BY INTERNATIONAL AUTHOR OF SUPERWOMAN **DAME SHIRLEY CONRAN**

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THE DO-IT-YOURSELF
6 STEP MATHS PLAN
FOR REAL LIFE

THIS IS STEP 3

Money Stuff

MATHEMATICS WILL GIVE YOU GIRL-POWER

She can afford a tropical break.

HOW TO NAVIGATE MONEY STUFF IS AT THE START OF STEP 1.

MONEY STUFF is a new way to learn, and each Part is built on the previous Part so - even if you know the basics - PLEASE START AT THE BEGINNING, with STEP 1. Some older testers started in the middle, got in a muddle and had to go back to the start. Don't risk it.

!!! Watch out for prices !!!

(Another warning)

The cost of living has been zig-zagging upwards for hundreds of years. In the sixteenth century, Queen Elizabeth I worried about the increasing costs of feeding and equipping her army and navy. Today, you can still expect prices to rise unsteadily in the unforeseeable future.

What causes prices to rise? Many reasons, including bad weather, which increases farmers' food prices. So workers need higher wages, which means that the cost of the goods they make will increase. If the prices of bricks, cement and steel increase then so will the cost of housing and rents.

Sometimes the price rises are so small you don't notice them – but you will certainly notice if your home energy bill shoots up in a few months and mum starts switching off the lights and heating.

These rising prices are called **inflation**.

When I started to write this maths course, the prices I used in the exercises were the same as the prices in the shops – but by the time I had finished **Step 1**, the shop prices had risen - so the exercise prices were out-of-date. That is why the prices in **MONEY STUFF** are not current prices; they are historically correct prices, paid by your grandmother and mother in the early **21st** century.

In maths, as in life, people have different ways to writing numbers. For example, you can write a fraction as either ½ with a diagonal line, as we do, or as $\frac{1}{2}$ which you may also see. Whichever you use, the meaning is the same. Likewise, some people write **1,000** or **1,000,000** as we do, with commas to break up the digits, others prefer just to leave a space, like this **1 000** or **1 000 000**. The choice is yours – that's the joy of maths!

Shop prices will alter throughout your life.

But the maths you need to shop will never alter.

Dame Shirley Conran

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Good calculation.
A Russian competes in
Junior Athletics
Championship. Spain.

Charlotte Dujardin of Britain won Olympic gold medal for Individual Dressage Event 2012.

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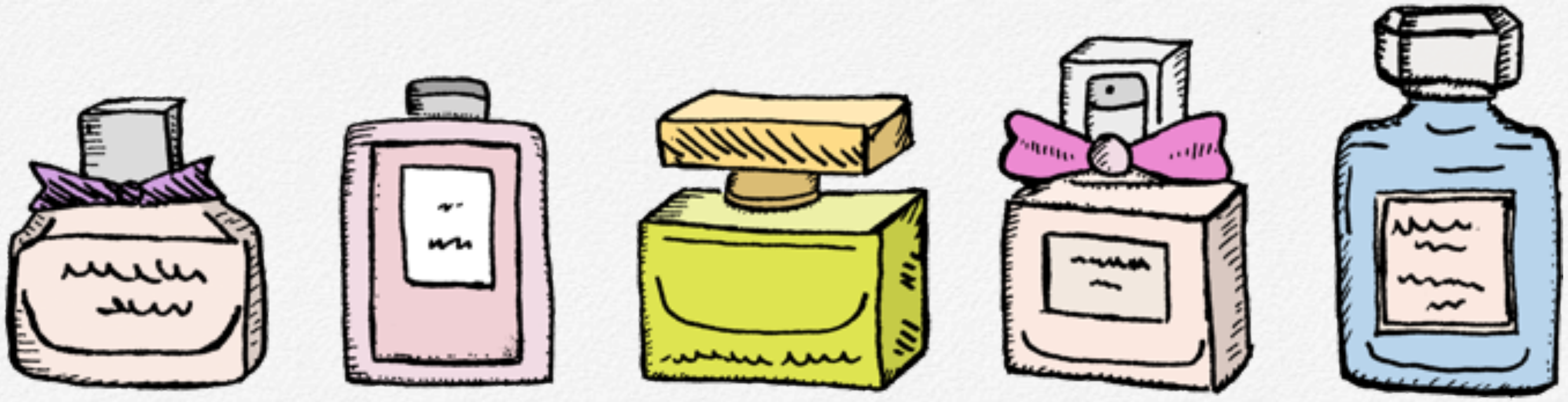
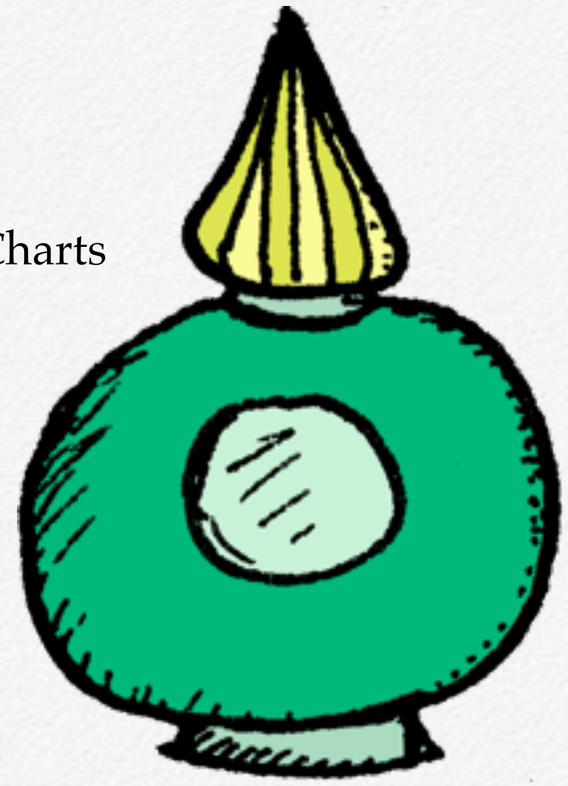
She's in control.





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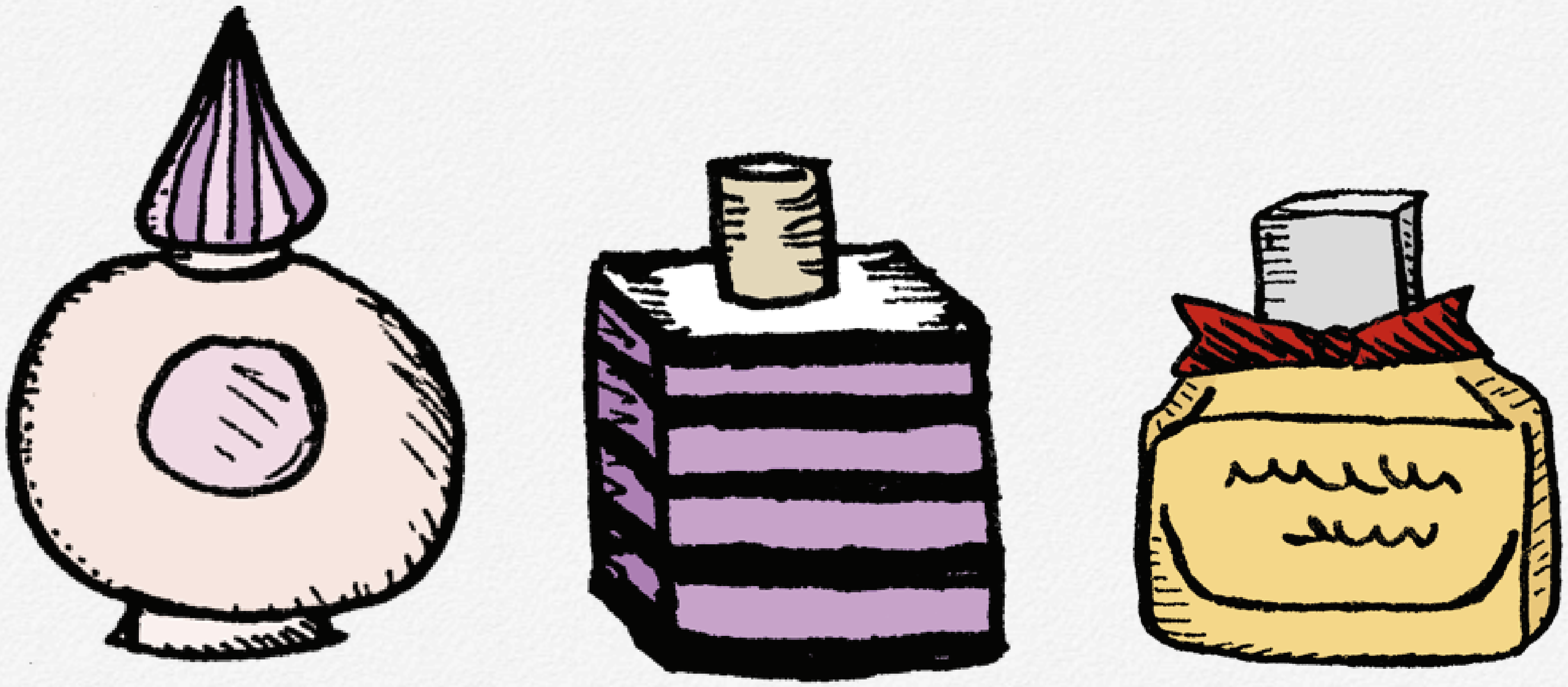
HOW TO SPEND MONEY

YOUR ACHIEVEMENT CERTIFICATE



YOUR WAY TO SUCCESS 1

Sometimes you want to be alone...

What motivates YOU?

How can you keep up your motivation, so it doesn't fizzle out like a New Year resolution?

What makes **YOU** determined to do your best?

When your energy is low, what sparks **YOU**? What gives **YOU** immediate energy?

I can't tell you, but **you** can work it out, if you think back and notice your own behaviour.

For instance, my dad once sourly commented that I always felt too tired to help him clear out the garage but I was all fizz if a boyfriend phoned. **And I was.**

What gives you energy?
Any of the following?

a) Your favourite guy phones.

b) Your best friend phones.

c) You're offered a working trip abroad.

d) You're given a task that interests you.

If that doesn't energize you, work out two things that do.

Only YOU can switch your energy button ON or OFF.

I'm not very ambitious. Yet when I play Scrabble against the computer, if I notice I'm losing, I always play better because, suddenly, *I'm determined not to lose.*
Not-losing is one of **my** motivators.

My friend Alice is a top-earning salesperson. Her motivation? Simple, she said, I like beating the guys.

What makes you **improve your game?** Remember two incidents.

To achieve your goals, you will discover that some dull, support work is necessary.
Get used to it. Do it fast, and get it out of the way, or it hangs over you and spoils the day.

Determination
Don't drift away from your goal. Refocus on that goal. Work out what activates your determination – which is also called **drive**, because it drives you on.

When you find out, put yourself in **determination mode.** Snap your fingers, to switch yourself on.

The Excuses Guide

As you climb your ladder of success, if you droop…

Try to catch yourself thinking:

I'm too busy, I don't have any spare time.

I'll do it later, I'll do it tomorrow…at the weekend… oh dear…

My NUMBERS buddy drifted away…it's **her** fault.

If your numbers buddy is no longer around, work out **why.**

Is there a good **reason**, or just an **explanation** of why she gave up? (An explanation is not an excuse.)

If you can find another numbers buddy, do so.

If not, imagine I'm sitting beside you,
every step of the way. **Because I am.**
YOU are the reason I designed MONEY STUFF,
so let's get on with it.

"Suddenly, I feel tired."
Fifteenth century
Florentine painting.

Are you ready to improve your life?
Or are you still at the Blame & Complain stage?

I’d rather do something else.
My friend Kelly plays computer games. She enjoys getting that inner winning glow, that feeling of achievement… **without really achieving anything.**

I can’t be bothered.
Remember why you started.
What’s more important than the rest of your life?

I’m having fun and I prefer it.

I feel tired. A Thirties movie star Marlene Dietrich remarked, “Life is tiring, Baby.”

Have you recognized yourself? If not, add a couple of your own excuses – and watch out for them.

Like school homework, the longer you leave something, the bigger and more difficult it gets in your mind. This is a habit that can stick to you for life.

Is that the life you want to live?

YOU choose.

Stretch yourself.

Keep going...

You've completed 50% of MONEY STUFF
and you know how much 50% is.
WELL DONE

You've learned to think logically, one step at a time.
You've learned to break a problem into small bits that are easier to manage.
That strategy will help you to tackle ANY problem in life, not just a maths or a money problem.

By the time you finish STEP 3:

- You will feel more self-confident.
- You'll know how to look after your money.
- You'll be able to spot a scam.
- You'll be able to work out how much paint you need to paint your bedroom any colour you want.
- You'll know how to avoid credit card debt.
- You're less likely to be cheated

Why? Because you will notice when you are overcharged in a shop, or exchange bureau or bank.

Computer errors have never been in my favour, except for one year, when my bank put £1.9 million of someone else's money into my account. A month later, somewhat reluctantly, I informed the bank, which had not noticed… and neither had the person to whom the £1.9 million belonged.

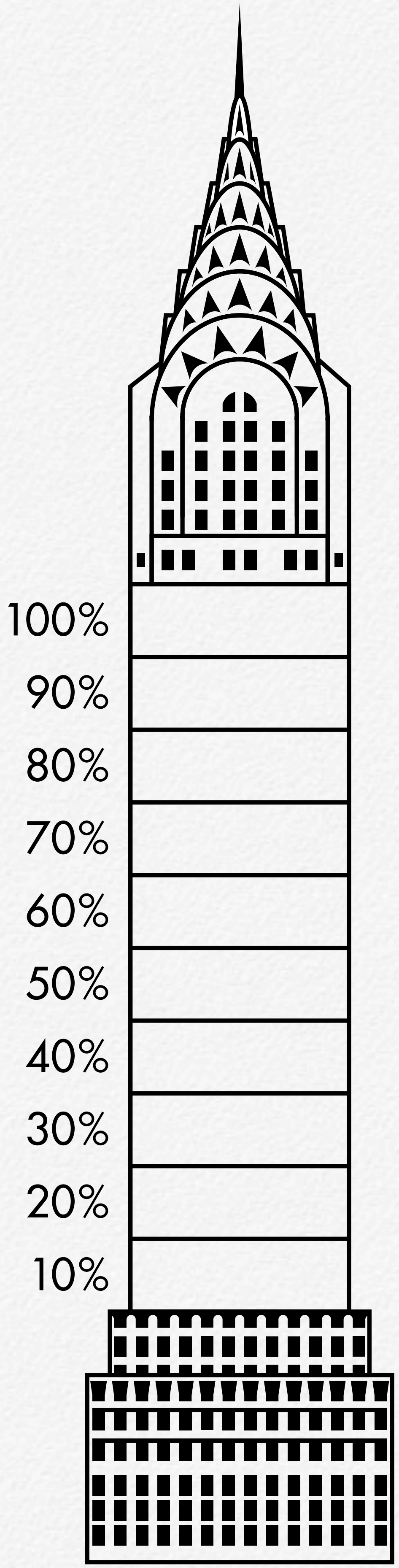
The hardest part of a project is when you are halfway.
So how can you encourage yourself to zip along to the end?

When I told bestselling novelist Judith Krantz that I give myself a present every time I finish writing a book, she laughed, "I give myself a present every time I finish a chapter!"

So plan your own incentives as you finish the end of each of the 10 Parts in STEP 3.

My own two useful strategies for finishing a project are on the next page. More tips will follow, sprinkled through these pages.

Choose your own strategy.



Draw a SUCCESS SKYSCRAPER

Do a rough drawing of a skyscraper. Rule into 10 areas. Label each with a percentage. Count from the bottom. Every time you complete another ten percent, you colour it into the drawing.

Because you've completed 50% of MONEY STUFF, perhaps you can now print this page then colour from the base up to 50% of the skyscraper. Now you can see how much you've completed. You can see there's not much further to go.

I stick both these drawings on the wall next to my work table, but you could also keep them in a drawer or some other handy place – not your bag, you've got enough in there already.

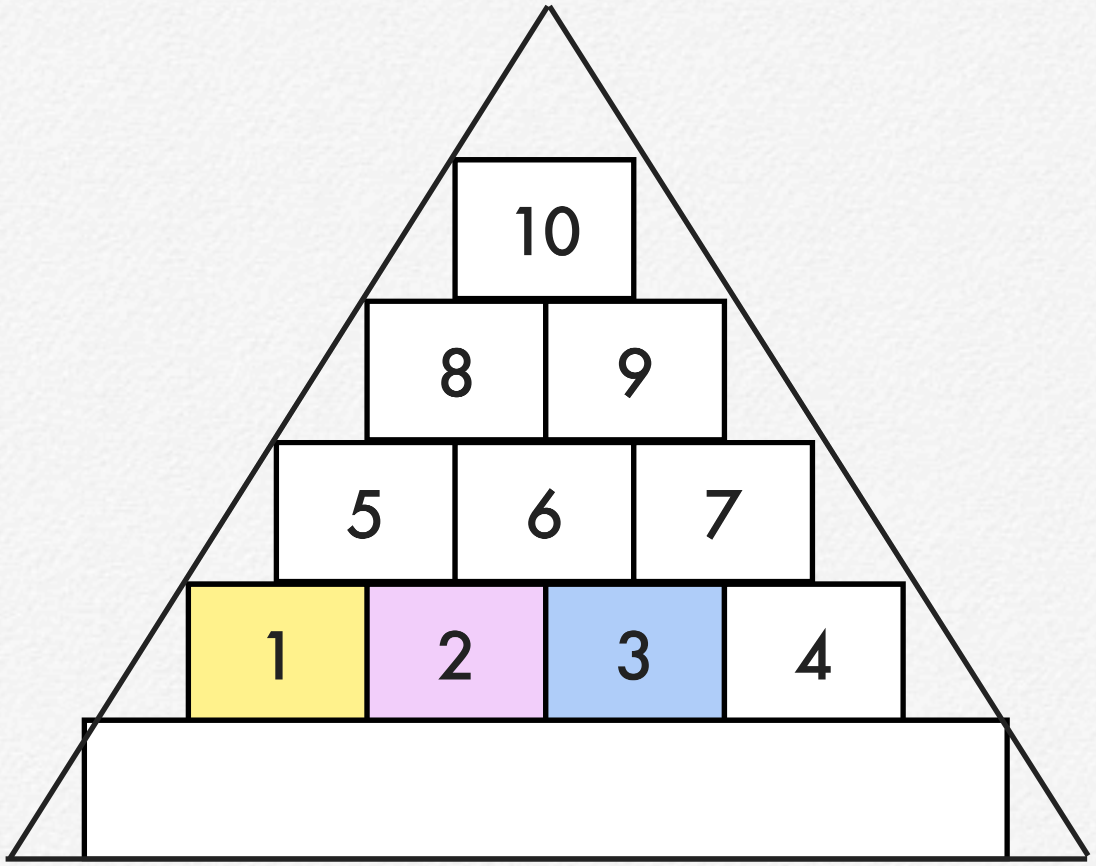
Draw a PUSH-AHEAD PYRAMID

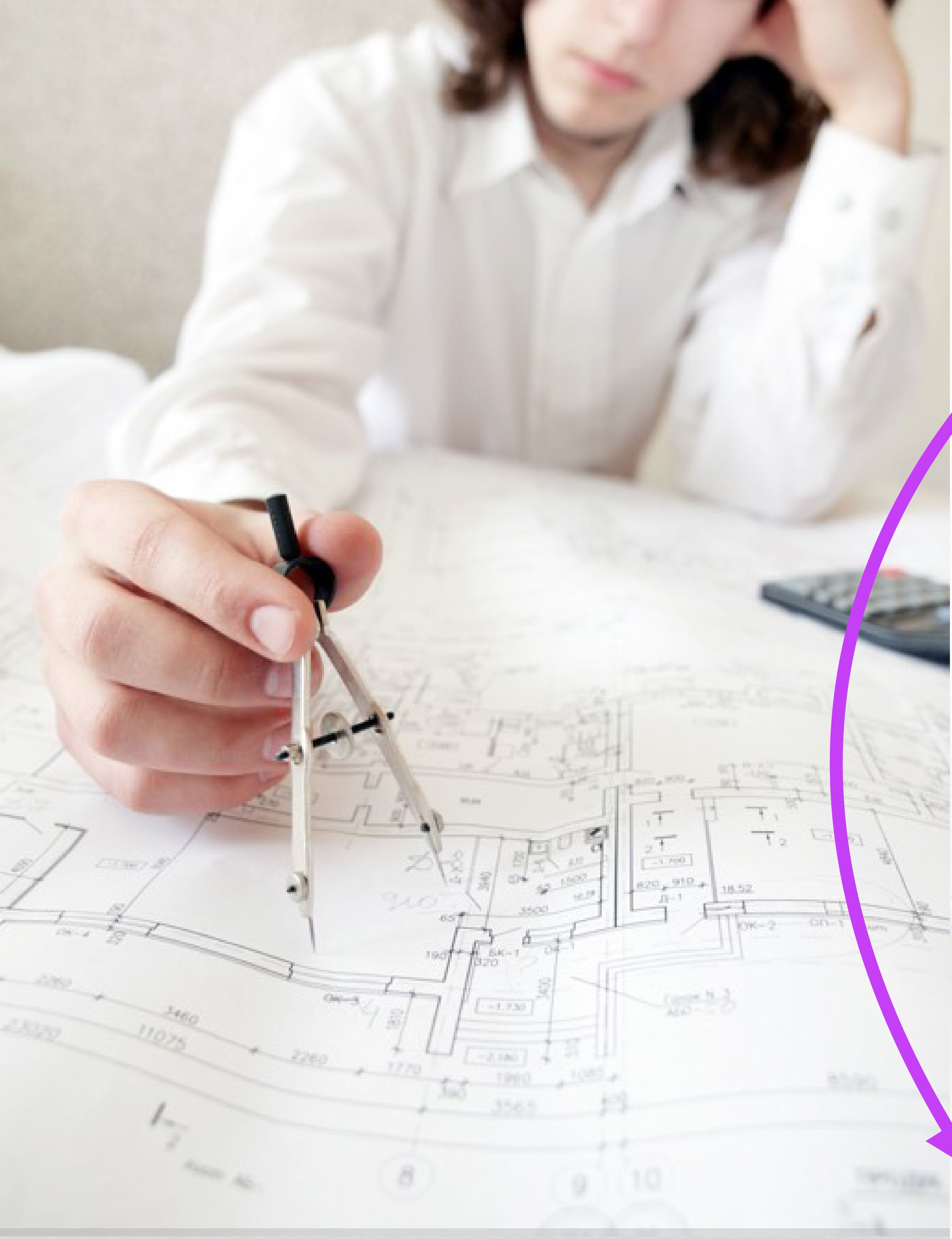
Do a rough drawing of a pyramid. Each stone block of your pyramid represents a different section of the work that remains to be done.

If you turn to the contents list, you will see that there are 10 Parts in STEP 3, so your pyramid needs 10 blocks.

Colour one block after you complete each part of this section. Watch it grow!

(I colour the top blocks first.)





Architect using compass.

NOW YOU WILL NEED:

A RULER

A COMPASS

A PROTRACTOR

A PENCIL

OUR MOTTO
Life is too short
to be short of money

PART 16
THE METRIC SYSTEM

How do you weigh spices?

Quick Quiz

Q1.

How is **three billion, sixteen million and twelve** written in numbers?

- A. 3,016,012
- B. 3,000,016,012
- C. 3,016,000,012
- D. 3,016,012,000

Quick Quiz

Q2.

What is 500 x 20?

- A. 100,000
- B. 10,000
- C. 1,000
- D. 100

Quick Quiz

Q3.

Which of the following fractions is not equal to a quarter?

- **A.** $\frac{3}{12}$
- **B.** $\frac{2}{8}$
- **C.** $\frac{2}{6}$
- **D.** $\frac{1}{4}$

Quick Quiz

Q4.

What is £58.95 rounded to the nearest 10?

- A. £60
- B. £50
- C. £59
- D. £58

Quick Quiz

Answers

Q1. 3,016,000,012

Q2. 10,000

Q3. $\frac{2}{6}$

Q4. £60

Basic Measurements

The Calculating Girl

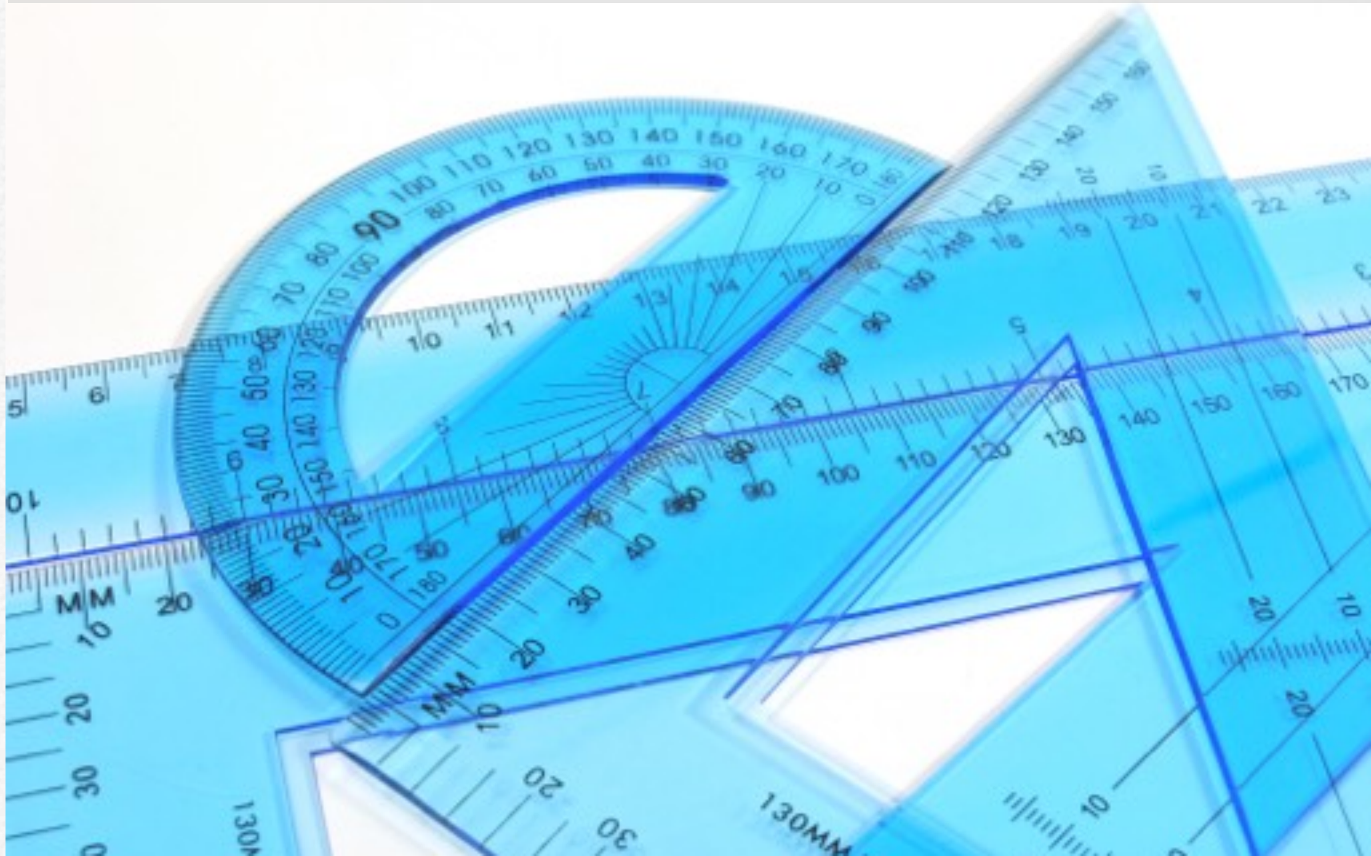
I bet you know your birthday – and I bet you let other people know that date. I bet you can tell the time. I bet you know your shoe size. Perhaps you know how to follow a recipe.

These are matters that you take for granted and you already know how useful they are: you mustn't be late to catch a train; you'll give a bad first impression if you are late for a job interview. Because you know your shoe size, you can order silver slippers over the internet or fight your way to the correct shoe rack in the January sales. Whether you love cooking or hate it, you need to measure ingredients for the simplest recipe.

So – trust me – when you **understand** the following measuring systems they will **really** help you and they will **really** make your life easier. You don't need to consciously learn them – just understand them. You can always refer back to MONEY STUFF.

In Britain, two measurement systems are used:
the **Metric system** and the eccentric **Imperial system**.
The logical metric system is the easier to use;
based on the number 10, it was devised after the
French Revolution and was adopted by most of the world,
although Britain only introduced it (partially) in 1971.
Most measurements are now metric, although
the imperial system is still used in certain cases and places,
such as the USA, which is why you need to understand
both systems and to be able to convert from one to the
other, before you hit New York.

For Ancient Greeks, modern maths aids would have seemed marvels.



The Metric System

The Metric System

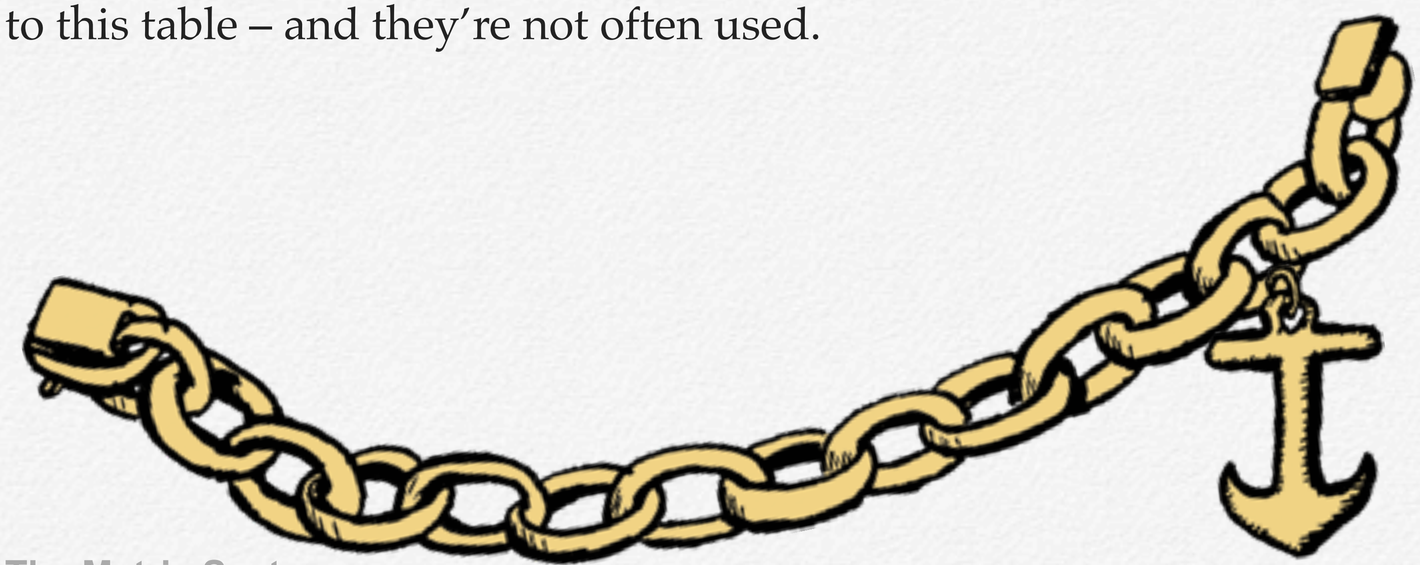
Uses the same basic system for all measurements – **the decimal system** (see STEP 2, Part 12).
Notice that the same beginning of a word (kilo-, centi-, milli-) is used for length, weight and also volume… another reason why the metric system is the simplest.

You don't need to learn the whole thing, but here is **complete metric system for length**, from millimetre (tiny) to kilometre (big):

1 **kilometre**	=	10 hectometres
1 hectometre	=	10 decametres
1 decametre	=	10 metres
1 **metre**	=	10 decimetres
1 decimetre	=	10 centimetres
1 **centimetre**	=	10 **millimetres**

In some parts of the world, 'metre' is spelled 'meter' and so you see 'kilometer' and 'millimeter'. However, the French invented the Metric system, and they spell it, "metre," so that's the way it will be here.

It can be difficult to remember words you've never seen before, like hectometre and decametre, but you can always look back to this table – and they're not often used.



Like adding charms, of gold, silver or colour, to a charm bracelet, each Part of MONEY STUFF - once completed by you - will add another maths skill to your collection.

Use maths to calculate quantities for a recipe.

The Kitty Reminder

The Kitty Reminder is a useful mnemonic which may help you to remember the order of the metric system which can be applied to length as well as weight and volume.

Kitty,	how	does	my	dog	catch	mice?
(kilo-)	*(hecto-)*	*(deca-)*	*(metre)* *(gram)* *(litre)*	*(deci-)*	*(centi-)*	*(milli-)*

Irritating Note

The middle word, '**my**' represents '**metre**' in measurements of length, but '**gram**' in measurements of weight, and 'litre' in units of volume.

	Kitty	How	Does	My	Dog	Catch	Mice
Length	**Kilo**metre *(km)*	**Hecto**metre	**Deca**metre	**Metre** *(m)*	**Deci**metre	**Centi**metre *(cm)*	**Milli**metre *(mm)*
Weight	**Kilo**gram *(kg)*	**Hecto**gram	**Deca**gram	**Gram** *(g)*	**Deci**gram	**Centi**gram *(cg)*	**Milli**gram *(mg)*
Volume (a measure of space)	**Kilo**litre *(kl)*	**Hecto**litre	**Deca**litre	**Litre** *(l)*	**Deci**litre	**Centi**litre *(cl)*	**Milli**litre *(ml)*

x10 x10 x10 x10 x10 x10

The most frequently used metric units are:

Length: kilometres (km), metres (m), centimetres (cm) and millimetres (mm).

Weight: kilograms (kg), grams (g) and milligrams (mg).

Volume (including liquids): litres (l), centilitres (cl) and millilitres (ml).

Temperature is slightly different (see the end of this, Part 16).

These metric abbreviations are written in small letters, not capital letters.

In Real Life you're unlikely to use hectometres, decametres and decimetres, so concentrate on learning the **four Essential Metric Facts**.
Here are the first two:

Essential Metric Fact 1:

Kilo means one thousand (1000)

Examples:

A kilo**metre** is 1000 times bigger than a **metre**, so…. 1 km = 1000 m

A kilo**gram** is 1000 times bigger than a **gram**, so…. 1 kg = 1000 g

A kilo**litre** is 1000 times bigger than a **litre**, so…. 1 kl = 1000 l

Essential Metric Fact 2:

Milli means one thousandth $(\frac{1}{1000})$

Examples:

A milli**metre** is a thousandth of a **metre**. 1 m is made from 1000 mm, so… 1 m = 1000 mm

A milli**gram** is a thousandth of a **gram**. 1g is made from 1000 mg, so… 1 g = 1000 mg

A milli**litre** is a thousandth of a **litre**. 1 l is made from 1000 ml, so… 1 l = 1000 ml

Use these facts in the **basic chart method**, which you have already used to calculate percentages and ratios.

The basic chart method will help you avoid the common mistake of multiplying instead of dividing, or vice versa.

First Example

What is the equivalent of **7,300** metres (**m**) in kilometres (**km**)?

First, draw the chart with the headings, kilometres and metres. It doesn't matter whether first you write km/m or m/km.

km	m

From Essential Metric Fact 1, you know that **1 km = 1,000 m**, so this is the first pair of numbers to write on your chart. Check that you put those amounts under the corresponding units; put **1** underneath '**km**' and **1,000** under '**m**'. **1 km = 1,000 m**.

Then insert the amount you want to convert in the correct column for its unit.

	km	m
1 km = 1000 m	1	**1,000**
7,300 m = ?	?	7,300

Multiply the diagonal numbers

Divide by the remaining number

Now use the basic chart rule: **Multiply the diagonal numbers, then divide by the remaining number**.

The calculation is: 1 x 7,300 ÷ 1,000 = 7.3

Answer: **7,300 metres = 7.3 kilometres**

Note: You can do this in your head, by simply moving the decimal point.

Second Example

How many milligrams (**mg**) in **0.2** grams (**g**)?

First, draw the chart with the headings, grams and milligrams.

From Essential Metric Fact 2, you know that **1 g = 1000 mg**, so insert these values on your chart. Then insert the amount you want to convert in the correct column for its unit.

	g	mg	
1 g = 1000 mg	1	1,000	Multiply the diagonal numbers
0.2 g = ?	0.2	?	Divide by the remaining number

Now use the basic chart rule: **Multiply the diagonal numbers, then divide by the remaining number**.

The calculation is: 0.2 x 1000 ÷ 1 = 200

Answer: **0.2 g = 200 mg.**

Note: you can do this in your head, by simply moving the decimal point

Note

In MONEY STUFF there are no references to mass, because in Real Life, we use the word **weight**, where a scientist might use the word **mass**, which has a different definition.

Tip

Remember ALWAYS to state the unit of measurement. If you forget this in an exam, you'll lose a mark and in Real Life, it could be disastrous. A **300 m** shelf is a very different length to a **300 cm** shelf.

Exercises

1) Lily's parents have a holiday cottage in Brittany. The walk from the cottage to the village shop is **0.3 km**. To buy morning croissants and a litre of milk, how many metres does Lily walk to the shop?

2) Some doctors think vitamins are unnecessary if you eat a balanced diet, but who eats a balanced diet? Olga takes **1,500 mg** of vitamin C every day. How much vitamin C does Olga take daily, in grams?

3) On the weekend trip to Paris, Gemma's hand luggage weighs **3.6 kg**. How much does Gemma's bag weigh in grams?

4) Sally drinks **1,200 ml** of Highland Malt Whisky every week. Has running a theatrical boarding house driven Sally to drink? Is she now an alcoholic?
How much is **1,200 ml** in litres?

5) In the first month of its life, the sunflower plant in Annabel's cottage garden grew an average of 0.035 m every day. How many millimetres did the sunflower plant grow every day?

Modern politician counts votes.
Hillary Clinton campaigns in Texas.

Centigrams are not commonly used, so only centimetres and centilitres are used in the following facts and examples.

Essential Metric Fact 3:

Centi means one hundredth ($\frac{1}{100}$)

Examples:

A centi**metre** is one hundredth of a **metre**. 1 m is made from 100 cm, so… 1 m = 100 cm

A centi**litre** is one hundredth of a **litre**. 1 l is made from 100 cl, so… 1 l = 100 cl

Essential Metric Fact 4:

There are 10 milli's in a centi.

Examples:

A centi**metre** is 10 times bigger than a milli**metre**, so… 1 cm = 10 mm (check your ruler)

A centi**litre** is 10 times bigger than a milli**litre**, so… 1 cl = 10 ml

First Example

How many centimetres are there in **2.5** metres?

First, draw up the chart with the headings, centimetres and metres.

From Essential Metric Fact 3, you know that **1 m = 100 cm**, so insert these values on your chart.
Then insert the amount you want to convert in the correct column for its unit.

	cm	m
1 m = 100 cm	100	1
2.5 m = ?	?	2.5

Multiply the diagonal numbers
Divide by the remaining number

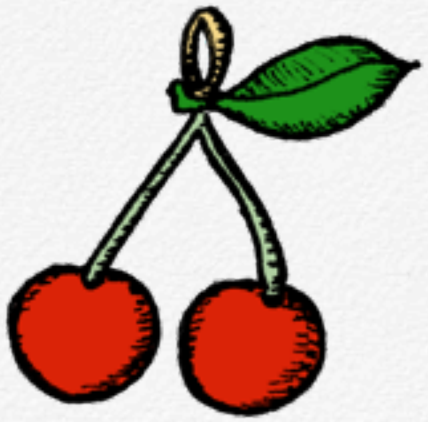
Now use the basic chart rule: **Multiply the diagonal numbers, then divide by the remaining number**.

The calculation is: 100 x 2.5 ÷ 1 = 250

Answer: **2.5 metres = 250 centimetres**

Chemists measure in milligrams (for solids) and millilitres (for liquids).

Builders and carpenters measure in millimetres for greater accuracy.
So, to a builder my picture would measure **700mm** high **x 400mm** wide.



Second Example

The volume of an average can of Coke, is **330 ml**. How much is this in centilitres?

First, draw up the chart. Use the units in the question for the headings.

From Fact 4, you know that **1 cl = 10 ml**, so insert these values on your chart.

Then insert the amount you want to convert in the correct column for its unit.

	cl	ml	
1 cl = 10 ml	1	**10**	Multiply the diagonal numbers
330 ml = ?	?	330	Divide by the remaining number

Using the basic chart rule, the calculation is: 1 x 330 ÷ 10 = 33

Answer: **330 ml = 33 cl**

Exercises

6) The heels on Tania's black stiletto boots are scarlet and measure **75 mm**. How much is this in centimetres?

7) Melanie buys **4** bottles of white wine for her weekend lunch party. When she adds their combined volumes, Melanie finds she has **300 cl**.
How many litres of wine has she bought?

8) An A4 size page is **29.7 cm** long.
How long is this in millimetres?

Jordan's Queen Rania lights a candle during a sit-in to express rejection of violence against children.

Beyond Kitty

In the world of computing, **where bigger units of measurement** are used, the prefix (the bit stuck on the front of a word) may be different: for example, **mega**-, **giga**- and **tera**-.

A byte is something invisible… a part of the measurement system of a computer's memory: the more bytes, the bigger the memory. When choosing a computer, how can you tell which computer has the bigger memory,
the one with 512 megabytes or the one with 1 gigabyte?

You check the following measurements:

1,000 bytes = 1 kilobyte (kB)

1,000 kB = 1 megabyte (MB) = 1,000,000 bytes (1 million bytes)

1,000 MB = 1 gigabyte (GB) = 1,000,000,000 bytes (1 billion bytes)

1,000 GB = 1 terabyte (TB) = 1,000,000,000,000 bytes (1 trillion bytes)

The computer with 1 gigabyte of memory has a bigger memory than the computer with 512 megabytes.

Memory aid is: **BLACK MAGGOT**

The Computer Memory

There are two types of computer memory, long-term and short-term memory.

1) RAM (**Random Access Memory**). This is short-term memory that you use for dealing with the task in hand, which might be answering a letter from your best friend, or deciding where to go for your holiday. The more tasks you have open, the more RAM you need.

2) The **Hard Drive memory**. This is long-term memory and it is much bigger. The hard drive memory is like a gigantic filing system that stores all your documents and photos.

If you want to see a document you wrote a couple of months ago, the hard drive processor loads the document from your hard drive into the RAM. Both types of memory are measured in bytes.

Summary of the big prefixes

In maths, it's important that any abbreviations refer to **NOTHING ELSE**.

Example: **milli, mega** and **metre** are 3 different measures, but only **mega** is abbreviated to a capital M (see abbreviations in table below).

Prefix	Quantity	Abbreviation
Kilo-	1,000 One thousand	k
Mega-	1,000,000 One million	M
Giga-	1,000,000,000 One billion	G
Tera-	1,000,000,000,000 One trillion	T

Here are some commonly used metric abbreviations:
kg for kilogram or kilo; **km** for kilometre; **kB** for kilobyte

These abbreviations are also used in finance.
£1k = £1,000. **£2k = £2,000**. Someone trying to be flash might say ‘I just spent fifty **k** on a Porsche’.

Likewise **£1M =** a million pounds
and **£1B =** a billion pounds.

Irritating Note

1,000 kg is called a **tonne** not a megagram.
Always check the spelling: if spelt **ton**, then it’s an imperial ton, which is **16 kg** smaller than its metric counterpart. Sorry about that.

Modern entrepreneur Saloni Lodha.
Two Indian factories produce her international fashion designs.
She couldn’t organize that without maths.

Different Temperature Scales

The **Fahrenheit** scale of temperature measure was invented in 1724 by a German, Mr Fahrenheit. Later, in 1742 a Swedish astronomer, Mr Celsius, introduced another scale, the one we use today by international agreement: **Celsius** is also called **centigrade**.

A few years later, a British scientist, Lord Kelvin, invented a third scale which is used by scientists: it has no minus numbers. Zero Kelvin is believed to be the lowest possible temperature – you can't get any colder than that.

Note

The **Kelvin** scale is the official metric unit for temperature, replacing the Celsius scale which was the original metric measure for temperature. However, it's more natural to say 'what a hot day, it must be **40°C**' than to say 'what a hot day, it must be **313 °K**'.

Consequently, the Celsius system lives on in common usage (all over the world except America) and is the one used in MONEY STUFF.

The Celsius scale uses the **freezing point of water as zero (0°C) and the boiling point of water as 100° Celsius (or 100°C)**.

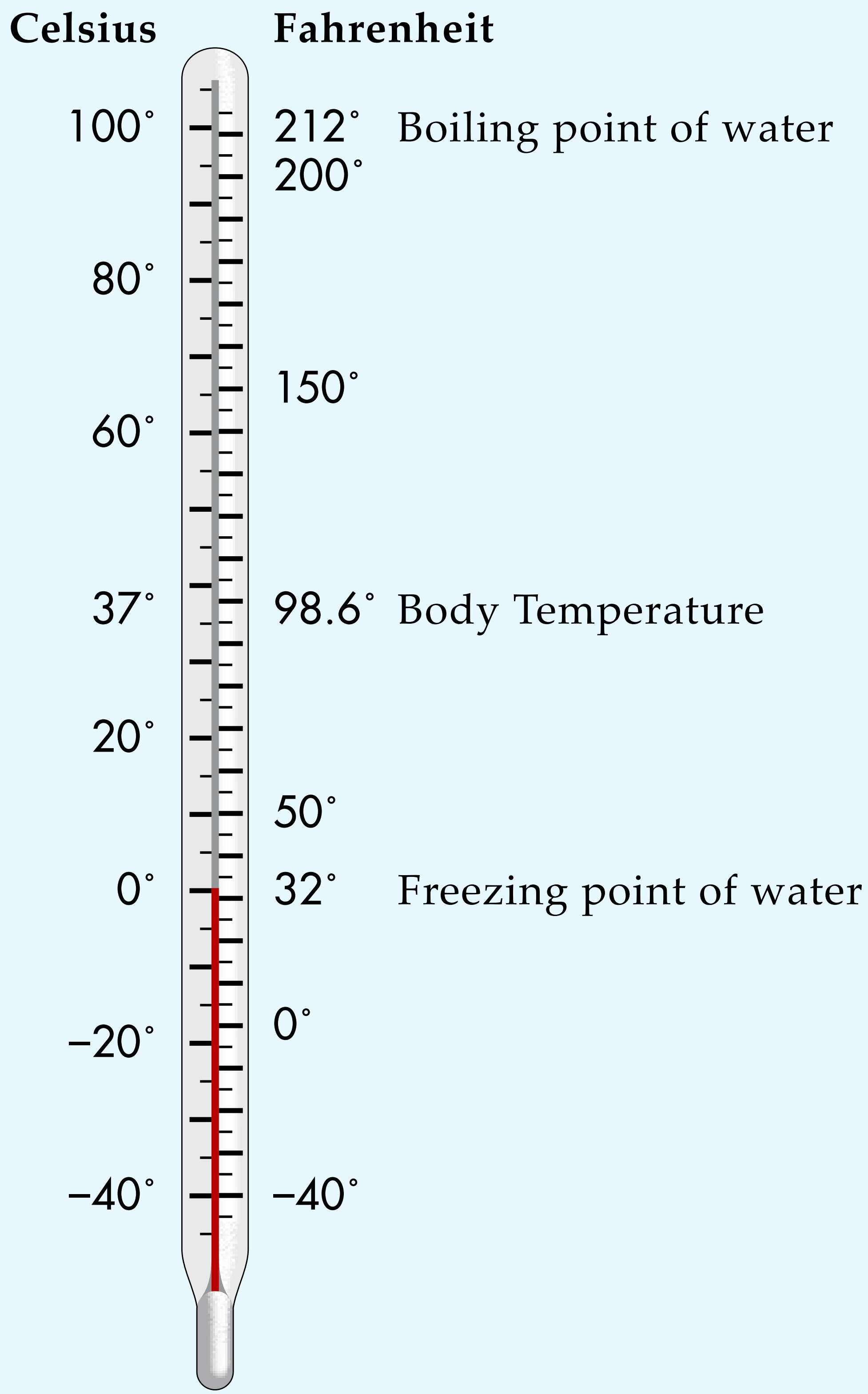
Temperatures below freezing point are written with a minus sign. "It's three degrees below freezing outside this igloo", means that the outside temperature is **-3°** Celsius. The temperature inside my deep freeze is **-18°** Celsius, which is colder than **-3°** Celsius
(check the thermometer in STEP 1, Part 10).

Shorthand for Celsius is C. Weather forecasters **write -3°C** but on TV they **say** "minus three degrees Celsius" or "Three degrees below zero" (meaning on the Celsius scale).

Get a grip on it.
Junior competitors, European Judo tournament, Ukraine.

Most of us think in either one or the other, Celsius or Fahrenheit. Following is a list of common temperatures and a temperature scale in both units:

100 °C	= 212 °F	Boiling point of water
60 °C	= 140 °F	Drinkable cup of tea
48 °C	= 118 °F	Hand hot water
43 °C	= 109 °F	Hot bath
37 °C	= 98.6 °F	Normal body temperature
30 °C	= 86 °F	Heat wave
25 °C	= 77 °F	Warm summer's day
22 °C	= 72 °F	A comfortable room
15 °C	= 59 °F	Winter's day
5 °C	= 41 °F	Very cold winter's day
4 °C	= 39 °F	Inside a fridge
0 °C	= 32 °F	Freezing point of water
-18 °C	= 0 °F	Temperature in a freezer



Is human body temperature really higher than a heat wave? Yes it is.

For **temperature conversions** between Celsius and Fahrenheit, YOU **CANNOT** USE THE CHART METHOD because the zeros are not at the same temperature.
If you haven't got a thermometer with both units to hand, you can convert as follows.

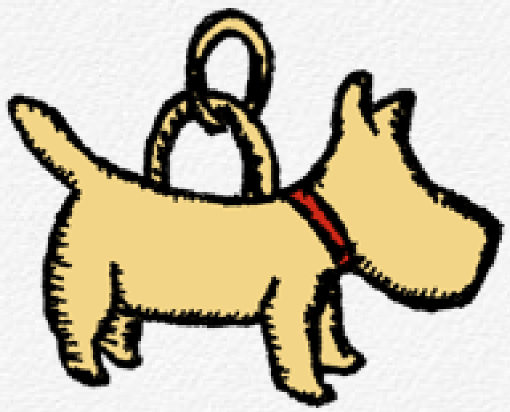
Fahrenheit —> Celsius

- Take-away **32** from Fahrenheit temperature
- Then divide the answer by **1.8**

Celsius —> Fahrenheit

- Multiply the Celsius temperature by **1.8**
- Then add **32** to the answer

For **oven temperatures** there is another set of temperatures.



OVEN TEMPERATURES

Solid Fuel	Gas	Electricity	
	(Gas Mark)	(Fahrenheit)	(Celsius)
Very cool	1/4 – 1/2	240 °F	116 °C
Cool	1	275 °F	136 °C
	2	300 °F	149 °C
Slow	3	325 °F	163 °C
Moderate	4	350 °F	177 °C
	5	375 °F	191 °C
Moderately hot	6	400 °F	204 °C
Hot	7	425 °F	218 °C
Very hot	8	450 °F	232 °C
	9	475 °F	246 °C

For more help with temperature conversions, look ahead to Part 19.

Answers to Part 16

1) Lily's parents have a holiday cottage in Brittany. The walk from the cottage to the village shop is **0.3 km**. To buy morning croissants and a litre of milk, how many metres does Lily walk to the shop?

Since you need to convert **0.3 km** to metres, choose **km** and **m** as the column titles.

From your Essential Metric Facts you know that **1 km = 1000 m**. Insert these numbers in the correct columns then add **0.3 km**.

km	m
1	1000
0.3	?

Multiply the diagonals, then divide by the remaining number:

0.3 x 100 ÷ 1 = 300

Answer: **0.3 km = 300 m for Lily to walk to the village shop**.

2) Some doctors think vitamins are unnecessary if you eat a balanced diet, but who eats a balanced diet?

Olga takes **1,500 mg** of vitamin C every day. How much vitamin C does Olga take daily in grams?

Since you need to convert **1,500 mg** to grams, choose **mg** and **g** as the column titles.

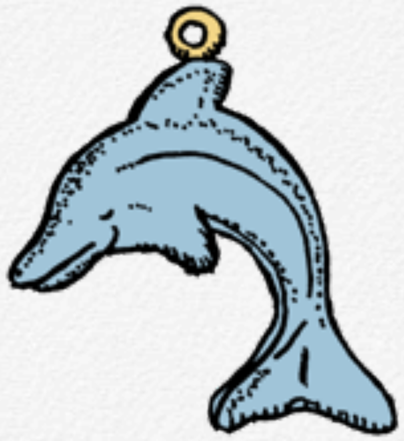
From your Essential Metric Facts you know that **1000 mg = 1 g**. Insert these numbers in the correct columns then add **1,500 mg**.

mg	g
1000	1
1500	?

Multiply the diagonals, and divide by the remaining number:

1500 x 1 ÷ 1000 = 1.5

Answer: **1,500 mg = 1.5 g of vitamin C**.



3) On the weekend trip to Paris, Gemma's hand luggage weighs **3.6 kg**. How much does Gemma's bag weigh in grams?

Since you need to convert **3.6 kg** to grams, choose **kg** and **g** as the column titles.

From your Essential Metric Facts you know that **1 kg = 1000 g**. Insert these numbers in the correct columns then add **3.6 kg**.

kg	g
1	1000
3.6	?

