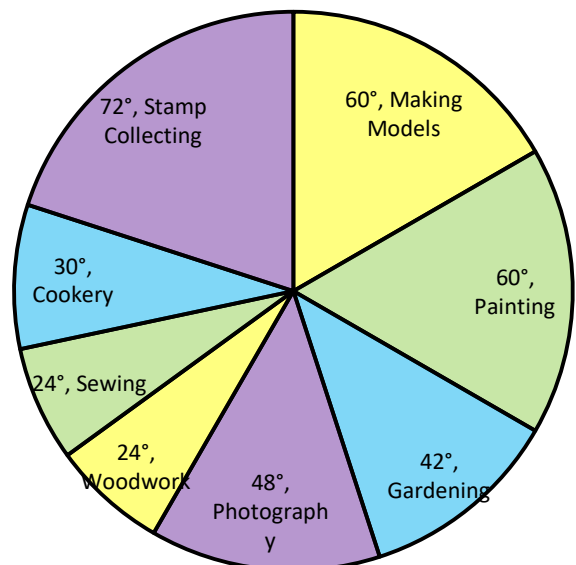


(c) This pie chart shows what several people do in their leisure time.

12 people collect stamps. How many people:

- (i) were surveyed **in total**?
- (ii) like **gardening**?
- (iii) enjoy **photography**?
- (iv) Which two hobbies had the same number of people partaking in them?

Leisure time activities

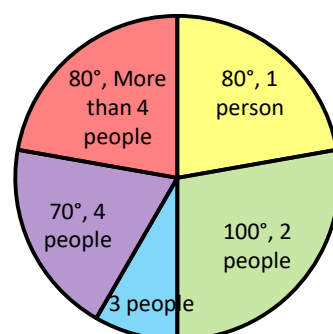


(d) This pie chart shows how many people were in a car when surveyed by Siwan.

Siwan looked at a total of 180 cars.

- (i) How many cars had **2 people** in them?
- (ii) How many cars had **3 people** in them?
- (iii) In how many cars were there **4 people**?

How many people were in the car?



(e) This pie chart shows the nutritional value of a packet of crisps weighing 36g.

- How much of the crisps is made up of **carbohydrate**?
- How much of the crisps is made up of **fat**?
(Use your protractor to help.)
- How much of the crisps is **protein**?

Exercise 45 (Revision)

6

(a) Draw a pie chart for the following data showing the **manufacturer** of 20 cars belonging to teachers.

<i>Ford</i> 5	<i>Vauxhall</i> 4	<i>Toyota</i> 3
<i>Audi</i> 2	<i>Volkswagen</i> 5	<i>Fiat</i> 1

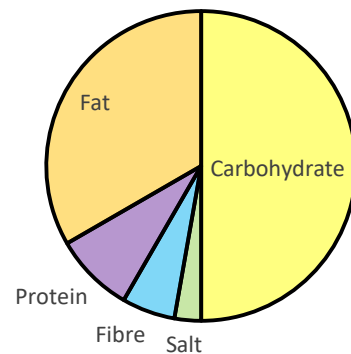
(b) Jessica drew the pie chart shown on the right which shows where a group of people had been on holiday last year.

16 people had been in Scotland.

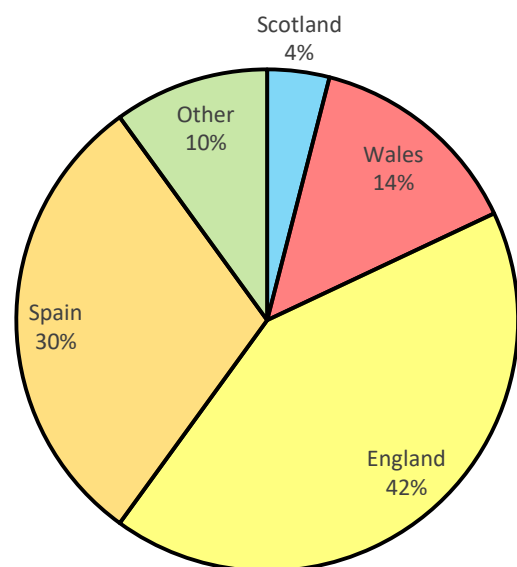
- (i) Daniel looked at the chart and said “*Most of the people had spent their holiday in England*”. Jessica said that this was not true. Explain why Daniel is **wrong**.
- (ii) Dafydd looked at the chart and said “*Because 16 people have been in Scotland, it must be that 1% represents 4 people*”. Is Dafydd **correct**?
- (iii) How many people had been to **Spain** on their holiday?

Dafydd added that Jessica had surveyed **400** people. Jessica gave two reasons why Dafydd was **wrong** in saying this. What could these reasons be?

Nutritional value of a packet of 36g crisps



Jessica's Holiday Survey



Evaluation

Key Words	Further Questions	What went well?	To reach my target level I will...
			<div> My Level <input type="text"/> My Target <input type="text"/> </div>

Puzzle: Pair the solid to its top view.