Multiply the diagonals, and divide by the remaining number:

3.6 x 1000 ÷ 1 = 3,600

Answer: **Gemma's hand luggage weighs 3,600 g.**

4) Sally drinks **1,200 ml** of Highland Malt Whisky every week. Has running a theatrical boarding house driven Sally to drink? Is she now an alcoholic? How much is **1,200 ml** in litres?

Since you need to convert **1,200 ml** to litres, choose **ml** and **l** as the column titles.

From your Essential Metric Facts you know that: **1000 ml = 1 l**. Insert these numbers in the correct columns then add **1,200 ml**.

ml	l
1000	1
1200	?

Multiply the diagonals, and divide by the remaining number:

1200 x 1 ÷ 1000 = 1.2

Answer: **1,200 ml = 1.2 l of Highland Whisky.**

5) In the first month of its life, the sunflower plant in Annabel's cottage garden grew an average of **0.035 m** every day. How many millimetres did the sunflower plant grow every day?

Since you need to convert **0.035 m** to millimetres, choose **m** and **mm** as the column titles.

From your Essential Metric Facts: **1 m = 1000 mm**. Insert these numbers in the correct columns then add **0.035 m**.

m	mm
1	1000
0.035	?

Multiply the diagonals,
and divide by the remaining number:

0.035 x 1000 ÷ 1 = 35

Answer: **The sunflower plant grows 35 mm on average, every day**, that's 3.5 centimetres.

6) The heels on Tania's black stiletto boots are scarlet and measure **75 mm**. How much is this in centimetres?

Since you need to convert **75 mm** to centimetres, choose **mm** and **cm** as the column titles.

From your Essential Metric Facts you know that **10 mm = 1 cm**. Insert these numbers in the correct columns then add **75 mm**.

mm	cm
10	1
75	?

Multiply the diagonals,
and divide by the remaining number:

75 x 1 ÷ 10 = 7.5

Answer: **Tania's scarlet heels are 7.5 cm high.**

7) Melanie buys **4** bottles of white wine for her weekend lunch party. When she adds their combined volumes, Melanie finds she has **300 cl**.

How many litres of wine has she bought?

Since you need to convert **300 cl** to litres, choose **cl** and **l** as the column titles.

From your Essential Metric Facts you know that **100 cl = 1 l**. Insert these numbers in the correct columns then add **300 cl**.

cl	l
100	1
300	?

Multiply the diagonals,
and divide by the remaining number:

300 x 1÷ 100 = 3

Answer: **Melanie has bought 3 litres of wine.**

8) An A4 size page is **29.7 cm** long (as long as a standard ruler). How long is this in millimetres?

Since you need to convert **29.7 cm** to millimetres, choose **cm** and **mm** as the column titles.

From your Essential Metric Facts you know that **1 cm = 10 mm**. Insert these numbers in the correct columns then add **29.7 cm**.

cm	mm
1	10
29.7	?

Multiply the diagonals,
and divide by the remaining number:

29.7 x 10 ÷ 1 = 297

Answer: **An A4 page is 297 mm long.**

YOUR BRAIN WORKOUT

Q1.

What would you use kilometres to measure?

- **A.** The weight of a baby
- **B.** The temperature of the sea
- **C.** The distance between two villages
- **D.** The volume of a bottle

YOUR BRAIN WORKOUT

Q2.

What would you use centimetres to measure?

- **A.** The distance from London to Paris
- **B.** The length of a book
- **C.** The capacity of a suitcase
- **D.** The weight of a box

YOUR BRAIN WORKOUT

Q3.

What would you use grams to measure?

- **A.** The weight of a lorry
- **B.** The length of a bed
- **C.** The distance between two parked cars
- **D.** The weight of a cake

YOUR BRAIN WORKOUT

Q4.

What would you use litres to measure?

- **A.** The amount of petrol in the tank
- **B.** The length of a leaf
- **C.** The height of a window
- **D.** The weight of a leaf

YOUR BRAIN WORKOUT

Q5.

What would you use milligrams to measure?

- **A.** The weight of an elephant
- **B.** The amount of vitamin C in a pill
- **C.** The volume of a teaspoon
- **D.** The length of a teaspoon

YOUR BRAIN WORKOUT

Q6.

What would you use degrees Celsius to measure?

- **A.** The temperature of the oven
- **B.** The thickness of a book
- **C.** The height of a skyscraper
- **D.** The space in a room

YOUR BRAIN WORKOUT

Q7.

Which of the following statements is **not** true?

- **A.** 1 km = 1000 m
- **B.** 2 km = 2000 m
- **C.** 4.5 km = 4500 m
- **D.** 5.5 km = 5000 m

YOUR BRAIN WORKOUT

Q8.

Which of the following statements is **not** true?

- **A.** 2 litres = 2000 ml
- **B.** 5 litres = 5000 ml
- **C.** 0.7 litres = 7000 ml
- **D.** 1.3 litres = 1300 ml

YOUR BRAIN WORKOUT

Q9.

Which of the following statements is **not** true?

- **A.** 2 cm = 200 mm
- **B.** 6 cm = 60 mm
- **C.** 2 m = 2000 mm
- **D.** 30 cm = 300 mm

YOUR BRAIN WORKOUT

Q10.

Which of the following statements is **not** true?

- **A.** 3 kg = 3000 g
- **B.** 4 g = 400 mg
- **C.** 2.5 g = 2500 mg
- **D.** 0.5 kg = 500 g

YOUR BRAIN WORKOUT

Answers

Q1. The distance between two villages

Q2. The length of a book

Q3. The weight of a cake

Q4. The amount of petrol in the tank

Q5. The amount of vitamin C in a pill

Q6. The temperature of the oven

Q7. 5.5 km = 5000 m

Q8. 0.7 litres = 7000 ml

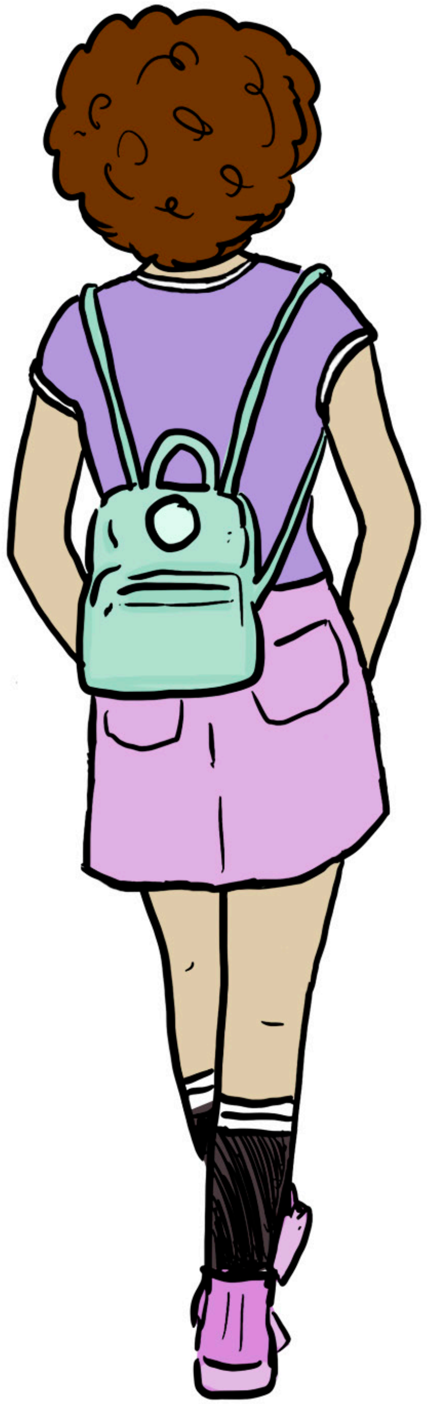
Q9. 2 cm = 200 mm

Q10. 4 g = 400 mg

PART 17
MEASURES

Lunchtime pizza bill ÷ 4

Quick Quiz

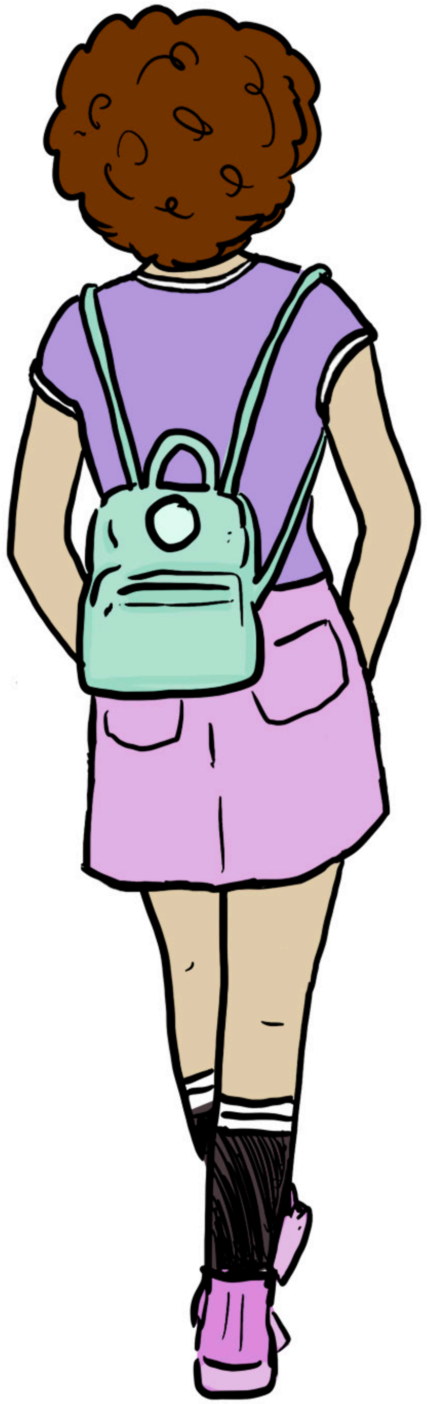


Q1.

Which is a correct sequence from the 30 times table?

- **A.** 30, 60, 100, 130, ...
- **B.** 30, 90, 120, 150, ...
- **C.** 30, 60, 90, 120, ...
- **D.** 30, 60, 90, 130, ...

Quick Quiz

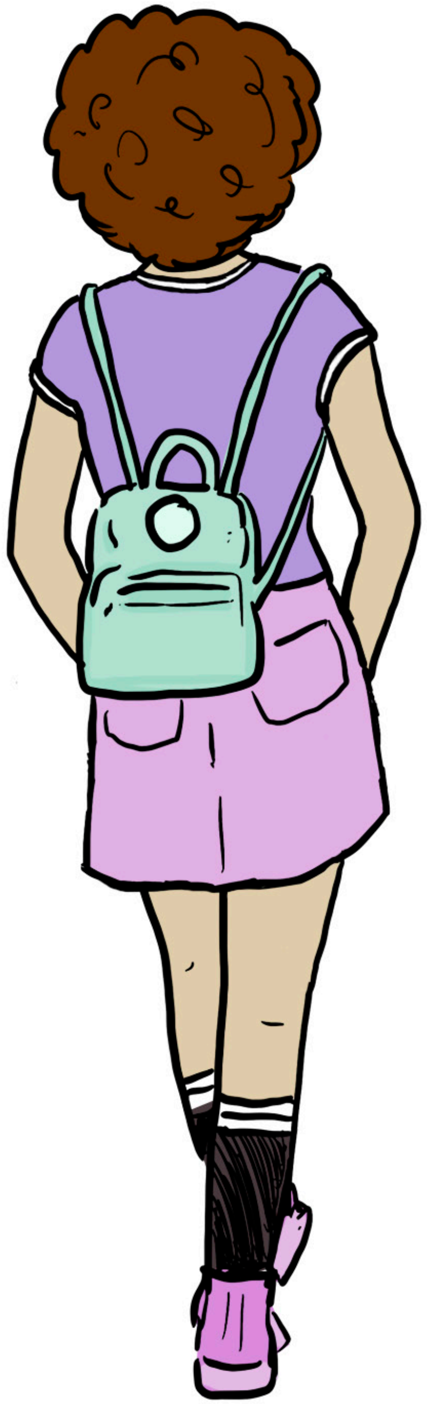


Q2.

Choose the sum which is written correctly.

- A. $6 \div 30 = 5$
- B. $30 \div 6 = 5$
- C. $30 - 5 = 6$
- D. $6 + 5 = 30$

Quick Quiz

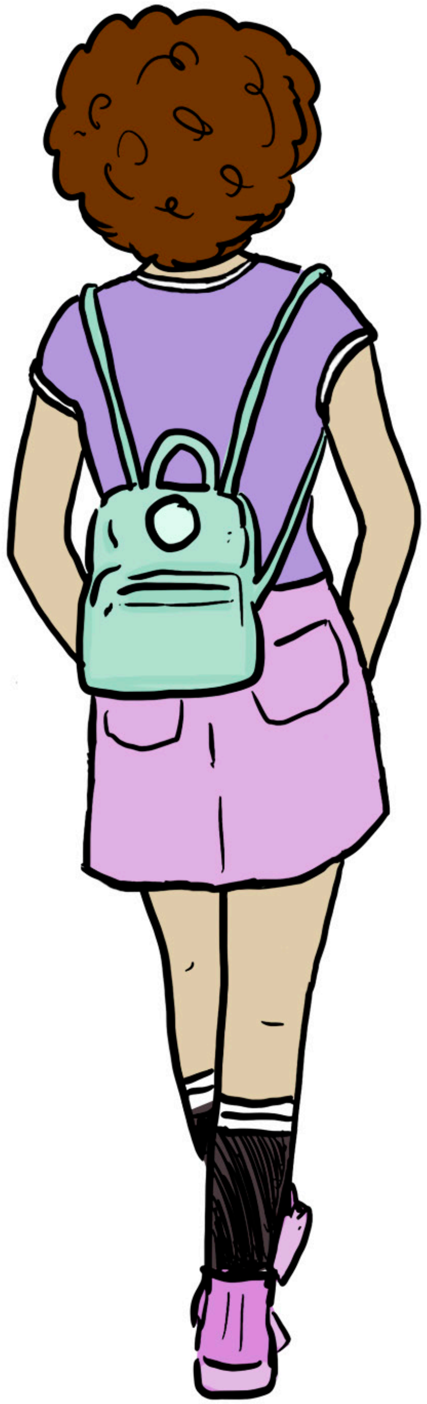


Q3.

Which of the following fractions is greater than a half?

- **A.** $\frac{3}{8}$
- **B.** $\frac{9}{20}$
- **C.** $\frac{5}{6}$
- **D.** $\frac{2}{4}$

Quick Quiz

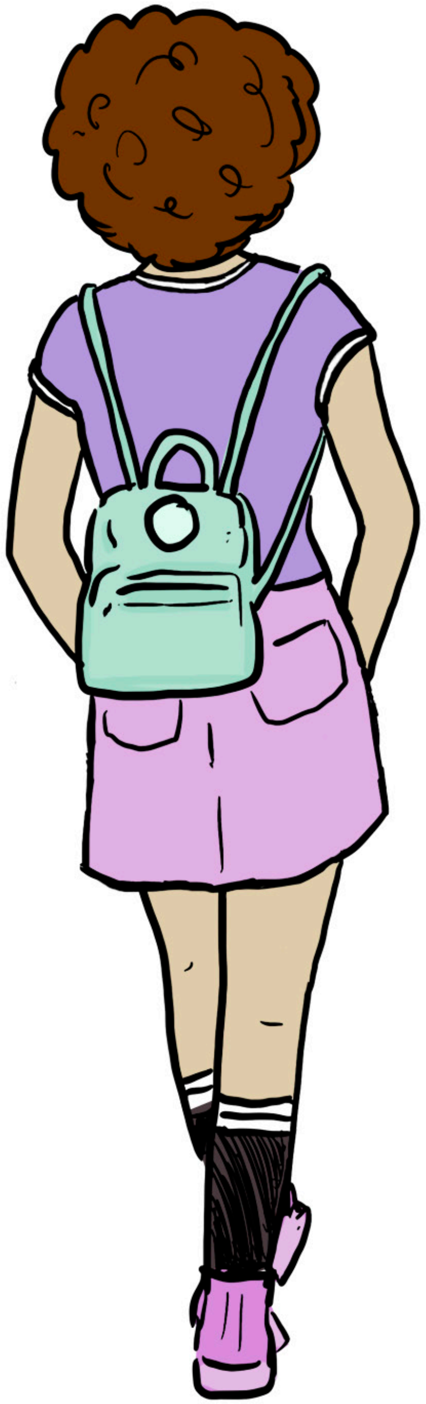


Q4.

Which of the following is not equal to the rest?

- **A.** 7.5
- **B.** 75%
- **C.** $\frac{3}{4}$
- **D.** 0.75

Quick Quiz



Answers

Q1. 30, 60, 90, 120, ...

Q2. $30 \div 6 = 5$

Q3. $\frac{5}{6}$

Q4. 7.5

Imperial Measurements

Until about 1970, measurements in the UK were largely calculated with **imperial units**, which are vaguely based on the human body. A **yard** is an average man's pace; a **foot** is the length of a man's foot, in a size 10 shoe. An **acre** is a square measuring roughly 70 of his paces on all sides.

In Britain, in 1971, the decimalisation of money was carried out quickly and without the expected drama: most people mastered the new coinage within a few days.

The familiar imperial units of length, weight and capacity were not phased out according to plan. Feet, inches, yards, pounds, stones, pints, gallons, acres and so on, are still firmly used in Britain, alongside the metric system.

So you might use metres and centimetres to measure your new bed, but measure your height in feet and inches. You might measure the weight of your luggage in kilograms, but your own weight in stones and pounds. You buy milk in litres but beer is purchased in pints. Road signs still tell you how many miles you still need to travel.

Water drops on a Granny Smith.

Imperial Units for Length

For length and distance, inches, feet, yards and miles are the imperial units that you are most likely to use.

12 inches = 1 foot

3 feet = 1 yard

1760 yards = 1 mile

As granny knows, the abbreviation for "inches" is a double apostrophe (″) and the shorthand for "feet" is a single apostrophe (′).
So a height of **5** feet and **7** inches is written as **5′7″**.

Imperial Units for Weight

Ounces (oz), pounds (lb), stones and tons are the weight measurements to know.

16 oz = 1 lb

14 lb = 1 stone

160 stone = 1 imperial ton

Imperial Units for Volume (capacity)

Fluid ounces (fl oz), pints, quarts and gallons:

20 fl oz = 1 pint

2 pints = 1 quart

4 quarts = 1 gallon

Romanesco broccoli - Nature designs with maths.

American Measurements

The USA is the only major country in the world that has retained a non-metric system.

The British Imperial system is different from the American traditional system of measure. To make this doubly irritating, if you are following a recipe from an American cook book, the same words are used, but representing different quantities when compared to the British counterpart (see following Transatlantic Translations).

The reason for these differences is because the British Empire and its colonies standardised their measures in 1824, after Americans had become independent and were darned if they'd do what the British did. Because the Americans standardised in a slightly different way, be careful when you are dealing with American measurements. For example, an American pint is smaller than an imperial pint.

Nature designs circles in onions.

American Cups: Transatlantic Translations

In Canada and the USA, most ingredients for recipes are measured by volume, in cups, rather than by weight. How much does a cup hold? How many tablespoons are there in a cup? Amazingly enough, it depends in which country you are standing. The standard cup used in Great Britain is larger, **280ml** (**10 fl oz, 1/2 pint**), than the one used in the United States, which is **235ml** (**8.3 fl oz**).

British Cup
280 ml
10 fl oz

American Cup
235 ml
8.3 fl oz

Transatlantic Translations

Other measurements are also slightly different in the US although they share the same names:

Volumes	
1 imperial fluid ounce	= 0.96 US fluid ounces
1 imperial pint	= 1.2 US pints
1 imperial gallon	= 1.2 US gallons
Note: Unless your recipe calls for precision, you needn't bother to translate these volumes.	

Weights	
Imperial and US pounds are the same. But the Tons are different.	
1 imperial ton	= 2240 lb.
1 US ton (also known as the short ton)	= 2000 lb.
Note: Americans don't use "stone" to represent 14 pounds (lb.).	

Length
All imperial and US measurements for length and distance are the same.

PART 18
CONVERSIONS

Mask designers need maths.

Quick Quiz

Q1.

If there are **21** firemen for three fire engines, what is the ratio of firemen to fire engines?

- **A.** 21 : 1
- **B.** 7 : 3
- **C.** 7 : 1
- **D.** 21 : 6

Quick Quiz

Q2.

Which of the following numbers is a prime number?

- **A.** 33
- **B.** 35
- **C.** 37
- **D.** 39

Quick Quiz

Q3.

What is **5%** of **£60**?

- A. £3
- B. £6
- C. £9
- D. £12

Quick Quiz

Q4.

What is −7 x 3?

- **A.** 4
- **B.** −10
- **C.** 21
- **D.** −21

Quick Quiz

Answers

Q1. 7 : 1

Q2. 37

Q3. £3

Q4. -21

Immigrant Helena Rubinstein invented modern makeup. Born in Poland, American citizen.

Imperial & Metric Conversions

Conversion methods look tedious… until you need one. So go through all the exercises in the following sections… then just refer back when you need to convert in Real Life.

The basic chart method is a good way to convert one unit of measure to another. You have already used this method for some problem solving, percentages and ratios (see STEP 1, Parts 1, 2 and 3).

You use the same method to convert units of measure. Keep the different measurement units in separate columns, and use extra care when handling imperial measurements if they are in two or more different units (e.g. feet and inches, or pounds and ounces).

You need to know when you're buying a very small quantity of face cream in a very large pot.

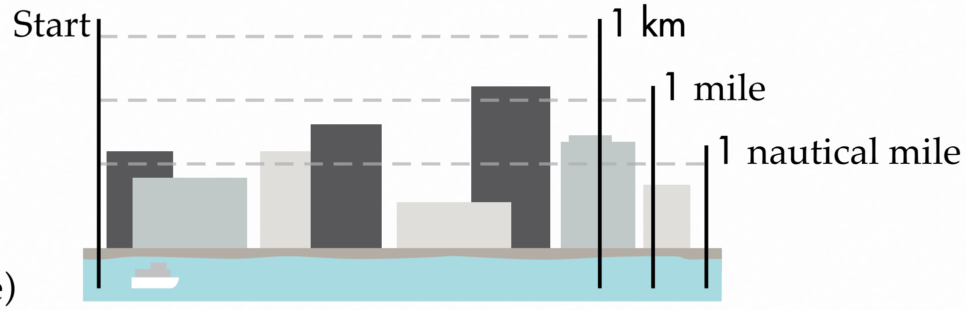
Approximate Conversions List

To help you remember key facts... for imperial and metric measurements... visualise them.

Length

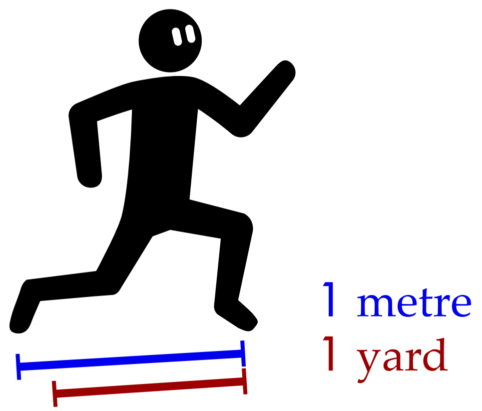
5 miles = 8 km
or
1 mile = 1.6 km = 1600 m

1 nautical mile = 1.852 km
(NB a nautical mile is 15% longer than a normal mile)

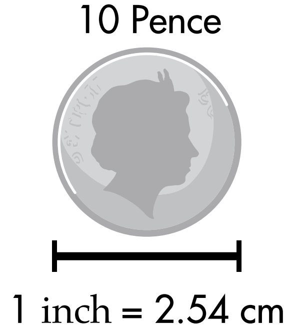


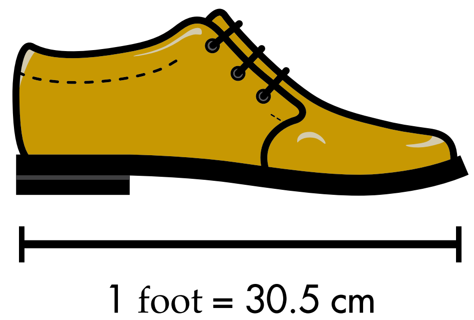
1 m = 39.4 inches = 1.1 yards
1 m = 100 cm
or
1 yard = 91 cm = 0.91 m
1 yard = 3 feet

Note: Remember that 1 metre is roughly 40 inches, which is 3 foot 4 inches.



10 cm = 4 inches
1 inch = 2.54 cm
1 foot = 30.5cm = 0.305 m
1 foot = 12 inches





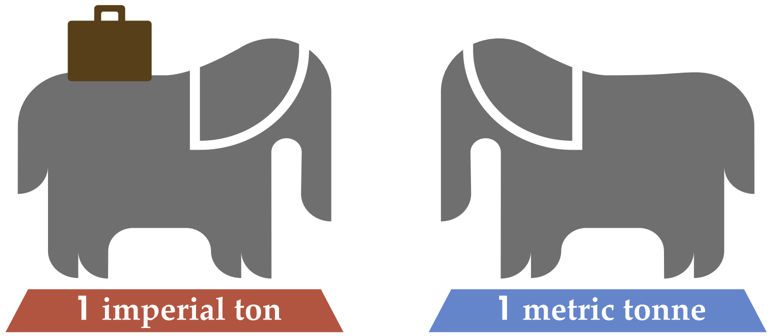
Weight

1 ton = 1.016 tonnes
(imperial) (metric)

1 ton = 2240 lb

1 tonne = 1000 kg

(Suitcase weighs **0.016** tonnes)



1 stone = 6.35 kg

1 stone = 14 lb

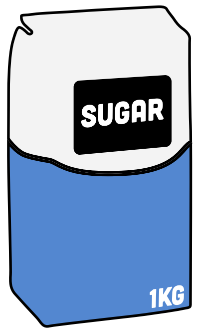
Note: 100 lb = roughly 7 stone

1 stone

1 kg = 2.2 lb

1 lb = 0.45 kg = 450 g

1 lb = 16 oz



1 kg of sugar

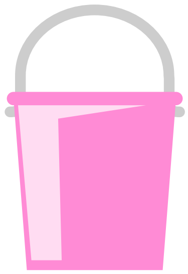
1 oz = 28 g (or 0.028 kg)

Three pound coins weigh approximately 1 oz or 28.5 g

Volume/Capacity

4.5 litres = 1 gallon

1 gallon = 4 quarts = 8 pints



Most buckets are,
2 gallons
or
9 litres

1 litre = 1.76 pints (approx $1\frac{3}{4}$ pints)

1 litre = 1000 ml

1 litre = 35.2 fluid ounces

1 Litre

$1\frac{3}{4}$ pints

1 fl oz = 28.4 ml

1 traditional shot of espresso coffee
is approx 1 fl oz (or 28 ml)

5 ml = 1 teaspoon

5 ml

How to Convert Imperial to Metric

Since Britain is still in the transition of changing from imperial to metric, often it will be necessary to change between the two. It's simpler to do calculations in the metric system (which is the main system taught in schools) so you will usually be changing imperial into metric, rather than the other way around.

First Example

How many litres in **8** gallons of petrol?

From the Approximate Conversions List (see previous page) '**4.5** litres = **1** gallon'. Use this in the chart:

	litres	gallons	
From the Approximate Conversions List you know:	4.5	1	Multiply the diagonal numbers
? litres = 8 gallons	?	8	Divide by the remaining number

As usual, use the basic chart rule,

Multiply the numbers that are diagonal to each other and divide by the other number.

So the calculation is: **4.5 x 8 ÷ 1 = 36**

Answer: **8 gallons of petrol is equivalent to 36 litres of petrol.**

If you need to convert an imperial measure that contains two or more units of measure, you will need to convert each imperial unit separately... and then add the results:

"Oh help, I've just filled my car with Diesel instead of petrol."

Second Example

Tennis Champion Jenny is 5′7″ tall.

What is Jenny's height in metres?

First, convert the feet to metric, then convert the inches to metric.

Part A: Convert the feet:

Use the Approximate Conversions List to see that:

1 foot = **30.5 cm**.

From the Approximate Conversions List you know:	feet	cm	
	1	30.5	Multiply the diagonal numbers
5 feet = ? cm	5	?	Divide by the remaining number

The calculation is: **5 x 30.5 ÷ 1 = 152.5**

Part A answer: **5 feet = 152.5 cm**

Part B: Convert the inches to metric:

The Approximate Conversions List tells you that:

1 inch = **2.54 cm**.

From the Approximate Conversions List you know:	inch	cm	
	1	2.54	Multiply the diagonal numbers
7 inches = ? cm	7	?	Divide by the remaining number

The calculation is: **7 x 2.54 ÷ 1 = 17.78**

Part B answer: **7 inches = 17.78 cm**

Now, add the two answers together:

152.5 + 17.78 = 170.28 cm

So **5′7″ is equivalent to 170.28 cm**. This is a metric measurement, although not the one asked for in the question, so now you need to convert this from centimetres to metres.

Part C: Convert the centimetres to metres:

Draw up another chart. From the Essential Metric Fact 3 (see page 32) you should know that **1 m = 100 cm**, so insert these values in your chart. Then insert the amount you want to convert in the correct column.

	m	cm	
1 m = 100 cm	1	**100**	Multiply the diagonal numbers
170.28 cm = ?	?	170.28	Divide by the remaining number

The calculation is: **1 x 170.28 ÷ 100 = 1.7028**

For height it's usual to round metres to **2** decimal places, so **1.7028 m** rounds to **1.70 m**

Final Answer: **The metric equivalent for 5′7″, (tennis champion, Jenny's height), is 1.70 m.**

FACT!

Imperial and metric measures both remain in daily use in Britain, so employers need staff who can convert between one and the other.

Ref: Confederation of British Industry (CBI) Report 'Working on the Three R's: Employers' Priorities for Financial Skills in Maths and English.' Published 2006

Exercises

Work out the following imperial quantities as metric quantities using Approximate Conversion List:

1) **10** pints of milk were purchased by Rachel to make custard for the boy scouts' annual trifle-eating contest. How many litres of milk were used?

2) In a letter to her new French pen-friend, Lily wants to explain how far she travels to school each day. Lily knows that she travels **3** miles to school.
How far is **3** miles in kilometres?

3) Gemma has seen some sensational, black, knee-length boots for sale on eBay. The heel measures **3.5** inches. As Gemma's mum doesn't want her daughter to break her ankle, Gemma is not allowed shoes with heels higher than **7 cm**. Would Gemma's mum approve of these boots?

4) Carla is enjoying a holiday at her gran's flat in Brighton. Carla decides to make a rice pudding, using one of her gran's favourite recipes. The recipe reads, "Finally, add **8** fluid ounces of double cream." In the supermarket all pots of cream are labelled only in millilitres. How many millilitres of cream should Carla buy?

5) Ruth is worried that her two-year old, Jemima, is not very big. When Ruth herself was born, she weighed **7 lb 3 oz**. Jemima weighed **3.2 kg** at birth. Which was the heavier new born baby, Ruth or Jemima?

Hint: Change the pounds into kilograms, then separately convert the ounces into kilograms.
After that add the answers together.

Brave, desperate or both?
1930s European emigrants travel to America.
(I count ten patterns, by the way.)

Pattern in the heart of a rose.

How to Convert Metric to Imperial

Use the basic chart method to convert metric to imperial.

You will see how to adjust the answer if it turns out to be a decimal.

First Example

At her annual obligatory insurance health check, Carla is told by the nurse that she weighs **56 kg**. When staying at the seaside with her gran, Carla wants to check that her gran's bathroom scales are correct. What reading should the bathroom scales correctly give in stones and pounds?

First, check the Approximate Conversions List and set out the chart to convert from **kg**.

Choose the bigger unit... stones rather than pounds.

	stone	kg
From the Approximate Conversions List you know:	1	6.35
? stone = 56 kg	?	56

Using the basic chart rule, **multiply the numbers that are diagonal to each other then divide by the other number**, the sum is:

$1 \times 56 \div 6.35 = 8.819$

So Carla weighs **8.819** stone, which is **8** stone plus some more. Imperial measurements are rarely given as decimals.

Each stone is divided into pounds so convert the decimal part into pounds, to give the answer in stones and pounds.

How many pounds there are in a stone?

1 stone = **14** pounds (see Approximate Conversions List).

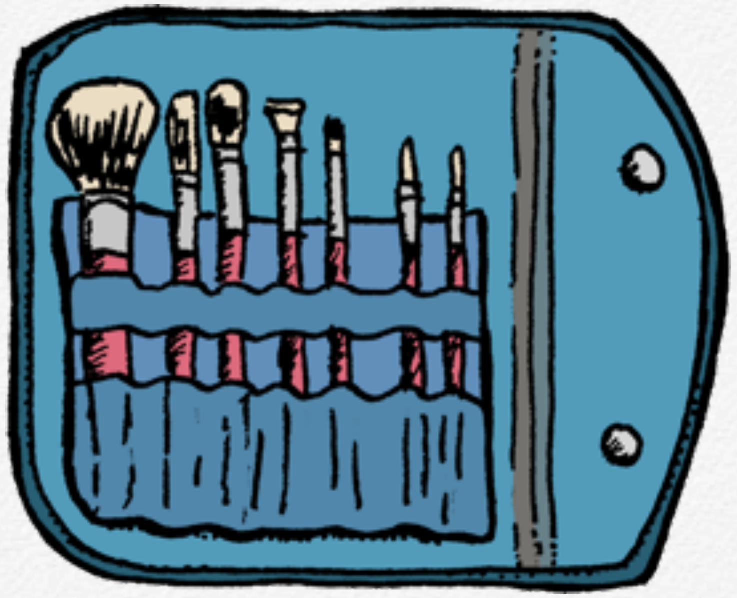
So use the chart again to convert 0.819 stone to pounds.

	stone	pounds (lb)
	1	14
0.819 stone = ? lb	0.819	?

$0.819 \times 14 = 11.47$ lb. Round this up to $11\frac{1}{2}$ lb

Answer: **Carla weighs 8 stone $11\frac{1}{2}$ pounds**.

This is the reading when Carla stands on her gran's scales, which still work correctly.



Second Example

Carla wants to make her gran a birthday cake, using a new magazine recipe which uses metric weights. Gran's ancient kitchen scales give only imperial measurements, with the weights in pounds and ounces.

Carla needs **800 g** of flour for the recipe.

How much is **800 g** in pounds and ounces?

First, check the Approximate Conversions List for the conversion of pounds to grams (because pounds are bigger than ounces) and put the figures into your chart:

	pounds (lb)	g
From the Approximate Conversions List you know:	1	450
? lb = 800 g	?	800

Calculation: **1 x 800 ÷ 450 = 1.78 lb**

Carla's answer needs to be in pounds and ounces. She now knows she will need **1 lb** of flour, plus a further **0.78 lb**. How many ounces is **0.78 lb**?

The decimal part (**0.78 lb**) needs to be converted into ounces. There are **16 oz** in **1 lb**, so use the chart again.

	pounds (lb)	ounces (oz)
	1	16
0.78 lb = ? oz	0.78	?

Calculation: **0.78 x 16 ÷ 1 = 12.48 oz**.

This rounds down to **12oz**

Answer: **Carla needs 1 lb 12oz of flour** for the birthday cake recipe.

Exercises

Convert the following metric measurements to imperial units:

6) To make a chocolate mousse, Carla needs half a litre of double cream. How much is half a litre in fluid ounces?

7) Jenny joins a dating agency, Dream Partners. Jenny's first blind date is reportedly 1.88 m tall. Jenny hopes he is over 6′ tall.
What is the height of Jenny's date in feet and inches?

Hint: When rounding a measurement, two decimal points is usually enough.

8) Marilyn is 5 ft 9 ins and weighs 10 stone 4 lb.
Work out Marilyn's height and weight in metric units.
Use the basic chart method to convert.

Quick Tip

A kilometre is $\frac{5}{8}$ of a mile.

When driving in Europe, here's a rough way to convert kilometres to miles:

Halve the number of kilometres and then add 10% of the kilometres.

Examples:
100 km will be roughly (50 + 10 =) 60 miles (accurate answer is 62.5 miles)

500 km will be roughly (250 + 50 =) 300 miles (accurate answer is 312 miles)

1000 km is roughly (500 + 100 =) 600 miles (accurate answer is 625 miles)

How to Cheat

When you need to convert units, go online and use **Google**, which has a great calculator function. In the normal Google search area, just type your question; first, give the amount you want to convert (with units), followed by the word ***in***, then the units to which you want to convert.

Example:
To see how much **9** stone **3** pounds is in kilograms, type in '**9 stone 3 pounds in kilograms**' (or '**9 stone 3 lb in kg**') then hit 'enter'. The answer will be in a box at the top of the list of search results.

Google doesn't understand all abbreviations. If it hasn't understood your sum, try again, typing your measurements in full.

The Google Calculator also converts currencies with up-to-the-minute exchange rates. Neat.

Hydrangea petal pattern.

Answers to Part 18

Find the metric equivalents of the following imperial quantities:

1) 10 pints of milk were purchased by Rachel to make custard for the boy scouts' annual trifle-eating contest. How many litres of milk were used?

From the Approximate Conversions List you know that:
1 litre = 1.76 pints

litre	pints
1	1.76
?	10

$1 \times 10 \div 1.76 = 5.68181$

Answer: **5.7 litres of milk were used for the custard**.

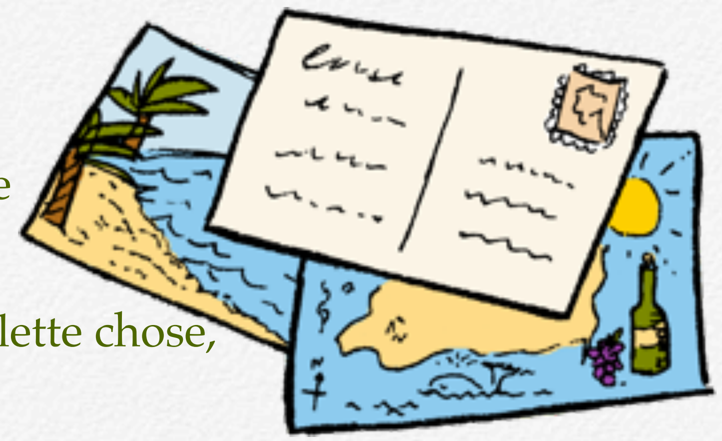
2) In a letter to her new French pen-friend, Lily wants to explain how far she travels to school each day. Lily knows that she travels **3** miles to school; how far is **3** miles in kilometres?

From the Approximate Conversions List you know that:
5 miles = 8 km

miles	km
5	8
3	?

$3 \times 8 \div 5 = 4.8$

Answer: **Lily should tell her pen-friend that she travels 4.8 km to school each day**.



When travelling,
the French writer Colette
sent picture postcards
to her mother, which Colette chose,
"to inspire daydreams."
The pictures in MONEY STUFF can remind you that – with numbers – you may make your daydreams come true.

3) Gemma has seen some sensational, black, knee-length boots for sale on eBay. The heel measures **3.5** inches. As Gemma's mum doesn't want her daughter to break her ankle, Gemma is not allowed shoes with heels higher than **7 cm**. Would Gemma's mum approve of these boots?

From the Approximate Conversions List you know that:
1 inch = **2.54 cm** (or use **10 cm** = **4** inches)

inches	cm
1	2.54
3.5	?

$3.5 \times 2.54 \div 1 = 8.89$

Answer: **No, Gemma's mother would not approve of the boot because the heels measure nearly 9 cm high.**

4) Carla is enjoying a holiday at her gran's flat in Brighton. Carla decides to make a rice pudding, using one of her gran's favourite recipes. The recipe reads, "Finally, add **8** fluid ounces of double cream." In the supermarket all pots of cream are labelled only in millilitres. How many millilitres of cream should Carla buy?

From the Approximate Conversions List you know that:
1 fl oz = 28.4 ml

fl oz	ml
1	28.4
8	?

$8 \times 28.4 \div 1 = 227.2$

Answer: **Carla will need to buy a pot of cream that contains more than 227 ml of cream.**

5) Ruth is worried that her two-year old, Jemima, is not very big. When Ruth herself was born, she weighed **7 lb 3 oz**. Jemima weighed **3.2 kg** at birth. Which was the heavier new born baby, Ruth or Jemima?

Hint: Change the pounds and the ounces separately into kilograms. Then add the answers together.

Convert the Ruth's weight to metric.
Change the pounds and ounces separately:

First, convert the pounds (**lb**):
From the Approximate Conversions List you know that:
1 lb = 0.45 kg

pound	kg
1	0.45
7	?

7 x 0.45 ÷ 1 = 3.15 kg

If you use **1 kg = 2.2 lb** you'll find that **7 lb** is approximately equal to **3.18 kg**.

Next, convert the ounces (**oz**):
From the Approximate Conversions List you know that:
1 oz = 0.028 kg

ounces	kg
1	0.028
3	?

3 x 0.028 ÷ 1 = 0.084 kg

Add the two values: **3.150 + 0.084 = 3.234 kg**
(or **3.180 + 0.084 = 3.264 kg** if you used **1 kg = 2.2 lb**)

So Ruth weighed **3.234 kg** (or **3.264 kg**) and Jemima weighed **3.2 kg**.

Final Answer: **Ruth was the bigger baby**.

Ruth's mother said, "You worry needlessly about your child but you neglect yourself. I'm taking you on a cruise to Rio: your brother and his wife can look after your kids".

Ruth said, "Don't hope I'll meet a marriageable widower. Those are widows' cruises". She was correct, but the captain fell madly in love with Ruth.

6) To make a chocolate mousse, Carla needs half a litre of double cream. How much is half a litre in fluid ounces?

From the Approximate Conversions List you know that:
1 litre = 35.2 fl oz

litres	fl oz
1	35.2
0.5	?

0.5 x 35.2 ÷ 1 = 17.6 fl oz, which rounds up to 18 fl oz

Answer: **Carla needs 18 fl oz of double cream.**

Ruth and her mother went on a cruise to Rio (see Exercise 5).

7) Jenny joins a dating agency, Dream Partners. Jenny's first blind date is **1.88 m** tall. Jenny hopes he is over **6′** tall. What is the height of Jenny's date in feet and inches?

First, convert to feet (as these are bigger than inches):
From the Approximate Conversions List you know that:
1 foot = 0.305 m

feet (′)	m
1	0.305
?	1.88

1 x 1.88 ÷ 0.305 = 6.16′

But Jenny's answer needs to be in feet and inches.
Her date is more than 6 feet tall, 6 foot plus 0.16 of a foot.
Jenny needs to change 0.16 of a foot to inches.
From the Approximate Conversions List you know that:
1 foot = 12 inches

feet (′)	inches
1	12
0.16	?

0.16 x 12 ÷ 1 = 1.92 inches or approx 2 inches

Answer: **Jenny's blind date is over 6′ tall, he is 6′2″**. She's looking forward to meeting him.

8) Marilyn is **5 ft 9 ins** and weighs **10** stone **4 lb**. Work out Marilyn's height and weight in metric units. Use the basic chart method to convert.

Height

Convert both the feet and inches to centimetres, then add both the centimetre answers together.

First, convert the feet to centimetres:

From the Approximate Conversions List you know that:

1 foot = **30.5 cm**

feet (′)	cm
1	30.5
5	?

5 x 30.5 ÷ 1 = 152.5
So 5 feet = 152.5 cm

Next, convert the inches to **cm**:

From the Approximate Conversions List you know that:

1 inch = **2.54 cm**

inch (″)	cm
1	2.54
9	?

9 x 2.54 ÷ 1 = 22.86
So 9 inches = 22.86 cm

So 9 inches = 22.86 cm

Add the two values: **152.5 cm + 22.86 cm = 175.36 cm**.
Since centimetres are small in comparison to the height of a person, round height to the nearest centimetre, = **175 cm**.

Answer: **Marilyn's height of 5′9″ is 175 cm.**

Weight

Convert both the stones and pounds to kilograms, then add the two kilogram answers together.

First, convert the stones to kilograms:

From the Approximate Conversions List you know that:
1 stone = 6.35 kg

stone	kg
1	6.35
10	?

10 x 6.35 ÷ 1 = 63.5
So 10 stone = 63.5 kg

Next, convert the pounds to kilograms:

From the Approximate Conversions List you know that:
1 pound = 0.45 kg

pound (lb)	kg
1	0.45
4	?

4 x 0.45 ÷ 1 = 1.8
So 4 pounds = 1.8 kg

Add the two values: 63.5 kg + 1.8 kg = 65.3 kg.

Answer: **Marilyn's weight is 65.3 kg.**

Final answer:

	Imperial	Metric
Height	5′9″	175 cm
Weight	10 stone 4 lbs	65.3 kg

Basically, weight depends on type of build.

YOUR BRAIN WORKOUT

Q1.

What is the approximate length of a table fork?

- **A.** 18 cm
- **B.** 18 km
- **C.** 18 mm
- **D.** 18 g

YOUR BRAIN WORKOUT

Q2.

What is the approximate volume of a can of cola?

- **A.** 330 litres
- **B.** 330 cm
- **C.** 330 ml
- **D.** 330 cl

YOUR BRAIN WORKOUT

Q3.

What is the approximate volume of a petrol tank of a family car?

- **A.** 50 kg
- **B.** 50 litres
- **C.** 50 ml
- **D.** 50 fluid ounces

YOUR BRAIN WORKOUT

Q4.

What is the approximate weight of a smartphone?

- **A.** 140 kg
- **B.** 140 lb
- **C.** 140 stone
- **D.** 140 g

YOUR BRAIN WORKOUT

Q5.

What is the approximate height of a door?

- **A.** 2 miles
- **B.** 2 metres
- **C.** 2 feet
- **D.** 2 cm

YOUR BRAIN WORKOUT

Q6.

What is the approximate distance across the English Channel (from Dover to Calais)?

- **A.** 25 yards
- **B.** 25 inches
- **C.** 25 miles
- **D.** 25 metres

YOUR BRAIN WORKOUT

Q7.

Which is the average height of a professional footballer?

- **A.** 6 miles
- **B.** 6 feet
- **C.** 6 metres
- **D.** 6 cm

YOUR BRAIN WORKOUT

Q8.

What is the approximate weight of a car?

- **A.** 1 tonne
- **B.** 1 kg
- **C.** 1 stone
- **D.** 1 lb

YOUR BRAIN WORKOUT

Q9.

What is the approximate weight of my packed holiday suitcase?

- **A.** 20 tonnes
- **B.** 20 g
- **C.** 20 kg
- **D.** 20 oz

YOUR BRAIN WORKOUT

Q10.

What is the approximate thickness of a tablet computer?

- **A.** 10 miles
- **B.** 10 mm
- **C.** 10 metres
- **D.** 10 feet

YOUR BRAIN WORKOUT

Answers

Q1.18cm

Q2. 330ml

Q3. 50 litres

Q4. 140 g

Q5. 2 meters

Q6. 25 miles

Q7. 6 feet

Q8. 1 tonne

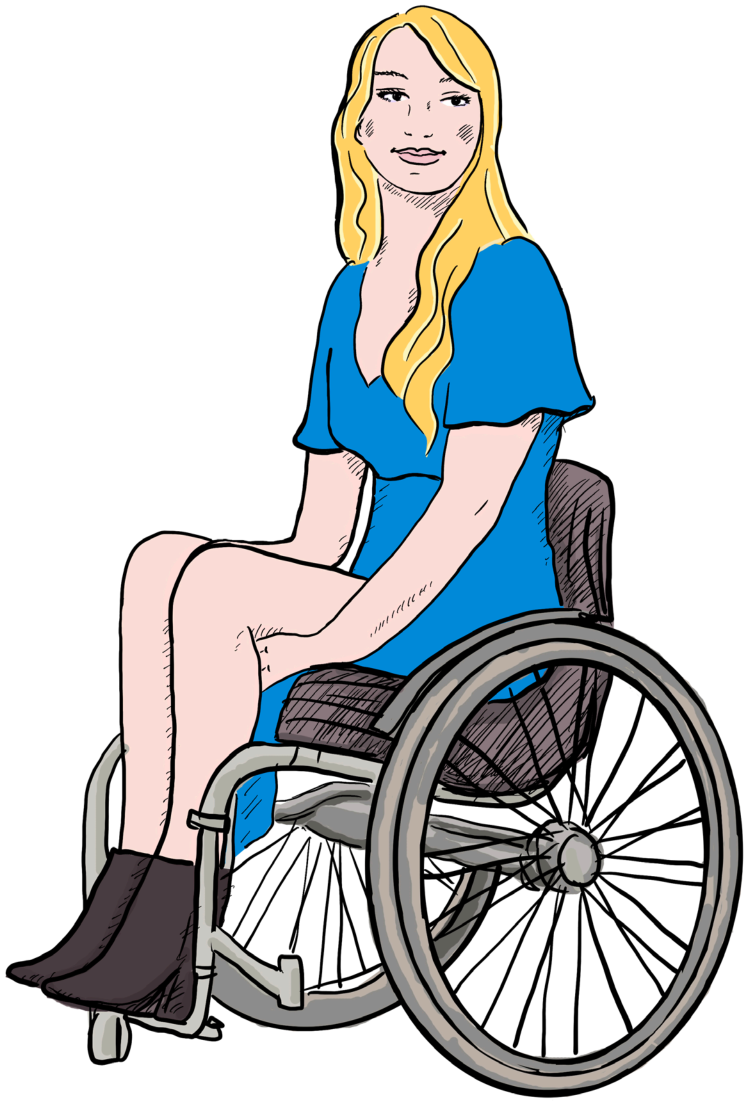
Q9. 20 kg

Q10. 10 mm

PART 19
CHANGES

Girls change into swans.

Quick Quiz

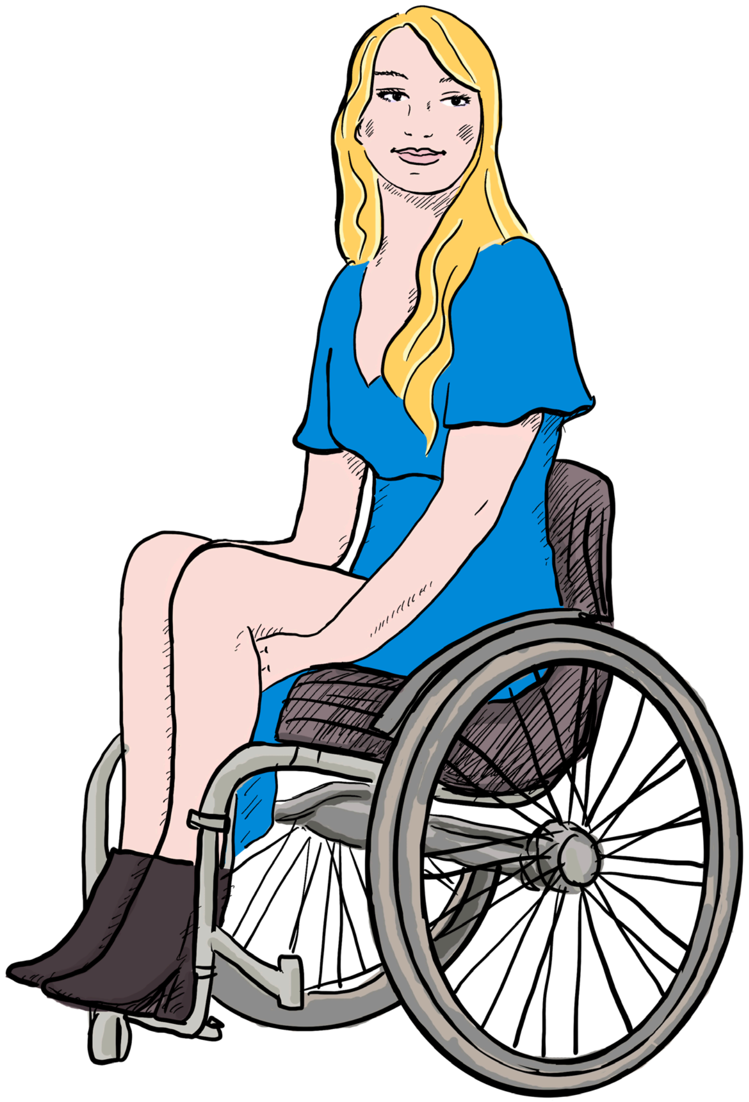


Q1.

What is the remainder when 75 is divided by 7?

- **A.** 3
- **B.** 4
- **C.** 5
- **D.** 6

Quick Quiz

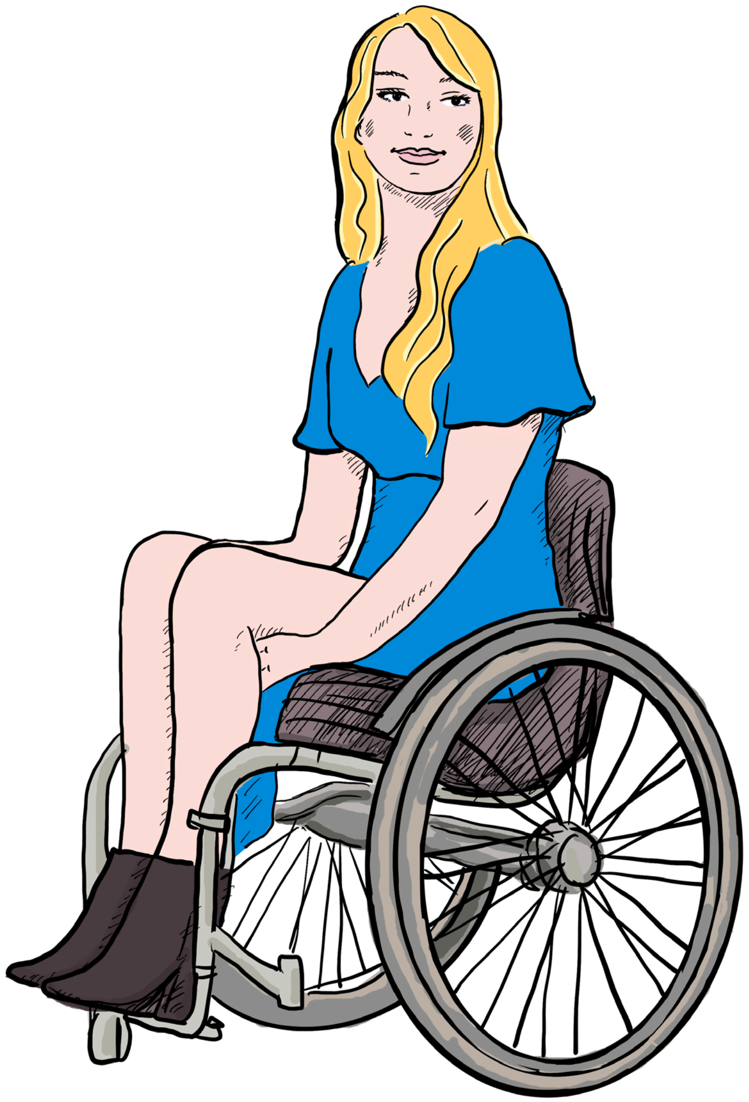


Q2.

Which of the following numbers is **not** a square number?

- A. 9
- B. 25
- C. 39
- D. 64

Quick Quiz

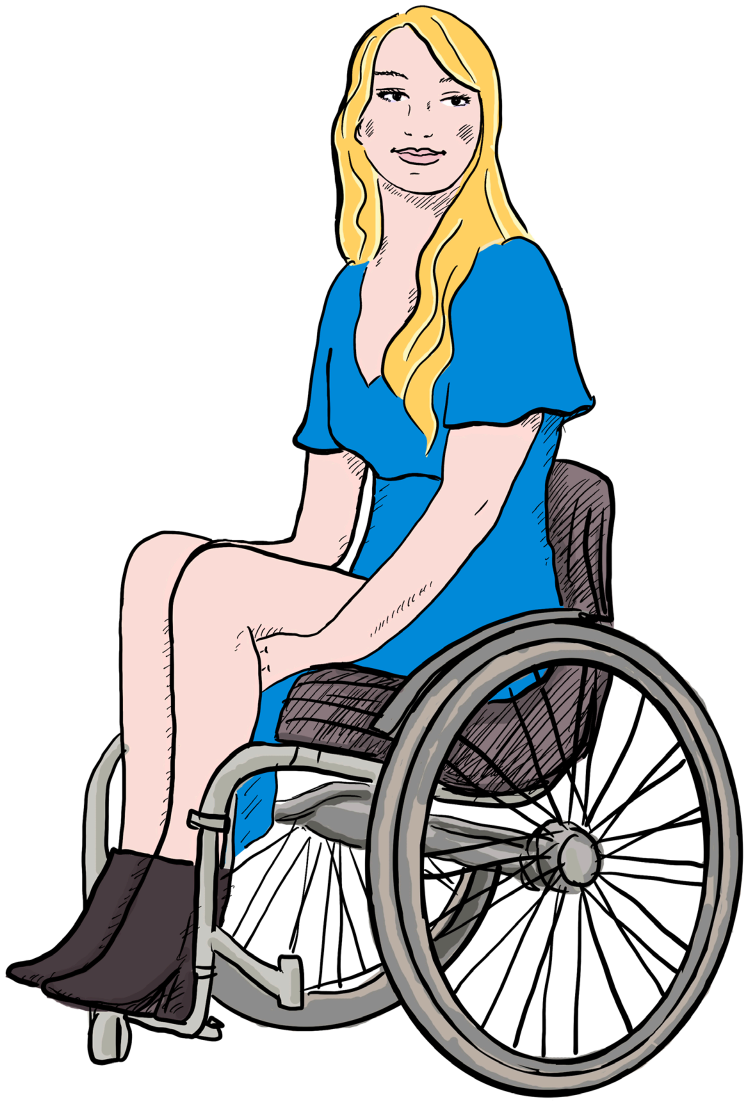


Q3.

What is $\frac{3}{4}$ written as a decimal?

- **A.** 0.5
- **B.** 0.25
- **C.** 0.8
- **D.** 0.75

Quick Quiz

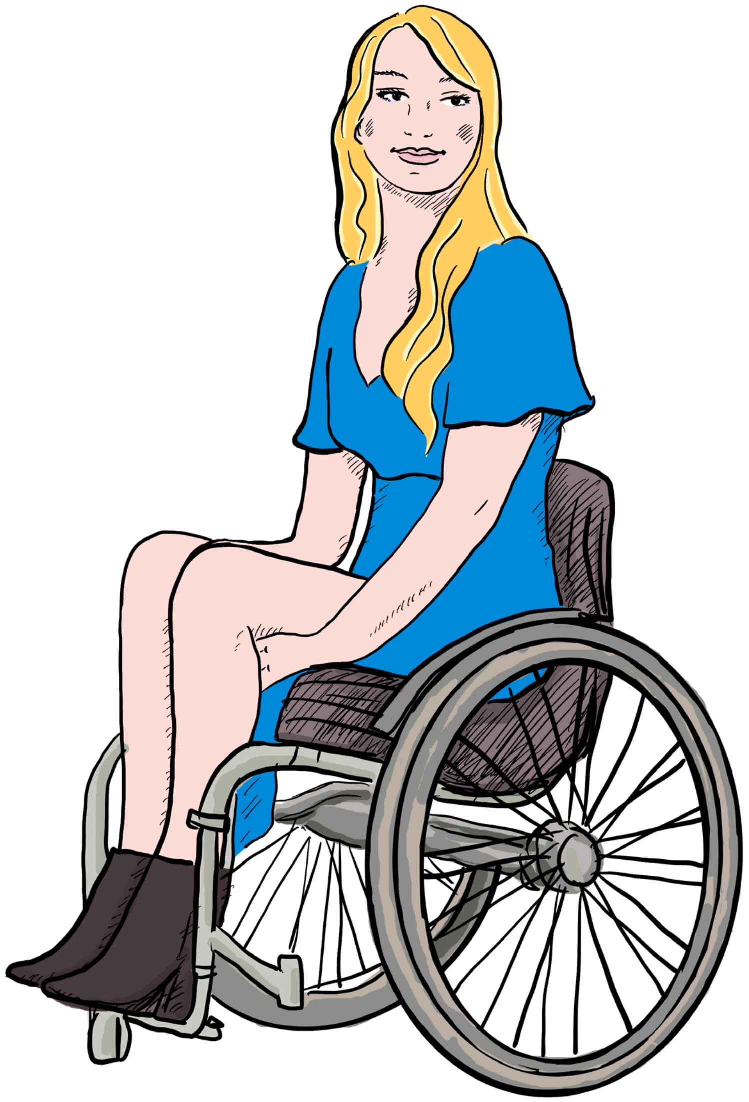


Q4.

What is the imperial unit of measure that is a similar length to 1 metre?

- **A.** Foot
- **B.** Yard
- **C.** Inch
- **D.** Mile

Quick Quiz



Answers

Q1. 5

Q2. 39

Q3. 0.75

Q4. Yard

The Basic Chart Method

By now you should be familiar with the **basic chart method**.

You've already used it to **convert units of measure**, to work out **percentages** and **ratios**, and for **problem solving**. You can also use it for **currency conversions**, **map scales** and **constructing pie charts**; if you're still a student, you'll find it useful for **similarity calculations** in geometry.

Dance rhythm is counted in numbers.

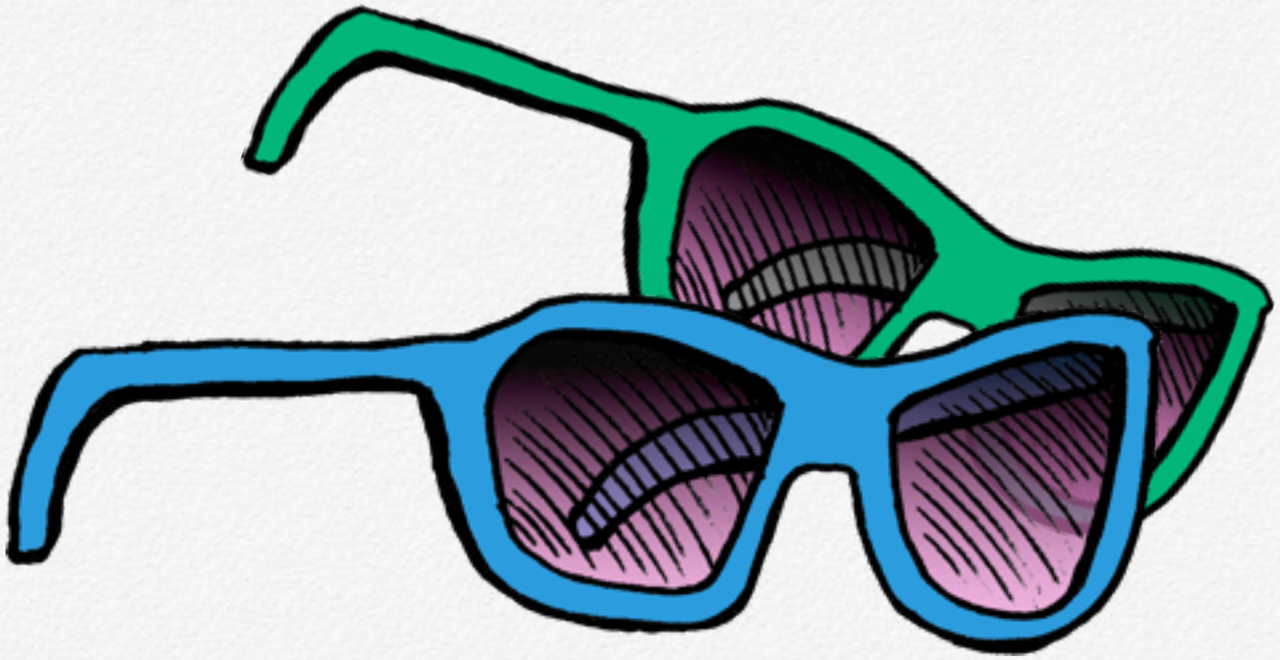
Temperature Conversions

In Real Life, there is one limitation to the basic chart method: you **can't** use it for temperature conversion. This is because the three units of temperature, Fahrenheit (°F), Celsius (°C) and Kelvin (K) all have different temperatures for zero.

0° in Celsius is the temperature at which water freezes.

0° in Fahrenheit is the temperature at which very salty water freezes.

0° in Kelvin is absolute zero, an extremely low temperature, currently thought to be the lowest possible temperature.



To Change Fahrenheit to Celsius

– First, take-away 32

– Next, divide by 1.8

First Example

While on holiday in Florida, Hilary's mum complained of the heat, which was over 90°F every day. Hilary, who is used to the Celsius scale, wonders what 90°F is in °C.

First, take-away 32: 90 – 32 = 58

Next, divide by 1.8: 58 ÷ 1.8 = 32.2

Answer: **The daily holiday temperature in Florida was above 32°C**, Hilary agrees that's really hot.

Note

Don't be tempted to do 90 – 32 ÷ 1.8 in one go on your calculator, because it will give you the wrong answer. Either do the sum in two stages (as before), or if you have a scientific calculator, put brackets around the first part of the sum: (90 – 32) ÷ 1.8

To Change Celsius to Fahrenheit

– First, multiply by 1.8

– Next, add on 32

Second Example

On holiday in Italy, Great Aunt Melanie feels unwell, so she takes her own temperature, which she finds is 37 °C, but she doesn't understand the Celsius scale. She knows only that a healthy body temperature is 98.6 °Fahrenheit. Great Aunt Melanie needs to translate from Celsius to Fahrenheit. Please do this for her.

First, multiply by 1.8: 37 x 1.8 = 66.6

Next, add on 32: 66.6 + 32 = 98.6

Answer: **Hypochondriac Great Aunt Melanie doesn't have a high temperature; she has exactly the healthy body temperature of 98.6 °F.**

To Change between Celsius and Kelvin

Since only scientists use Kelvin, you are unlikely to convert to or from Kelvin, but here's how, in case you need it.

One degree increase in Kelvin is equal to one degree increase in Celsius. The scales have different definitions of zero. 0 °K is equal to –273.15 °C, and 0 °C = +273.15 K.

To convert a Celsius temperature to Kelvin, simply **add** 273.15 (or round down to 273).

To convert Kelvin to Celsius, **subtract** 273.

Keeping her legs warm.

Exercises

Practice changing between Fahrenheit and Celsius by answering the following questions:

1) At what temperature does water boil on the Fahrenheit scale? (Water boils at 100° Celsius).

2) The easiest dish to cook to feed a lot of people is a roast, but Jenny is nervous because she is roasting a leg of lamb for the first time and submariner Pete (whom she met at Sarah's housewarming party) is at last able to visit Jenny in Brighton. Her mum's recipe says the oven should be at 375°F. Jenny's cooker has numbers that only go up to 240 so she realises that her oven is graded in Celsius. What is 375°F in Celsius?

First highlight or underline the maths information only, because maths problems in Real Life often need to be picked out of a lot of text that is irrelevant to the actual maths problem. For instance, it doesn't matter where Pete met Jenny, or that Pete is a submariner.

3) Design students, Jane and Karen are planning a trip to New York this February. They find that average temperatures in NY range from 27 to 40°F. What's that in Celsius?

Conversion Graphs

Conversion Graphs are also useful for converting from one unit to another: they can be used for all units of measure, including temperature. (See later for how to use a conversion graph.)

Traditional Japanese dancer.

Answers to Part 19

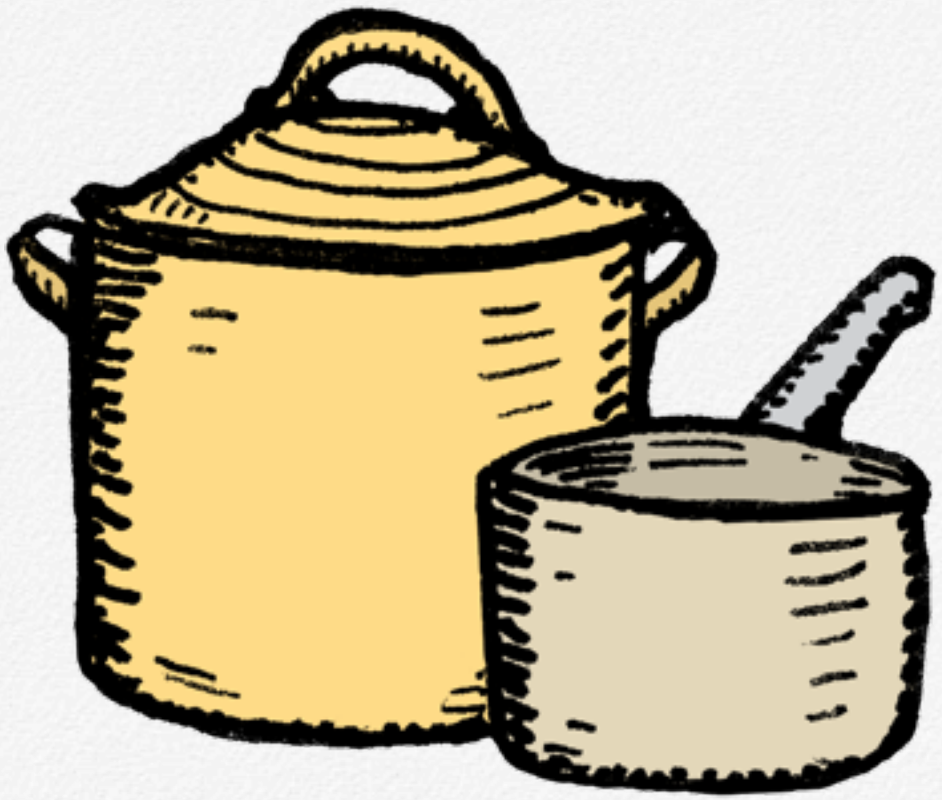
1) At what temperature does water boil on the Fahrenheit scale? (Water boils at 100° Celsius).

Change 100°C to Fahrenheit:

First, multiply by 1.8: 100 x 1.8 = 180

Next, add on 32: 180 + 32 = 212

Answer: **Water boils at 212°F.**



2) The easiest dish to cook to feed a lot of people is a roast, but Jenny is nervous because she is roasting a leg of lamb for the first time and submariner Pete (whom she met at Sarah's housewarming party) is at last able to visit Jenny in Brighton. Her mum's recipe says the oven should be at 375°F. Jenny's cooker has numbers that only go up to 240 so she realises her oven is graded in Celsius. What is 375°F in Celsius?

Change 375°F to Celsius:

First, take-away 32: 375 – 32 = 343

Next, divide by 1.8: 343 ÷ 1.8 = 190.6 (rounded to the nearest 10 = 190)

Answer: **Jenny should set her oven to 190°C to cook her leg of roast lamb.**

3) Design students, Jane and Karen are planning a trip to New York this February. They find that average temperatures in NY range from 27 to 40°F. What's that in Celsius?

Go from 27°F and 40°F to Celsius:

Change 27°F to Celsius first:
First take-away 32: $27 - 32 = -5$
Next divide by 1.8: $-5 \div 1.8 = -2.8$
So $27°F = -2.8°C$

Now change 40°F to Celsius:
First take-away 32: $40 - 32 = 8$
Next divide by 1.8: $8 \div 1.8 = 4.4$
So $40°F = 4.4°C$

Answer: Jane and Karen should pack warm clothes; **the February temperature for New York is usually between –3 and 5°C**.

The international language of dancers is music and numbers.

YOUR BRAIN WORKOUT

Q1.
Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

Water boils at 212 °F; in Celsius this is:

- **A.** 200 °C
- **B.** 100 °C
- **C.** 50 °C
- **D.** 0 °C

YOUR BRAIN WORKOUT

Q2.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

A hot summers day is 80°F; in Celsius this is:

- **A.** 100°C
- **B.** 58°C
- **C.** 27°C
- **D.** 10°C

YOUR BRAIN WORKOUT

Q3.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

Room temperature is 72°F; in Celsius this is:

- **A.** 42°C
- **B.** 32°C
- **C.** 22°C
- **D.** 12°C

YOUR BRAIN WORKOUT

Q4.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

On a frosty winter's day it's 28°F; in Celsius this is:

- **A.** -3°C
- **B.** 0°C
- **C.** 5°C
- **D.** 10°C

YOUR BRAIN WORKOUT

Q5.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

The recipe says bake the cake at 300°F; in Celsius this is:

- **A.** 300°C
- **B.** 80°C
- **C.** 20°C
- **D.** 150°C

YOUR BRAIN WORKOUT

Q6.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

Normal body temperature is 98°F; in Celsius this is:

- **A.** 50°C
- **B.** 37°C
- **C.** 25°C
- **D.** 10°C

YOUR BRAIN WORKOUT

Q7.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

Some say, to brew the perfect cup of tea, the water should be **200°F**; in Celsius this is:

- **A.** 300°C
- **B.** 104°C
- **C.** 58°C
- **D.** 93°C

YOUR BRAIN WORKOUT

Q8.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

My freezer is at −4°F; in Celsius this is:

- **A.** 0°C
- **B.** −3°C
- **C.** −20°C
- **D.** 4°C

YOUR BRAIN WORKOUT

Q9.
Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

My mother says, for the best roast potatoes, the oven should be **425°F**; in Celsius this is:

- **A.** 180°C
- **B.** 220°C
- **C.** 300°C
- **D.** 70°C

YOUR BRAIN WORKOUT

Q10.

Choose the temperature in Celsius that best matches the Fahrenheit temperature given.

The fridge is 39°F; in Celsius this is:

- **A.** -4°C
- **B.** 4°C
- **C.** 10°C
- **D.** 0°C

YOUR BRAIN WORKOUT

Answers

Q1. 100°C

Q2. 27°C

Q3. 22°C

Q4. -3° C

Q5. 150°C

Q6. 37°C

Q7. 93°C

Q8. -20° C

Q9. 220°C

Q10. 4° C

YOUR WAY TO SUCCESS 2

That inner, winning glow.

Remember Your Incentives?

MONEY STUFF will:

- make me richer

- stop me getting poorer

- give me more choices in life

- help me get ahead in life

- prove that I can be a self-starter

- improve my self-esteem: I will feel good about myself. I will stand taller. I will be proud of myself. With good reason.

Can you think of a couple more incentives that are important to you, personally? Say them aloud. Stick them on the fridge door. Secretly imagine them in crimson lipstick scrawled on your bathroom mirror.

Don't be an onlooker at your own life.

Keep reminding yourself of what your original incentive was and why.

If you've entirely lost your enthusiasm, if you no longer want to do something, again – work out why.

My friend Jane joined an expensive gym. Why did her visits tail off, she wondered. Because gym work on your own can be lonely. Repetitive work can be boring. Jane found a gym buddy.

Remember the time you've already spent on MONEY STUFF. Build on that. Don't waste it.

Incidentally, Jane was one of the people who tested MONEY STUFF, after which her fear of maths disappeared.

Traditional Polish costumes.

Don’t be an onlooker at your own life.

Your Feedback Guide

Do you feel you have no mentor or coach to guide you or challenge you?

Well, you do. I am your mentor, I am your fan, and a football coach who works with sports psychology helped me to produce this section.

Is the problem that you have no-one near to encourage you?

You don't need someone to encourage you. You know how well you are performing: you have reached STEP 3.

Go back and look at the contents pages of STEP 1 and STEP 2.

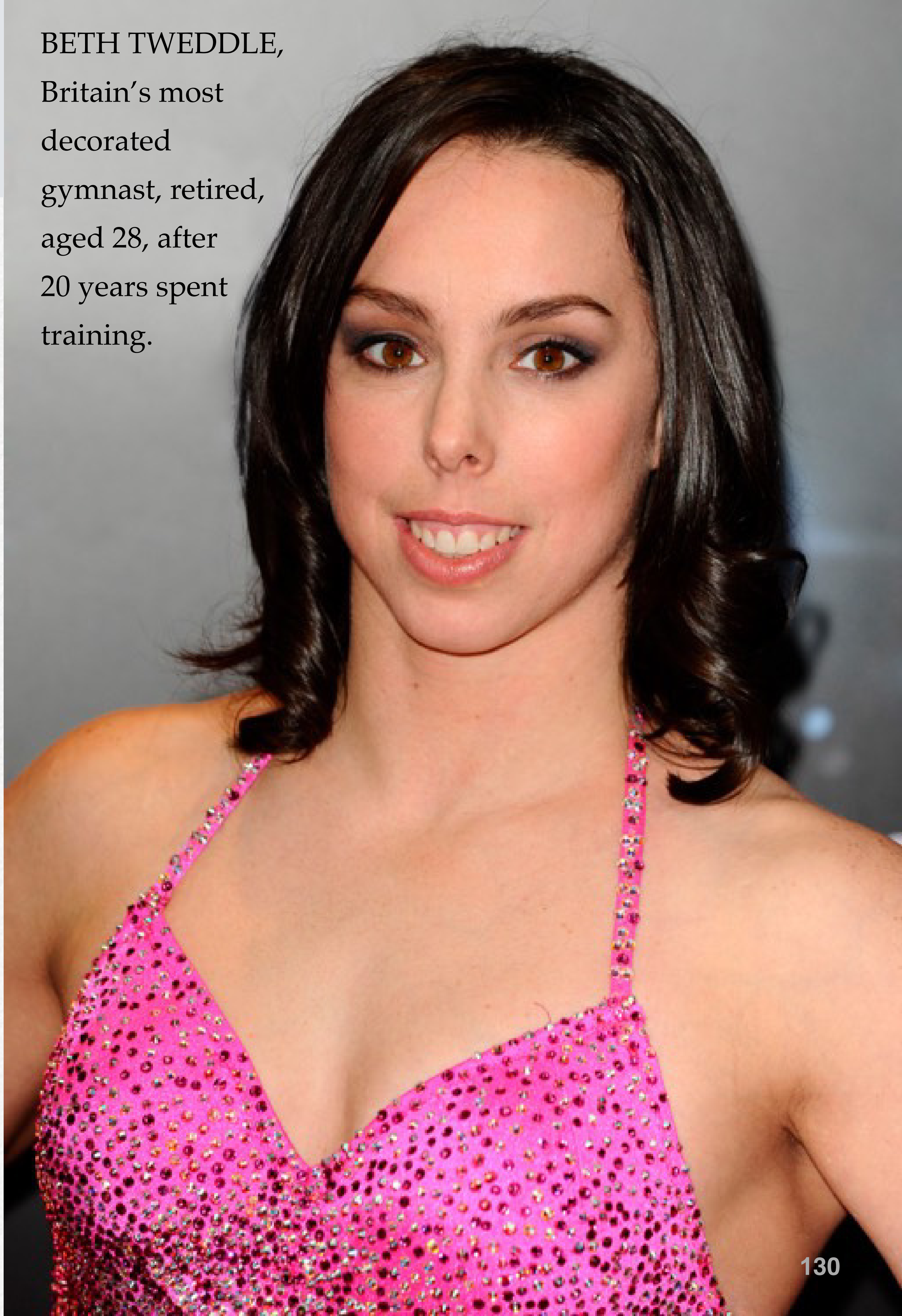
STEP 2 was the toughest in MONEY STUFF – and you did it!

You own this Course.

You decide how much effort you put into it.

You decide how much time you invest.

So don't be half-hearted – it's a waste of your time. Take a deep breath – let's get on with it.



BETH TWEDDLE, Britain's most decorated gymnast, retired, aged 28, after 20 years spent training.

Incentives

When I've finished STEP 3:

- I will feel the elation of achievement.

- I will always be able to use this tool to improve my life.

What is your special private incentive?

Tough Talk

If I don't finish STEP 3:

- I will be poorer. (I can almost guarantee that.)

- I've already finished a lot of MONEY STUFF. If I take one step at a time, I will achieve the next Part... and the next.

- I don't want to fail. I don't want to be a loser.

There's a lack of straight talk in British education. I want you to know the truth. Your life will be tougher without maths.

She's focussed and determined.

Your Smart Practice Guide

- To improve, you need more than practice. You need to push yourself beyond your comfort zone.
- Getting good at anything means that – as well as the **quantity** of practice – you need to check the **quality** of your practice.
- Practice only improves you, if you push yourself to try something... **that you haven't yet been able to do.**

This means that **you** need to raise the bar – and then keep trying until you can jump over it.

Then you raise the bar again.

- Only you can do it.
- Otherwise you'll just become **very good** at not improving.

You raise the bar.

PART 20
TIME

Fruit takes time to ripen...

Quick Quiz

Q1.

How is **eleven thousand, three hundred and six** written in numbers?

- **A.** 11,316
- **B.** 110,316
- **C.** 11,000,306
- **D.** 11,306

Quick Quiz

Q2.

Which of the following fractions is **not** equal to the other three?

- A. $\frac{6}{18}$
- B. $\frac{4}{8}$
- C. $\frac{4}{12}$
- D. $\frac{1}{3}$

Quick Quiz

Q3.

24, 32, 40, 48, 56 is a sequence from which times table?

- A. x8
- B. x9
- C. x11
- D. x12

Quick Quiz

Q4.

Gym membership is **£55** per month. Approximately how much is that per year?

- **A.** £1000
- **B.** £550
- **C.** £300
- **D.** £200

Quick Quiz

Answers

Q1. 11,306

Q2. $\frac{4}{8}$

Q3. x8

Q4. £550

Time

Counting and calculation are now generally based on the number ten, as in the decimal system. However, different counting systems, which date back to ancient times, are still used in some areas: **time** is one of these areas.

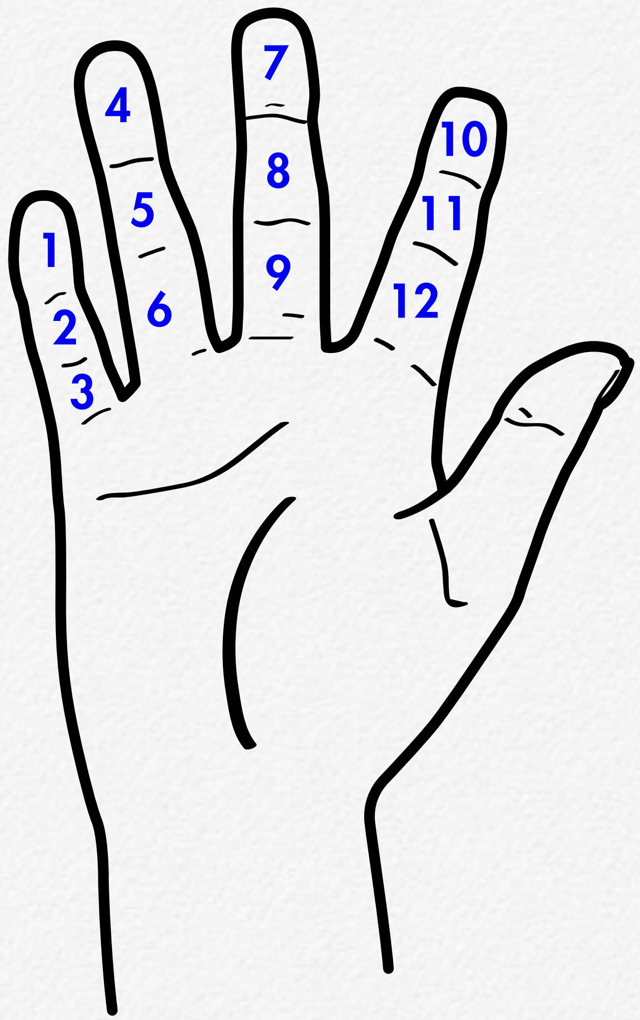
An hour is one twenty-fourth part $\left(\frac{1}{24}\right)$ of a full day.

This decision dates back to many ancient civilizations, when hours were defined as either one twelfth of the time between sunrise and sunset, or one twenty-fourth of a full day.

Perhaps the ancients preferred to base their counting on the number 12 rather than 10, because 12 is a more easily divisible number: you can exactly divide 12 by 2, 3, 4 and 6 but you can divide 10 only by 2 and 5.

Time has defied decimalisation, which is why there are still 24 hours in a day and still 12 months in a year.

How to count to 12, on the fingers of one hand.



There is also a 60-base counting system which dates back to the ancient Babylonians, and this is the reason that each hour is divided into 60 minutes and each minute is divided into 60 seconds.

So, in our 10–based world, doing time calculations can be confusing, which is why you need to know all the units in which time is measured.

Time Units

Time Units (from big to small)

1 year = the time it takes for the Earth to orbit the Sun
= 12 calendar months
= a bit more than 52 weeks
= 365 days (or 366 days in a leap year)

1 calendar month = beween 4 to $4\frac{1}{2}$ weeks
= beween 28 to 31 days

1 week = 7 days

1 day = the time for the Earth to spin on its axis
= 24 hours

1 hour = 60 minutes

1 minute = 60 seconds

Leap Year

Because the Earth takes $365\frac{1}{4}$ days to orbit the Sun, every fourth year (called a Leap Year) has an extra day added ($\frac{1}{4}$day x **4** = **1** day extra).

This extra day is the **29th** of February.

You can easily work out if a year is a leap year: check if the last two digits of the year are divisible by **4**. For example in the year 2012… **12** can be divided exactly by **4**, so 2012 is a leap year, and so was 1816 and so will be 2084.

12 Hour Clock and 24 Hour Clock

When using the 12 hour clock, you specify the time to which you are referring. **Am** for before midday or **pm** for after midday. **11.59 am** is only one minute before midday, when **am** changes to **pm**. So **12 pm is lunchtime**.

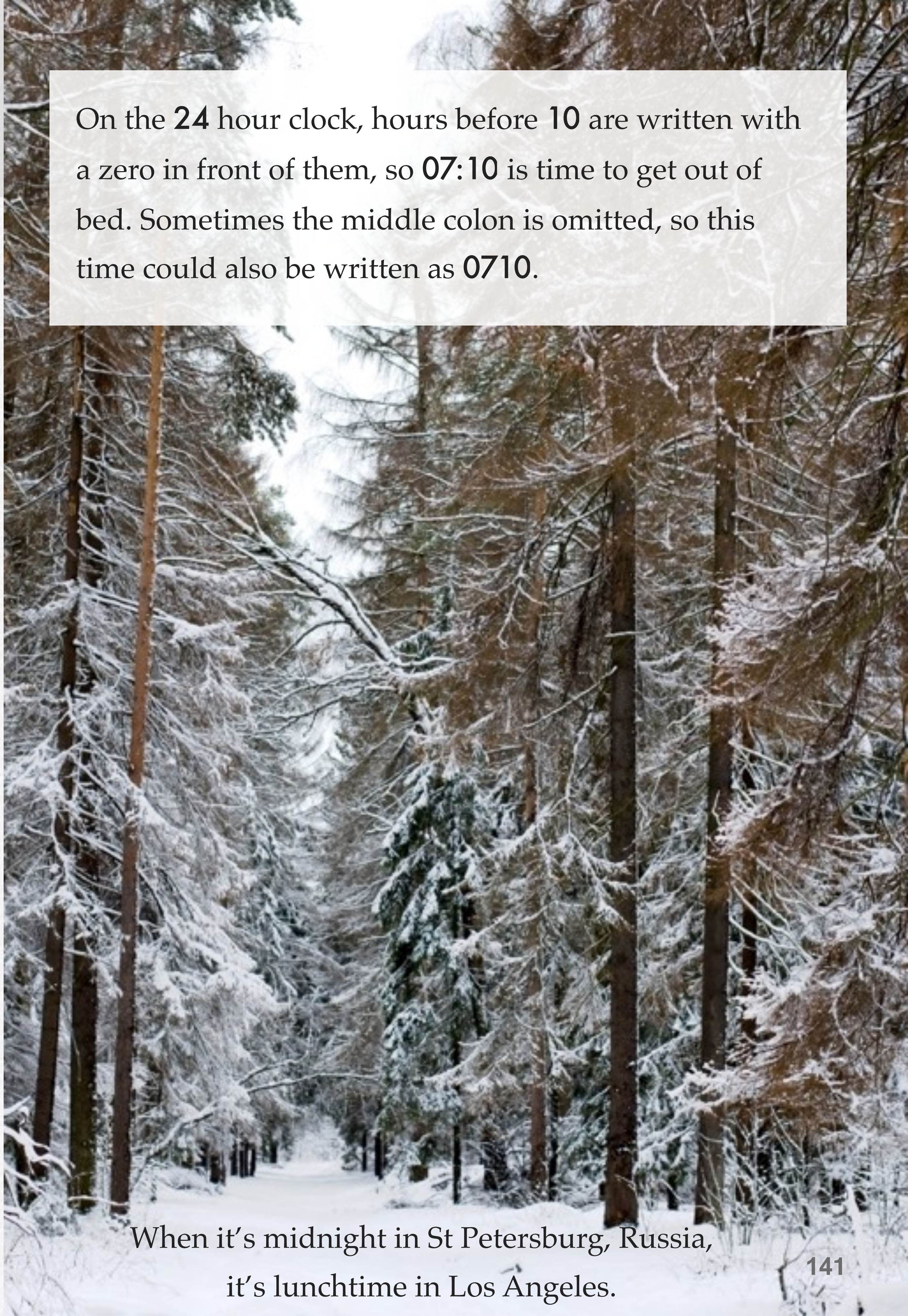
The **24 hour clock** is used for timetables at airports, bus and railway stations as each hour is numbered from **0** to **23**.

So time starts from 00:00 at midnight, to **23:59** at a minute before midnight. A few minutes past midnight – say **7** minutes – is written **00:07**, because the clock hasn't yet reached one hour.

On the **12 hour clock**, **00:07** is seven minutes past midnight, or written as **12:07 am**.

Always use a colon (two dots) to separate hours from minutes and not a decimal point (time is not expressed using the decimal system).

On the **24** hour clock, hours before **10** are written with a zero in front of them, so **07:10** is time to get out of bed. Sometimes the middle colon is omitted, so this time could also be written as **0710**.



When it's midnight in St Petersburg, Russia, it's lunchtime in Los Angeles.

Examples of changing 12 hour clock times to 24 hour clock times

First Example

What is 8:50 am written as a 24 hour clock time?

Since it is a time before midday (am time), there is no change to the numbers. Simply add zero on the beginning: 8:50 am = 08:50

Answer: 8:50 am = 08:50

Second Example

How is 9:12 pm written as a 24 hour clock time?

Since it is a time after midday (pm time), add 12 onto the hour number: 9 + 12 = 21

Answer: 9:12 pm = 21:12

Examples of changing 24 hour clock times to 12 hour clock times

Third Example

What is 18:18 written as a 12 hour clock time?

Since the hour number is more than 12, subtract 12 in order to change it to 12 hour clock time.

18 – 12 = 6. It will be a pm time.

Answer: 18:18 = 6:18 pm

Exercises

1) Convert the following times
from the **12** hour clock to the **24** hour clock:

a) **9:30 am**

b) **2:15 pm**

c) **8:45 pm**

d) **11:05 pm**

e) **11:05 am**

f) **12:20 am**

2) Convert the following times
from the **24** hour clock to the **12** hour clock:

a) **16:34**

b) **19:50**

c) **13:10**

d) **03:57**

e) **22:45**

f) **15:07**

Time Calculations

Mistakes are often made and often lead to disaster. You don’t want to turn up an hour late for a job interview; you don’t want to overcook the roast and burn it to a crisp. So calculate the hours and minutes separately, as follows.

Sale on!

A. What time will you finish?

First Example

What time should Tania and Frank arrive in Sheffield to visit Frank's parents if they set out at **7:20 pm** and the journey normally takes **2** hours **30** minutes?

First, add the minutes to the start time:

7:20 pm + 30 mins = 7:50 pm

Next, add the hours to the answer:

7:50 pm + 2 hours = 9:50 pm

Answer: **Tania and Frank should arrive in Sheffield at 9:50 pm.**

p.s. Frank's parents didn't like Tania; privately they told Frank that Tania's stiletto boots were vulgar. Frank told his parents not to be judgmental, and an argument followed. The next day, Frank moved in with Tania.

Second Example

Rachel, who is on a quick trip to Paris, wants to visit the Cathedral at Orleans. A train leaves Paris at **11:35 am** and the journey lasts for **1** hour **20** minutes. What time will Rachel arrive?

First add the minutes to the start time:

11:35 am + 20 mins = 11:55 am

Next, add the hours:

11:55 am + 1 hour = 12:55 pm

Answer: **Rachel will arrive at Orleans at 12:55 pm.**

B. What time do you start?

Perhaps you know the finish time, but want to know what time something should begin. For this, you calculate as before, but with subtraction instead of addition.

First Example

Jenny's Sunday lunch party meal will start at **1 pm**.
She calculates that it will take **2** hours **45** mins to cook the Sunday joint of roast lamb.
What time should Jenny put the leg of lamb in the oven?

First, subtract the minutes: 1:00 pm – 45 mins = 12:15 pm

Next, subtract the hours: 12:15 pm – 2 hours = 10:15 am

Answer: **Jenny needs to put the leg of lamb in the oven at 10:15 am.**

Second Example

In 'The Sound of Music' the part of Liesl von Trapp, the oldest daughter, is being cast. Sally's daughter, 17 year old Michelle, is very excited because she has reached the final audition for this part. The audition is at **11:30 am** in London's West End.

Michelle is currently acting in Portsmouth, so needs to allow **2** hours **50** minutes to get to the stage door. What time should Michelle leave home?

First, subtract the minutes: 11:30 am – 50 mins = 10:40 am

Next, subtract the hours: 10:40 am – 2 hours = 8:40 am

Answer: **Michelle should leave at 8:40 am for the audition**. In fact, she was so anxious that she left at 7.30 am – five hours before she landed the part!

C. How long will it take?

If you know the start and finish times of your journey, you can calculate how long it will take.

To do this, break the time into sections.

First Example

Carla left home for the office at **7:20 am**. Instead of arriving at Canary Wharf at **8 am** as usual, Carla's bus was stuck in a bad traffic jam, so Carla arrived at the office at **9:08 am**. How long did her journey to work take?

Split the journey into sections as follows

Start time	First o' clock after start	Last o' clock before end	End time
7:20 am	8:00 am	9:00 am	9:08 am

Next, work out the intervals between each time listed

Start time	First o' clock after start	Last o' clock before end	End time
7:20 am	8:00 am	9:00 am	9:08 am

40 mins 1 hr 8 mins

Next, add all the intervals together, minutes first, remembering that there are only 60 mins in an hour.

Minutes: **40 + 8 = 48 mins**

Plus the hours: **48 mins + 1 hr = 1 hr 48 mins.**

Answer: **Carla's journey to work took 1 hr 48 mins.**

Gloomily, Carla told Fausto that she needed to get a new flat, nearer her business, but she couldn't afford a flat near Canary Wharf. "Move in with me", Fausto suggested. Together they subsequently opened six sandwich bars in London's financial district and then Carla produced twin boys.

Second Example

Yesterday Rachel switched on tunnel vision to finish her history essay. She worked from **9:15 am** until **6:40 pm** with no breaks, eating at her desk. How long did Rachel work on her history essay?

Start time	First o' clock after start	Last o' clock before end	End time
9:15 am	10:00 am	6:00 pm	6:40 pm
45 mins	8 hrs	40 mins	

Add the minutes: **45 + 40 = 85 mins = 1 hr 25 mins**

Plus the hours: **1 hr 25 mins + 8 hrs = 9 hrs 25 mins.**

Answer: **Rachel worked for 9 hrs 25 mins on her history essay**.
Had Rachel taken a ten-minute break every two hours, she probably would have done better work in a shorter time.

Canary Wharf, London.

Exercises

3) Jenny's submariner boyfriend, Pete, is catching the train at **6:20 pm** to visit for the weekend. Jenny wants to surprise him by meeting him at the station. She knows the journey takes **1 hr 35 mins**. At what time should Jenny be at the station to meet Pete?

4) As it's a fine evening, Jenny decided to walk to the station. If her walk takes **20** minutes, at what time should Jenny leave home to meet Pete?

5) Unfortunately Pete's train is delayed; he eventually arrives at **9:07 pm**. Jenny arrived at the station at **7:50 pm**. How long did Jenny wait at the station?

6) Natalia and her mother need to be at the Russian Orthodox church by **2:20 pm** for the wedding of Natalia's friend Liuba. It will take **1 hr 45 mins** for Natalia and her mother to get to the church. What time should they start their journey?

7) Rachel's mum drives her to go shopping in the city centre and drops her off at **10:20 am**. Her mum will pick her up again at **1:45 pm**. How much time does Rachel have to shop?

8) Natalia spends most of the Saturday afternoon at the local ice rink, practising for an ice dancing competition. She arrives at **14:35** and pays for **2 hrs 30 mins** skating.
At what time will Natalia have to stop skating?
Give your answer as a **24** hour clock time.

9) Jenny wants to be as fit as submariner, Pete, so she joins a gym. If Jenny works out at the gym from
6:10 pm until **8:15 pm**, for how long will she exercise?

Time Sheets

If you are paid by the hour, you need to know how to calculate the total number of hours you have worked in a week, and then multiply that by the amount you earn per hour.

Many employers expect you to round **down** your time to the nearest quarter of an hour. Example: If you work for 5 hours and 50 **mins**, you invoice for 5 hours 45 **mins**.

Many self-employed people invoice like this, in 15 minute segments: there are four 15 minute segments in an hour.

15 minute segments converted into decimals

15 minutes = 0.25 hours
30 minutes = 0.5 hours
45 minutes = 0.75 hours

When it's afternoon shopping time in Vietnam, it's nightclub time in New York.

Example

Emmylou Benson (her mother's a country music fan) works as a temporary PA to Doctor Nichols.

Here is Emmylou's time sheet for 1 week in February.

Timesheet: **PA to Dr Nichols**

Name: **Emmylou Benson** Week commencing: **Monday 7th February 2011**

	Mon	Tues	Wed	Thurs	Fri
Start time:	9:00 am	9:15 am	9:10 am	9:45 am	9:00 am
End time:	4:00 pm	3.30 pm	4:45 pm	4:15 pm	5:00 pm
Hours at work:	7 hrs	6h15m	7h35m	6h30m	8 hrs
Lunch Break:	45 mins	1 hr	30 mins	50 mins	40 mins
Total hours worked:	**6h15m**	**5h15m**	**7h5m**	**5h40m**	**7h20m**

Hours worked in week (exact): **31h35m**
(Add together the total for each day: 6h15m + 5h15m + 7h5m + 5h40m + 7h20m)

Hours worked in week (rounded down to nearest 15 mins) **31h30m**

Hours worked in week (you convert to decimals): **31.5 hours**

Hourly rate: **£10.50 per hour**

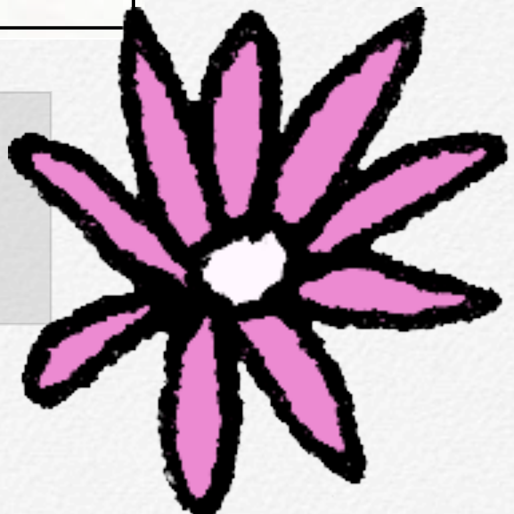
Total for week (hours in decimals x hourly rate) **£330.75**
(31.5 hours x £10.50)

Signature: .... Date: ....

Emmylou calculated the hours she was at work each day and then subtracted her lunch break. Next, she added the total hours worked each day together, to calculate the total hours she worked in the week, in hours and minutes (**31h35m**). She rounded this total **down** to the nearest 15 minutes.

In order to calculate her week's salary, Emmylou converted the time worked in hours and minutes into **decimal hours** (**31h30m** became **31.5** hours). On a calculator, she was then able to multiply the hours worked by the hourly rate.

When you are faced with a blank document such as a time sheet (a) go slowly, (b) take one step at a time and (c) review your work.



Exercises

10) Copy and fill in the following time sheet, to calculate Melanie's salary for last week.

Melanie, who can't get a job as a textile designer, has started a new job as a temporary receptionist at the headquarters of the RSPCA. Here are her work times for last week.

Timesheet: **Temporary receptionist RSPCA**

Name: **Melanie Matthews** Week commencing: **Monday 14th February 2011**

	Mon	Tues	Wed	Thurs	Fri
Start time:					
End time:					
Hours at work:					
Lunch Break:					
Total hours worked:					

Hours worked in week (exact) ....

Hours worked in week (rounded **down** to nearest 15 mins) ....

Hours worked in week (you convert to decimals): ....

Hourly rate: **£12.20 per hour**

Total for week (hours in decimals x hourly rate): ....

Signature: .... Date: ....

Monday:

9 am to **4:30 pm** with a **45** minute lunch break.

Tuesday:

8:45 am to **5 pm** with an hour for lunch.

Wednesday:

8:50 am to **4 pm** with half-an-hour for lunch.

Thursday:

9 am to **5:20 pm** with **40** minutes for lunch.

Friday:

9 am to **3:45 pm** with **25** minutes for lunch.

Melanie is paid **£12.20** per hour.

When you've finished filling in this time sheet, look at it carefully.

It **looks** quite complicated – full of figures – but **you** did it,

and you can see the reason for doing it – **getting paid properly.**

So don't be alarmed when you see a similar page full of figures, perhaps in an office document or on a train timetable.

Note

Some professionals – such as lawyers and accountants – **invoice in 10 minute segments**: there are six 10 minute segments in an hour. Some professionals **invoice in 6 minute segments**: there are ten 6 minute segments in 1 hour. I have noticed that the shorter the segment, the bigger the bill.

A catwalk show might involve 60 outfits in 15 minutes, so tight timing is essential.

How to Cheat

How to cheat: Time calculations on your calculator

A useful button on some scientific calculators can be used to help you with time calculations in hours, minutes and seconds. The button looks like this: [° ′ ″] or [D°M′S″]

(this button is really meant for angle measurements, but since they are also counted with a base of **60**, you can use it equally well for time).

To tap in a time, such as **8:15 pm**, tap in [8] [° ′ ″] [1] [5] [° ′ ″] [=]. and the calculator display will show 8°15′0″. (If you press the [° ′ ″] button again, the number will change to a decimal, **8.25** or eight and a quarter.)

Example: Use calculator for previous question (9).
Type in the following:
[8] [° ′ ″] [1] [5] [° ′ ″] [−] [6] [° ′ ″] [1] [0] [° ′ ″] [=]
Your display shows **2°5′0″**.
You interpret this as **2** hours **5** minutes and no seconds.

Fashion and design icon, **Mary Quant** at home.
Beautiful, brilliant designer, inventor of the miniskirt.

Time Zones

Because of the way the Earth spins round the Sun, daylight in one part of the globe is night on the other side of the globe; that's why you alter your watch to local time when you travel to another country in a different time zone.

Historically, time zones were calculated on the time in winter at Greenwich, UK, which is why time is still referenced as Greenwich Mean Time (GMT). If you go far enough **East** from Greenwich – towards Europe and Asia – you will **add** hours to your watch. If you go far enough **West** of Greenwich – towards America – you **subtract** hours.

www.timeanddate.com/worldclock lists the current time in the major world cities. Check it before phoning abroad, so you don't wake your friend in the middle of the night. When travelling across international borders, train and flight departure plus arrival times are always given according to the local time of the relevant country.

The 2nd clock from the left is planted in Greenwich, UK, where the local time is 9:12 GMT. Hours are added to the clocks on the right, in Africa and Asia. Hours are subtracted from the clock on the left, planted in North America.

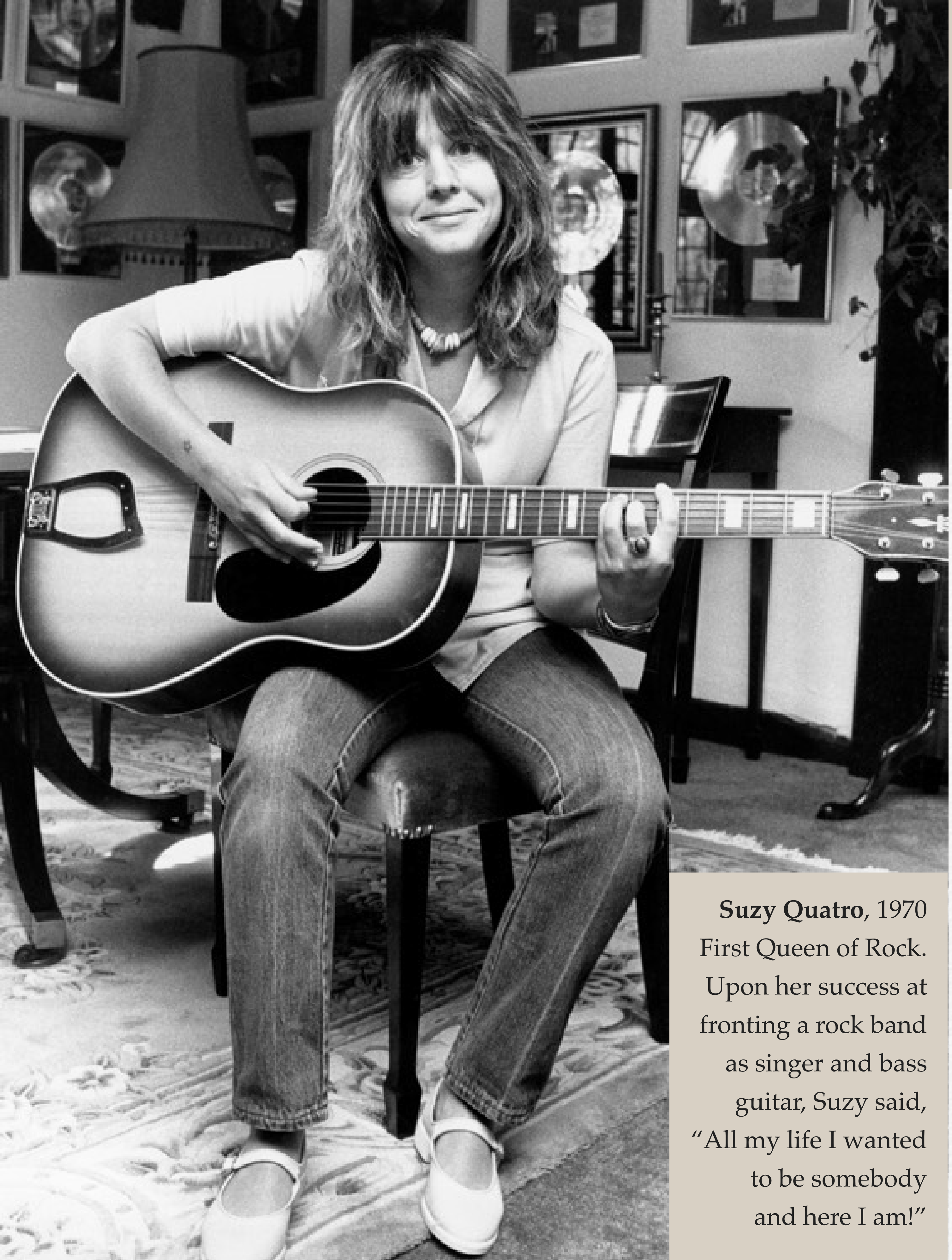
See a bigger time zone map at Wikipedia.

Example

Your flight departs from Nice 0800

Arrives in London 0900

Here, your flight time is not one hour but 2 hours. Because there is a one hour time zone change to the East (right, on the map) between France and Britain, deduct 1 hour.



Suzy Quatro, 1970
First Queen of Rock.
Upon her success at fronting a rock band as singer and bass guitar, Suzy said, “All my life I wanted to be somebody and here I am!”

Timetables

The quickest way to check plane, train or bus times, is to go online. Each travel company usually has a journey planner on its website. Type your destination, then your departure or arrival time, and automatically the best options will be found for you.

Nevertheless, there are still times when you need to read a bus or train **timetable**, and all timetables are similar. Perhaps after a night out in London, you need to work out which night bus will get you home, because the tube stopped working at midnight.

At first glance, the average timetable looks HORRENDOUSLY COMPLICATED. **It isn’t**. A huge amount of information is crammed into a small space, but **you** need only to locate one bit of it. KEEP CALM and use the edge of a sheet of paper or your index finger, to **pinpoint the bit of the timetable that you need**, (if you can, use a ruler).

First Example

Night bus timetable from Trafalgar Square.

1. First, **check you're looking at the correct timetable**. All destinations are listed in travel order on the left hand side. For instance, if you want to travel from Trafalgar Square to Lewisham, make sure that both places appear in the same column on the timetable.

2. Next, **make sure you're looking at the correct journey direction**, so check Trafalgar Square is **above** Lewisham in the list of travel stops, **not the other way round**.

If you want to travel in the reverse directions, from Lewisham to Trafalgar Square, the reverse travel directions are usually on the **back of the timetable**.

3. Now, look at the columns on the right of the place of departure.
On a bus timetable, each individual bus has a separate column which shows the time at which the bus will reach each stop.
The bus that leaves Trafalgar Square at **01:26** will arrive in Lewisham at **02:05**.

If the bus **does not halt** at a certain stop, you will see in the timetable a line or dash instead of a time.

Trafalgar Sq must appear above Lewisham

N21	Sunday night/Monday morning to Thursday night/Friday morning							
Trafalgar Square *Duncannon Street*	0056	0126	0156	0226	0259	0329	0359	0429
Aldwych *Law Courts*	0100	0130	0200	0230	0303	0333	0403	0433
Bank Station *Queen Victoria Street*	0106	0136	0206	0236	0309	0339	0409	0439
London Bridge Station *Bus Station*	0110	0140	0210	0240	0313	0343	0413	0443
Bricklayer's Arms *Old Kent Road*	0117	0147	0217	0247	0318	0348	0418	0448
Old Kent Road *Tesco*	0119	0149	0219	0249	0320	0350	0420	0450
New Cross Gate *Bus Garage*	0128	0158	0228	0258	0328	0358	0428	0458
Lewisham Station *Loampit Vale*	0135	0205	0235	0303	0333	0403	0433	0503
Lee Green *Old Tiger's Head*	0141	0211	0241	0308	0338	0408	0438	0508

N21	Sunday night/Monday morning to Thursday night/Friday morning						
Lee Green *Leegate*	0056	0126	0157	0231	0301	0331	0401
Lewisham *Police Station*	0100	0130	0201	0235	0305	0336	0406
New Cross Gate *Bus Garage*	0106	0136	0207	0241	0312	0343	0413
Old Kent Road *Tesco*	0113	0143	0214	0248	0320	0351	0421
Bricklayer's Arms *Old Kent Road*	0115	0145	0216	0250	0322	0353	0423
London Bridge *Southwark Cathedral*	0120	0150	0221	0255	0327	0358	0428
Bank Station *Queen Victoria Street*	0122	0152	0223	0257	0329	0400	0430
Aldwych *Law Courts*	0128	0158	0229	0303	0336	0407	0437
Trafalgar Square *Charing Cross Stn.*	0131	0201	0232	0307	0340	0411	0441

Second Example of a bus timetable

On the next page is an extract of a timetable for local bus no. 63 which travels between Oxford and Southmoor. Look underneath the timetable for an example of how to use it.

Watch Out!

Different sections depend on the day of the week and whether or not it's a school holiday.

Every move is calculated.

It’s important always to check the **timetable key**: in this case it’s on the left of the timetable.

If you plan to travel from Oxford to Southmoor after a day spent shopping, you need to catch the bus at **5:35 pm** (**1735**).

However, the timetable doesn’t tell you what time the bus arrives at Southmoor. Instead, it reads ‘r’. The key tells you that ‘r’ means a **request only stop**, so the time of arrival cannot be accurately judged.

To find out how long your journey will take, check the same journey on one of the other columns.

Good colour group: dancers rest their feet.

Route 63: Southmoor - Hinton Waldrist - Longworth - Fyfield - Appleton - Eaton - Cumnor - OXFORD

Sorry, NO SERVICE Sundays or Bank Holidays

*In OXFORD buses depart from Castle Street (Stop M1) outside the WESTGATE SHOPPING CENTRE

Monday to Friday - School Days									SC F
OXFORD, Castle Street, (Stop M1*)	----	----	----	1035	1230	1400	----	1735	2300g
CUMNOR, Glebe Road	----	----	----	1048	1243	1413	----	1753	2313
EATON, Appleton Road	----	----	----	1052	1247	1417	----	1757	2317
APPLETON, Green	----	----	----	1055	1250	1420	----	1800	2320
LONGWORTH, Post Office	----	----	0854	1104	1259	r	----	r	----
HINTON WALDRIST, Church Road	----	----	0858	1108	1303	r	----	r	----
SOUTHMOOR, Latton Close	----	----	0905	1115	1310	----	----	r	2328
notes	SC	SC							
SOUTHMOOR, Latton Close	0648	0750	0905	1115	1310	----	1640	----	----
HINTON WALDRIST, Church Road	----	----	(0858)	1122	1317	----	1647	----	----
LONGWORTH, Post Office	----	----	(0854)	1126	1321	----	1651	----	----
FYFIELD, Old Forge	0652	0754	0909	1131	1326	r	1656	r	(2324)
APPLETON, Green	0656	0758	0915	1137	1332	----	1702	----	----
EATON, Appleton Road	0658	0800	0918	1140	1335	----	1705	----	----
CUMNOR, Glebe Road	0702	0804	0922	1144	1339	----	1709	----	----
OXFORD, Castle Street (Stop M1*)	0720g	0830g	0938	1200	1355	----	1725	----	----

Monday to Friday - School Holidays									SC F
OXFORD, Castle Street (Stop M1*)	----	----	----	1035	1230	1400	1610	1735	2300g
CUMNOR, Glebe Road	----	----	----	1048	1243	1413	1623	1753	2313
EATON, Appleton Road	----	----	----	1052	1247	1417	1627	1757	2317
APPLETON, Green	----	----	----	1055	1250	1420	1630	1800	2320
LONGWORTH, Post Office	----	----	0854	1104	1259	1429	(1651)	r	----
HINTON WALDRIST, Church Road	----	----	0858	1108	1303	1433	(1647)	r	----
SOUTHMOOR, Latton Close	----	----	0905	1115	1310	1440	1640	r	2328
notes	SC	SC							
SOUTHMOOR, Latton Close	0648	0750	0905	1115	1310	1440	1640	----	----
HINTON WALDRIST, Church Road	----	----	(0858)	1122	1317	1447	1647	----	----
LONGWORTH, Post Office	----	----	(0854)	1126	1321	1451	1651	----	----
FYFIELD, Old Forge	0652	0754	0909	1131	1326	1456	1656	r	(2324)
APPLETON, Green	0656	0758	0915	1137	1332	1502	1702	----	----
EATON, Appleton Road	0658	0800	0918	1140	1335	1505	1705	----	----
CUMNOR, Glebe Road	0702	0804	0922	1144	1339	1509	1709	----	----
OXFORD, Castle Street (Stop M1*)	0720g	0830g	0938	1200	1355	1525	1725	----	----

Key to notes
SC Stagecoach Service 66 (Please contact Stagecoach for details)
F Friday only
g Stops at Gloucester Green NOT Castle Street
r Stops by request of passengers on board at Appleton

Saturdays	notes							SC
OXFORD, Castle Street (Stop M1*)	----	0820	1035	1230	1400	1610	1735	2300g
CUMNOR, Glebe Road	----	0832	1048	1243	1413	1623	1753	2313
EATON, Appleton Road	----	0834	1052	1247	1417	1627	1757	2317
APPLETON, Green	----	0836	1055	1250	1420	1630	1800	2320
LONGWORTH, Post Office	----	0854	1104	1259	1429	(1651)	r	----
HINTON WALDRIST, Church Road	----	0858	1108	1303	1433	(1647)	r	----
SOUTHMOOR, Latton Close	----	0905	1115	1310	1440	1640	r	2328
SOUTHMOOR, Latton Close	----	0905	1115	1310	1440	1640	----	----
HINTON WALDRIST, Church Road	----	(0858)	1122	1317	1447	1647	----	----
LONGWORTH, Post Office	----	(0854)	1126	1321	1451	1651	----	----
FYFIELD, Old Forge	0754	0909	1131	1326	1456	1656	r	(2324)
APPLETON, Green	0758	0915	1137	1332	1502	1702	----	----
EATON, Appleton Road	0801	0918	1140	1335	1505	1705	----	----
CUMNOR, Glebe Road	0806	0922	1144	1339	1509	1709	----	----
OXFORD, Castle Street (Stop M1*)	0820	0938	1200	1355	1525	1725	----	----

Example

Amanda has a job interview at **2:30 pm** in Oxford city centre. She needs to catch the bus from Longworth to Oxford. Which bus from Longworth should Amanda catch?

First, Amanda chooses the correct section. Amanda's interview is on a Tuesday in mid-August, so she looks at the section titled 'Monday to Friday – School Holidays'.

The top of this section covers Oxford to Southmoor; following it is the listing for the return journey, Southmoor to Oxford. Since Amanda is travelling **from Longworth** to Oxford, she needs the list in which **Longworth is above** Oxford in the list... the bottom part.

Next, Amanda checks the columns of bus times which range from early (on the left) to late in the day (on the right).

There is a bus that arrives in Oxford at **1200** (midday) and a bus at **1355** (five minutes to two pm). Amanda decides to catch the bus which arrives at **1355**. By looking up that column, Amanda can see that this bus stops in Longworth at **1321**. So Amanda needs to be at the bus stop well before **21** minutes past **1 pm**.

Amanda waits for the bus.

Exercises

11) Amanda's interview has finished by **3:15 pm**.
What time is the next bus back to Longworth?

12) Amanda gets the job working in a smart shoe shop on Saturday mornings. She needs to be at work by **9 am**.
What bus will Amanda need to catch to get to Oxford in time for **9 am**?

13) Amanda finishes work at **1 pm**.
What is the earliest time she can get back to Longworth?

You need maths to streak your hair.

Answers to Part 20

Answers to 12 and 24 hr clocks

1) Convert the following times from the 12 hour clock to the 24 hour clock:

a) 9:30 am = 09:30

b) 2:15 pm = 14:15

c) 8:45 pm = 20:45

d) 11:05 pm = 23:05

e) 11:05 am = 11:05

f) 12:20 am = 00:20

2) Convert the following times from the 24 hour clock to the 12 hour clock:

a) 16:34 = 4:34 pm

b) 19:50 = 7:50 pm

c) 13:10 = 1:10 pm

d) 03:57 = 3:57 am

e) 22:45 = 10:45 pm

f) 15:07 = 3:07 pm

Answers to time problems

3) Jenny's submariner boyfriend, Pete, is catching the train at **6:20 pm** to visit for the weekend. Jenny wants to surprise him by meeting him at the station. She knows the journey takes **1 hr 35 mins**. At what time should Jenny be at the station to meet Pete?

Pete will arrive **1 hr 35 mins after 6:20 pm**, so **add** the times.

First, add the minutes: 6:20 pm + 35 mins = 6:55 pm

Next, add the hours: 6:55 pm + 1 hr = 7:55 pm

Answer: **Jenny needs to be at the station by 7:55 pm.**

4) As it's a fine evening, Jenny decided to walk to the station. If her walk takes **20** minutes, at what time should Jenny leave home to meet Pete?

Jenny needs to leave **20 mins before 7:55 pm**, so **subtract 20 mins** from 7:55 pm.

First, subtract the minutes: 7:55 pm – 20 mins = 7:35 pm

There are no hours to subtract.

Answer: **Jenny needs to leave home by 7:35 pm** to get to the station at **7:55 pm**.

5) Unfortunately Pete's train is delayed; he eventually arrives at **9:07 pm**. Jenny arrived at the station at **7:50 pm**. How long did Jenny wait at the station?

First, find how long the period is **between 7:50 pm** and **9:07 pm**:

Start time	First o' clock after start	Last o' clock before end	End time
7:50 pm	8:00 pm	9:00 pm	9:07 pm

7:50 pm $\xrightarrow{\text{10 mins}}$ 8:00 pm $\xrightarrow{\text{1 hr}}$ 9:00 pm $\xrightarrow{\text{7 mins}}$ 9:07 pm

Answer: **Jenny waits at the station for 1 hr 17 mins**. But Pete was worth the wait.

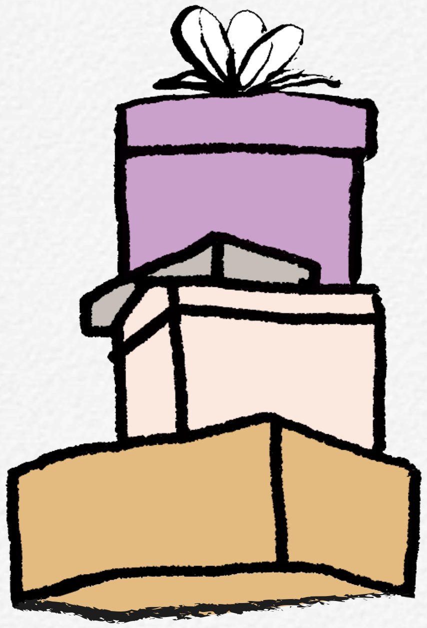
6) Natalia and her mother need to be at the Russian Orthodox church by **2:20 pm** for the wedding of Natalia's friend Liuba. It will take **1 hr 45 mins** for Natalia and her mother to get to the church. What time should they start their journey?

Natalia and her mother need to start their journey **1 hr 45 mins before 2:20 pm**, so **subtract**.

First, subtract the minutes: **2:20 pm – 45 mins = 1:35 pm**

Next, subtract the hours: **1:35 pm – 1 hr = 12:35 pm**

Answer: **Natalia and her mother will need to start their journey at 12:35 pm.**



7) Rachel's mum drives her to go shopping in the city centre and drops her off at **10:20 am**. Her mum will pick her up again at **1:45 pm**. How much time does Rachel have to shop?

Need to find how long **between 10:20 am** and **1:45 pm**.

Start time	First o' clock after start	Last o' clock before end	End time
10:20 am	11:00 am	1:00 pm	1:45 pm

10:20 am $\xrightarrow{\text{40 mins}}$ 11:00 am $\xrightarrow{\text{2 hr}}$ 1:00 pm $\xrightarrow{\text{45 mins}}$ 1:45 pm

Answer: **Rachel has 3 hrs 25 mins to do her shopping.**

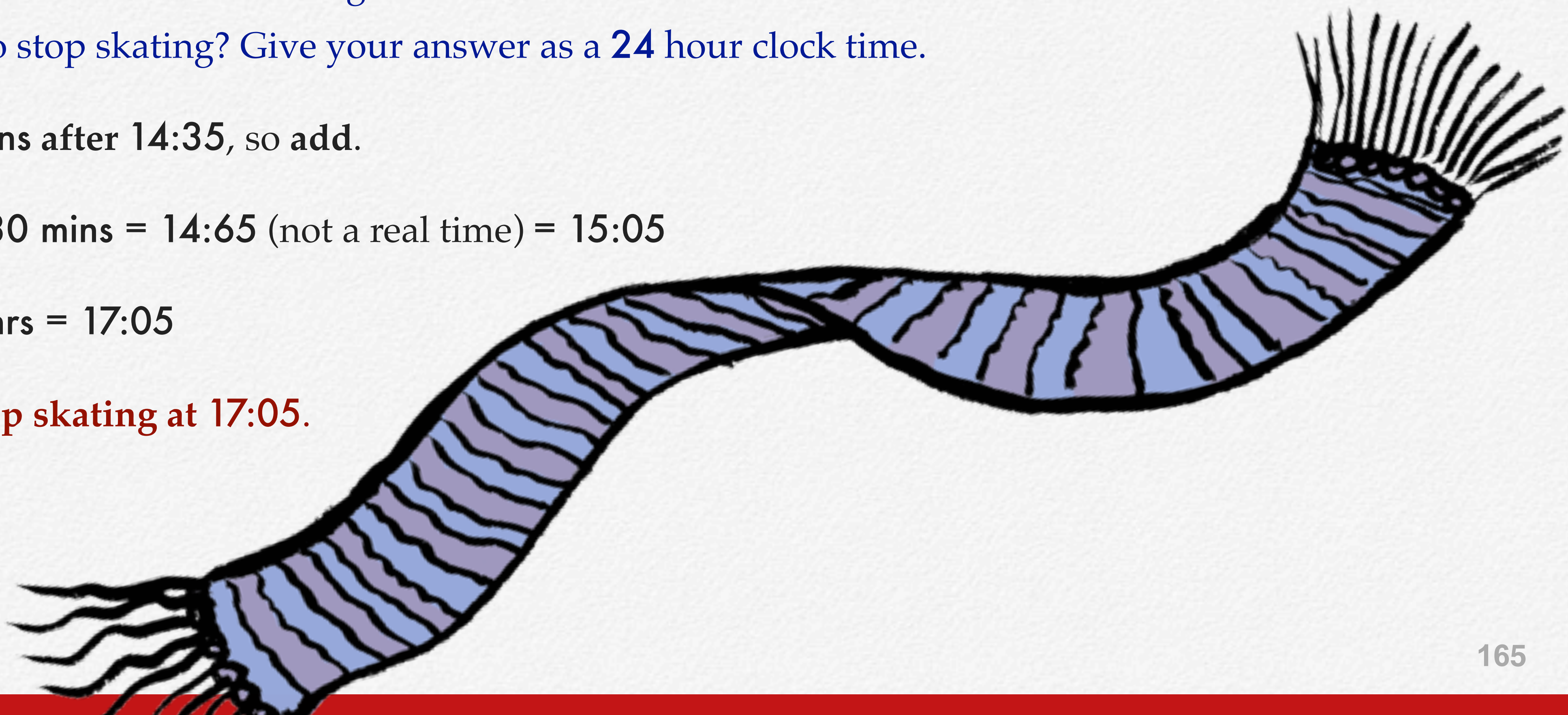
8) Natalia spends most of the Saturday afternoon at the local ice rink, practising for an ice dancing competition.
She arrives at **14:35** and pays for **2 hrs 30 mins** skating.
At what time will Natalia have to stop skating? Give your answer as a **24** hour clock time.

Natalia can skate for **2 hrs 30 mins after 14:35**, so **add**.

First, add the minutes: **14:35 + 30 mins = 14:65** (not a real time) **= 15:05**

Next, add the hours: **15:05 + 2 hrs = 17:05**

Answer: **Natalia will need to stop skating at 17:05.**



9) Tennis Champion Jenny wants to be as fit as submariner, Pete, so she joins a gym. If Jenny worked out at the gym from **6:10 pm** until **8:15 pm**, for how long was she exercising?

How long **between 6:10 pm** until **8:15 pm**?

Start time	First o' clock after start	Last o' clock before end	End time
6:10 pm	7:00 pm	8:00 pm	8:15 pm

6:10 pm $\xrightarrow{\text{50 mins}}$ 7:00 pm $\xrightarrow{\text{1 hr}}$ 8:00 pm $\xrightarrow{\text{15 mins}}$ 8:15 pm

Answer: **Jenny worked out at the gym for 2 hrs 5 mins.**

She'll need to take a shower after that session.

Answers to Time Sheet

10) Copy and fill in the following time sheet to calculate Melanie's salary for this week.

Timesheet: **Temporary receptionist RSPCA**

Name: **Melanie Matthews** Week commencing: **Monday 14th February 2011**

	Mon	**Tues**	**Wed**	**Thurs**	**Fri**
Start time:	9:00 am	8:45 am	8:50 am	9:00 am	9:00 am
End time:	4:30 pm	5:00 pm	4:00 pm	5:20 pm	3:45 pm
Hours at work:	7h30m	8h15m	7h10m	8h20m	6h45m
Lunch Break:	45 mins	1 hr	30 mins	40 mins	25 mins
Total hours worked:	**6h45m**	**7h15m**	**6h40m**	**7h40m**	**6h20m**

Hours worked in week (exact): **34h40m**
(Add together the total for each day: 6h45m + 7h15m + 6h40m + 7h40m + 6h20m)

Hours worked in week (rounded **down** to nearest 15 mins) **34h30m**

Hours worked in week (you convert to decimals): **34.5 hours**

Hourly rate: **£12.20 per hour**

Total for week (hours in decimals x hourly rate): £420.90
(34.5 hours x £12.20)

Signature: .... Date: ....

Answers to Bus Timetable questions

11) Amanda's interview has finished by **3:15 pm**.
What time is the next bus back to Longworth?

Look in the section titled 'Monday to Friday – School Holidays', in the first part, where the buses start their journeys at Oxford.

Answer: **The next bus Amanda can catch to Longworth from Oxford leaves Oxford at 1610.**

12) Amanda gets the job working in a smart shoe shop on Saturday mornings. She needs to be at work by **9 am**.
What bus will Amanda need to catch to get to Oxford in time for **9 am**?

First, look at the section for 'Saturdays', next check in it for the buses to Oxford. The bus that arrives in Oxford before **0900** does not stop in Longworth. So Amanda will need to walk to Fyfield to take the bus to Oxford.

Answer: **Amanda needs to catch the 0754 bus from Fyfield in order to get to Oxford before 9 am.**

13) Amanda finishes work at **1 pm**.
What is the earliest time she can get back to Longworth?

First, look at the section for 'Saturdays', next check in it for the buses from Oxford. The next bus to leave Oxford after 1 pm is the **1400** bus, which arrives in Longworth at **1429**.

Answer: **The earliest that Amanda will arrive back in Longworth after work on Saturdays is 2:29 pm**
(if the bus is on time).

YOUR BRAIN WORKOUT

Q1.

How many weeks in a year?

YOUR BRAIN WORKOUT

Q2.

How many days in a week?

YOUR BRAIN WORKOUT

Q3.

How many days
in a year?

YOUR BRAIN WORKOUT

Q4.

How many hours
in a day?

YOUR BRAIN WORKOUT

Q5.

How many months in a year?

YOUR BRAIN WORKOUT

Q6.

How many minutes
in an hour?

YOUR BRAIN WORKOUT

Q7.

How many seconds in a minute?

YOUR BRAIN WORKOUT

Answers

Q1. 52

Q2. 7

Q3. 365 and 366 in a leap year

Q4. 24

Q5. 12

Q6. 60

Q7. 60

YOUR WAY TO SUCCESS 3

A happy marriage = success.

Keep on Keeping at it.

There's nothing like **just keeping at it** to improve your ability in anything. Your present improvement is built on what you have already achieved.

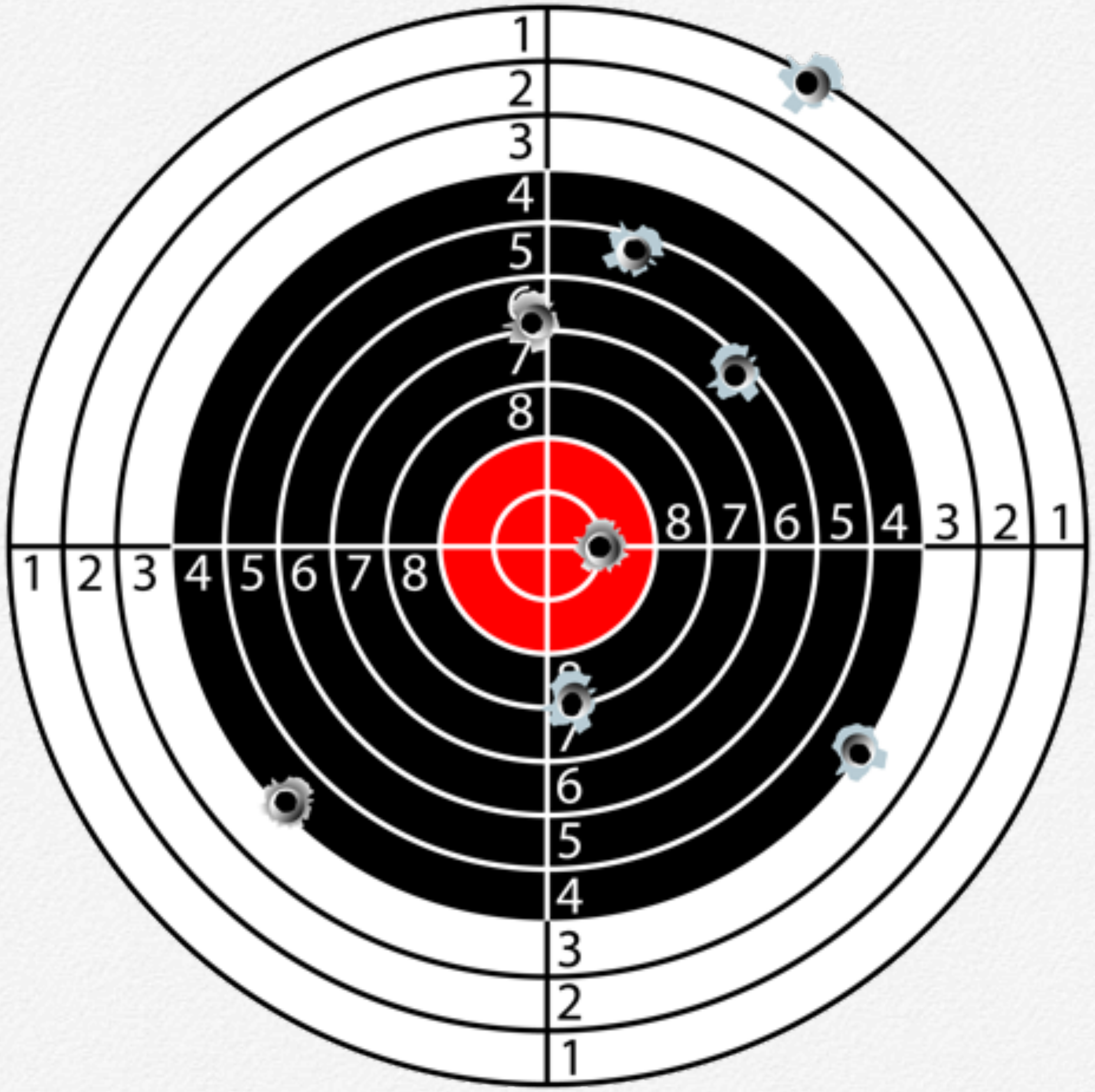
Remember, maths is a **logical** subject, so you have no **logical** reason to fail.

The only reason you have for failure is, if you decide to give up. That is, **if you decide to fail.**

I once read that over 8,000 experiments of inventor Thomas Edison failed – before he invented the light bulb. Success doesn't happen without effort, **success is built on failures**. Imagine how many failures in test-tubes and Petri dishes are behind every scientific advance, every new drug.

Unfortunately, girls often call for help or give up at the first hurdle. Boys, at the same level of ability, **persevere** when something gets tough.

KEEPING-AT-IT is something you can learn. Make it a habit. Keeping-at-it leads to success. "KEEP AT IT" should be embroidered on cushions, but who has the time?



How many times must you try before hitting the bullseye repeatedly?

What do winners say?

- "The more I practice, the luckier I get."

[*Champion golfer, Arnold Palmer*]

- "Mistakes are part of learning, not sticks to beat yourself with." - Stylist and presenter Grace Woodward

[From Stylist Magazine, September 2013]

- Basketball star Michael Jordan said, "I've failed over and over and over again in my life. And that is why I succeeded."

[Quoted in The Week 31 August 2013]

- Although he was a Nobel prize-winner, Professor Richard Feynman came home depressed one day, because he had read someone else's lecture and hadn't understood it: it seemed complicated.

His sister advised him to wait until next morning, and then read every word again, as if he were a student again.

"I reread it, and found it to be very obvious and simple," said Feynman, **"I had been afraid to read it, thinking it was too difficult."**

['Surely You're Joking, Mr. Feynman!', by Richard Feynman]

- "You can only do your best, whether people love it or hate it." - Sarah Burton of Alexander McQueen

Your Reputation

My first boss told me that this is what sorts out the winners from the losers.

1. Whether a person is a **self-starter** – whether he or she can be trusted to work alone.
2. Whether or not a person is **reliable**.
3. Whether a person can be relied on **to finish the job as well as he or she started it.**

Don't let yourself down.

Don't let yourself become a quitter, because
quitting becomes a habit
and you don't want to get known as
the person who never finishes anything she starts,
the person who lets people down.

"I didn't get them for baking cakes, son."

Russian World War II veteran with young soldiers, Victory Parade Memorial. Moscow 2012.

Our motto:

MAKE THE MOST OF WHAT YOU'VE GOT.

Only you can do it.

French pilot, Dorine Bourneton, paralysed from the waist down, flies full time for the Fire & Rescue Department in France.

THE BATTLE OF WILLS: Will Will-power win, or will Won't-power win? Always, it's your decision.

PART 21
BASIC STATISTICS

Statistically
the planet's tallest people,
the Masai in traditional
jump dance, Kenya.

Quick Quiz

Q1.

Which of the following sums is true?

- **A.** 6 – 18 = 12
- **B.** 6 – 18 = –12
- **C.** 18 – 6 = –12
- **D.** 18 ÷ 6 = 12

Quick Quiz

Q2.

Which of the following decimals is the smallest?

- **A.** 7.04
- **B.** 7.4
- **C.** 4.07
- **D.** 4.7

Quick Quiz

Q3.

If the caterers allow **9** canapés per guest, which calculation should you use to calculate the number of canapés at a wedding with **230** guests?

- **A.** 9 x 230
- **B.** 230 ÷ 9
- **C.** 230 + 9
- **D.** 9 ÷ 230

Quick Quiz

Q4.

What is 0.3333 rounded to 1 significant figure?

- A. 0.34
- B. 0.3
- C. 0.33
- D. 0.4

Quick Quiz

Answers

Q1. 6 – 18 = –12

Q2. 4.07

Q3. 9 x 230

Q4. 0.3

Basic Statistics

Every pop singer wants to see her latest album high in the charts. This section will give you a bird's eye view of the World of **Charts**.

In order to get rich and stay rich, you need to understand money matters. To understand money matters, you need to be able to read charts. Why? What's the point of a chart?

Making a decision about money is not always easy or quick. In order to make a good decision, you need to know all the facts. Financial people who make decisions know how important this is… and they like all their facts **at a glance**: a little picture can do this – a chart.

As you practice reading charts, you will discover which is your favourite type. Sometimes the information (called **data**) dictates what system will give the best bird's eye view of the facts. For example, **pie charts** are popular because they give you the general picture at a glance, but **bar charts** are able to give you more accurate information.

Why should anyone want to make a chart? You might want to decide which computer to buy. Your bus company might need to decide whether a bus service is needed in an unpopulated part of the Highlands. A supermarket chain might want to see how **many** people in Britain live alone, and **where** they live, before it plans to produce packs of food for one person only.

Slick marketing operators can use statistics to manipulate people.

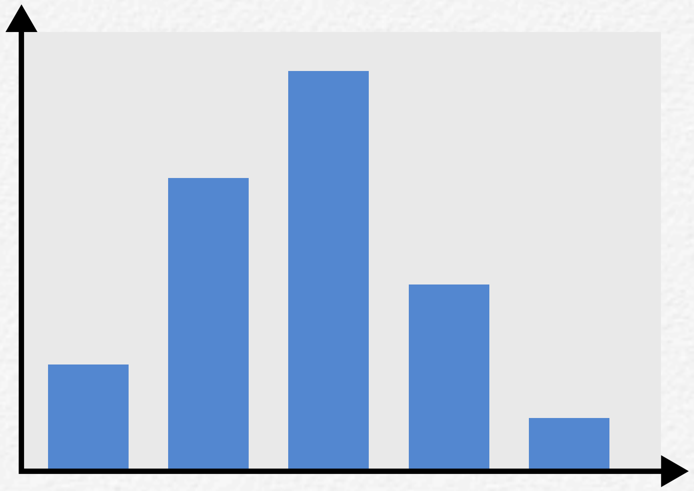
How to Read Statistical Charts

A statistical chart gives you a lot of information that's quick and easy to read at a glance – once you know how.

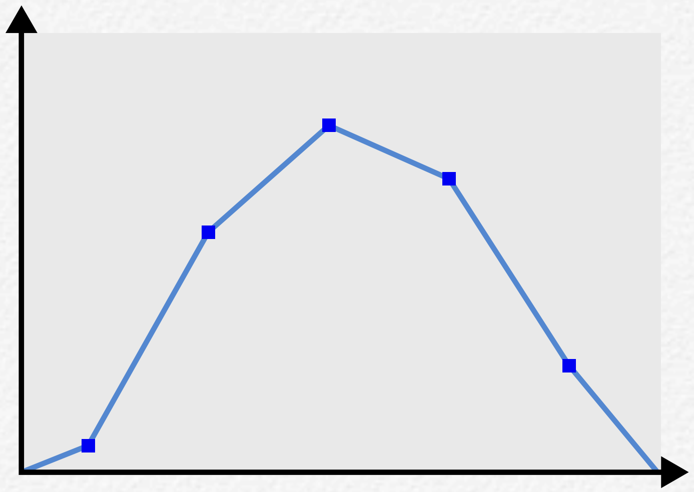
As long as you know the numbers involved, you can show the same information in a variety ways. Here is a quick guide. (More information follows later.)

Cheap travel to exotic places.

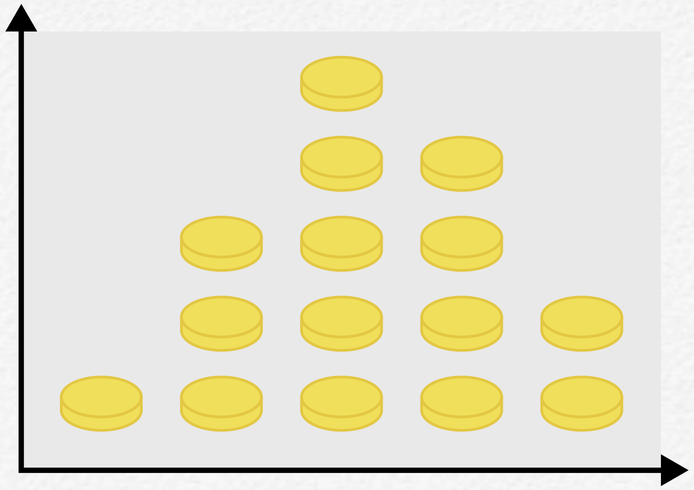
- A **bar chart** gives you information with bars that can look like skyscrapers.



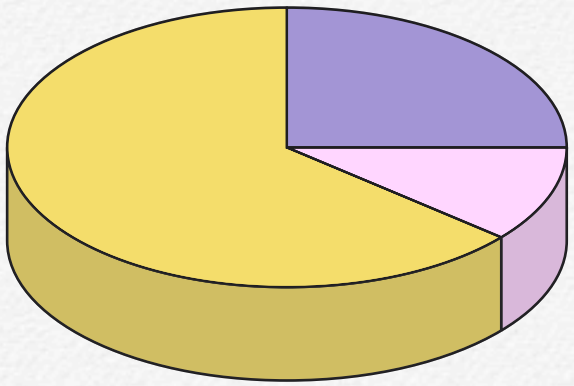
- A **frequency polygon** chart is an alternative to a bar chart, but instead of skyscrapers it has joined-up dots. (Poly means 'many', from the Greek word, 'polus'. A polygon is a many-angled shape.)



- A **pictogram** is basically a bar chart that gives the information in symbols or pictures, like these stacks of gold coins.

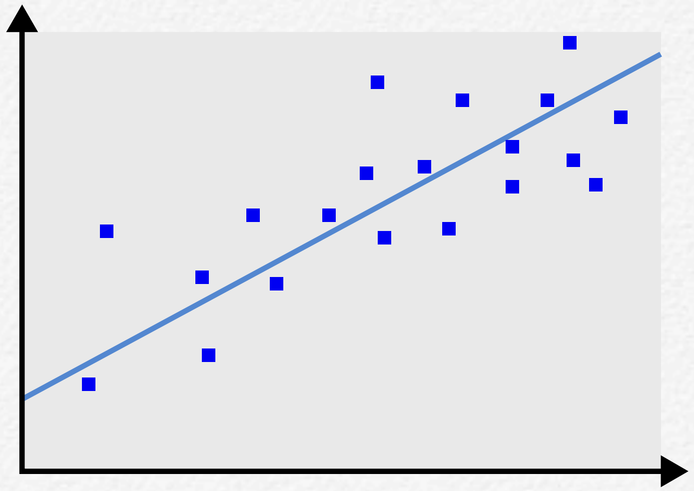


- A **pie chart** is a circle sliced into different sized sections, like slices of a pie, unfairly divided. Your local council uses a pie chart to explain what your council tax is spent on: you can see that, in the diagram below, most of the money is spent in the yellow area and the least money is spent in the pink area. Theoretically, this makes you feel better about paying your local tax.



- A **scatter graph** can plot a lot of information to reveal a trend. Here, the dots represent the information and the black line which runs through the most densely dotted areas reveals **the trend**.

Knowing about a trend is important in many businesses. For example, in fashion, **the trend** might show that women are starting to buy bright red coats, so the coat manufacturer can plan what to make – bright red coats.



The blue, diagonal line in the scatter graph is called '**the line of best fit**'.

Plotting Co-ordinates

Co-ordinates are used to locate a point on a graph. They are written as a pair of numbers enclosed in brackets, like this **(10,5)** – see the following examples.
Use a comma to divide the 2 numbers.

The rule is: go across first, **then go up**.

Memory Aid: When you enter the front door of a house, you have to walk across the hall **first**, before you **go up** the stairs.

Note

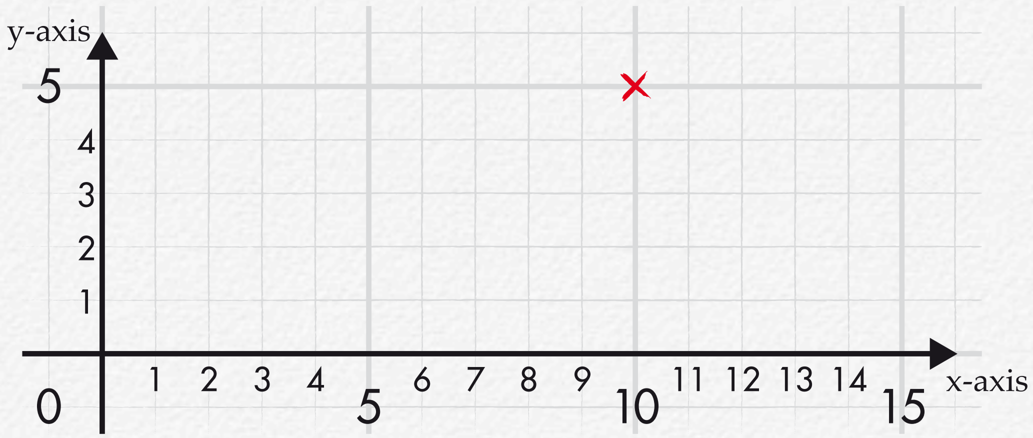
The **horizontal** line of your graph is called the **x-axis**. Time is always measured on the **x-axis**.
The **vertical** line of your graph is the **y-axis**.

What do you do if the co-ordinates you want lie between the main numbers marked on each axis?
This is why you use squared paper.

First, you look at the marked numbers and check what each square represents. In the example that follows, each square represents **1**, and from zero it is easy to count squares **1**, **2**, **3**, **4** and then you reach **5**.

The red cross is **10** on the x-axis and **5** on the y-axis **(10,5)**.

Example:

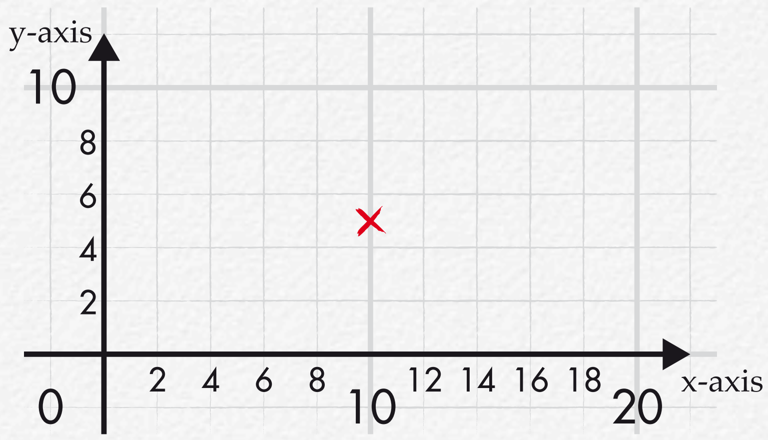


Warning!

One square doesn't always represent **1**, which is why you need to check before starting. One square might represent **2** or **10** or **100**…

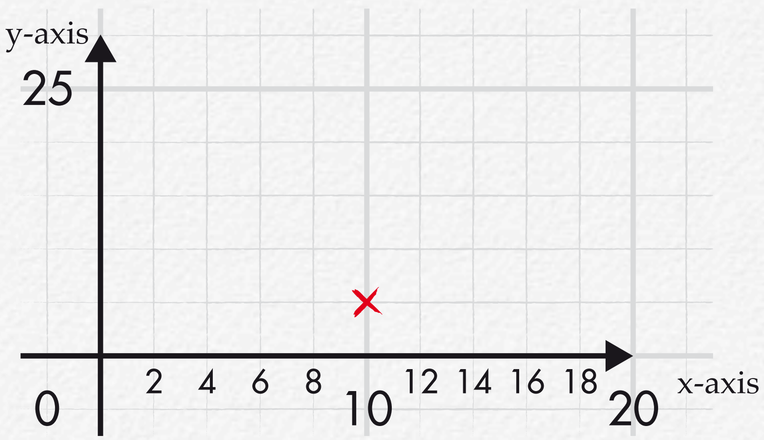
Example

Here each square represents **2**, on both the horizontal scale and the vertical scale. Notice that the red cross is half way between **4** and **6** on the vertical axis.



Example

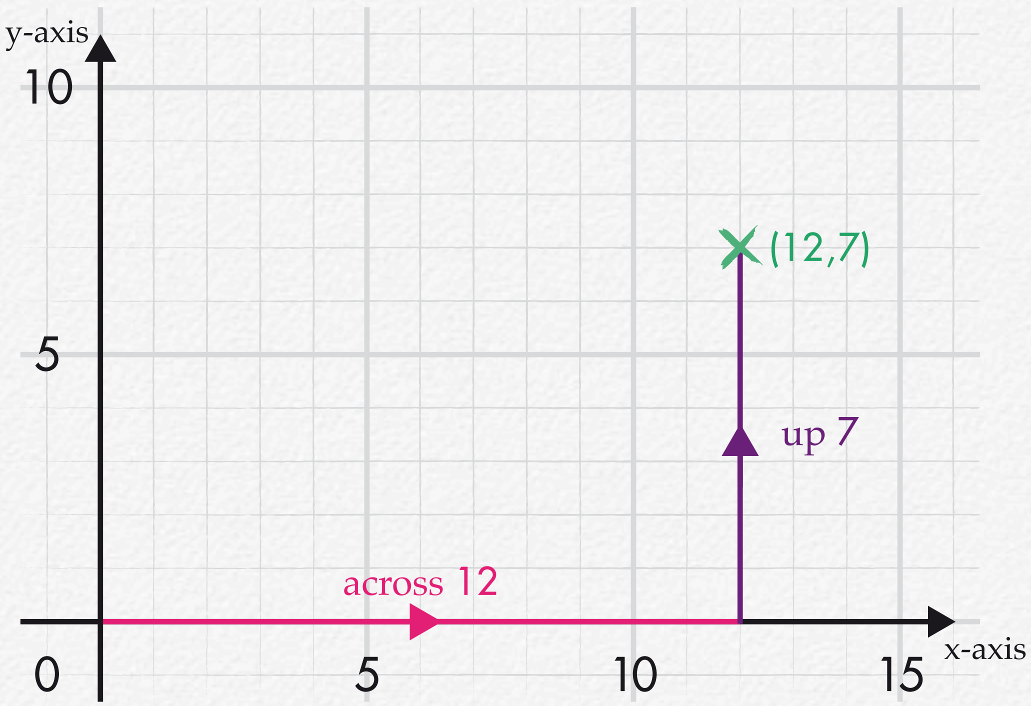
Here each square on the horizontal scale represents **2**, while on the vertical scale, each square represents **5**.



Example of how to plot a point:

Plot the point **(12, 7)**.

Go across first to **12** on the horizontal axis and mark it in pencil. From that point, go up until you reach the level of the **7** on the vertical axis. Use a ruler or a pencil on its side, to show when you are in line with **7** on the vertical axis: mark this point with a cross. This point is **(12,7)**.



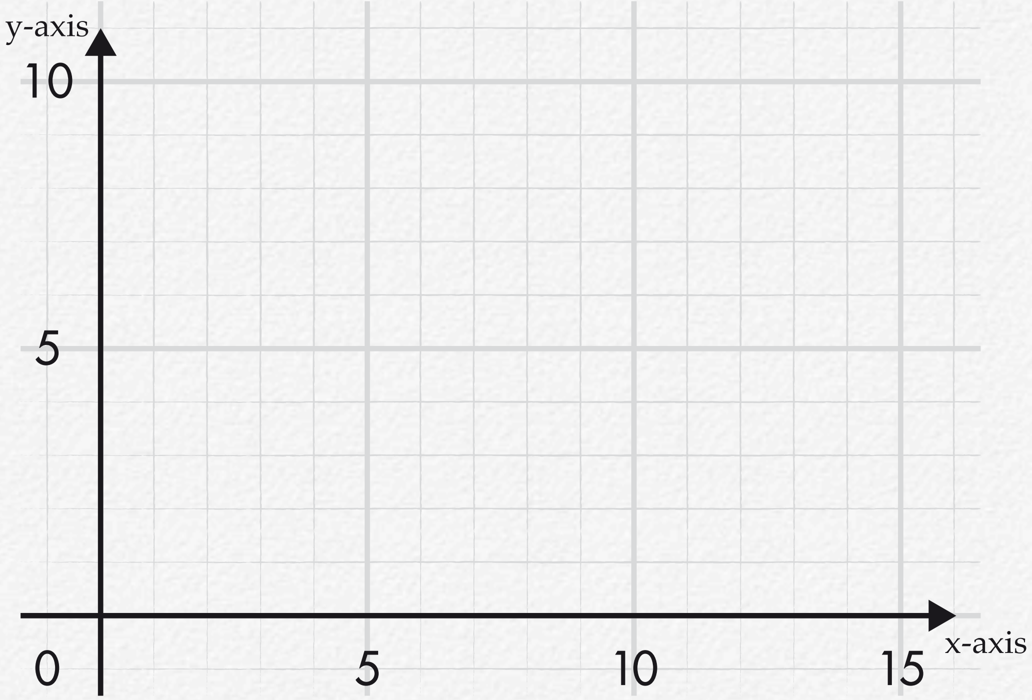
Exercises

Copy the blank graph below onto some squared paper and plot the following points:

1) Plot point **(2,8)**

2) Plot point **(7,5)**

3) Plot point **(10,9)**



Determination.
Bulgarian athlete competes in women's 400 metre hurdles, Spain.

Map References

How do numbered grid references on a map work? On the same principle as co-ordinates on a graph:
go across first, **then go up**. With a map, there are no brackets around co-ordinates, and no comma between numbers.

Where am I?
Numbers are essential for map-reading.

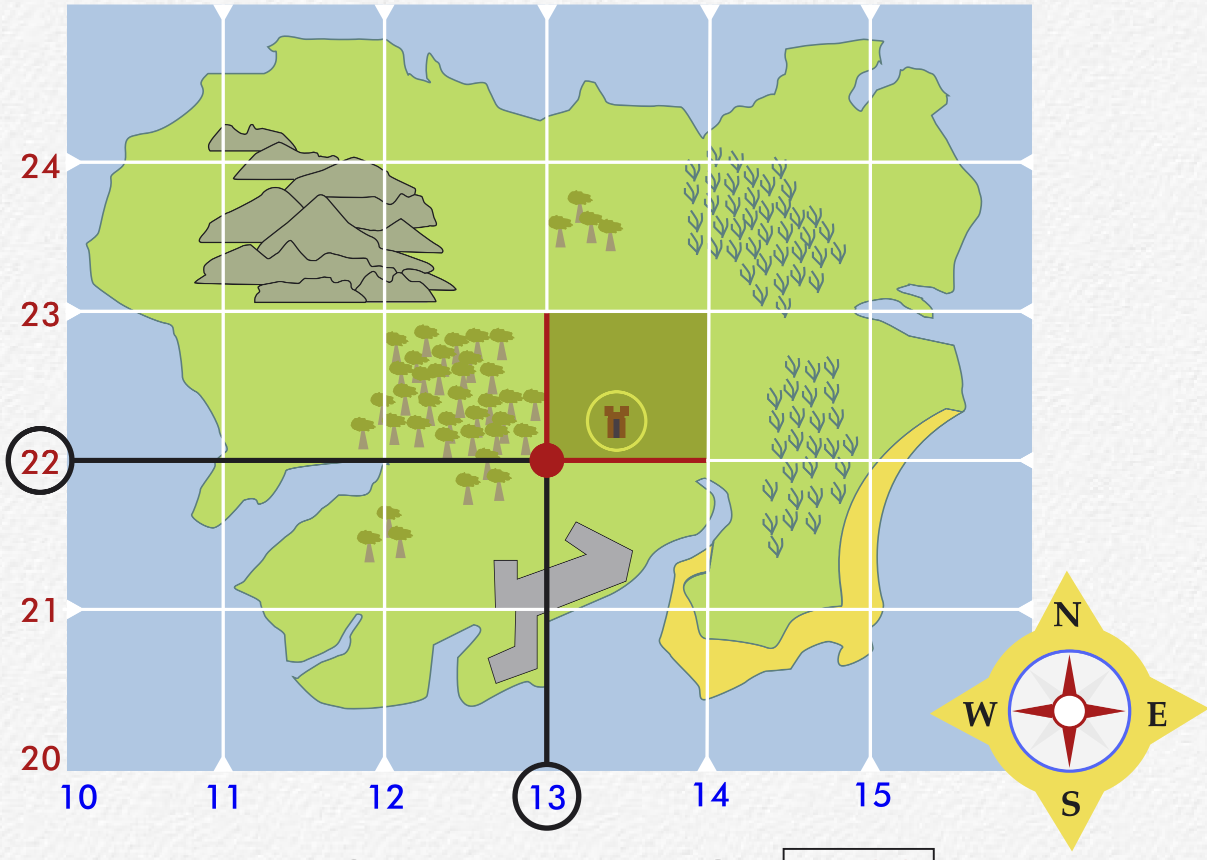
Example

The Treasure Tower on the following map is at grid reference **1322**.

While you're learning to read a map, stick a comma in the **middle** of the grid reference, like this: **13,22**. On the left of the comma is the **horizontal grid reference** and the right is the **vertical grid reference**. Since there are four digits in this grid reference, the first two digits are the horizontal and the second two are the vertical references.

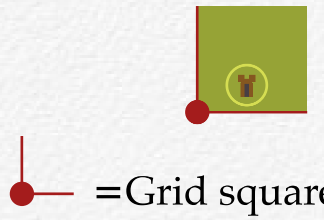
Grid references always contain an even number of digits. Example: **0127** or **1007** or **003296** or **213006**.

To find the Treasure Tower at **13,22**. You need to find **13** on the horizontal axis, then **22** on the vertical axis.



GRID REFERENCE 13 22

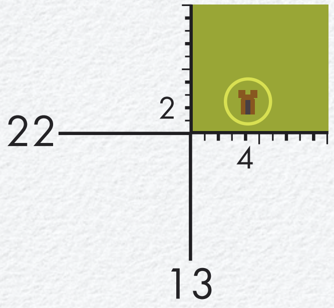
Move your index finger across the bottom grid line (the horizontal axis) to point **13**. Then move your finger up from that point until it is in line with **22** on the vertical axis. This pinpoints the bottom left-hand corner of the grid square (marked in red) that contains the Treasure Tower.



=Grid square with grid reference **1322**

Notice, the pinpoint is at the bottom left-hand corner of the grid square.

For pinpointing a spot with greater accuracy, mentally subdivide each grid square by 10 horizontally and 10 vertically, like this:



The grid reference for the Haunted Tower would then be 134,222. In Real Life, this map reference is written 134222; it's up to you to insert the comma.

Every point on a graph or grid can be located with a reference to a co-ordinate on both the horizontal and vertical axis. Remember this when reading or drawing statistical charts.

Grids, graphs and tables can all be called **charts**.

Concentration
Singer songwriter Nova performs onstage in California, USA.

Back to Statistical Charts

The information on a statistical chart is called **data**. Statistical charts are used every day on TV, in newspapers and for business reports. Let's start with a few frivolous chart examples.

Princess Caroline, aged 15, has a large walk-in wardrobe. Even princesses learn maths; having discovered the joys of statistical charts, Princess Caroline decided to practice by analysing her own wardrobe. She didn't include a chart for her evening dresses, because she only has one ball gown for state occasions and she hates it: made of cream silk, it has a high neckline and long sleeves, and when Princess Caroline complained that it was dull, her mother nodded, "Exactly!"

Your ideal wardrobe?

Ready for the wardrobe.

Bar Charts

Every statistical chart needs a title; this is the first thing to look at when you meet any sort of statistical chart. Read aloud the title of figure 1.

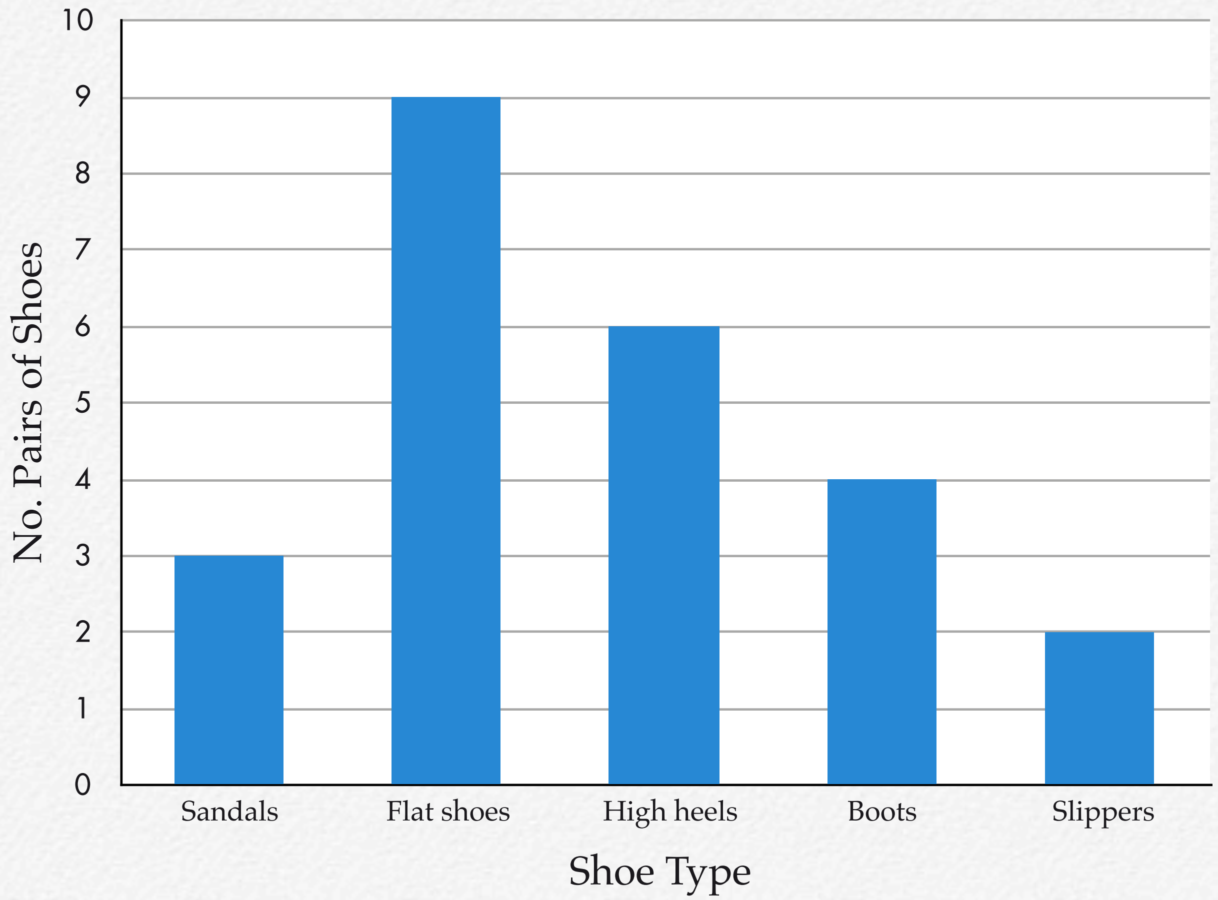
Fig 1. is a **vertical bar chart**

This is a very simple bar chart. There is one bar for each type of shoe. To find how many sandals Princess Caroline has, go to the top of the sandals bar, look to the left and read the corresponding number on the **vertical** axis.
Princess Caroline has **3** pairs of sandals.

How many flat shoes does Princess Caroline have? Go to the top of the flat shoe bar and check the vertical axis, which reads **9**.
So Princess Caroline has **9** pairs of flat shoes.

To see how many pairs of high heels Princess Caroline has, go to the top of the high heel bar and read the vertical axis which is **6**.
So Princess Caroline has **6** pairs of high heels.

Fig 1. Bar Chart showing Princess Caroline's Collection of Shoes



Exercises

4) How many pairs of boots does Princess Caroline have?

5) How many pairs of slippers does Princess Caroline have?

Fig 2. is a **horizontal** bar chart, drawn more elaborately in 3D. This makes a bar chart unnecessarily complicated because it's more difficult to read accurately.

This bar chart has a colour guide to differentiate between the **types** of clothing.

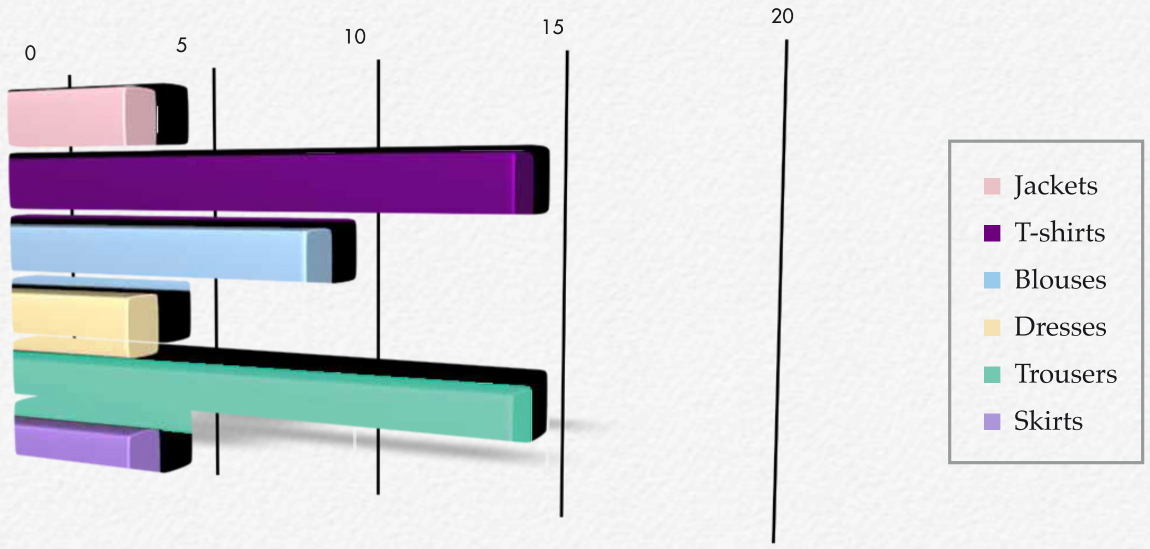
Don't make the mistake of thinking that Princess Caroline's jackets are all pink and her skirts are all pale purple: the bars are merely coloured differently, to make the chart more easily understandable.

On a horizontal bar chart, you read the numbers on the **horizontal** axis. Lay your pencil in line with the end of the pink bar and you will see that Princess Caroline has **4** jackets, although the 3D shading could lead you to believe she has **nearly 5** jackets. It isn't clear.

On any bar chart, the bars should always be labelled to show what they represent. The bar labels might be at the bottom of each bar (as in Fig 1.) on the bar itself; or with a key on the side of the chart (see Fig 2. left).

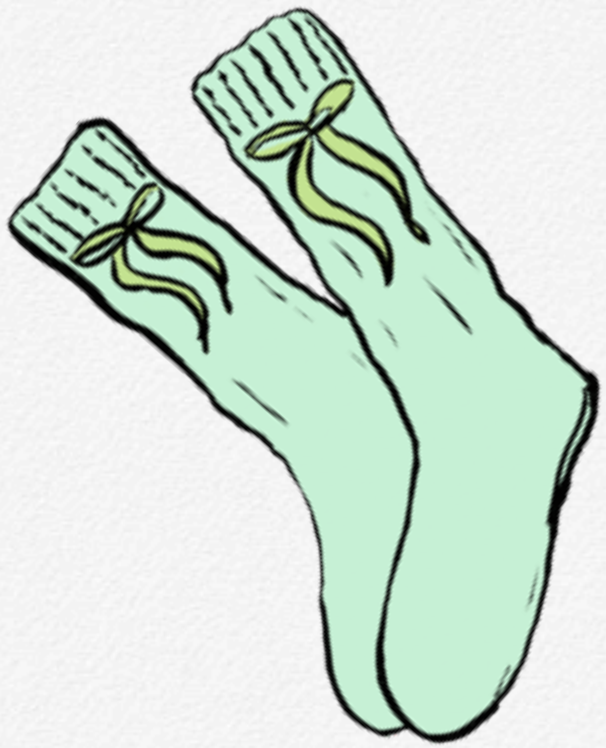
The other axis is usually numbered to show the number of items, etc.

Fig 2. Horizontal 3D Bar Chart showing Princess Caroline's Clothes



Exercises

6) How many blouses, dresses, trousers and skirts does Princess Caroline have?



Compound Bar Charts

A **compound bar chart** shows **more than one bar for each category**. Here, Princess Caroline has drawn the contents of her underwear drawer as a compound bar chart.

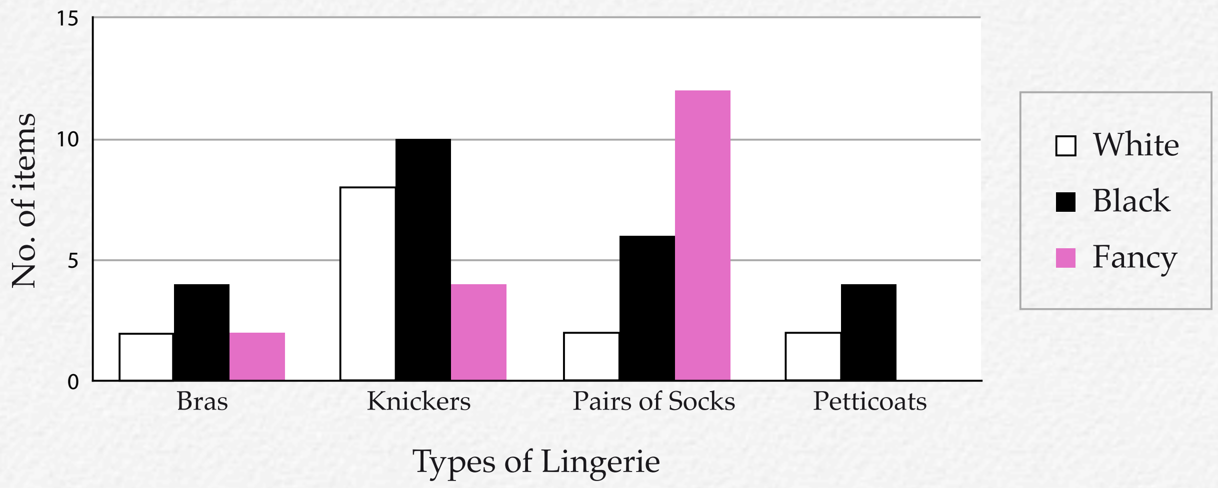
Most of her underwear is either black or white, with a few odd items such as tartan knickers and a pale pink gingham bra.

So Princess Caroline decided to analyse her collection as black, white and fancy. (In this chart, pink is the colour code for "fancy" - ALL Princess Caroline's underwear that is not black or white.)

In Fig 3, you can clearly see that Princess Caroline has a few more black knickers than white.

She has 12 pairs of fancy socks, 6 pairs of black, but only 2 pairs of white, so she will need to buy more white socks before summer tennis.

Fig 3. Compound Bar Chart showing Princess Caroline's Underwear



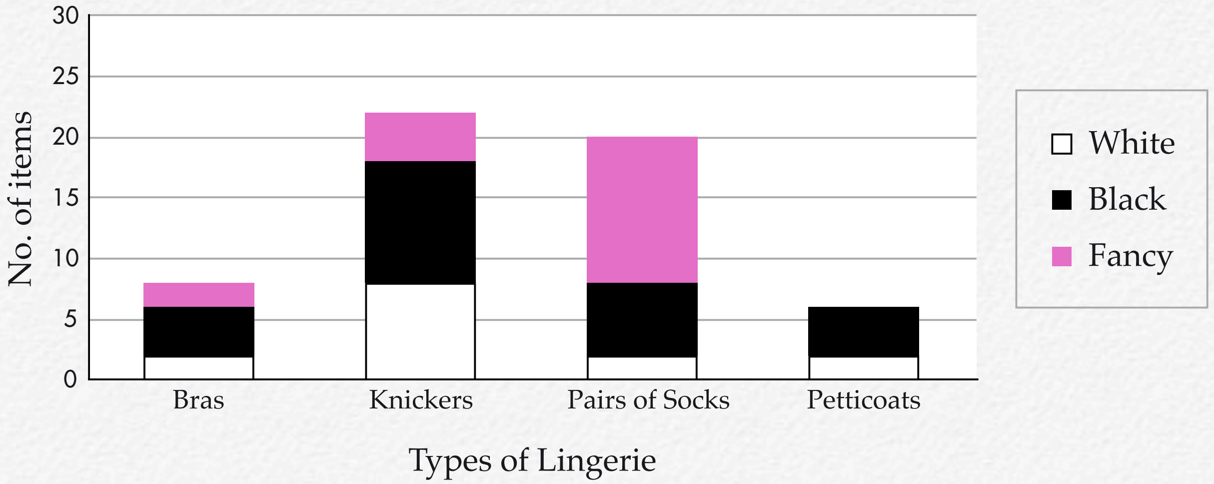
Exercises

7) How many of each type of bra does Princess Caroline have?

8) How many of each type of petticoat does Princess Caroline have?

Fig 4. is an alternative way of showing the same data. Here, the different coloured bars are piled on top of each other to make towers. You can see easily that Princess Caroline has more knickers than anything else, but it is not so easy to check the numbers of the different colours.

Fig 4. Compound Bar Chart showing Princess Caroline's Underwear and Colours



Example

From Fig 4, you can see that Princess Caroline has eight bras in total. You can also see that she mostly has black bras.

Exercises

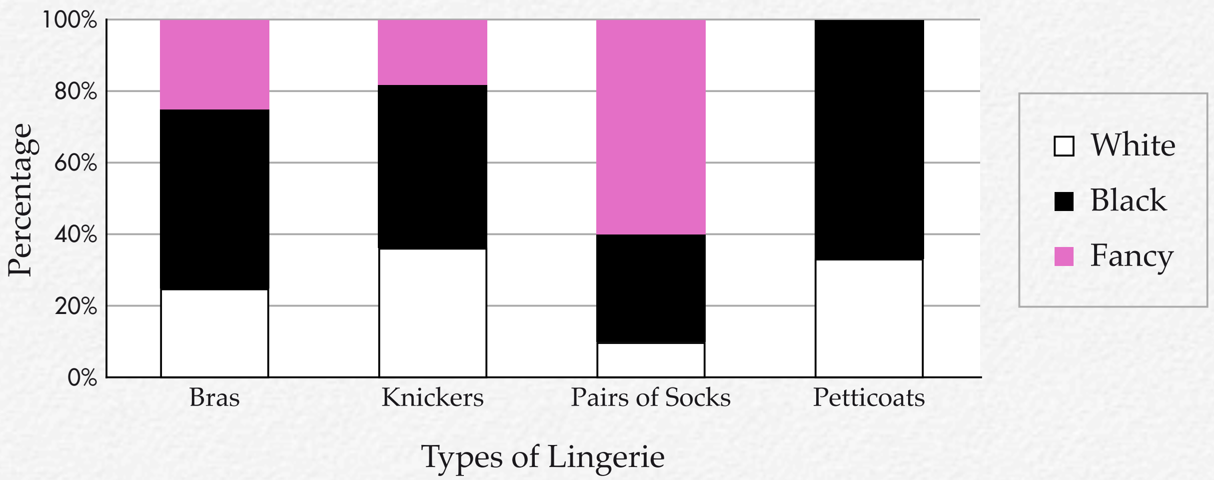
9) What is the total number of Princess Caroline's knickers? Which type of knickers predominates?

10) What is the total number of pairs of socks that Princess Caroline's owns? How many pairs of socks are fancy?

11) What is the total number of Princess Caroline's petticoats? Which type of petticoat predominates?

Please be patient. You should know about a third type of compound bar chart. Fig 5. shows each bar as representing **100%** of each category of lingerie. So each bar is the same height regardless of numbers.

Fig 5. Compound Bar Chart showing the relative amounts of colours for each type of Princess Caroline's Lingerie



Here, the purpose is to show how the colours are distributed within each category. Example: there are far more fancy socks than there are black socks, and there are far more black socks than white.

With this type of bar chart, it's impossible to see the exact numbers of each item, so you might, at first glance, think that there are as many petticoats as there are knickers. In fact, Princess Caroline has fancy knickers, but no fancy petticoats.

Example

Look at the sock bar in Fig 5. Find the percentage of each type of sock Princess Caroline owns: (a) white, (b) black and (c) fancy.

a) The bar for white socks is at the bottom and extends from **0%** to **10%**. So Princess Caroline has **10%** white socks.

Answer: **10% white socks**

b) The bar for black socks starts at **10%** and goes upwards to **40%**. To find the percentage of black socks, subtract **10%** from **40%**.

40 – 10 = 30%

Answer: **30% black socks**

c) The bar for fancy socks goes from **40%** to **100%**, so subtract **40%** from **100%**.

100 – 40 = 60%

Answer: **60% fancy socks**

Exercises

12) Look back to Fig 5. From it, estimate as well as you can, the percentage of Princess Caroline's knickers which are:

a) White knickers

b) Black knickers

c) Fancy knickers

13) Give the percentage divisions of Princess Caroline's petticoats. Estimate the percentage of Princess Caroline's petticoats which are:

a) White petticoats

b) Black petticoats

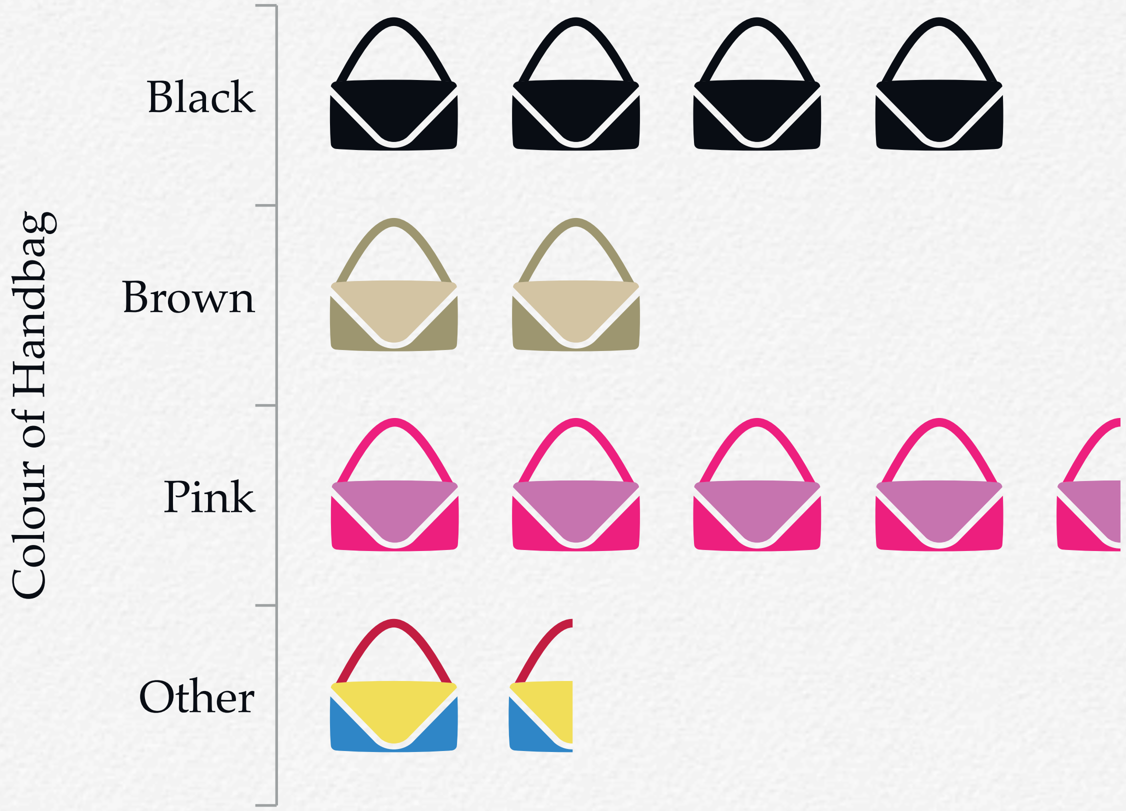
Princess Caroline.

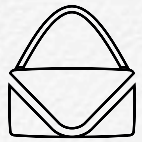
Pictograms

Pictograms are very similar to bar charts. A pictogram always has a key to show exactly what the picture represents. Here, each picture of a handbag represents **two** handbags, so Princess Caroline actually owns 8 black handbags, not 4. If one picture of a handbag represents two handbags, then half a handbag represents **one** handbag. So Princess Caroline has a total of 9 pink handbags, not four-and-a-half handbags.

Look at Fig 6. What is Princess Caroline's favourite handbag colour? She obviously loves pink handbags.

Fig 6. Pictogram showing Princess Caroline's Handbag Collection

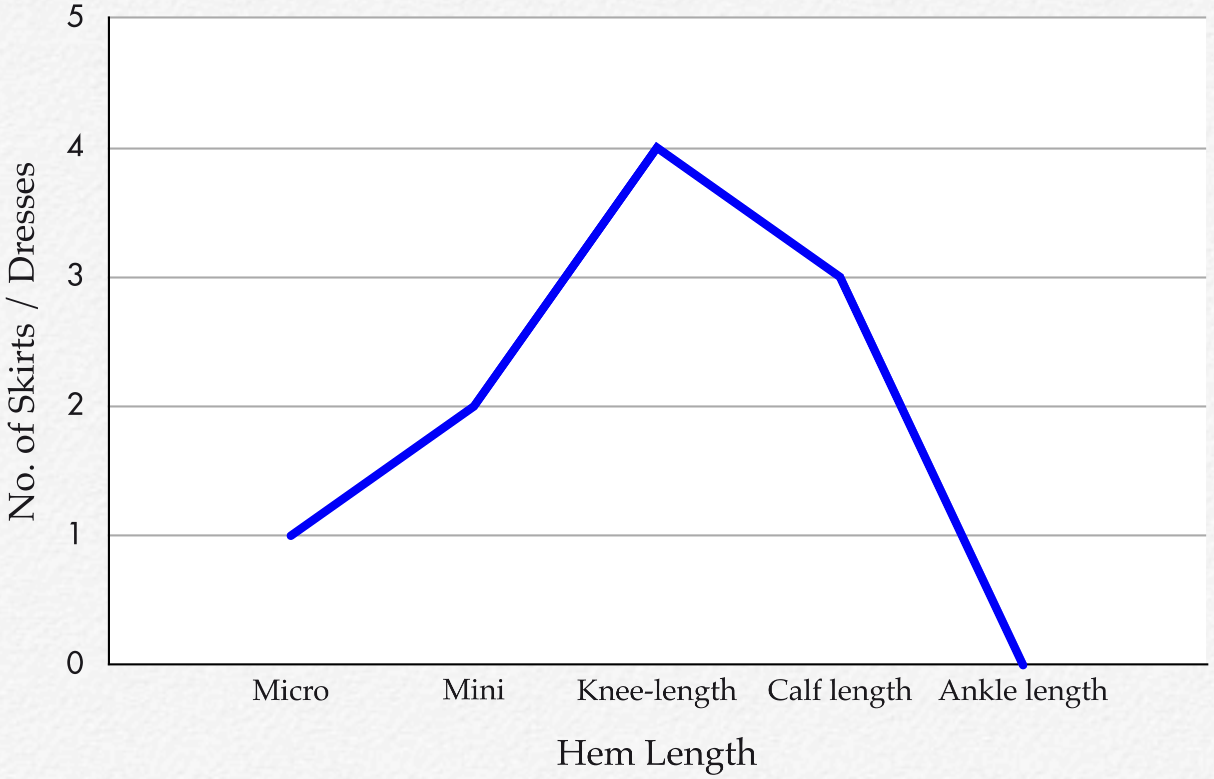


 = 2 handbags

Always use only one type of picture on a pictogram: more might confuse.

Frequency Polygons

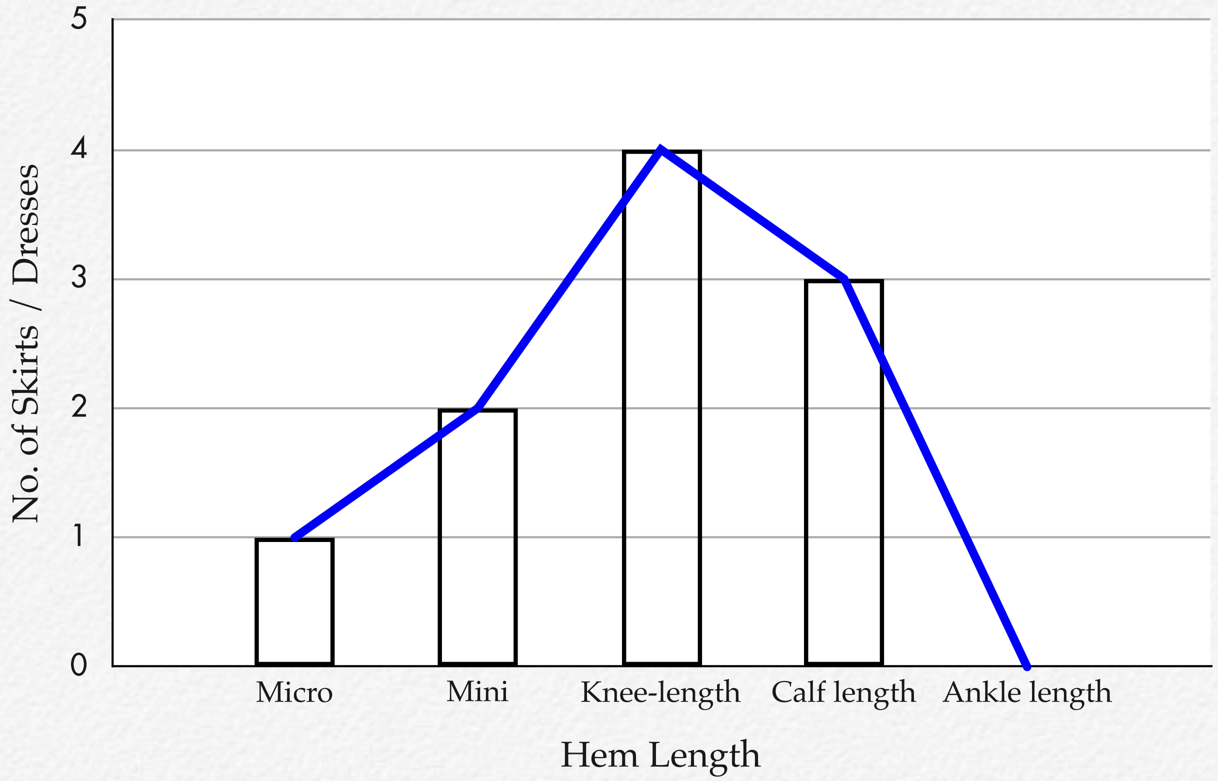
Fig 7. Frequency Polygon showing the Hem Lengths of Princess Caroline's skirts and dresses



The above, finished **frequency polygon** is constructed in a similar way to a bar chart.

The following diagram shows that the graph line of the frequency polygon is a line that joins all the middle points of the bar tops, if a bar chart were drawn first.

Fig 8. Diagram with Bar Chart and Frequency Polygon for the same data on Hem Length



A frequency polygon can be useful when the items on the horizontal axis consist of numbers or categories which can be put in a definite, meaningful order. The frequency polygon will then give the shape of the data distribution.

The frequency polygon in Fig 8. shows Princess Caroline has to wear knee-length skirts. She has few very short skirts and no long, day dresses.

Pie Charts

The entire **pie chart** represents all Princess Caroline's jewellery. Each type of jewellery is represented by a slice of the pie. The bigger the slice, the more items it represents.

A pie chart is used to give a quick picture of relative quantities. Each piece of pie is labelled, so you can see what it represents.

Fig 9. 3D Pie Chart showing Princess Caroline's Jewellery Collection

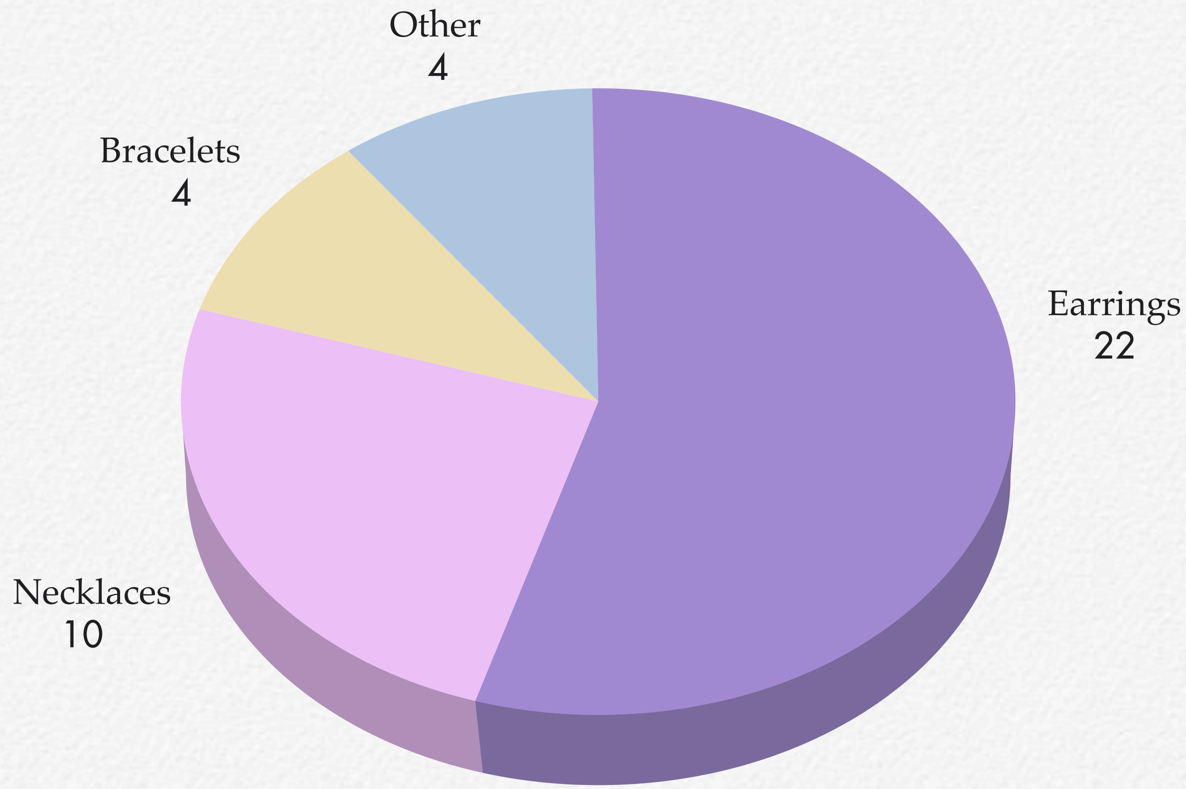
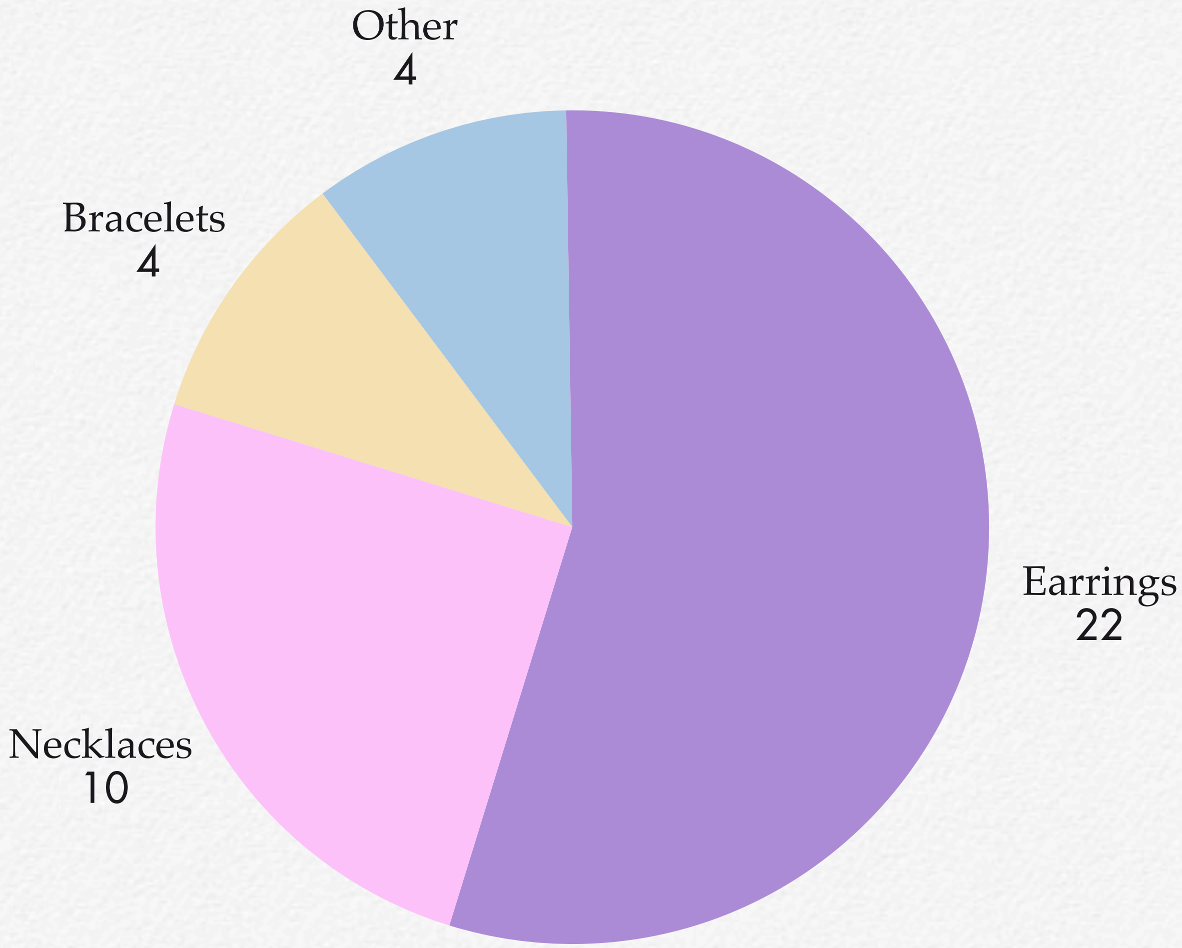


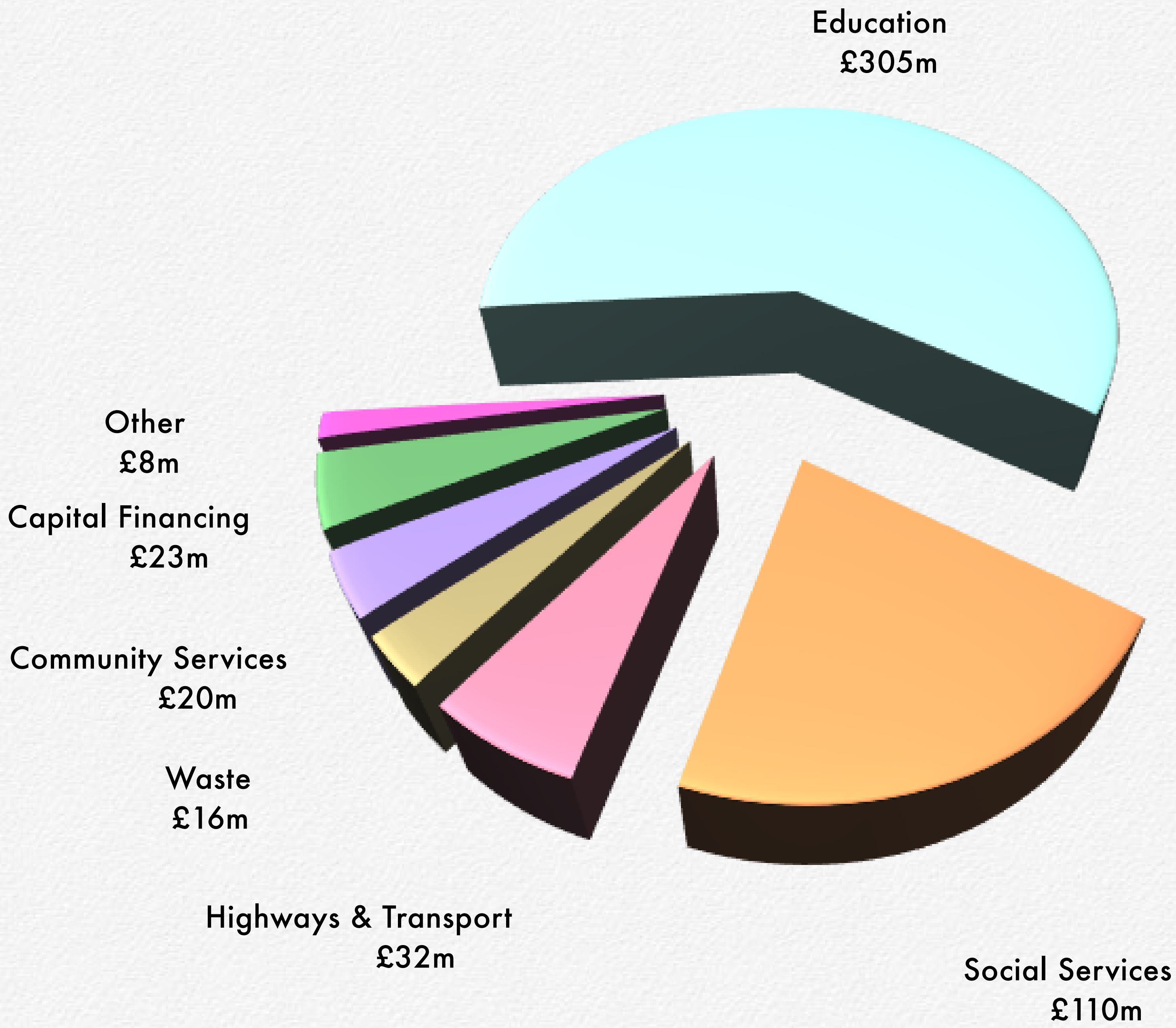
Fig 10. Pie Chart, Bird's eye view: Princess Caroline's Jewellery Collection



Note

This flat pie chart is usually preferable to a 3D version, which can often be misleading.

Fig 11. 3D Pie Chart showing spending for Leicestershire County Council in 2004



This pie chart shows how Leicestershire County Council divided its budget of **£514,000,000**, to fund local government services in 2004.

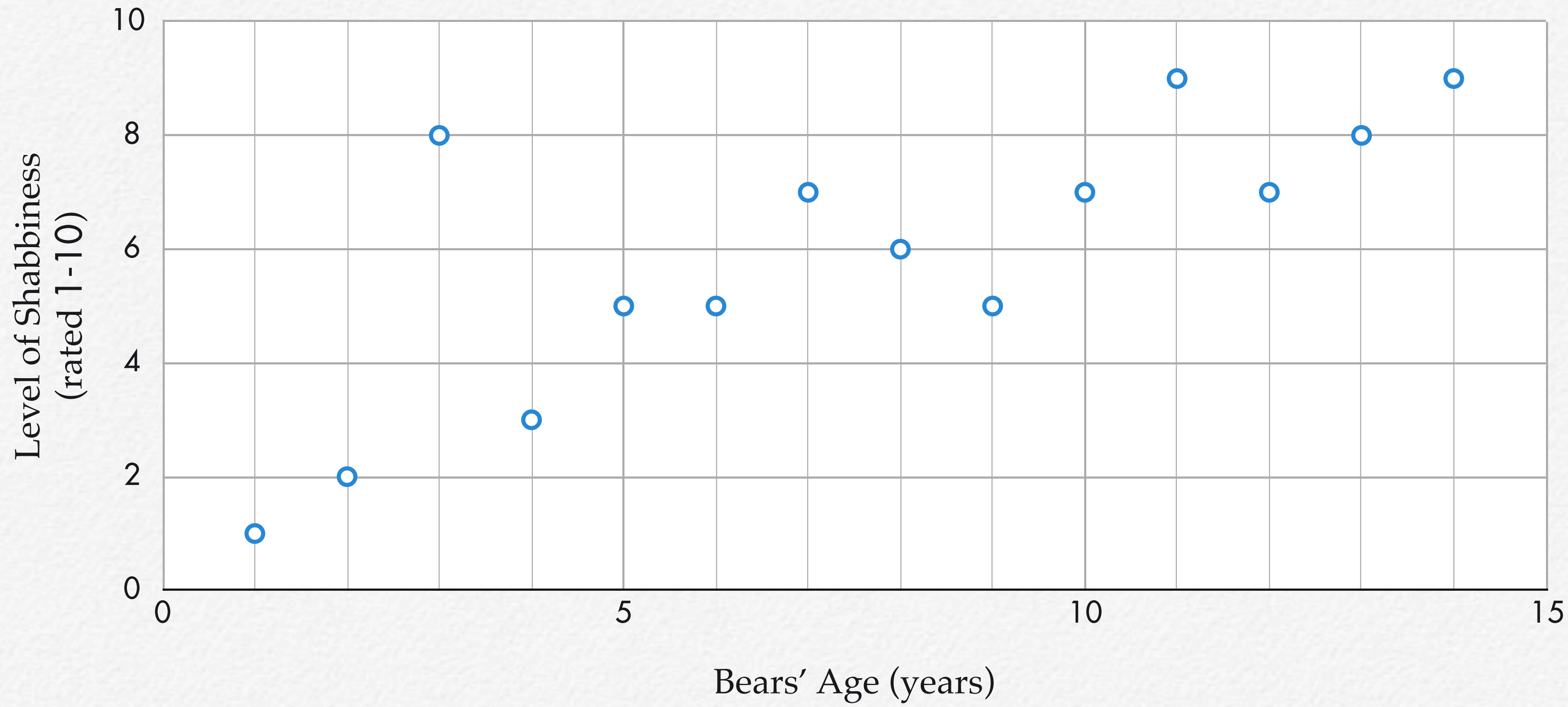
You can see immediately that the majority of the money is spent on education and social services. A relatively small amount of the budget goes on highways and transport, community services, waste/garbage disposal, capital financing of County Council projects (such as building an extension on the town hall), and other projects.

Scatter Graphs

Scatter graphs are used to check whether there is a relationship between different sets of data. Each data item is plotted as a dot on the graph, so you end up with a scatter of dots. You can then see if the dots form a pattern.

Princess Caroline keeps her childhood teddy bear collection in her bedroom. On each birthday, she was given a bear by her gran, the Dowager Queen. Although some of the older bears are quite shabby, Princess Caroline still loves them. To practice her charts, she has made a scatter graph to check whether there is any link to the age of the toy and its shabbiness. She knows when she was given each bear, and she rates the shabbiness on a scale of 1 to 10: 1 for good-as-new, 10 for really tatty and falling apart. Her graph (Fig 12.) is shown as follows:

Fig 12. Scatter Graph to show the Shabbiness of the Teddy Bears against the age of each Teddy Bear

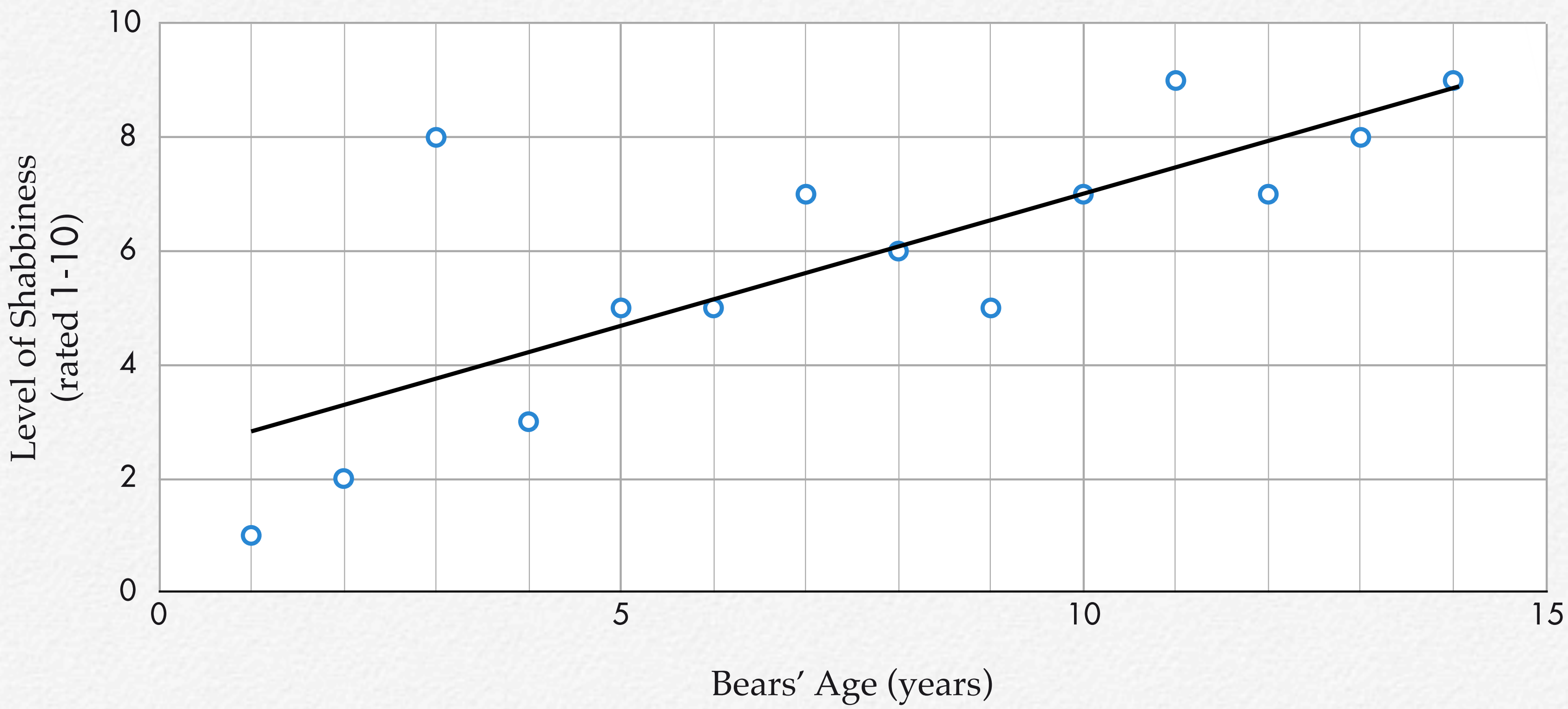


If you look at all the points on Fig 12. you see that most of them would fit into an invisible band going diagonally across the graph, from the bottom left to the top right. So there is definitely a pattern, with the occasional exception: such as the three year old teddy that Princess Caroline had on her 12th birthday, which her little brother buried in the sandpit.

Princess Caroline adds a straight **line of best fit**, which goes in the same direction as the invisible band. She aims to make it touch as many points as possible, with an equal number of points on each side. This graph shows that the older the bear, the more shabby it becomes.

Fig 13. Scatter Graph with line of best fit.

It shows the Shabbiness of the Teddy Bears against the age of each Teddy Bear



Often, there's no absolutely correct line of best fit, because this can depend on human judgement.

What do the two graphs show? That there is a clear relationship between the age of the bears and their shabbiness: the old bears are the shabbiest.

Where there is such a clear connection, such as age and shabbiness, it is called **correlation**.

A correlation can be **positive** or **negative**. The **correlation** is **positive** when two variables move in the same direction: the **correlation** is **negative** when they move in opposite directions. Please look at the next three examples.

First example

There is a **positive correlation** between the size of a melon and the weight of that melon. The correlation is that as the melon grows bigger, it gets heavier: as one thing **increases**, the other also **increases**.

Second example

There is a **negative correlation** between the number of guests you invite to your party and the size of your bank account: as the number of guests grows bigger, the amount of money left in your bank account will grow smaller. As one thing **increases**, the other thing **decreases**.

There is **no correlation** when two variables have no effect on each other.

Third example

- While the yacht sailed at **3** knots per hour, I ate **2** scoops of caramel ice cream. The amount of ice cream I ate had no effect on the speed of the yacht, so there is **no correlation** between the two factors: the speed of the yacht and the amount of ice cream consumed.

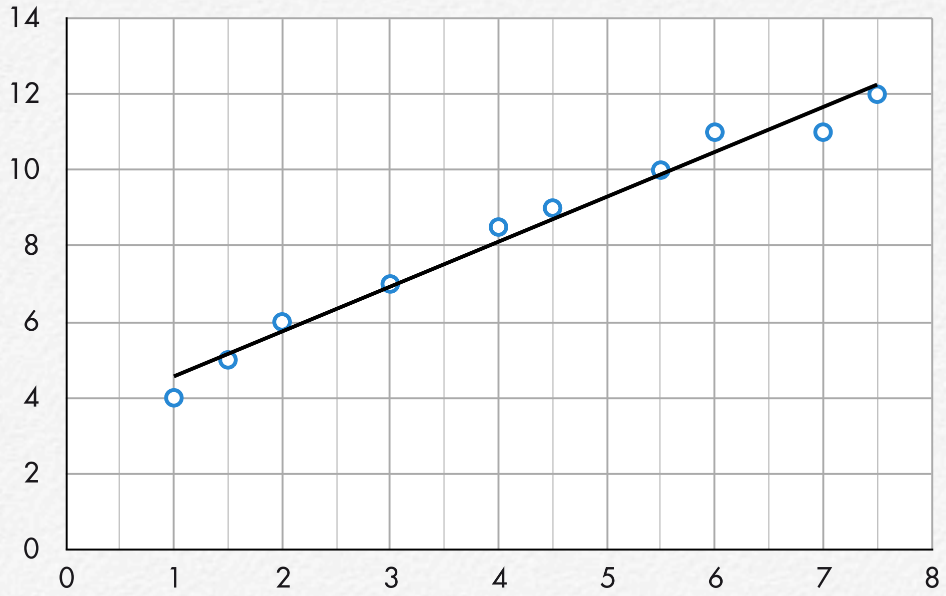
REMINDER

- If the correlation is going **up**, as it goes left to right, it is a **positive correlation** (see Fig 14.).
- If the correlation is going **down**, as it goes left to right, it is a **negative correlation** (see Fig 15.).
- On a graph, if the points are randomly scattered across the graph, and you can't decide which way to draw the line of best fit, there is said to be **no correlation** (see Fig 16.).
- If points fit neatly onto a straight line, there is a **strong correlation** (see Fig 14.).
- If points wobble loosely around the line, there is a **weak correlation** (see Fig 15.).

First Example

Melon size and weight.

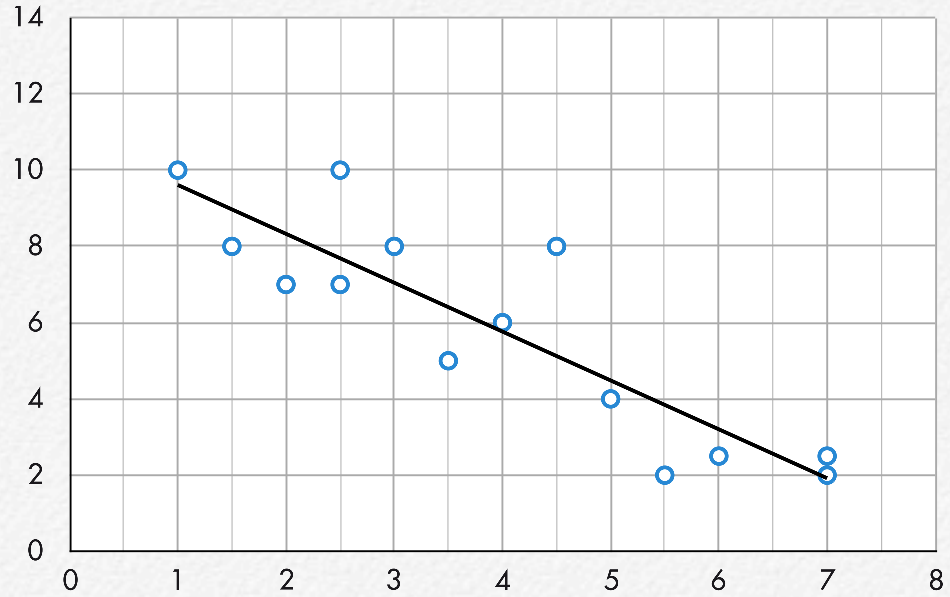
Fig 14. Strong Positive Correlation



Second Example

Number of guests and size of bank account.

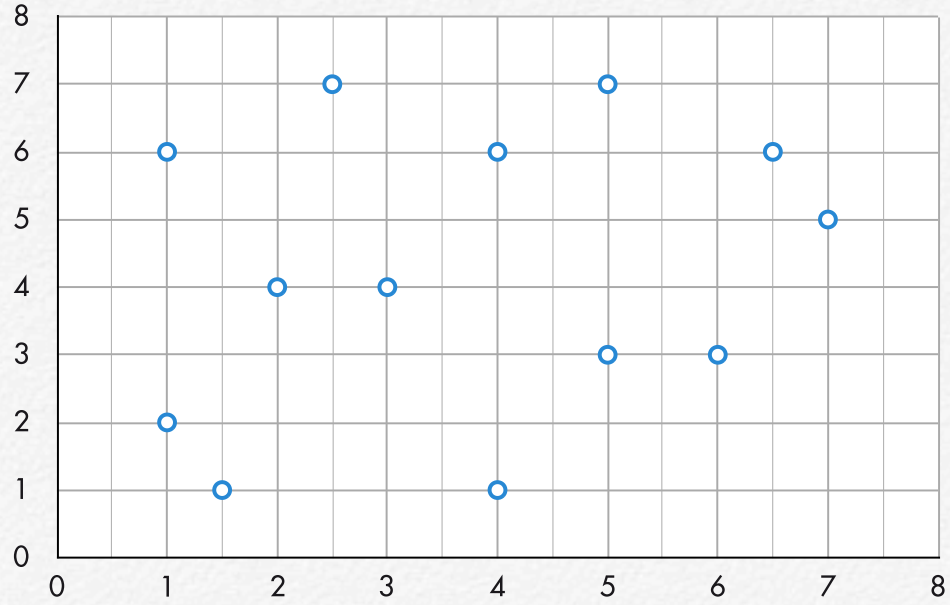
Fig 15. Weak Negative Correlation



Third Example

Ice cream and yacht speed.

Fig 16. No Correlation



You can draw graphs on a computer, using Microsoft's Excel application, Apple's Numbers application, or similar programmes.

Demographics

All available, relevant information is called **data**.

Demography is the scientific study of human populations, focusing on their size, structure and distribution. **Demographics** is the **data** about population statistics, which results from demography.

The following demographic study was carried out by household goods manufacturer, Unilever. Statistical charts quickly and easily present meaningful data.

Why does Unilever – which sells domestic products such as PG Tips and Persil – need to understand the changing dynamics of family life? Because it assists Unilever's business decisions. Perhaps Unilever will produce more one-person packets of their products, as more people now live alone.

If the executives of a building firm had commissioned this report, perhaps, as a result, they might decide to increase the number of their new-build studio apartments.

What follows is a huge amount of research work, condensed to some of the most relevant facts, in statistical charts – which is what Unilever wanted to know.

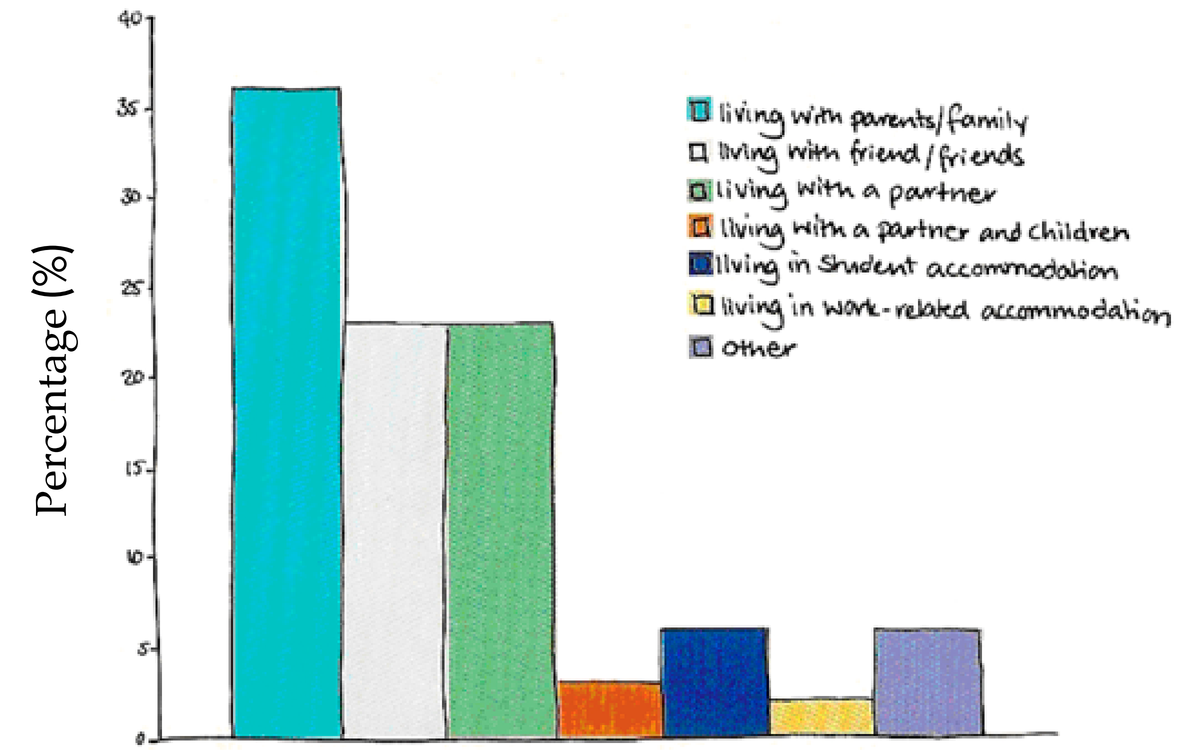
Data is more meaningful if you know how many people were in the original sample.

Musicians and lighting designers need maths.
Beatle Paul McCartney performs in Moscow, Russia.

Real Life Examples of Statistical Charts

In the previous 30 years there had been a sharp rise in solo living. This excellent study analysed the reasons for this demographic shift and also gave the implications of this trend. It says, “Many young people actively seek the independence associated with solo living. An overwhelming 96% of people surveyed, believed living alone is an important stage of life to experience before settling down." The study also showed that breakdown in a relationship is a major reason that people live alone.

Fig 18. Living arrangements prior to person living alone

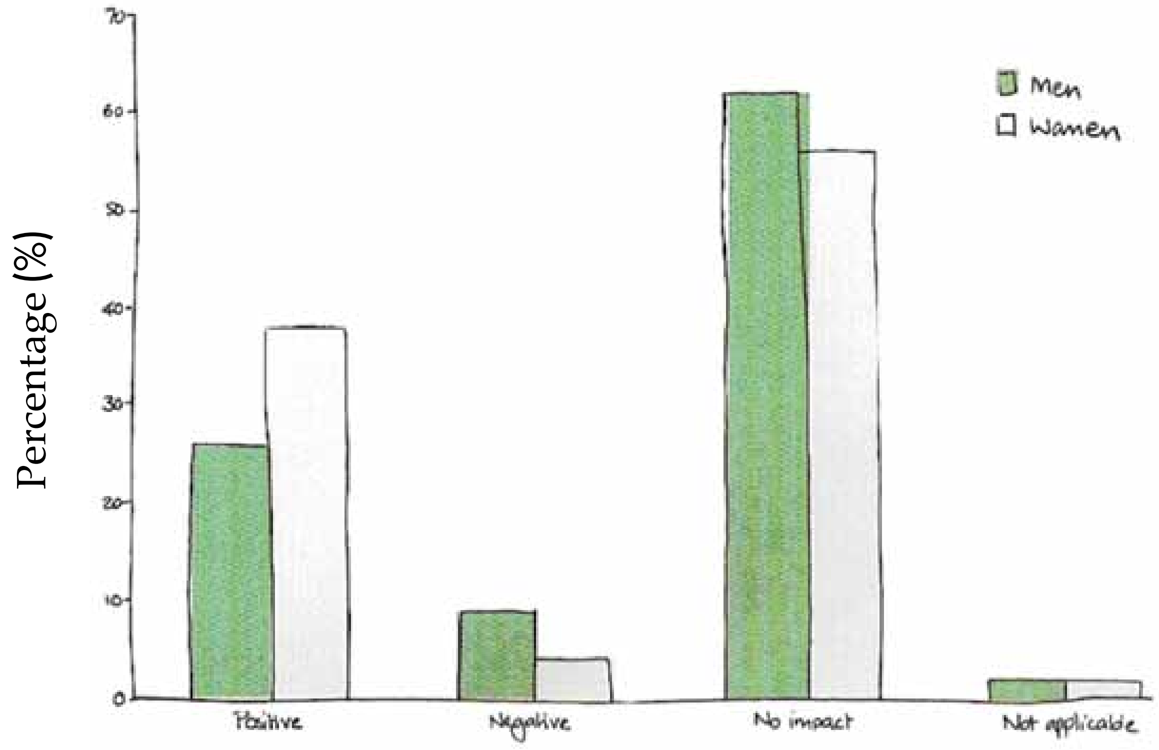


Source: Unilever / You Gov poll

Findings: The vertical axis gives the percentages. Reading off the vertical axis, you can see that:

Over **35%** of singletons previously lived with their family.
23% lived with friends.
23% lived with their partners.

Fig 19. Compound bar chart showing the impact of living alone on relationships with friends



Source: Unilever / You Gov poll

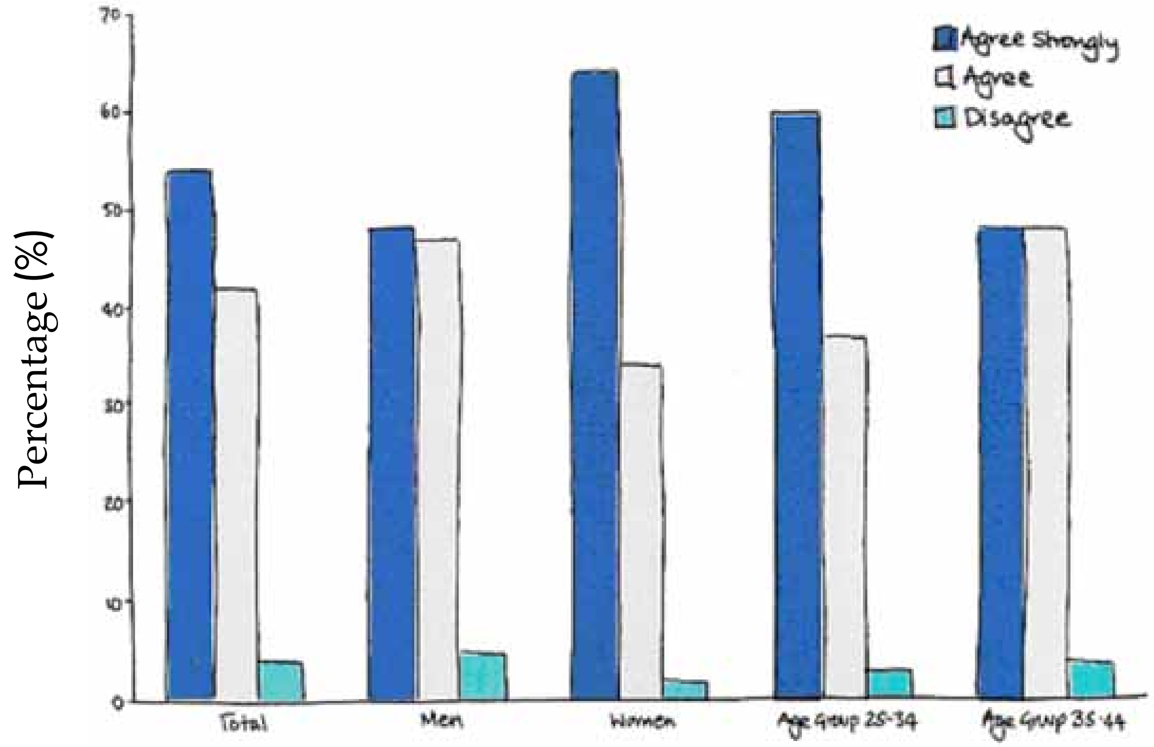
Findings: most people say that living alone has no impact on their relationship with their friends. More women than men say that living alone has a positive impact. More men than women say it has a negative impact; this finding may be partly due to divorced fathers finding that living alone, apart from their children, is difficult.

Exercise

14) What findings can you deduce from the following compound bar chart in Fig 20?

Fig 20. Views on living alone

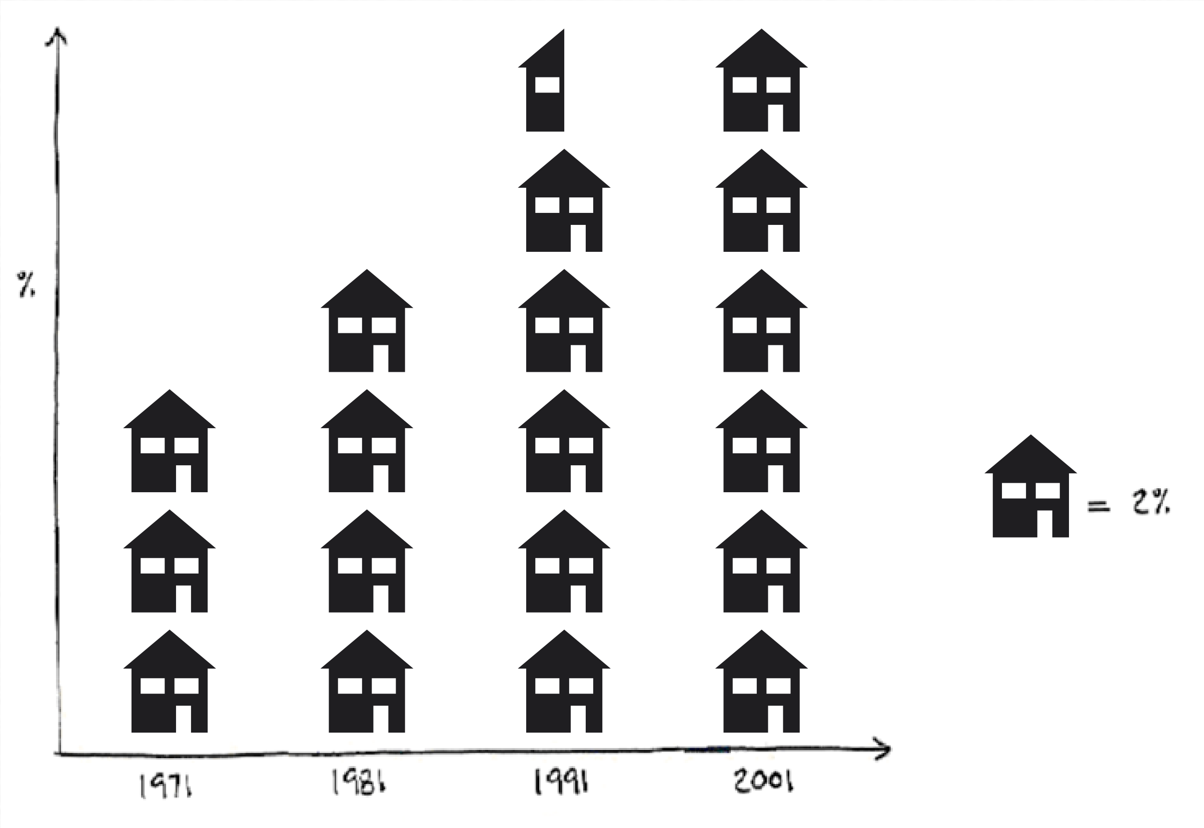
It's good to live on your own before you settle down.
Do you agree?



Source: Unilever / You Gov poll

Pictogram Example based on survey figures

Fig 21. Percentage of population in one person households



The scale of this pictogram is: one house is equal to 2%.

Between 1971 and 2001 there was an unmistakeable, steady increase in the percentage of the population of Great Britain who lived alone.

From the pictogram you can see that **6%** of the population was living alone in 1971, whereas **12%** did so in 2001.

Vertical scales are not generally used in a pictogram, because each picture has a defined value.

Exercise

15) From the pictogram, what percentage of the population of Great Britain lived alone in:

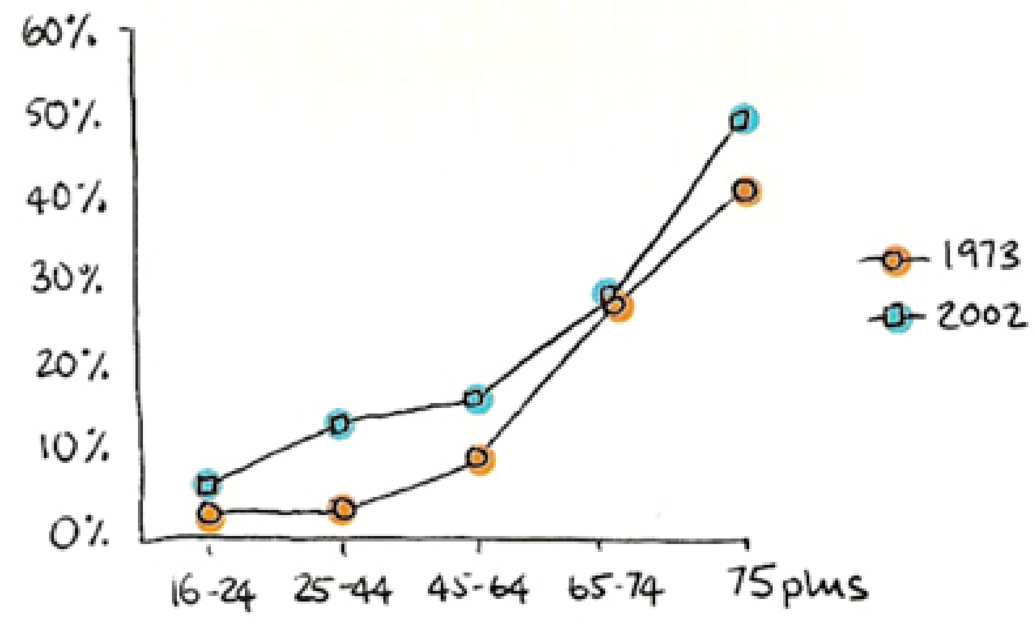
a) 1981?

b) 1991?

Frequency polygons

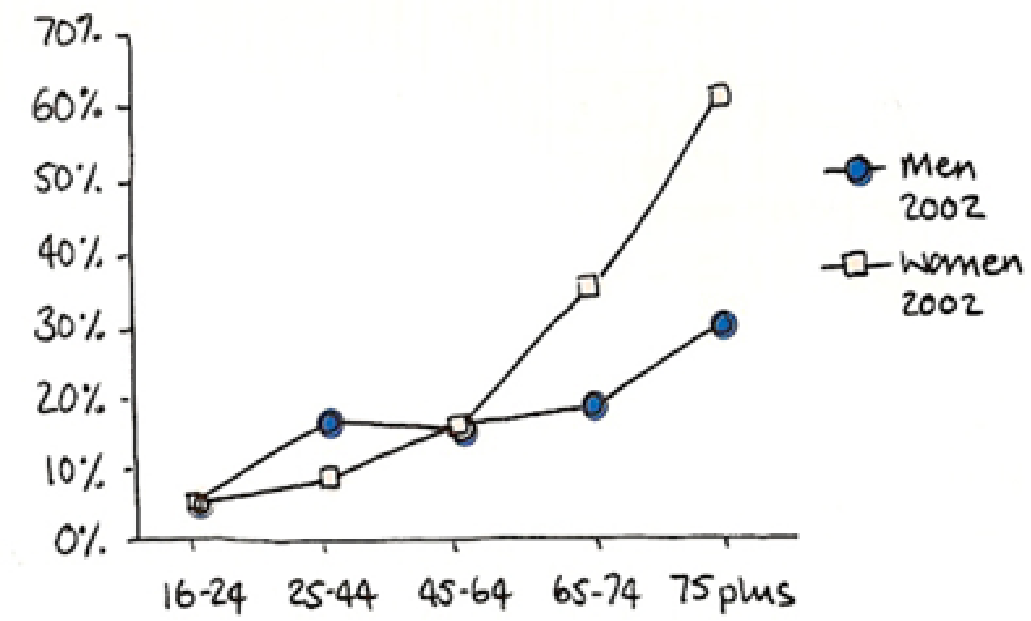
In Fig 22, the frequency polygon compares solo living in 1973 with that of 2002. You can see that the biggest increase in single households is in the 25-44 age bracket. There is also a big difference between the percentage of the population who live alone over the age of 75 and younger age groups; this is partly because widows and widowers are living longer, thanks to free healthcare.

Fig 22. Percentage of people living alone in 1973 and 2002, by age



Source: Social Trends 35 - Census, Labour Force Survey, ONS 2005

Fig 23. Percentage living alone grouped by sex and age



Source: ST35 - General Household Survey, ONS 2005

In Fig 23, you can see there are more men living alone than women in the 25-44 age group. This may be due to the rise in divorce, after which many former husbands live alone but the former wife lives with their children.

After age 65, there is a steep increase in women who live alone (divorcées, widows, singletons). This may be because women tend to live longer than men.

Exercises

16) Pick an interesting fact from each of the frequency polygons in Fig 22. and Fig 23.

Demographic Map

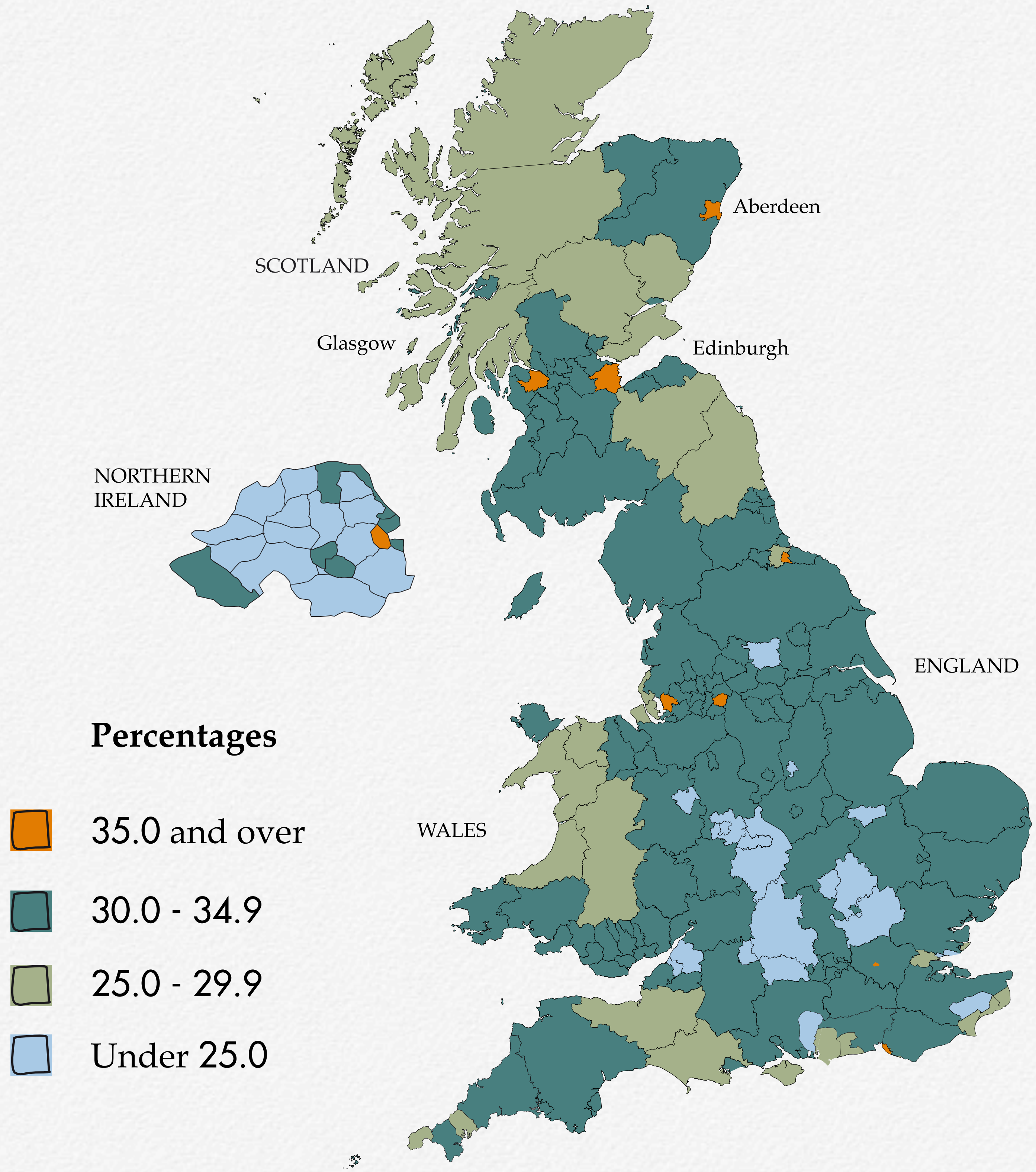
Another way of displaying demographics is on a map. The following map shows the percentage of households in each area that consist of only one person. Each of the four different colours represent a different percentage group. For example, in the orange areas, more than **35%** of households are occupied by only one person.

Fig 24 shows that in Scotland, the highest percentage of one-person households (orange blobs) is in the big cities: Glasgow, Edinburgh and Aberdeen.

The lowest percentage of one-person households (pale blue blobs) is in the middle of England and Northern Ireland.

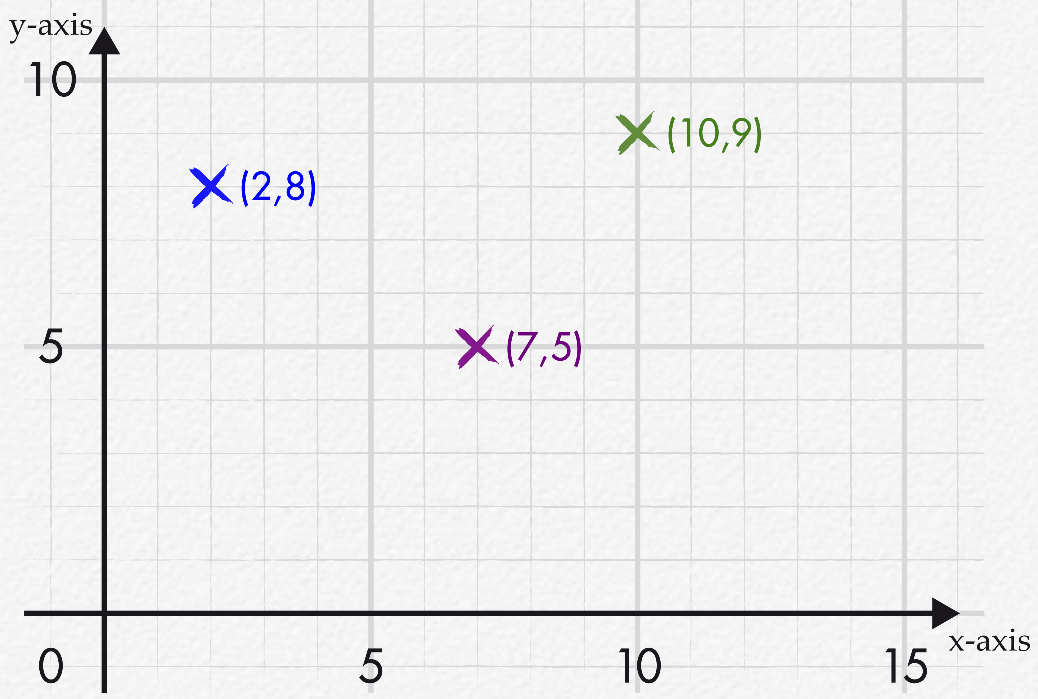
(Report commissioned by Unilever; researched and written by Jenny Lewis on behalf of IPPR Trading Limited)

Fig 24. Map of Great Britain showing the proportion of households which consist of one person



Answers to Part 21

Answer to exercises 1, 2 and 3 are in this graph:



4) How many pairs of boots does Princess Caroline have?

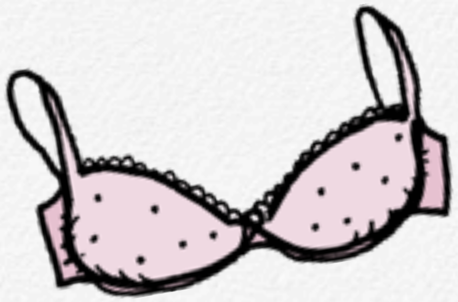
Answer: **Princess Caroline has 4 pairs of boots**.

5) How many pairs of slippers does Princess Caroline have?

Answer: **Princess Caroline has 2 pairs of slippers**.

6) How many blouses, dresses, trousers and skirts does Princess Caroline have?

Answer: **9 blouses**
4 dresses
14 trousers
4 skirts.

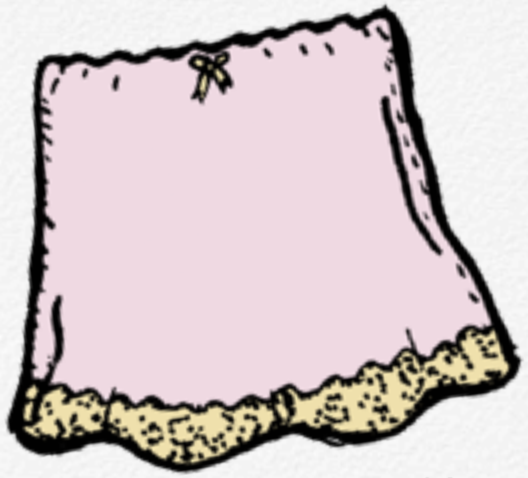


7) How many of each type of bra does Princess Caroline have?

Answer: **2 white bras**
4 black bras
2 fancy bras.

8) How many of each type of petticoat does Princess Caroline have?

Answer: **2 white petticoats**
4 black petticoats
0 fancy petticoats.



9) What is the total number of Princess Caroline's knickers? Which type of knickers predominates?

Answer: **Princess Caroline has 22 pairs of knickers, mostly black.**

10) What is the total number of pairs of socks that Princess Caroline owns? How many of these pairs of socks are fancy?

The bar reaches to 20, so Princess Caroline has 20 pairs of socks altogether.

The fancy sock bar extends from 8 to 20. So Princess Caroline has 20 – 8 = 12 pairs of fancy socks.

Answer: **Princess Caroline has 20 pairs of socks; 12 of these pairs are fancy socks.**

11) What is the total number of Princess Caroline's petticoats? Which type of petticoat predominates?

Answer: **Princess Caroline has 6 petticoats, mostly black.**

12) Look back to figure 5. From it, estimate as well as you can, the percentage of Princess Caroline's knickers which are:

a) White knickers

The bar for white knickers extends from 0% to 36%.

36 – 0 = 36%

Answer: **Approximately 36% white knickers.**

b) Black knickers

The bar for black knickers extends from 36% to 82%.

82 – 36 = 46%

Answer: **Approximately 46% black knickers.**

c) Fancy knickers

The bar for fancy knickers extends from 82% to 100%.

100 – 82 = 18%

Answer: **Approximately 18% fancy knickers.**

Your answers for exercises 12 and 13 may differ by up to 5%, depending on how accurately you could read the chart.

13) Give the percentage divisions of Princess Caroline's petticoats. Estimate the percentage of Princess Caroline's petticoats which are:

a) White petticoats

The bar for white petticoats extends from 0% to 33%.

33 – 0 = 33%

Answer: **Approximately 33% white petticoats**.

b) Black petticoats

The bar for black petticoats extends from 33% to 100%.

100 – 33 = 67%

Answer: **Approximately 67% black petticoats**.

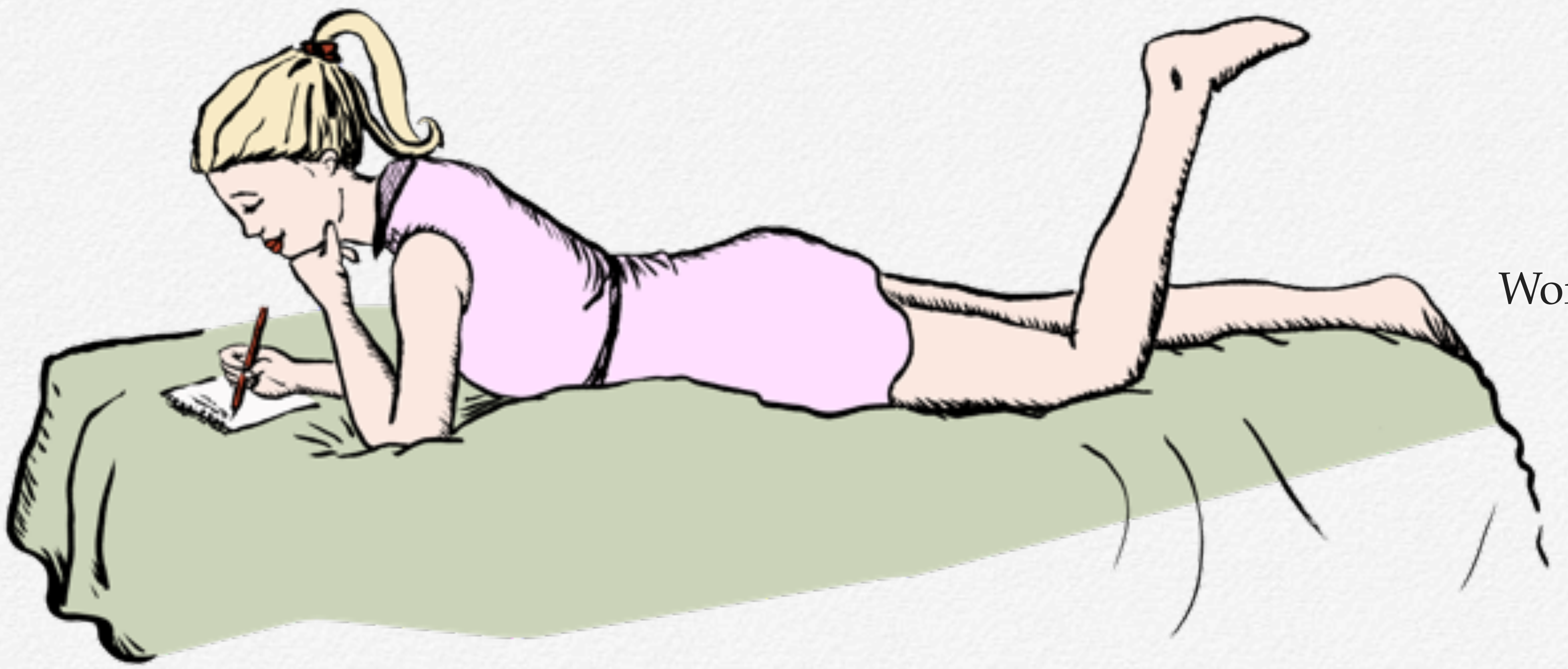
14) What findings can you deduce from the following compound bar chart in Fig 20?

Answer: **The bar chart shows that most people agree it is good to live on your own before you settle down. Women agree more strongly than men. Women in age group 25-34 agree more strongly than women in age group 35-44**.

15) From the pictogram, what percentage of the population of Great Britain lived alone in:

a) 1981? Answer: 8%

b) 1991? Answer: 11%



Working out her ideal wardrobe.

16) Pick an interesting fact from each of the frequency polygons in Fig 22. and Fig 23.

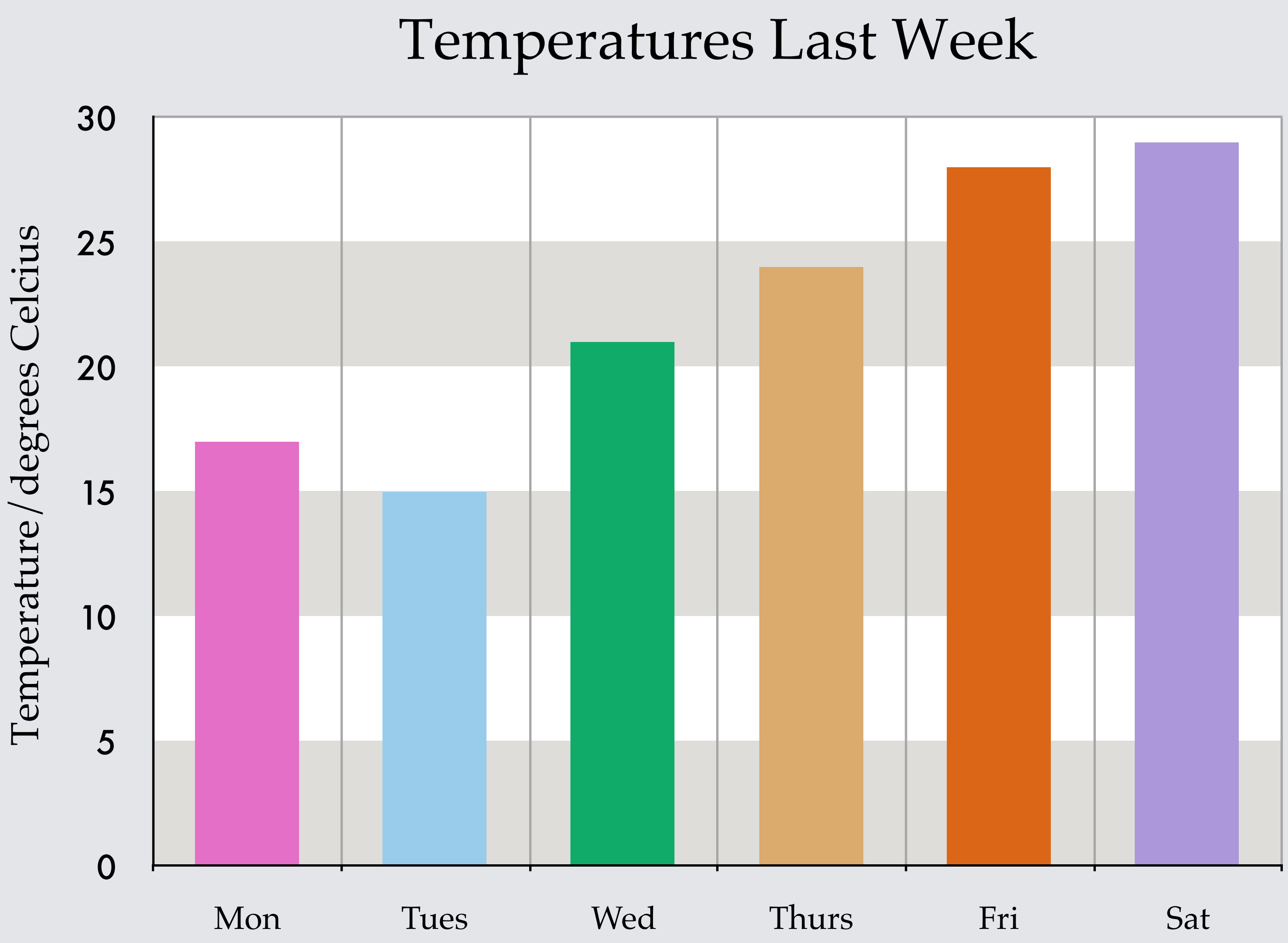
Answer: **In Fig 22, the percentage of people living alone in the 65-74 age bracket has hardly changed between 1973 and 2002. There may have been a change in the type of people who live alone – perhaps more divorcées and fewer widows and widowers – but this would not show on this chart.**

In Fig 23, the points coincide for the 16-24 age group and the 45-64 age group. Equal percentages of men and women living alone may be because people in these two age brackets are much less likely to be living with children, so the gender difference is not so pronounced.

The 16-24 year olds are statistically unlikely to have children; the children of the 45-64 age group are likely to have left home, leaving the divorced mothers alone, hopefully living a happier life.

Texture: the dress relies for effect on the contrast between two expensive fabrics: the cloudy net against the smooth silk.

YOUR BRAIN WORKOUT

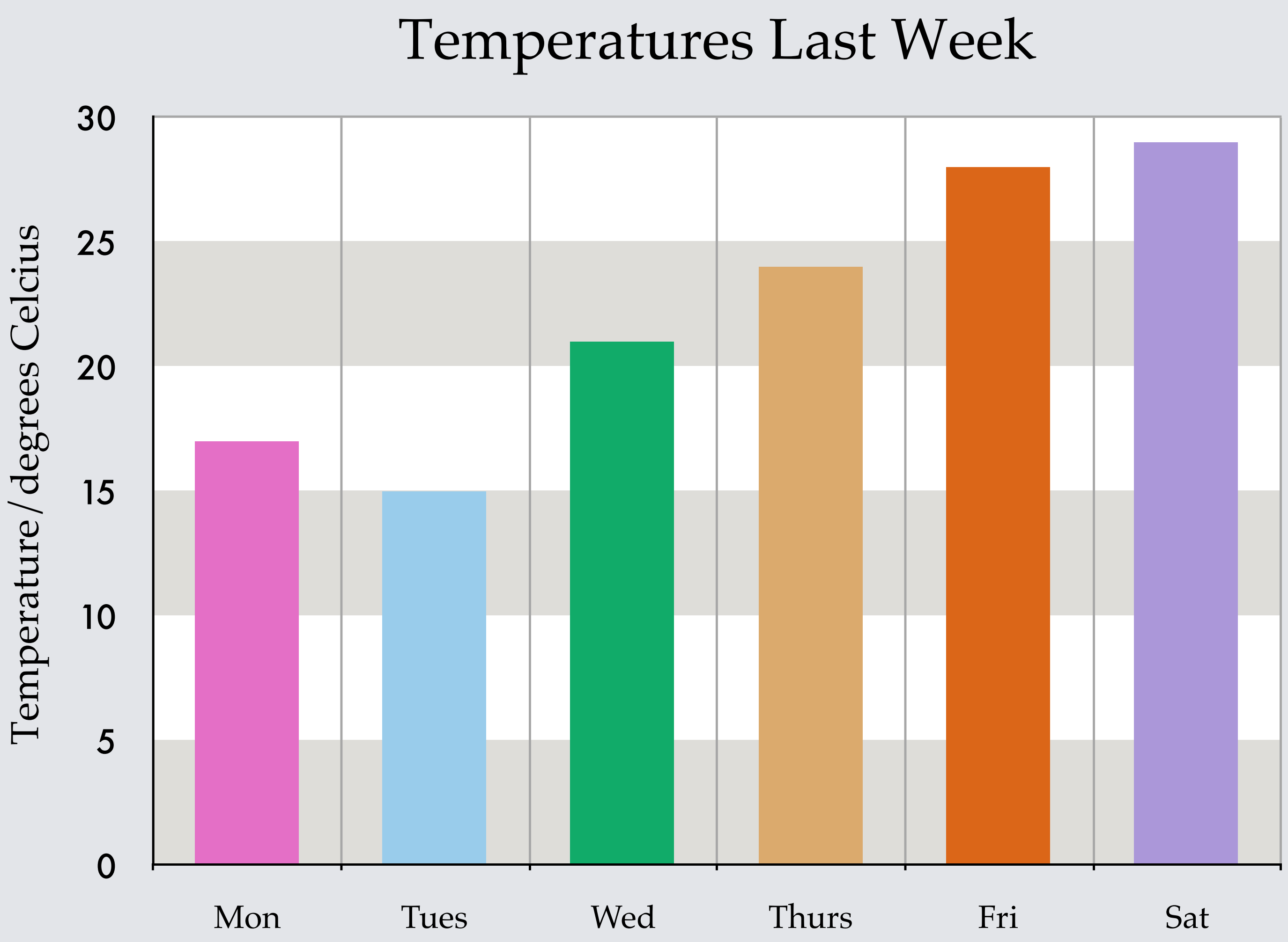


Q1.

On which day was it hottest?

- **A.** Monday
- **B.** Tuesday
- **C.** Friday
- **D.** Saturday

YOUR BRAIN WORKOUT



Q2.
On which day was it coldest?

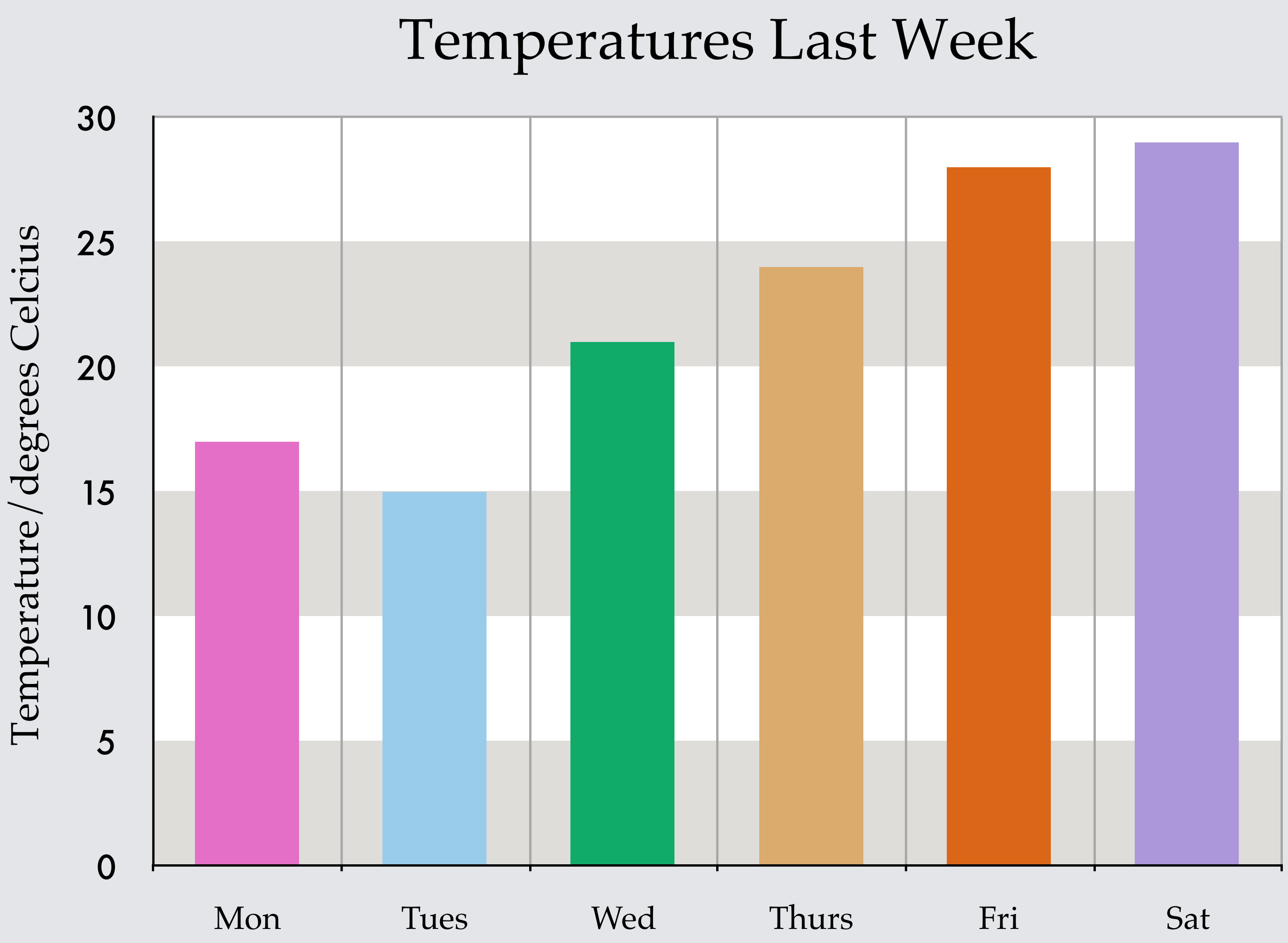
A. Monday

B. Tuesday

C. Friday

D. Saturday

YOUR BRAIN WORKOUT

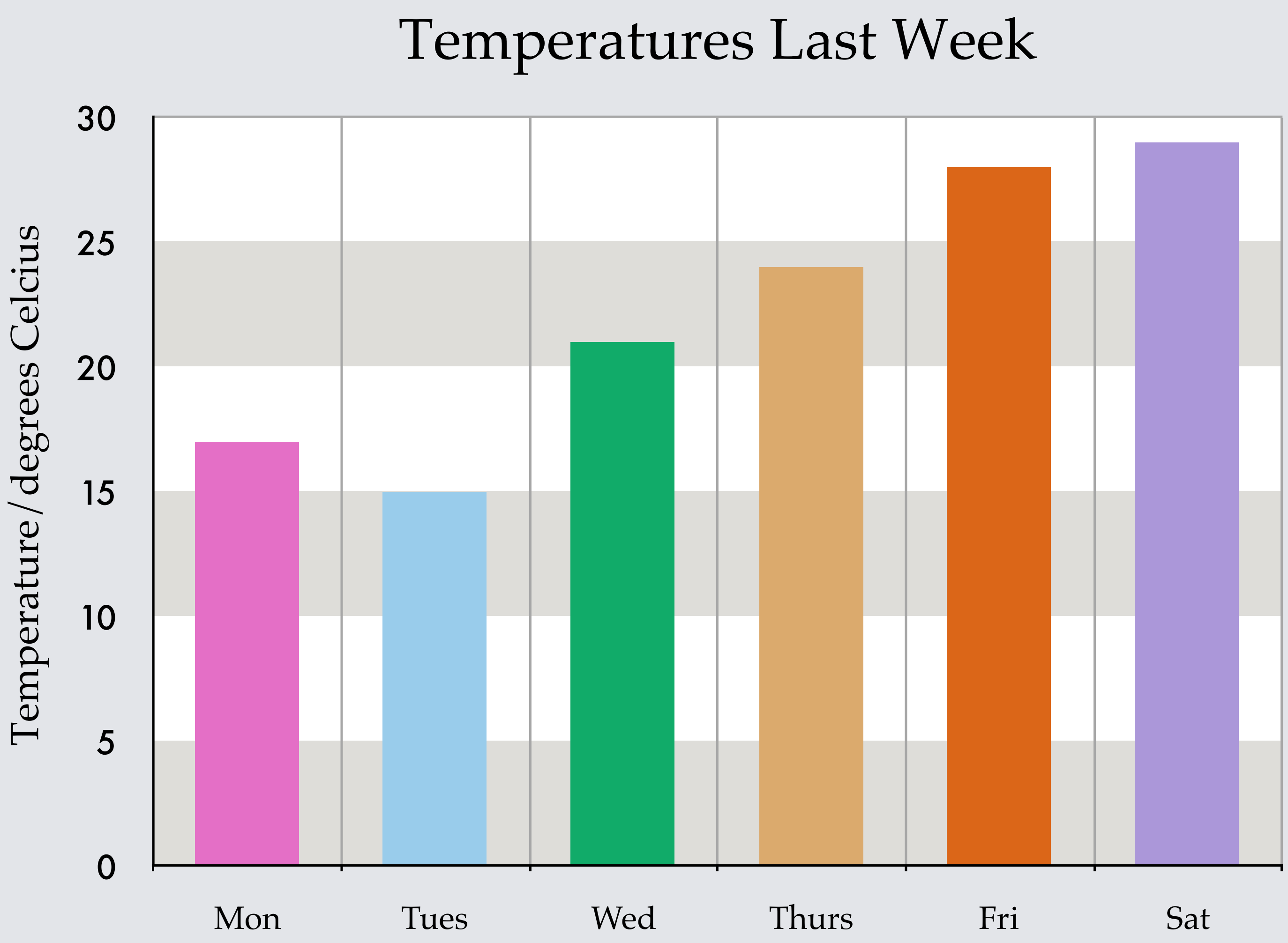


Q3.

What was the highest temperature last week?

- A. 30°C
- B. 29°C
- C. 25°C
- D. 20°C

YOUR BRAIN WORKOUT

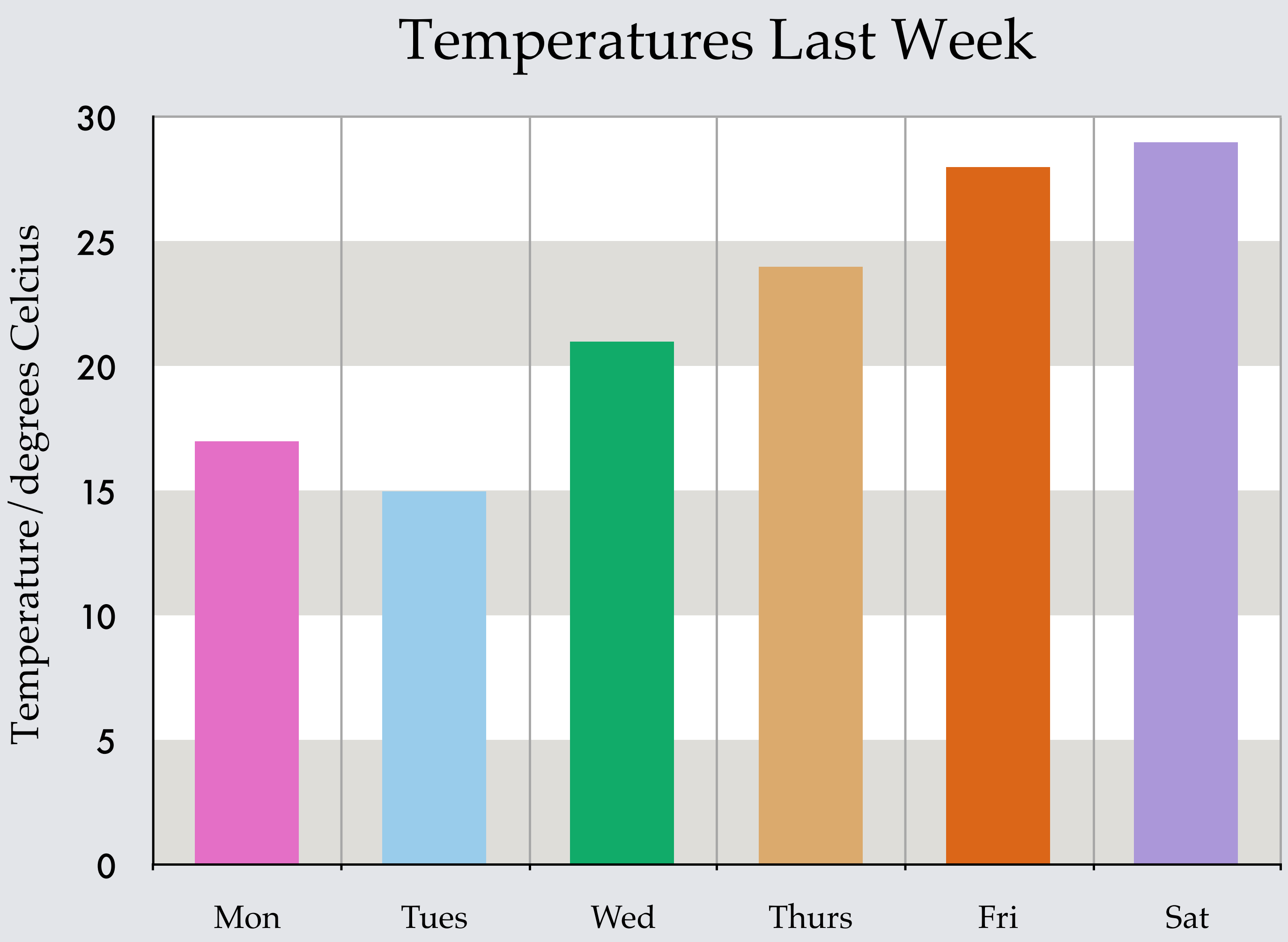


Q4.

What was the lowest temperature last week?

- A. 5°C
- B. 10°C
- C. 15°C
- D. 20°C

YOUR BRAIN WORKOUT

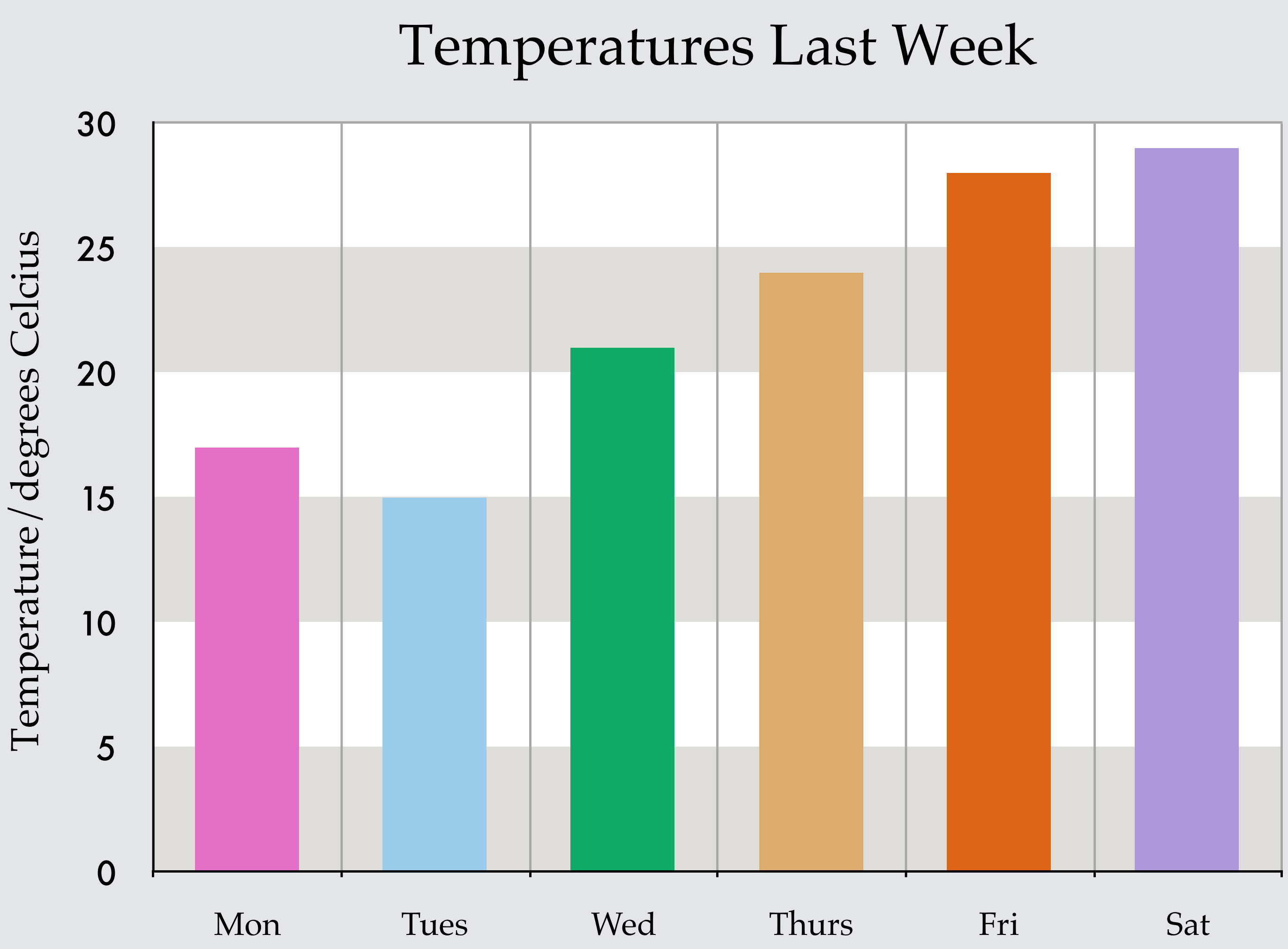


Q5.

What was the difference in temperature between the hottest and coldest days last week?

- **A.** 5°C
- **B.** 8°C
- **C.** 10°C
- **D.** 14°C

YOUR BRAIN WORKOUT

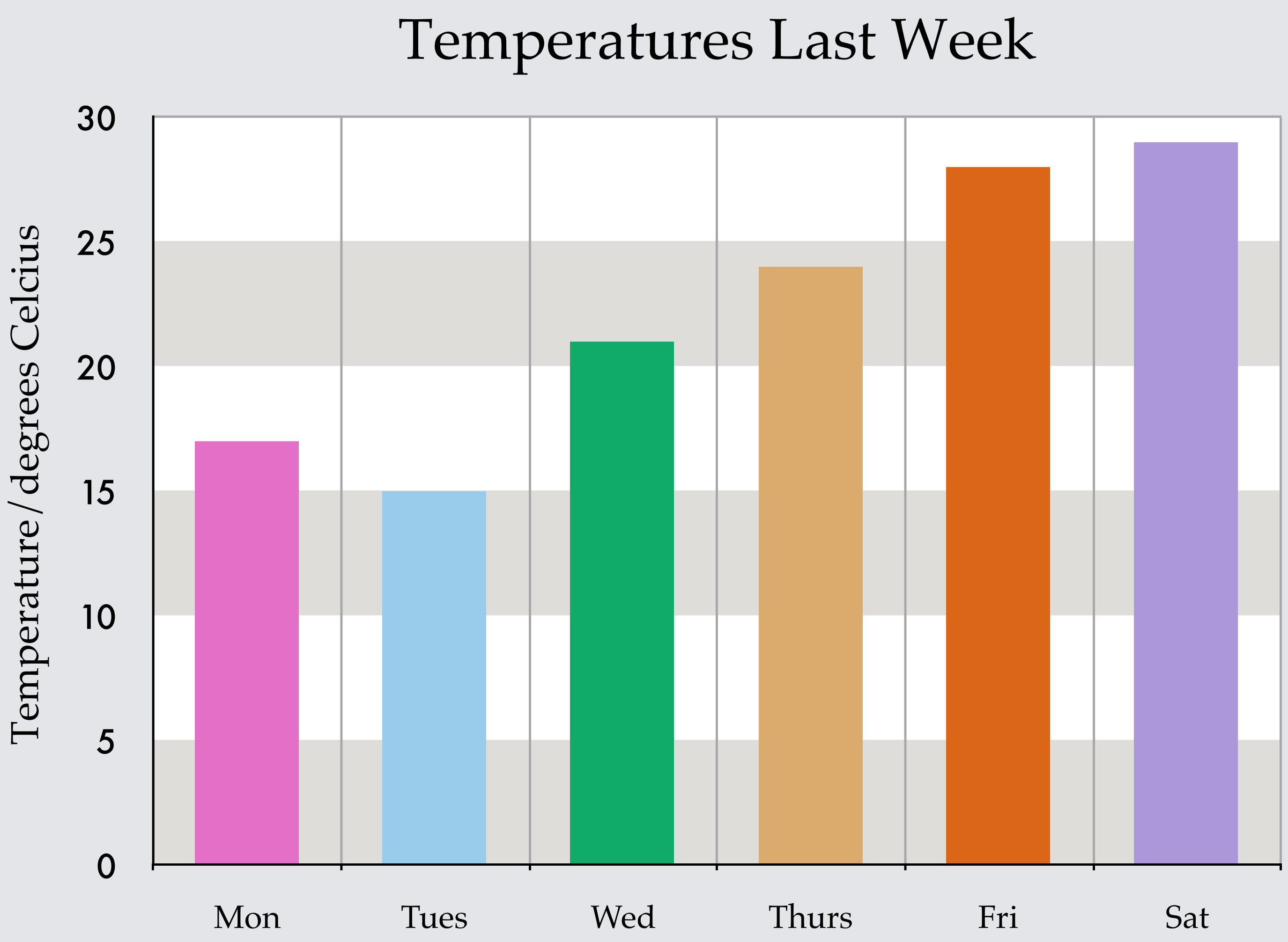


Q6.

Which describes best what happened with the temperatures last week?

- **A.** It started to get colder at the beginning of the week but then steadily got hotter each day.
- **B.** It started off hot and got cooler all week.
- **C.** The temperature stayed the same all week.
- **D.** It dipped to the lowest temperature in the middle of the week but jumped higher at the end of the week.

YOUR BRAIN WORKOUT

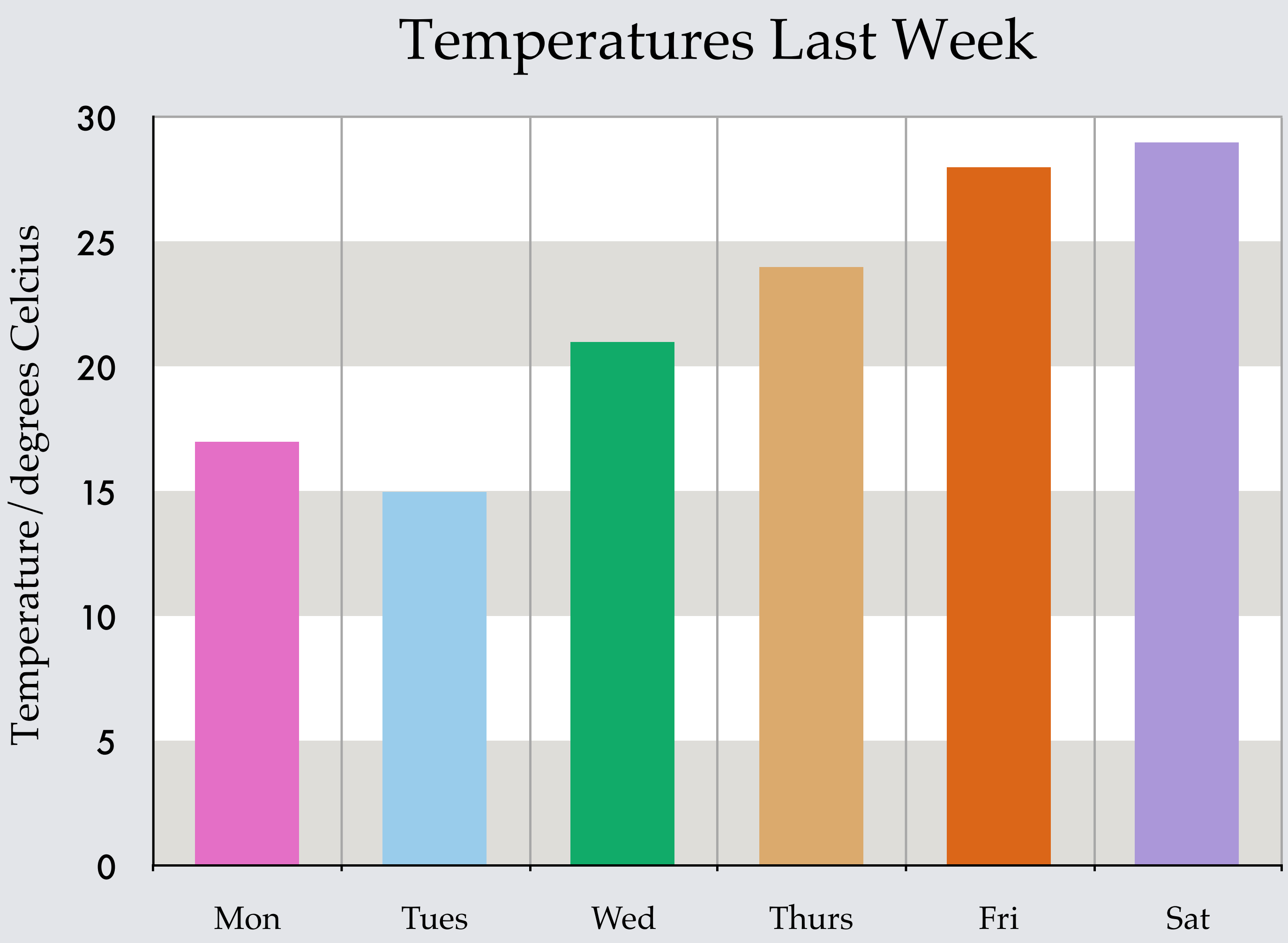


Q7.

Which two days were most similar in temperature?

- **A.** Monday and Tuesday
- **B.** Wednesday and Thursday
- **C.** Thursday and Friday
- **D.** Friday and Saturday

YOUR BRAIN WORKOUT



Answers

Q1. Saturday

Q2. Tuesday

Q3. 29˚C

Q4. 15˚C

Q5. 14˚C

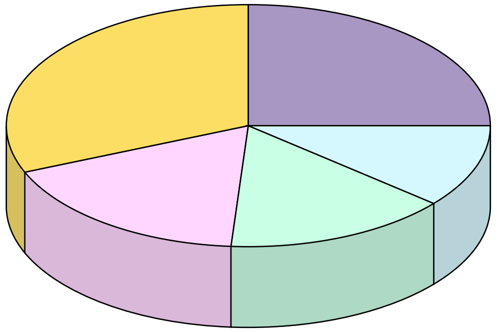
Q6. It started to get colder at the beginning of the week but then steadily got hotter each day.

Q7. Friday and Saturday

YOUR BRAIN WORKOUT

Q1.

What is the name of the type of chart below?



YOUR BRAIN WORKOUT

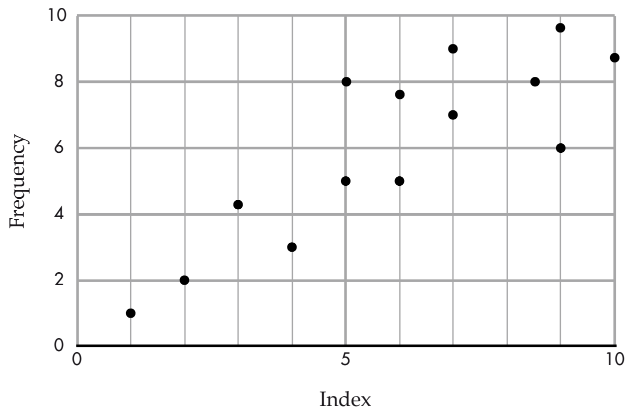
Q2.

Which type of chart can be used to see whether there are any correlations?

YOUR BRAIN WORKOUT

Q3.

What type of correlation is in the scatter graph below?



Swipe to reveal answer

YOUR BRAIN WORKOUT

Answers

Q1. Pie Chart

Q2. Scatter Graph

Q3. Positive Correlation

PART 22
DO IT YOURSELF

Wasp at breakfast.

Quick Quiz

Q1.

What is 250 x 400?

- A. 1,000
- B. 10,000
- C. 100,000
- D. 1,000,000

Quick Quiz

Q2.

What is -3 x -4 + 2?

- **A.** 14
- **B.** -10
- **C.** -14
- **D.** 10

Quick Quiz

Q3.

Which of the following fractions is not equal to **20%**?

- A. $\frac{1}{5}$
- B. $\frac{20}{100}$
- C. $\frac{4}{20}$
- D. $\frac{2}{5}$

Quick Quiz

Q4.

What is the approximate height of a kitchen table?

- **A.** 72 m
- **B.** 72 cm
- **C.** 72 mm
- **D.** 72 feet

Quick Quiz

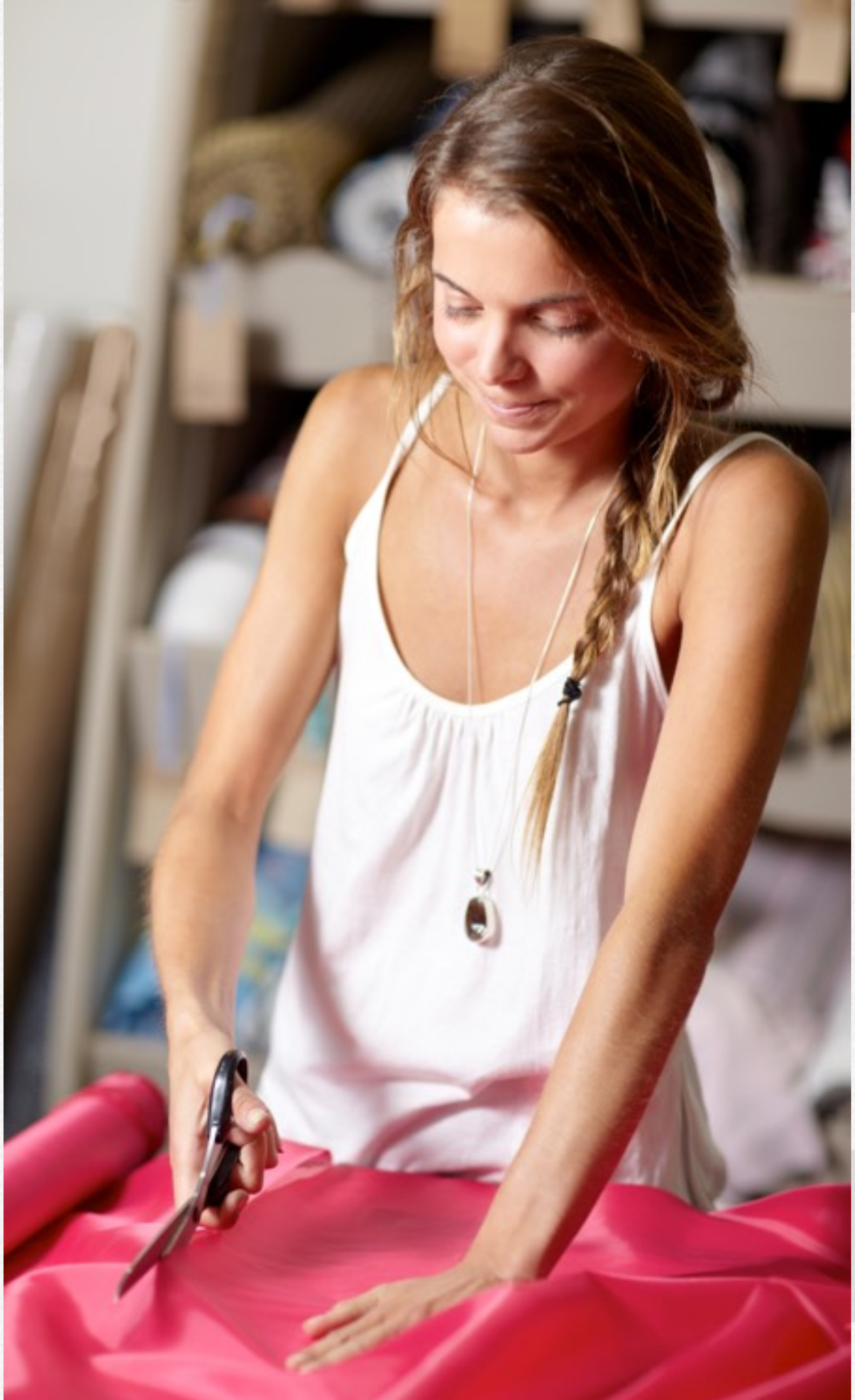
Answers

Q1. 100,000

Q2. 14

Q3. $\frac{2}{5}$

Q4. 72 cm



Making your Own Bar Charts and Pie Charts

Why should you want to do this?

Because actually creating a bar chart or a pie chart helps to give you a real understanding of the chart system. Then, at a glance you can absorb information that would otherwise take many tedious pages to describe.

Ever tried dress making?
Saves money.
And fits you.

Collecting Data: Tally Charts

Before you can draw your own chart you need to collect your data; try to do this in short, factual sentences. However you collect it – questionnaires, surveys, or counting things in your wardrobe – use a **tally chart**.

A tally chart is a chart for your own use; it doesn't have to be very neat, but it needs to be well organised. You need different rows for each category of items you expect to count, plus extra rows, in case you need to add categories you didn't think of earlier.

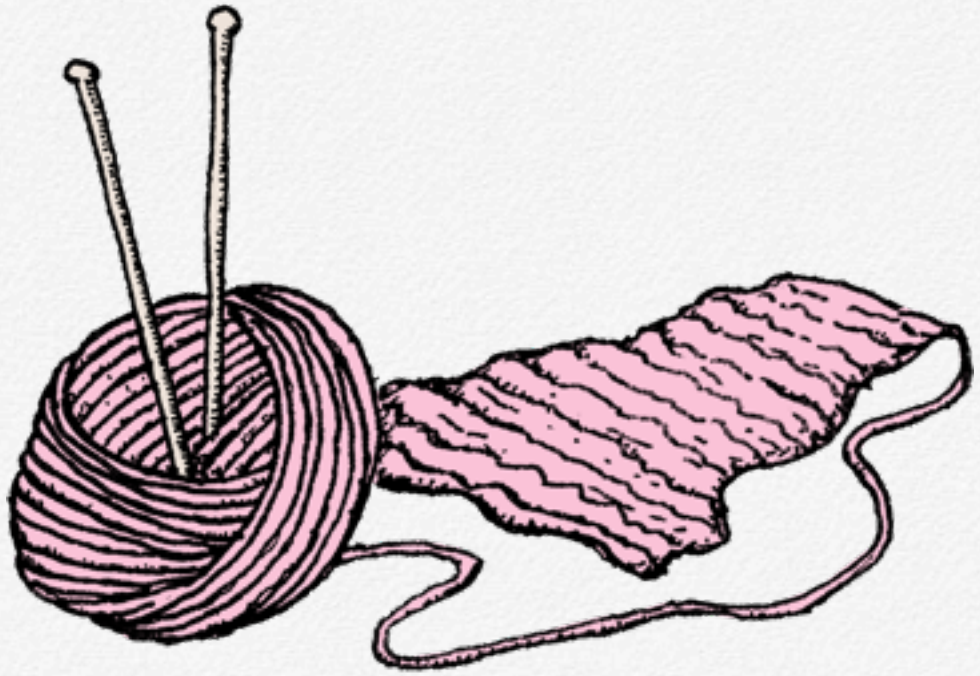
To **tally** is a simple way of **counting** used by ancient civilisations: every time you count an item, draw a little vertical line (see the following tally chart). Your fifth line needs to be a line which crosses your group of four lines (llll). Your sixth line starts the next group of **5**.

Example

Coral, a fashion-conscious personal trainer, used the following tally chart to count her clothes:

Item	*Tally*	*Total*
Skirts	~~IIII~~ ~~IIII~~	10
Trousers	~~IIII~~ ~~IIII~~ ~~IIII~~ I	16
Dresses	~~IIII~~ I	6
Blouses	~~IIII~~ ~~IIII~~ III	13
T-shirts	~~IIII~~ ~~IIII~~ ~~IIII~~ IIII	19
Jackets	IIII	4

As Coral finished counting each group, she wrote the totals in the end column, using the **5** times table, plus extra lines that were not crossed through.



Frequency Tables

When your information is on your tally chart, condense it into a neat **frequency table**. Here is Coral's frequency table.

Item	Total
Skirts	10
Trousers	16
Dresses	6
Blouses	13
T-shirts	19
Jackets	4
Total	68

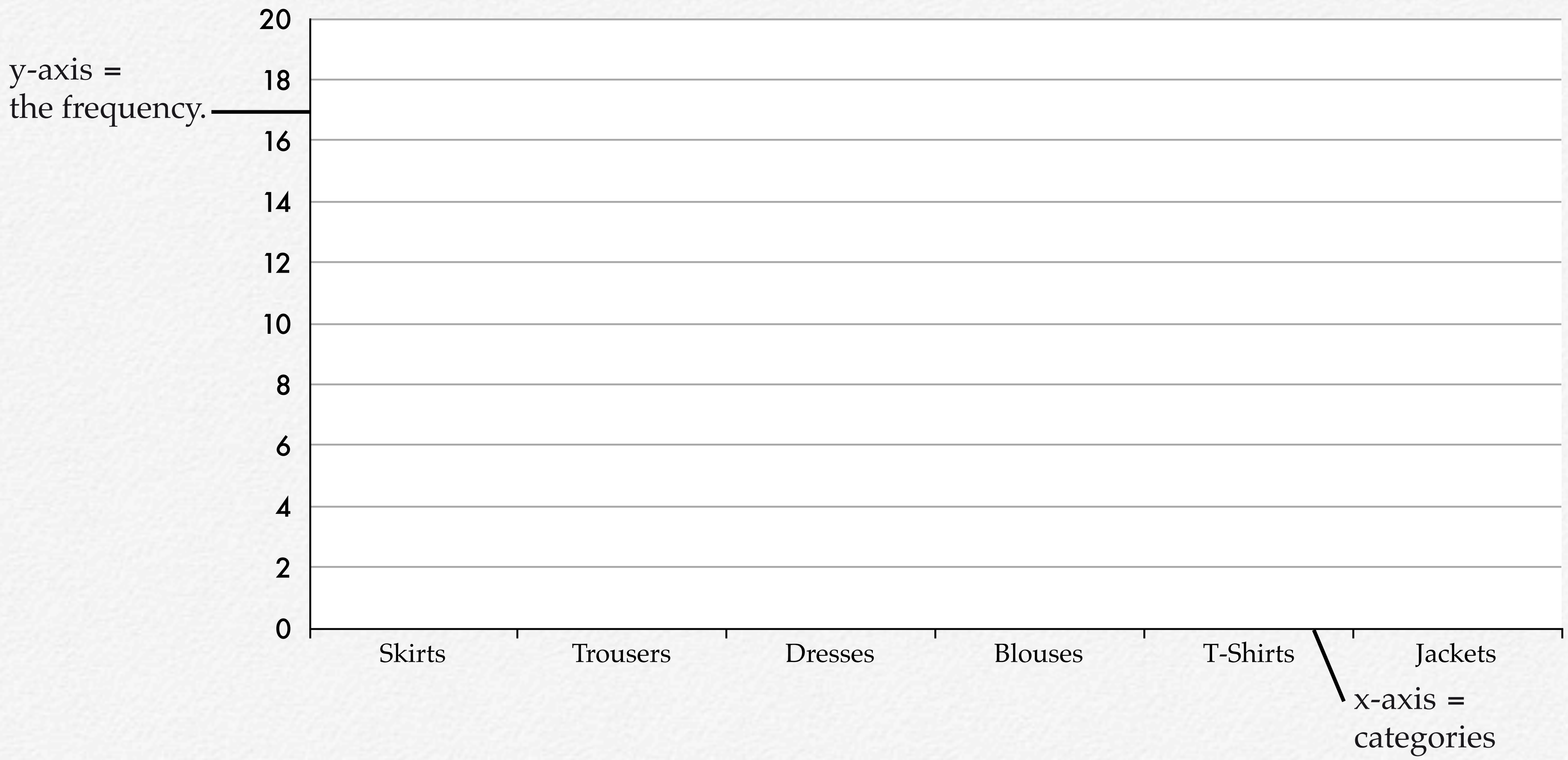
Ever tried knitting?
Creative.
Soothing.
Saves money.

Construct a Bar Chart

As you know, bar charts are always drawn on a graph with two axes (axes is the plural of axis): The horizontal axis is the bottom line, the vertical axis is on the left. The correct name for the horizontal line is the **x-axis**, the vertical axis is the **y–axis**.

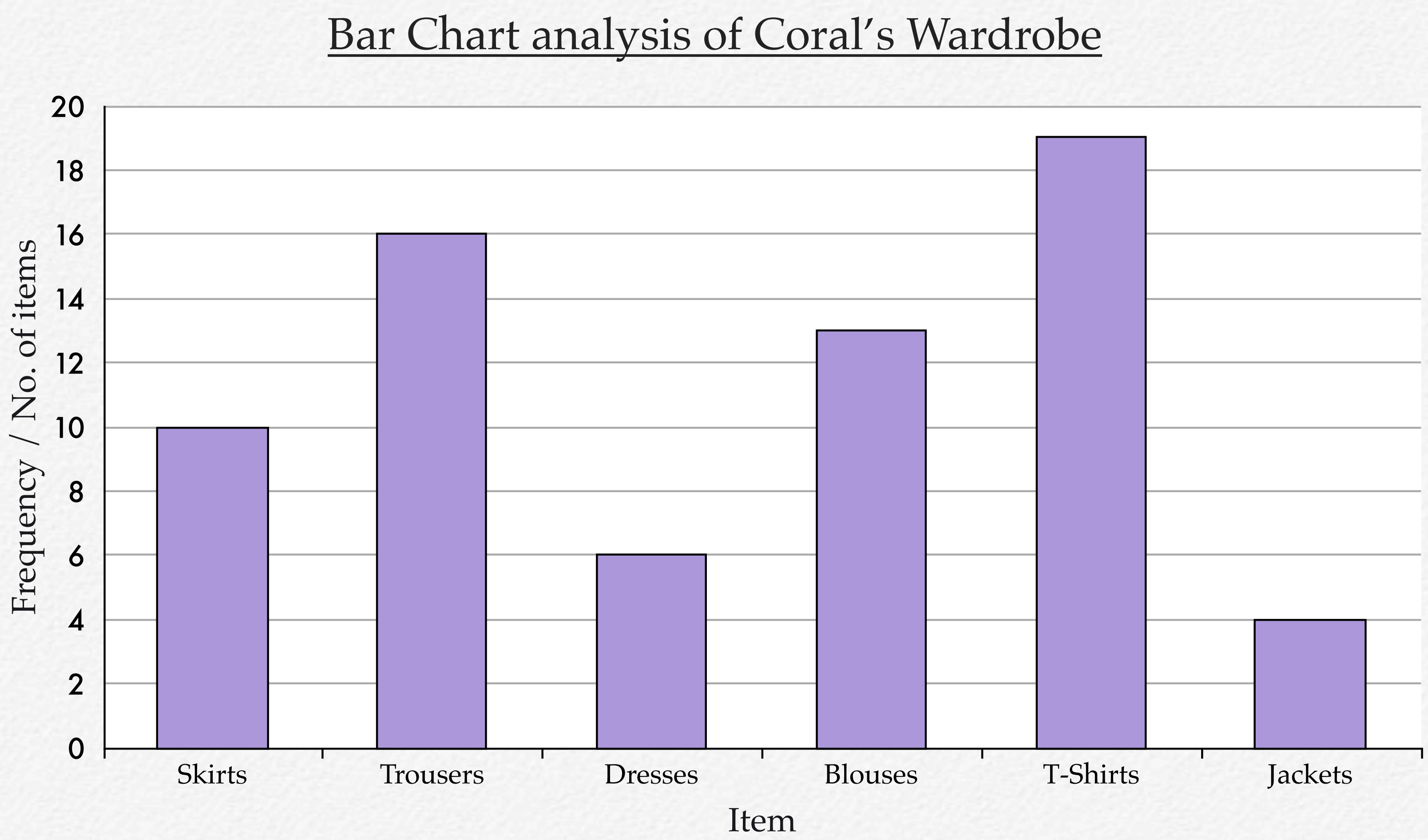
The x-axis is normally labelled with the time scale, the categories or names of items, while the y-axis usually shows the frequency (number of items). You decide the scale of your y-axis. In Coral's wardrobe, the highest frequency (number of items) is 19, so the y-axis has been drawn to 20, which is the round number that follows 19.

When you come to draw your own bar chart, you will find squared paper and a ruler useful.



At last you are ready to start drawing the bars on your chart. Here's how you might draw the chart below.

However wide you choose to draw your bars, each bar must be the same width. First, on the x-axis, write all your categories, as below. Looking at the y-axis, draw a dot where the top of each bar will be. There are **10** skirts, so make your dot on the **10** level of the y-axis, directly above the word 'Skirts'. In this chart, your frequency on the bar chart is labelled in twos: **2**, **4**, **6**, **8**… Because Coral has **19** T-shirts, draw your dot halfway between **18** and **20**. Next, draw your bars.



Before you finish your chart, make sure that each axis is labelled clearly.

Lastly, give the chart a key (if necessary) plus the all-important title. The title usually starts 'Bar Chart to show ………'

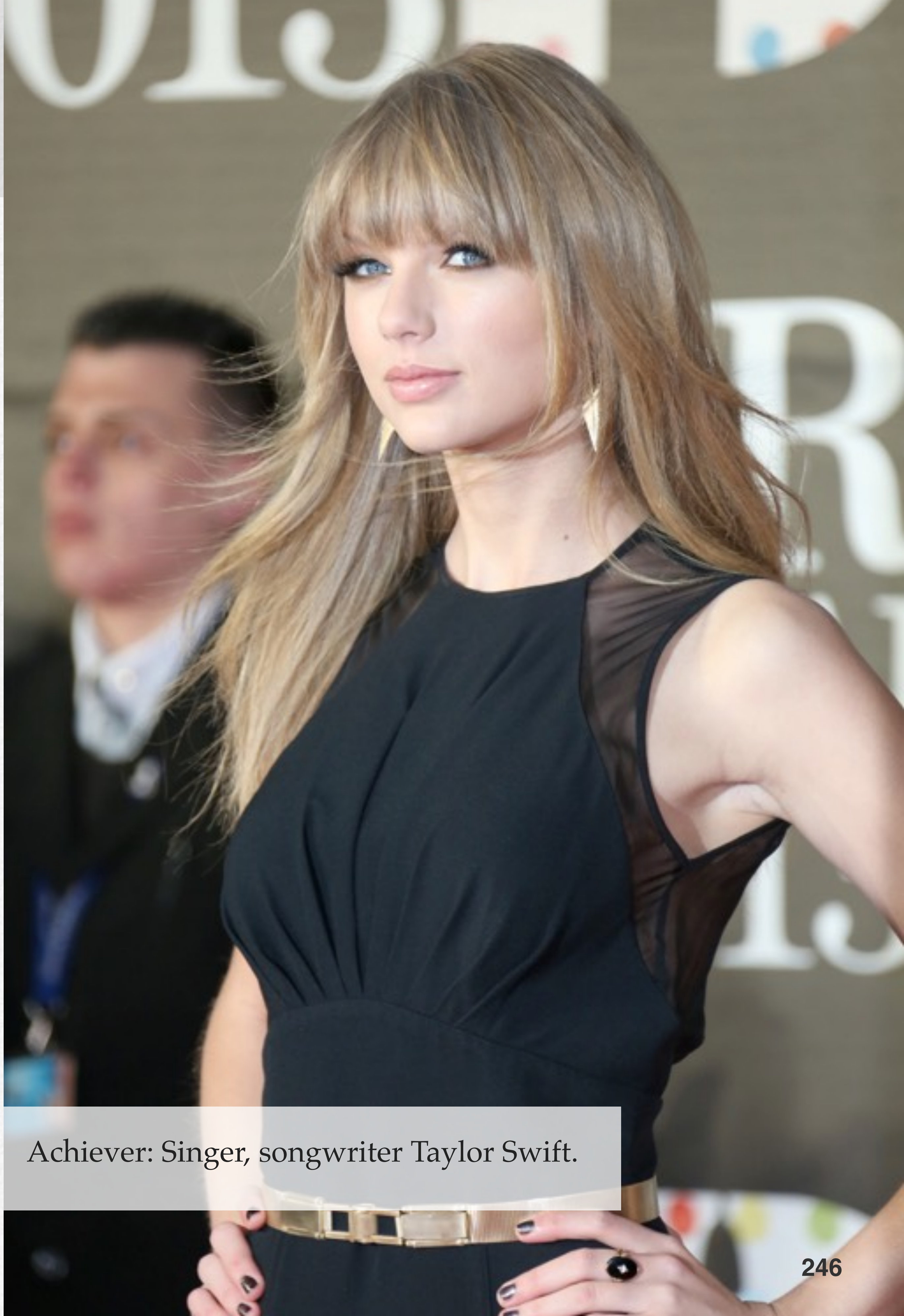
Grouping Data

You will probably need to create your own groups by putting your data into categories* that you decided.

Say you are conducting a survey on the weight of 40 children in Year 7; rather than write down the exact weights of each child, you might group weights in suitable categories, such as 0 to less than 10kg / 10 to less than 20kg / 20 to less than 30kg / 30 to less than 40kg etc... (see exercises later).

Note

* The correct mathematical term for a category is **a class interval**.



Achiever: Singer, songwriter Taylor Swift.

Drawing Pie Charts

Look back to the third page of Part 21, and have another look at How to Read Statistical Charts.
This tells you what a basic pie chart is. Then fast-forward to the heading "**Pie Charts**", which explains a bit more.
Now you are ready to draw a **pie chart** by yourself.

To draw a **pie chart,** you need a pair of compasses for drawing the circle (the pie) and a protractor for measuring and drawing the correct angles. These can be bought cheaply from WH Smith or your local stationery shop.

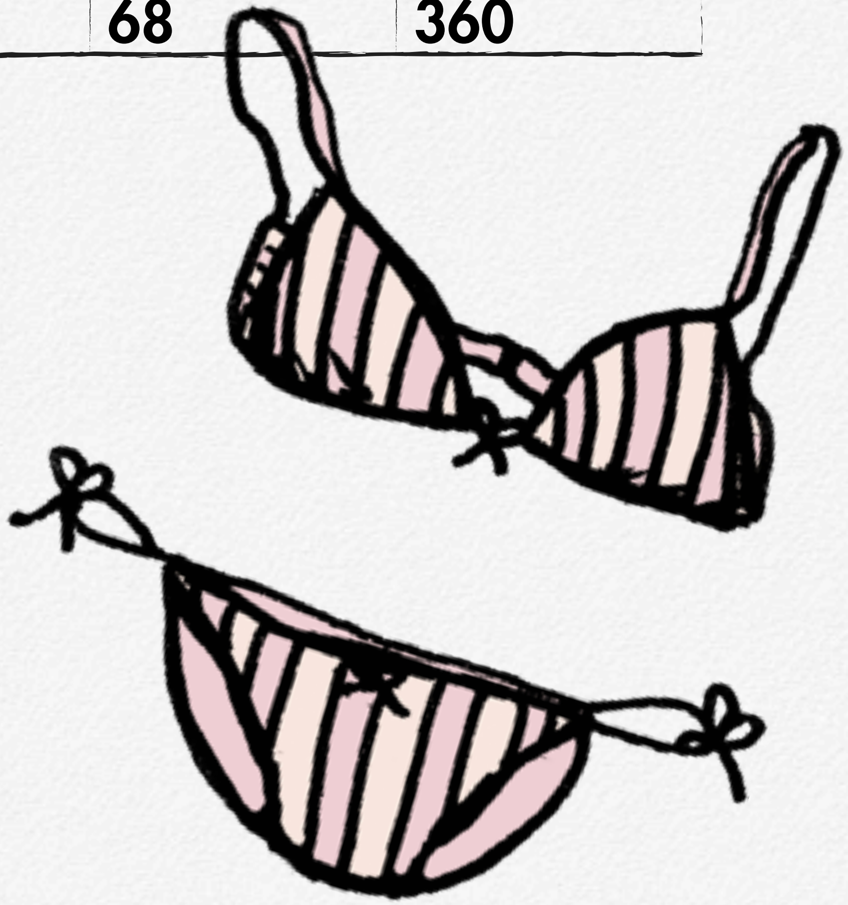
Because you need to know the exact centre of the circle, you can't get away with drawing round a cup or plate. You need a pair of compasses to draw your circle.

The angle around the centre point of any circle measures $360°$. So all the slices (angles) of the entire pie chart will always add up to $360°$.

You need to work out how to divide this $360°$ among the categories you want to display on your pie chart.

Start with a frequency table. Here is the frequency table for fitness instructor Coral's clothes. An extra column has been added, titled 'Angle' with the degree sign given in brackets. Before you start, fill in the total of $360°$ at the bottom of the frequency table.

Item	**Frequency**	**Angle (°)**
Skirts	10	
Trousers	16	
Dresses	6	
Blouses	13	
T-shirts	19	
Jackets	4	
Total	**68**	**360**



To work out each angle, use the basic chart method for each category. Start at the bottom of the frequency table and work your way up to the top. Here, the bottom line is 'jackets'. So, work out the angle for the jackets, using the simple chart rule: **multiply the numbers that are diagonal to each other and divide by the remaining number** (see the following frequency table).

Item	Frequency	Angle (°)
Skirts	10	
Trousers	16	
Dresses	6	
Blouses	13	
T-shirts	19	
Jackets	4	
Total	**68**	**360**

4 x 360 ÷ 68 =

1440 ÷ 68 = 21.2°

The total number of jackets (the frequency) is represented by an angle of **21.2°**. Round to **21°**. Fill **21°** in the table.

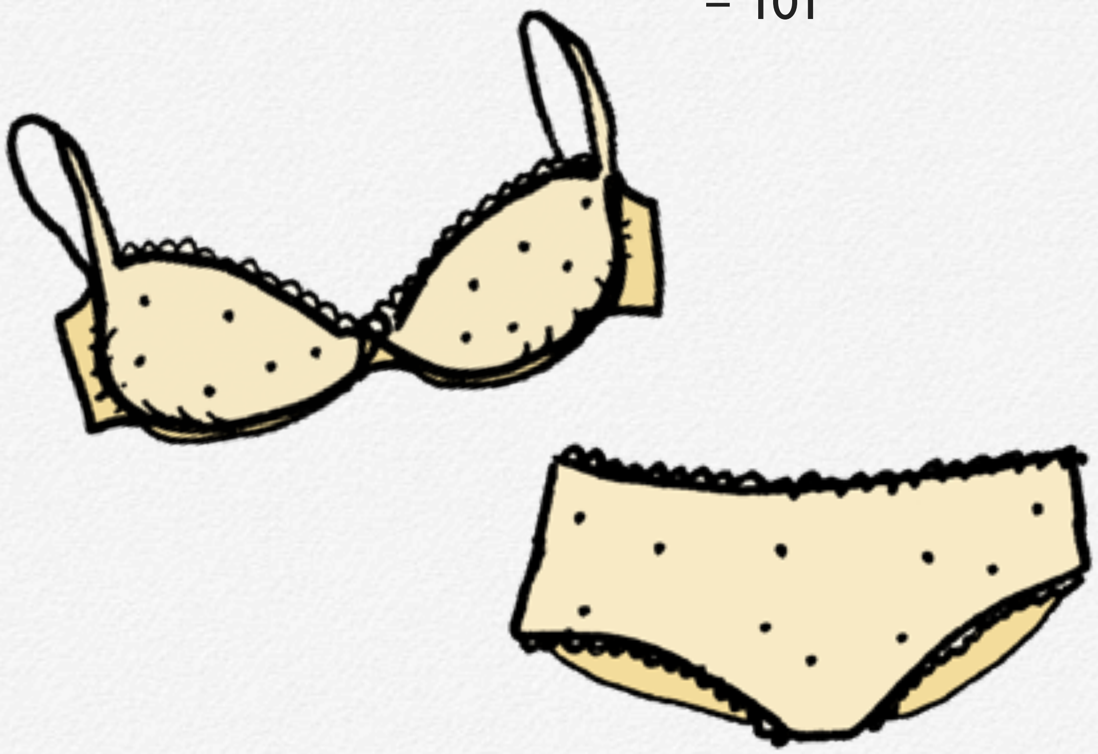
Next, cover the jacket line with a pencil and calculate the angle for the T-shirts. Repeat the basic chart method rule to calculate the T-shirt angle.

Item	Frequency	Angle (°)
Skirts	10	
Trousers	16	
Dresses	6	
Blouses	13	
T-shirts	19	
Ja		
Total	**68**	**360**

19 x 360 ÷ 68 =

6840 ÷ 68 = 100.6°

= 101°



Quick Trick

Notice that one part of the calculation remains the same each time: ? x **360 ÷ 68** = ?.

To save time, calculate **360 ÷ 68 = 5.29** and use this answer of 5.29 to simplify all your calculations, as follows.

So instead of ? **x 360 ÷ 68** = ANSWER, you can write…

… ? **x 5.29** = ANSWER

Examples:

To calculate the angle for the blouses: 13 x 5.29 = 68.8° = 69°

To calculate the angle for the dresses: 6 x 5.29 = 31.7° = 32°

To calculate the angle for the trousers: 16 x 5.29 = 84.6° = 85°

To calculate the angle for the skirts: 10 x 5.29 = 52.9° = 53°

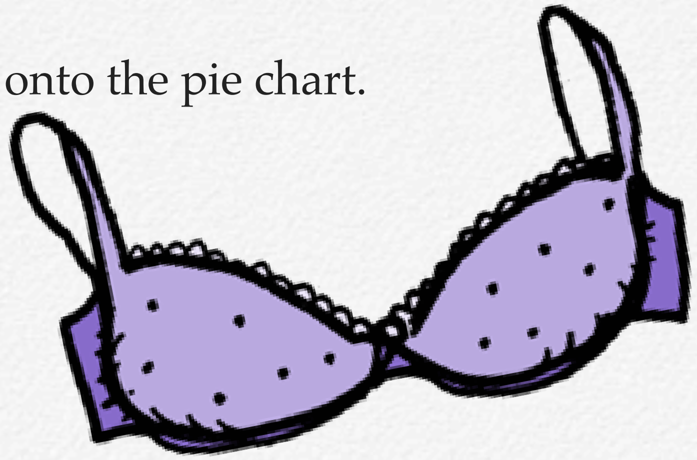
You can't use **5.29** for every pie chart, because the frequency total (number of items) will change with each chart. So make new ones.

Fill in all your answers into the table as you go: the resulting table will be as follows:

Item	**Frequency**	**Angle (°)**
Skirts	10	53
Trousers	16	85
Dresses	6	32
Blouses	13	69
T-shirts	19	101
Jackets	4	21
Total	**68**	**360**

Check that the angles in the angle column add up to **360°**. Due to rounding, it may add up to **359°** or **361°**. So adjust one of the other angles (preferably the biggest); one degree will not make a significant difference to the overall picture of the pie chart. Here, the T-shirt angle will be reduced to **100°** rather than **101°**.

Now, draw the angles onto the pie chart.

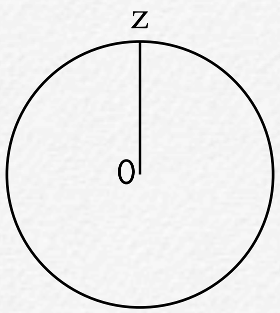


How to Draw your Pieces of Pie

If you were to write detailed instructions for making a cup of tea for a visitor from Mars, it would fill a page and look complicated. Similarly, what follows is very simple, as soon as you've done it once.

With your compass, draw a circle, with a dot at the centre. Draw a line from the centre of your pie chart to the edge of the circle. You will measure your first angle from this line. Here, the centre is marked by **0**, (centre points are always marked zero). The point where the line hits the circle is marked here with a Z.

<u>Drawing A</u>



Start with the smallest angle from the last frequency table. In this example, the smallest angle is **21 °** (Coral's jackets). Next, are Coral's dresses.

The British love National Treasure Clare Balding. Sport commentator, former junior champion rider.

To choose a role model, Clare advises, "Who moves you? Who makes you get up in the morning thinking, 'Yes, I've only got one life and I'm going to use it!' "

How to Use a Protractor

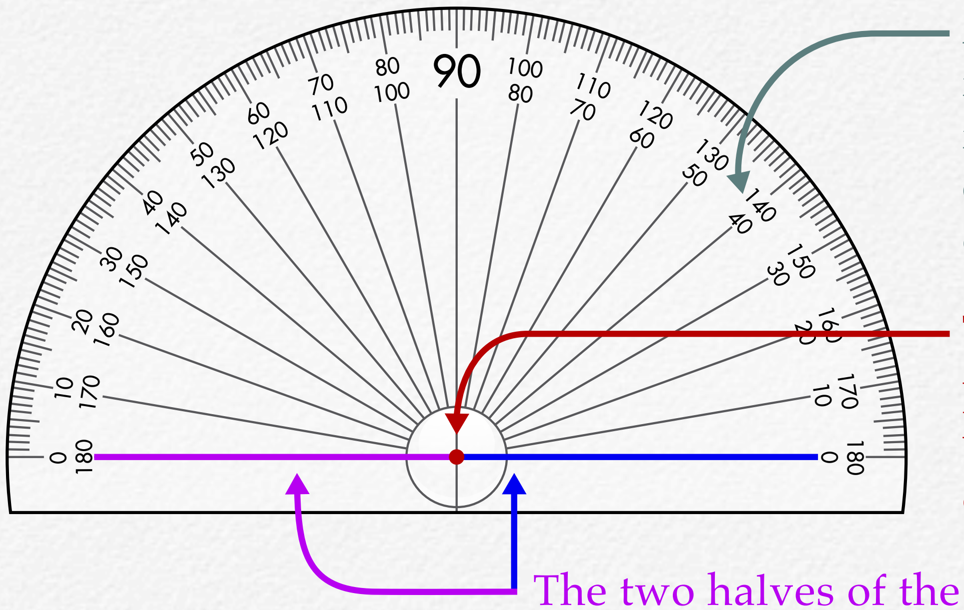
Next, get a protractor, a tool which measures angles on paper and helps you draw them. When placing your protractor on your diagram, watch out for two important points.

1) The **centre of the protractor's** baseline must be placed exactly on the centre point **O** of your diagram.

2) Half the **base line of the protractor**, MUST BE EXACTLY ON TOP OF THE LINE **OZ** ON YOUR DIAGRAM.

<u>Drawing B:</u>

<u>Important points on your protractor.</u>

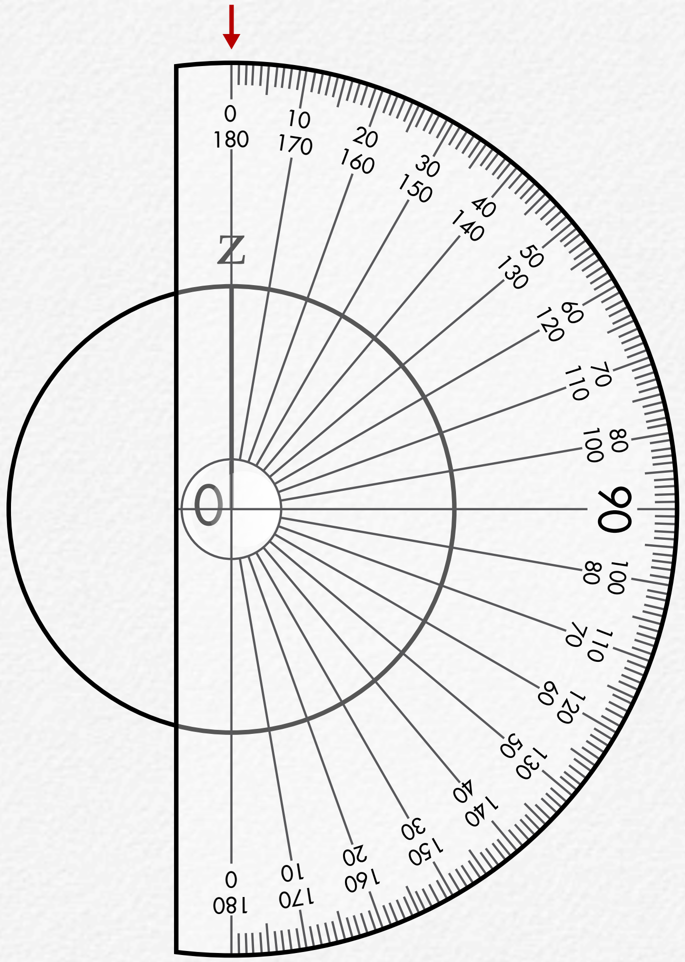


A protractor has two scales for measuring degrees: one for measuring clockwise and one for measuring anti-clockwise (see later).

The centre point on the protractor needs to line up with the exact centre of the circle on your diagram.

The two halves of the base line go right across the protractor.
Half of the base line of your protractor needs to be lined up with the first line of any angle drawn on paper.
Which half? It doesn't matter (see later).

If you choose to make **clockwise** pie slices, place the protractor to the right, like this, and start reading the scale from the arrow point, 0°, 10°, 20° and so on.

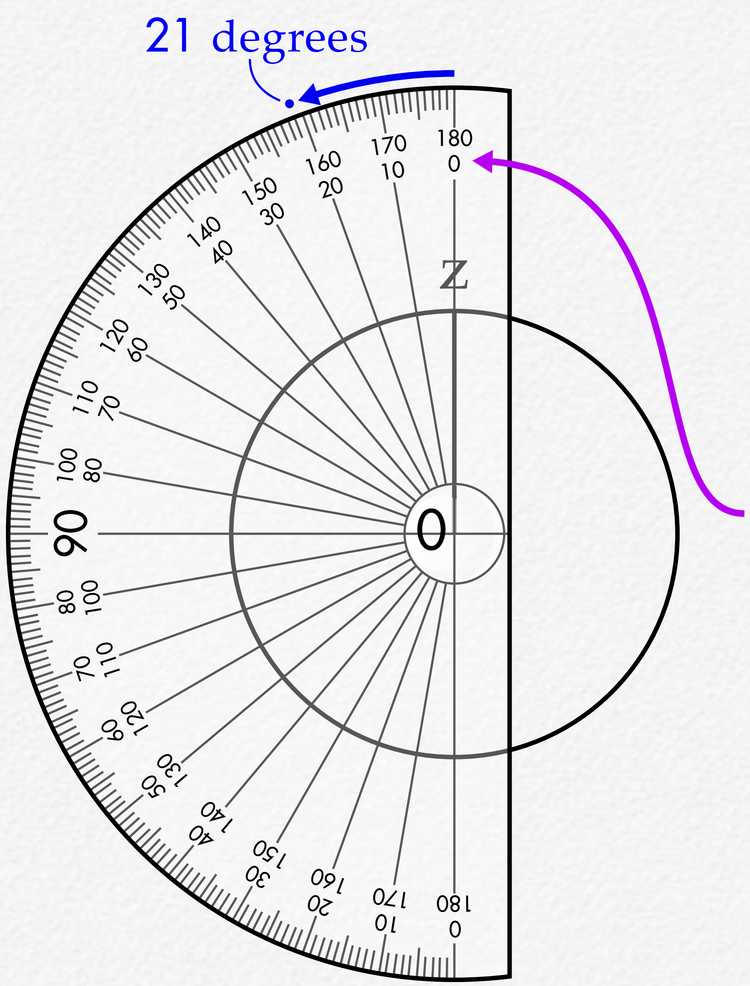


Protractor position when drawing an angle from the line OZ to the right (clockwise).

Achiever. Former Spice Girl, excellent fashion designer and businesswoman, Victoria Beckham, mother of four, overcame spotlit career setbacks to create her family brand, the 3rd best known on the planet (after the British Royal Family and the family in the White House).

<u>Drawing C: How to use your protractor.</u>

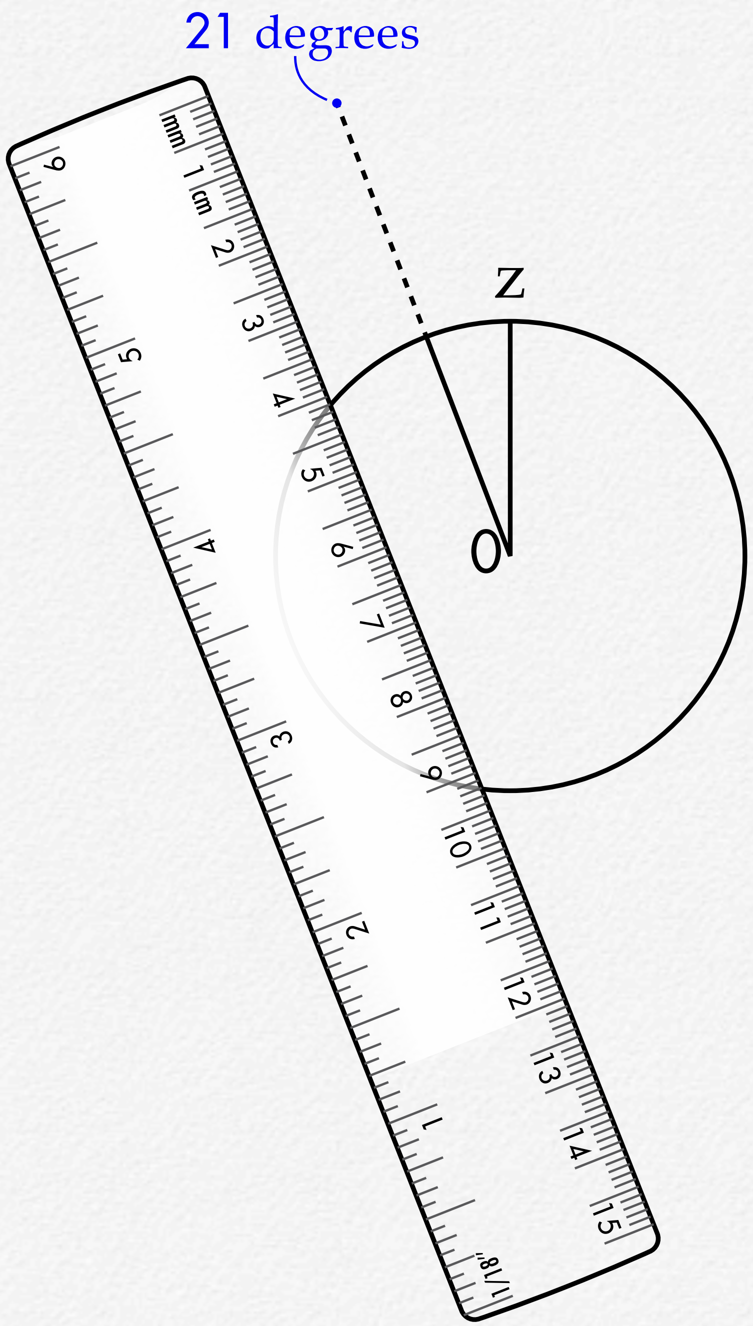
If you choose anti-clockwise pie slices (to the left)...
Place your protractor on the left as shown in diagram C.
Line up the protractor with your chosen start line 0Z.
Make sure the central cross of the protractor is placed **exactly on top of the 0** in line 0Z.



There are two scales written on the protractor. How do you choose which scale to use? You've already placed the base line of the protractor on the line 0Z. Look beyond Z to the two scales: one will read 180 and one will read 0. ALWAYS CHOOSE THE ZERO.

On the last frequency table, **Coral's jackets** were represented by **21°**. So count **21°** anti-clockwise on your protractor and make a dot at the edge of the protractor at **21°**.

Drawing D: Anti-clockwise pie slices.

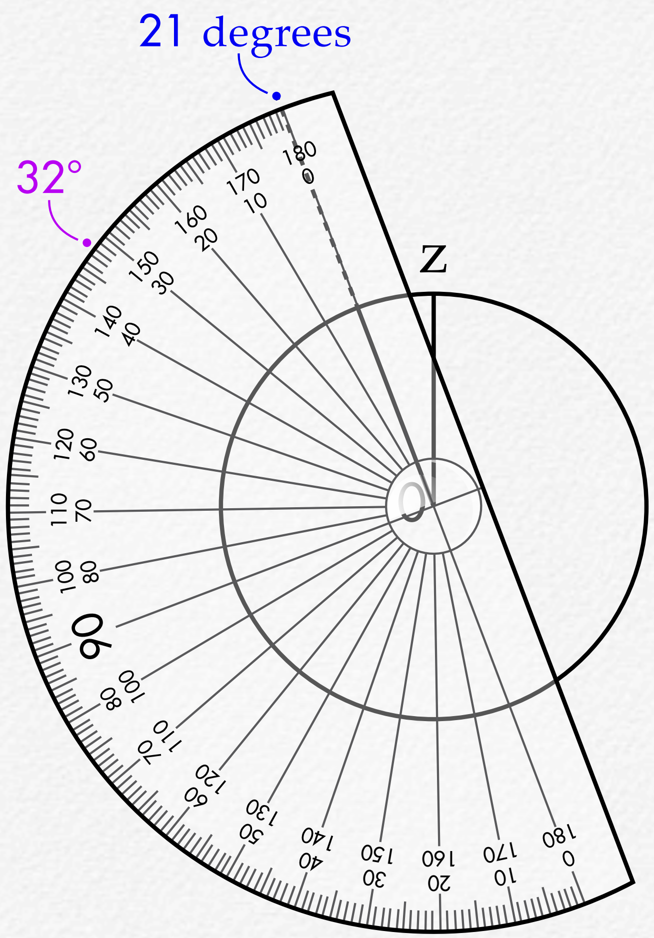


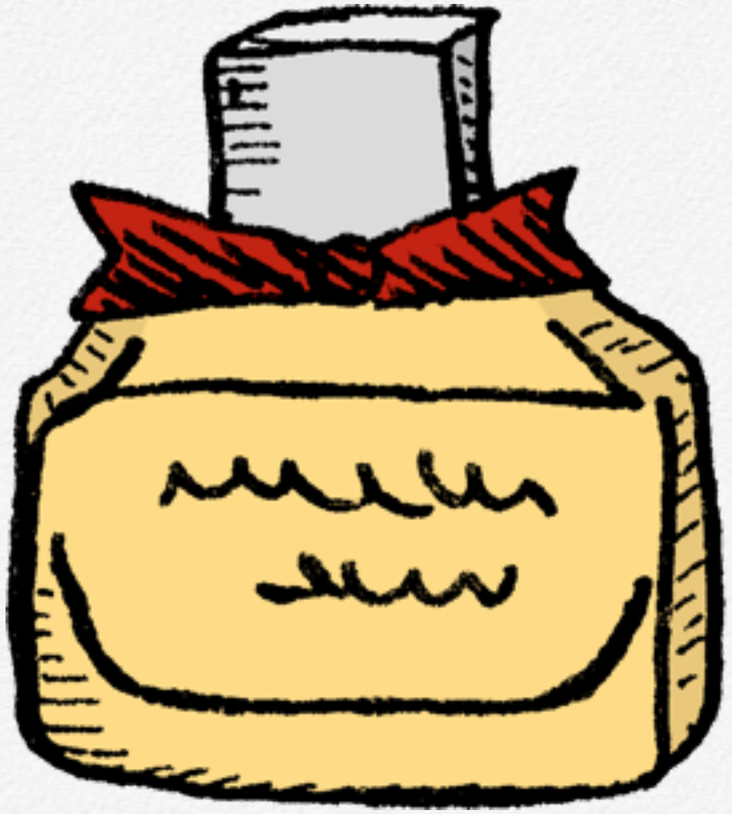
Remove the protractor and join the dot with the centre of the circle, using a ruler, or flat edge of the protractor.

The resulting piece of pie has an angle of **21** degrees at its centre.

The next smallest angle on the last frequency table is **32°** which represents **Coral's dresses**. To measure **32°** on your diagram, put your protractor back on your diagram but **don't align the base line of the protractor with your line 0Z**. Instead **place the base line of the protractor on the 21° line**, making sure that the centre of the protractor's base line is on the centre of your circle.

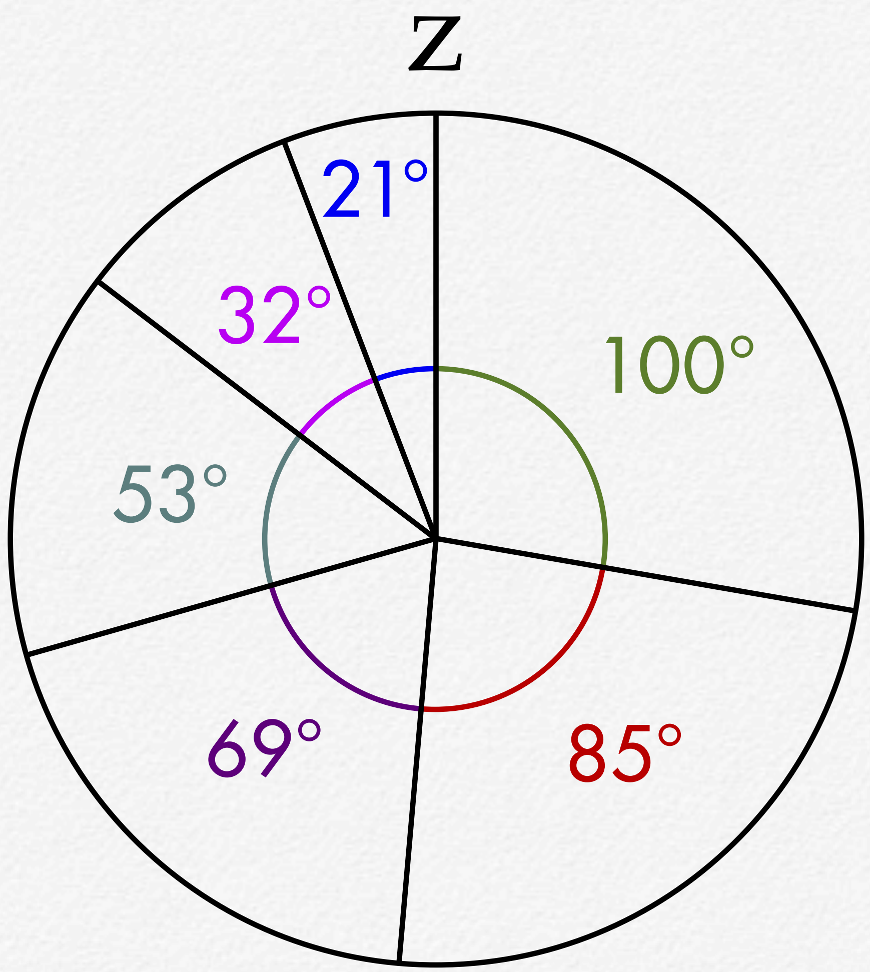
<u>Drawing E</u>

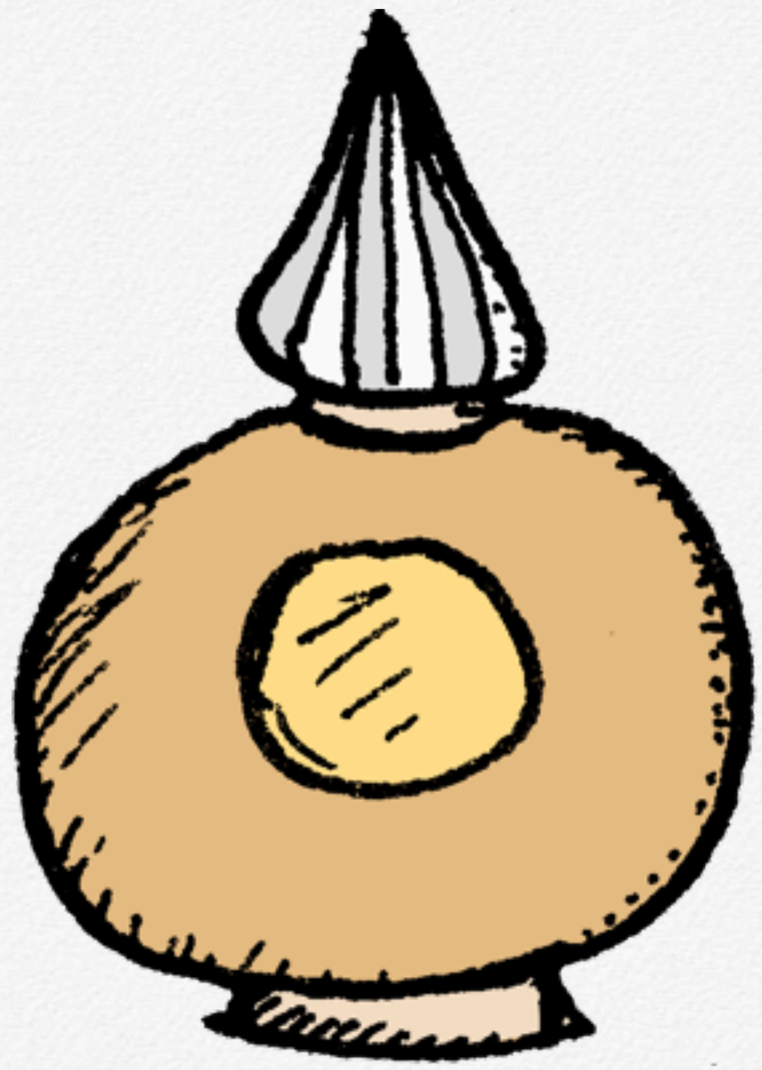




Now measure and draw the angle for **Coral's skirts**, which is 53°. The next slice of pie will measure 69° for **Coral's blouses**. Then 85° for **Coral's trousers**. There's no need to draw the remaining T-shirt angle of 100°, but put your protractor on the last trouser line and check that the remaining slice measures about 100°. This is also a way of double-checking that your angles are correct. If the T-shirt slice of pie isn't close to 100°, you've inaccurately measured one of your previous angles.

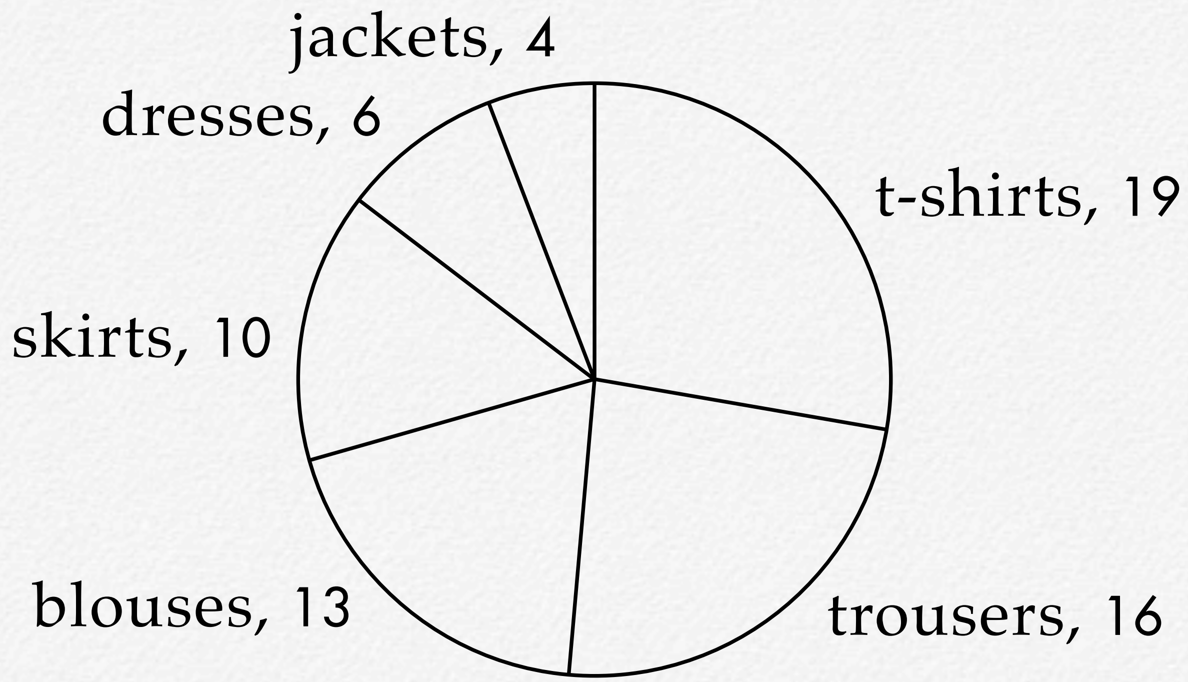
Drawing F





You can now draw a pie chart. To complete it professionally, give the pie chart a title which says what it does. Then look back to your last frequency chart and label each slice of pie with the item name plus the frequency number. Example: jackets **4**, followed by dresses **6**, followed by skirts **10**, etc. You may want to colour or shade each piece differently, to give added clarity.

<u>Pie Chart of Fitness Trainer Coral's Clothes</u>



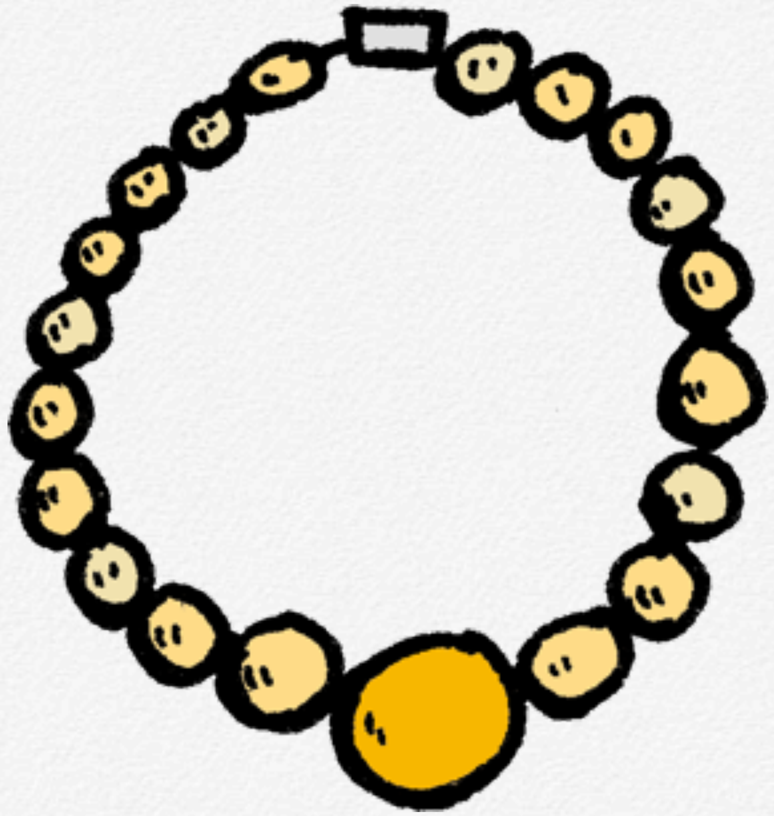
Exercises

1) The following figures show Antonia's home-made necklace sales during her first month of selling jewellery online.

£15	£7.50	£18	£5	£10	£5	£8	£12.50	£4	£5	£10	£9

a) Fill in the **tally chart** that follows using the data from Exercise 1.

Class Interval	Tally	Total
£0 to £4.99		
£5 to £9.99		
£10 to £14.99		
£15 to £19.99		
Over £20		



b) Use the information from your tally chart to make a **frequency table**.

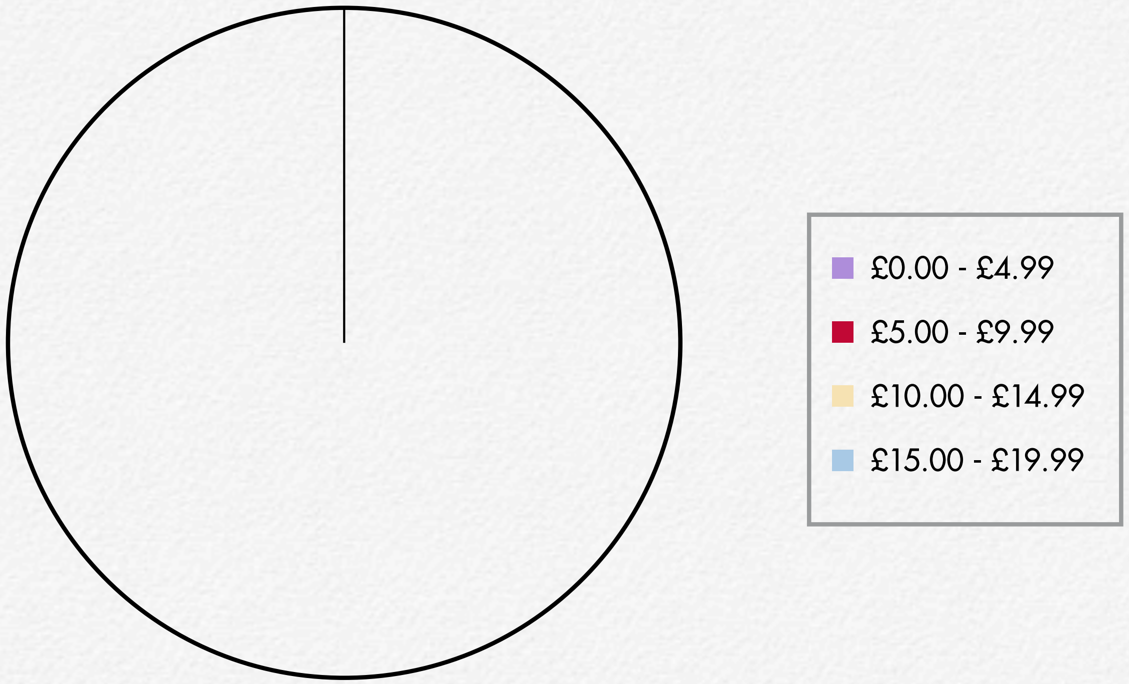
Class Interval	Frequency
Total	

c) Use your frequency table to construct a **bar chart** showing Antonia's necklace sales in her first month online.

Bar Chart showing the Values of Antonia's First Month of Online Necklace Sales

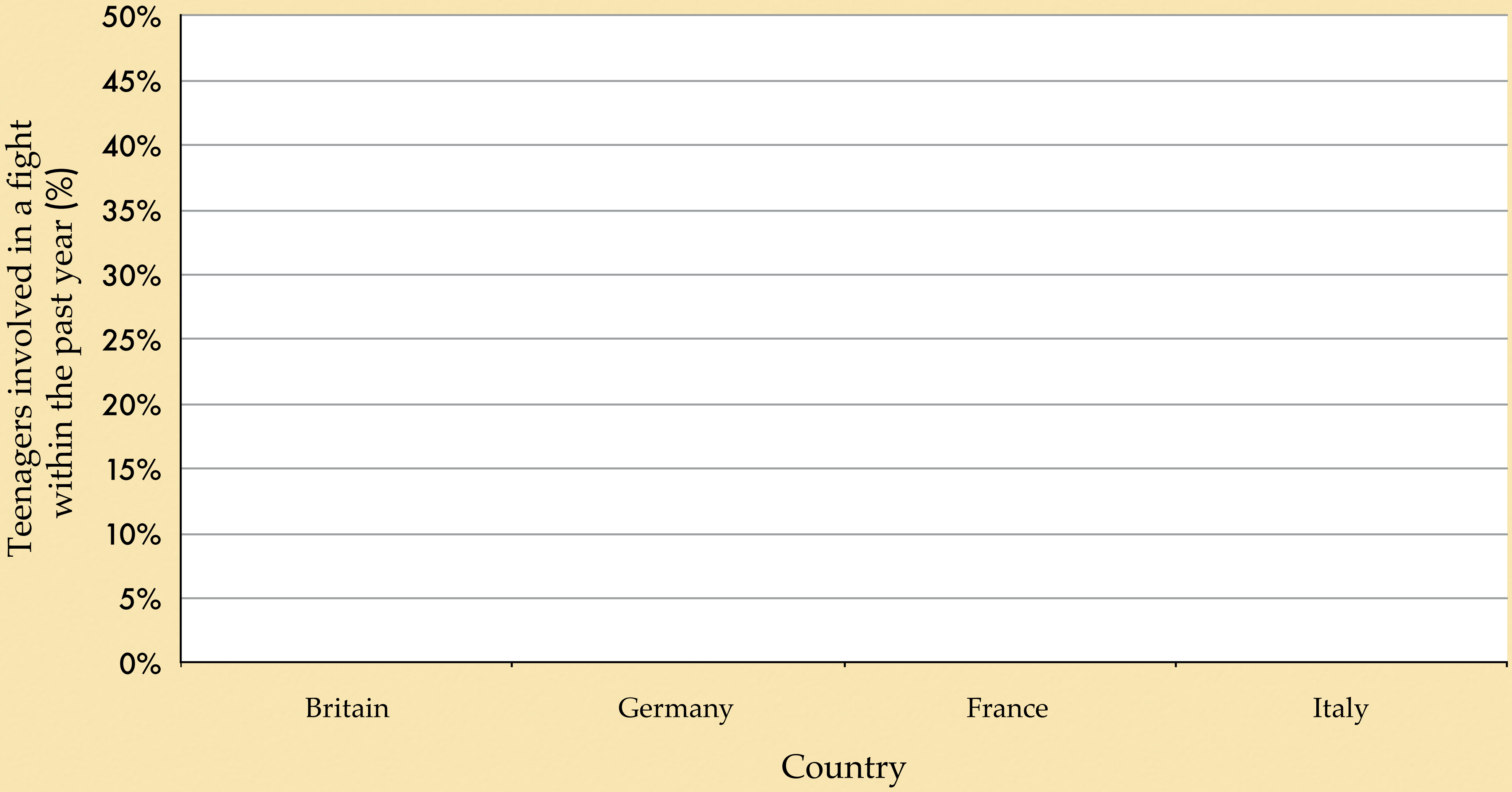
d) Use your frequency table again to calculate the angles for a **pie chart** containing all the information, then construct the pie chart. Hint: on your frequency table add another column, for angles.

Pie Chart showing the Values of Antonia's First Month of Online Necklace Sales



2) A 2007 newspaper report stated, "**44%** of British teenagers have been involved in a fight within the past year, compared with **28%** in Germany, **36%** in France and **38%** in Italy."

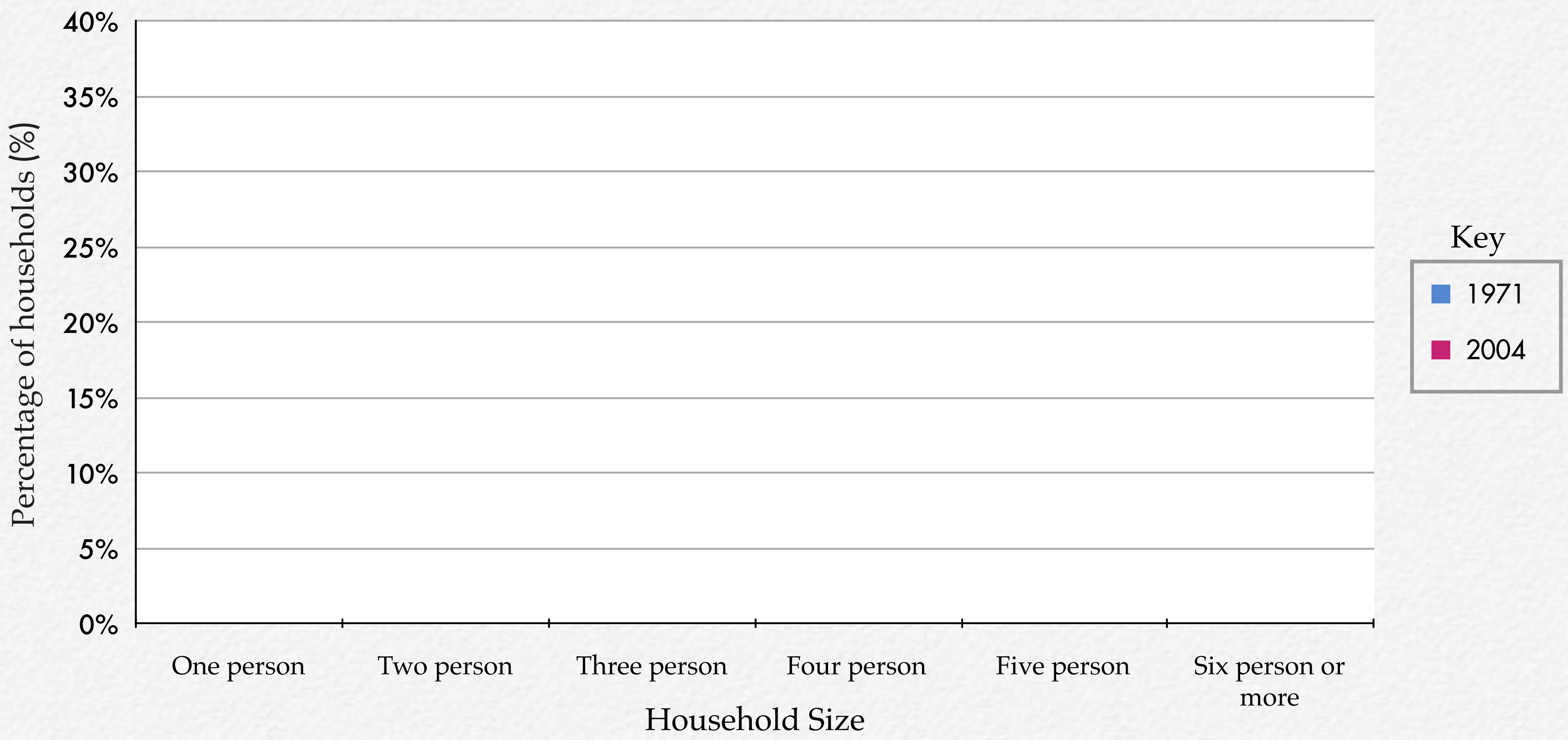
Present the data given in the newspaper report as a bar chart. First, draw what's below.



3) The following table gives information about the sizes of households in Britain in 1971 and 2004.

Household	**Percentage of households**	
	1971	**2004**
One person	18	29
Two person	32	35
Three person	19	16
Four person	17	14
Five person	8	5
Six person or more	6	2

a) Draw a **compound bar chart** to visually compare the two sets of data on the graph that follows. Draw the 1971 bars and 2004 bars next to each other (use search icon to go to Compound Bar Chart Showing Princess Caroline's Underwear).



b) How have UK household sizes changed between 1971 and 2004?

4) Make a **pie chart** showing the changes in financial position that occur when people begin to live alone.

Change in Financial position	Percentage of people who began to live alone. (%)	Angle (°)
Better off	25	
Worse off	43	
About the same	32	
Total		

Makeup palette and brushes.

Colour is coded by numbers.

Answers to Part 22

1) The following figures show Antonia's home-made necklace sales during her first month of selling online.

£15 £7.50 £18 £5 £10 £5 £8 £12.50 £4 £5 £10 £9

a) Fill in the **tally chart** that follows using the data from Exercise 1.

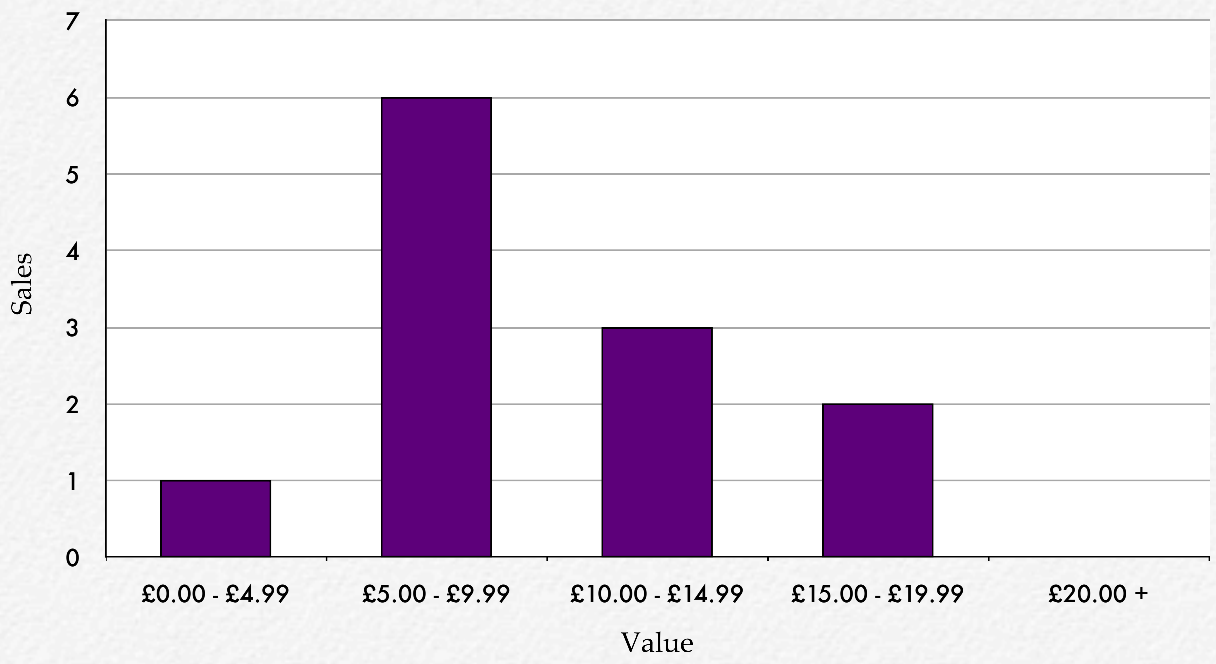
Class Interval	Tally	Total
£0 to £4.99	*I*	1
£5 to £9.99	*~~IIII~~ I*	6
£10 to £14.99	*III*	3
£15 to £19.99	*II*	2
Over £20		0

b) Use the information from your tally chart to make a **frequency table**.

Class Interval	Frequency
£0 to £4.99	1
£5 to £9.99	6
£10 to £14.99	3
£15 to £19.99	2
Over £20	0
Total	**12**

c) Use your frequency table to construct a **bar chart** showing Antonia's necklace sales sold in her first month online.

Bar chart showing the Value of Antonia's First Month of Online Necklace Sales



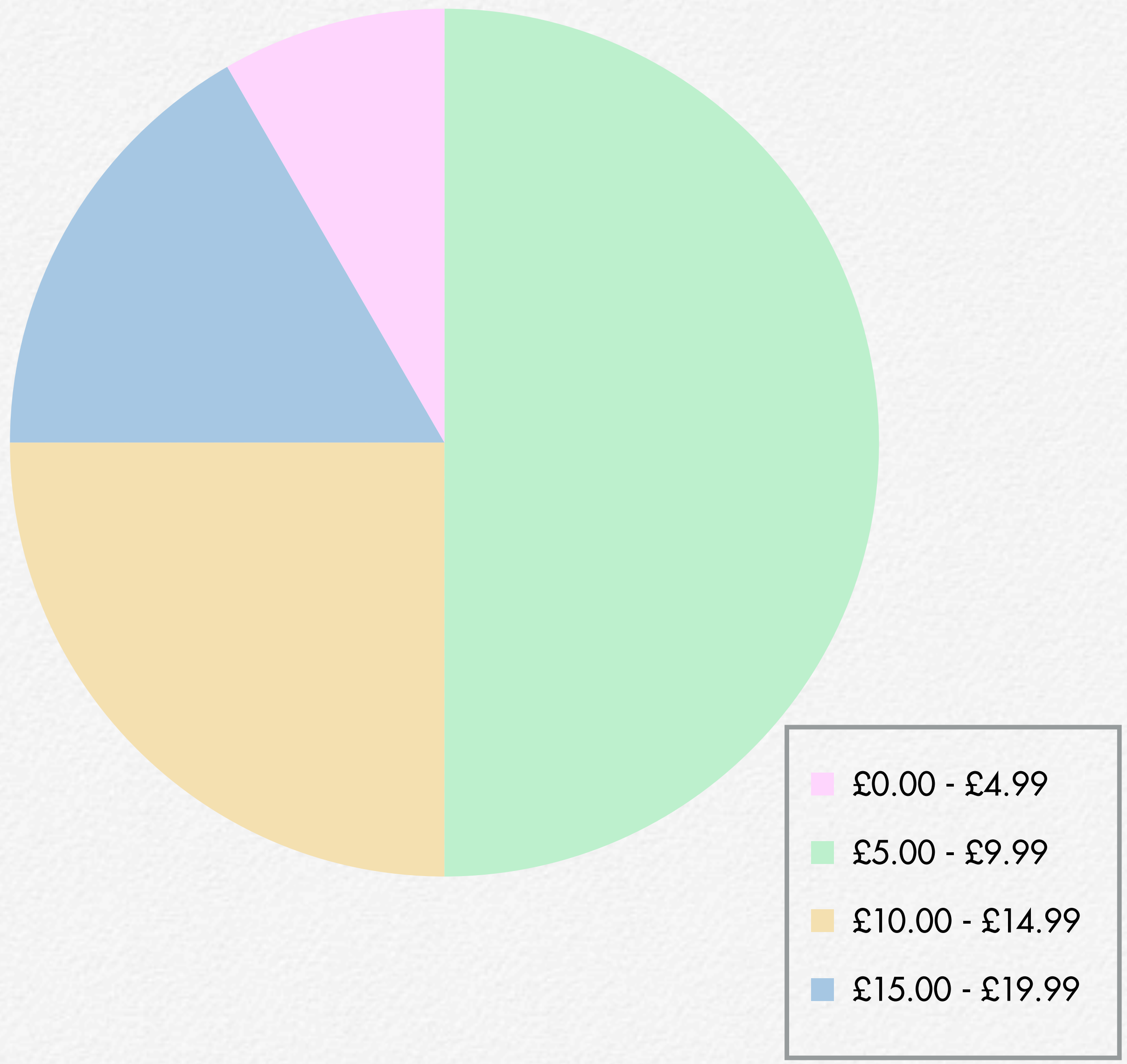
d) Use your frequency table again to calculate the angles for a **pie chart** containing all the information, then construct the pie chart.

Hint: on your frequency table add an extra column, for angles.

In the angle column, insert **360°** as the total.
Then work **up** the frequency table, using
the basic chart method to fill in the missing angles:

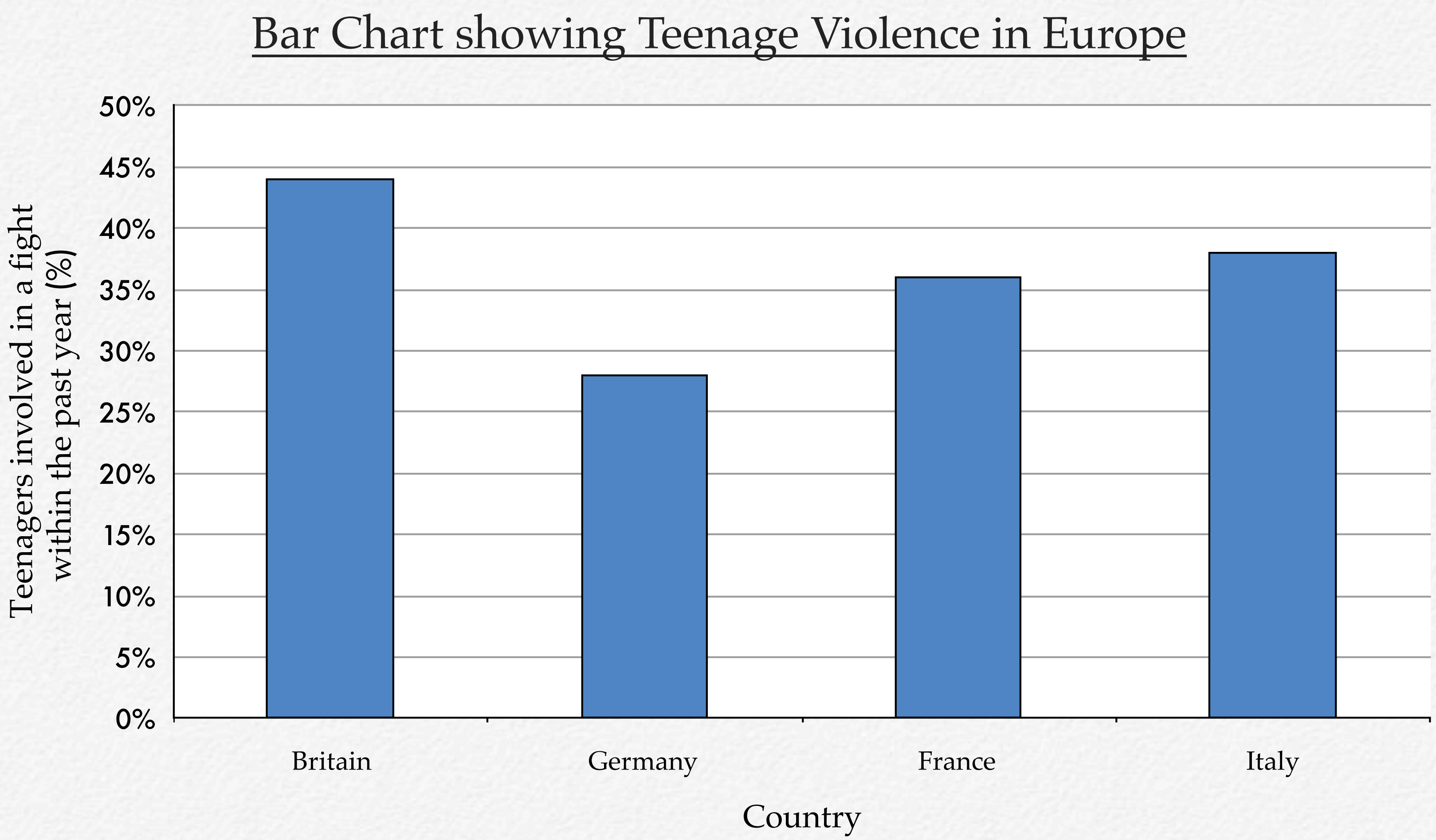
Class Interval	Frequency	Angle	(Calculations)
£0 to £4.99	1	30°	1 x 360 ÷ 12
£5 to £9.99	6	180°	6 x 360 ÷ 12
£10 to £14.99	3	90°	3 x 360 ÷ 12
£15 to £19.99	2	60°	2 x 360 ÷ 12
Over £20	0	0°	0 x 360 ÷ 12
Total	**12**	360°	

Pie Chart showing the Values of Antonia's First Month of Online Necklace Sales



2) A **2007** newspaper report stated, "**44%** of British teenagers have been involved in a fight within the past year, compared with **28%** in Germany, **36%** in France and **38%** in Italy."

Present the data given in the newspaper report as a bar chart.

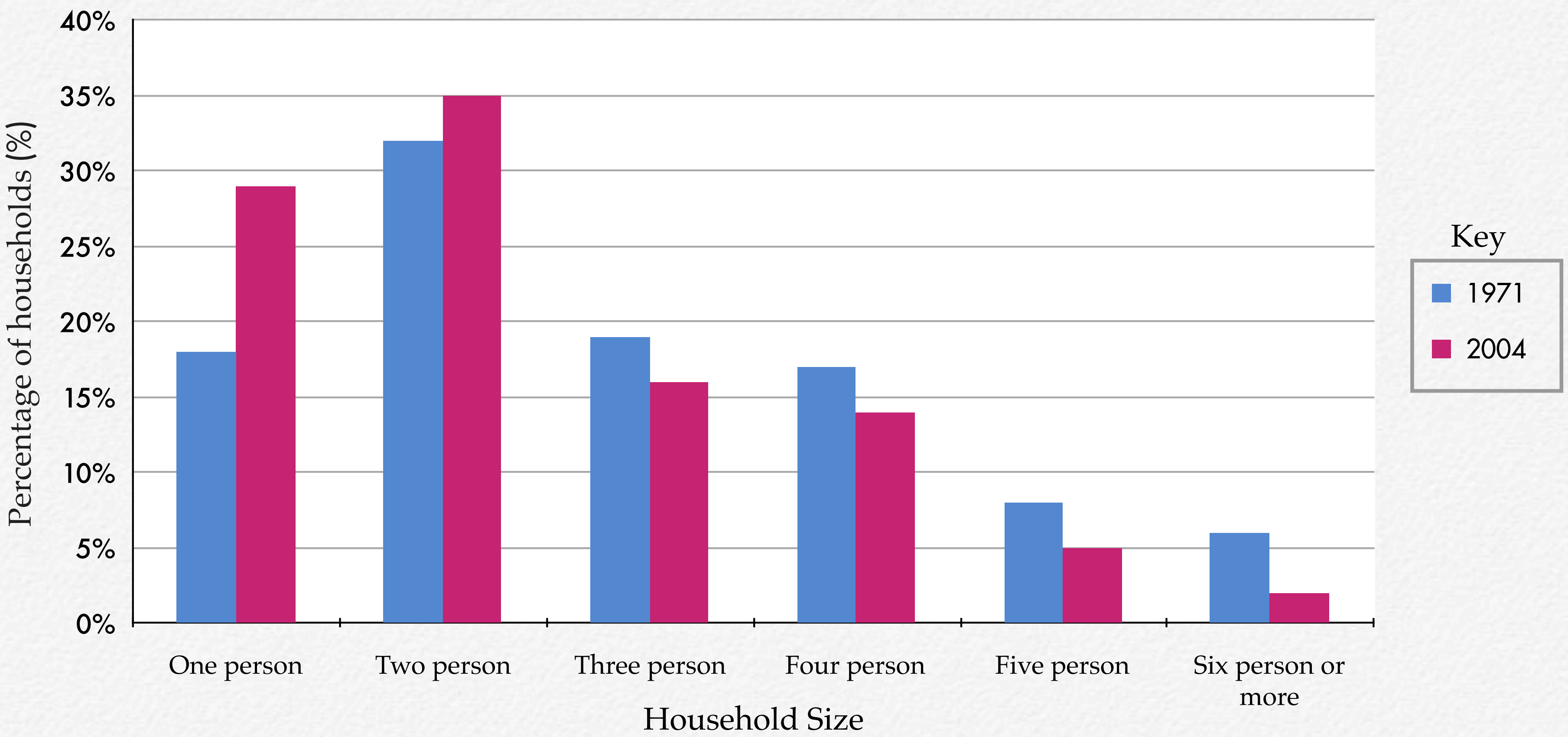


3) The following table gives information about the sizes of households in Britain in **1971** and **2004**.

Household	Percentage of households	
	1971	**2004**
One person	18	29
Two person	32	35
Three person	19	16
Four person	17	14
Five person	8	5
Six person or more	6	2

a) Draw a **compound bar chart** to visually compare two sets of data on the following graph.
Draw the **1971** bars and **2004** bars next to each other (see compound bar chart on page 121).

Bar Chart showing the size of households and distribution in 1971 and 2004



b) How have UK household sizes changed between 1971 and 2004?

Answer: **Between 1971 and 2004, there had been an increase in the percentage of one-person and two-person households.**
The biggest increase was in one person households.

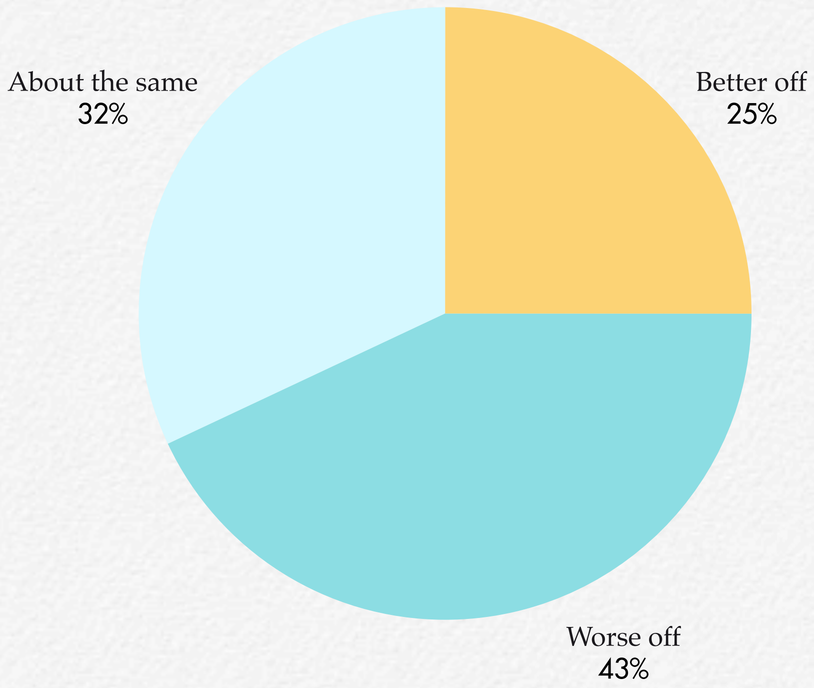
The percentage of households bigger than two-persons in 1971 had all decreased by 2004.

Colour used on classical building.
Numbers used to calculate paint required.

4) Make a pie chart showing the changes in financial position that occur when people begin to live alone.

Change in Financial position	Percentage of people who began to live alone. (%)	Angle (°)
Better off	25	90
Worse off	43	155
About the same	32	115
Total	**100**	**360**

Pie Chart showing the change in Financial Position that occurs when people begin to Live Alone



Colour can brighten a dull wall, or your pie chart.

YOUR BRAIN WORKOUT

Q1.

Choose the correct class intervals suitable for the following data.

Age **2** to age **21**, split into **4** classes?

- **A.** 2 - 5, 6 - 10, 11 - 14, 15 - 21
- **B.** 2 - 6, 7 - 11, 12 - 16, 17 - 21
- **C.** 2 - 6, 7 - 11, 11 - 16, 16 - 21
- **D.** 2 - 5, 7 - 11, 12 - 16, 17 - 21

YOUR BRAIN WORKOUT

Q2.

Choose the correct class intervals suitable for the following data.

Weights from **0** to **11.99 kg**, in **3** classes?

- **A.** 0 kg – 3.99 kg, 4.00 kg – 6.99 kg, 9.00 kg – 11.99 kg
- **B.** 0 kg – 3.99 kg, 3.00 kg – 7.99 kg, 8.00 kg – 11.99 kg
- **C.** 0 kg – 4.99 kg, 5.00 kg – 8.99 kg, 9.00 kg – 11.99 kg
- **D.** 0 kg – 3.99 kg, 4.00 kg – 7.99 kg, 8.00 kg – 11.99 kg

YOUR BRAIN WORKOUT

Q3.

Choose the correct class intervals suitable for the following data.

The number of roses per plant from 0 to 14, split into 3 classes?

- **A.** 0–5, 5–10, 10–14
- **B.** 0–5, 6–11, 12–14
- **C.** 0–4, 5–9, 10–14
- **D.** 0–4.9, 5–9.9, 10–14

YOUR BRAIN WORKOUT

Answers

Q1. 2 - 6, 7 - 11, 12 - 16, 17 - 21

Q2. 0 kg – 3.99 kg, 4.00 kg – 7.99 kg, 8.00 kg – 11.99 kg

Q3. 0–4, 5–9, 10–14

PART 23
GRAPHS

Quick Quiz

Q1.

What is **25,000 ÷ 500**?

- **A.** 50
- **B.** 500
- **C.** 5,000
- **D.** 500,000

Quick Quiz

Q2.

Each ticket costs **£4.15**. Approximately, how much will nine tickets cost?

- **A.** £40
- **B.** £50
- **C.** £400
- **D.** £500

Quick Quiz

Q3.

At what temperature does water boil?

- A. 50°C
- B. 37°C
- C. 0°C
- D. 100°C

Quick Quiz

Q4.

How many inches in a foot?

- A. 10
- B. 12
- C. 14
- D. 20

Quick Quiz

Answers

Q1. 50

Q2. 40

Q3. 100˚C

Q4. 12

Graphs

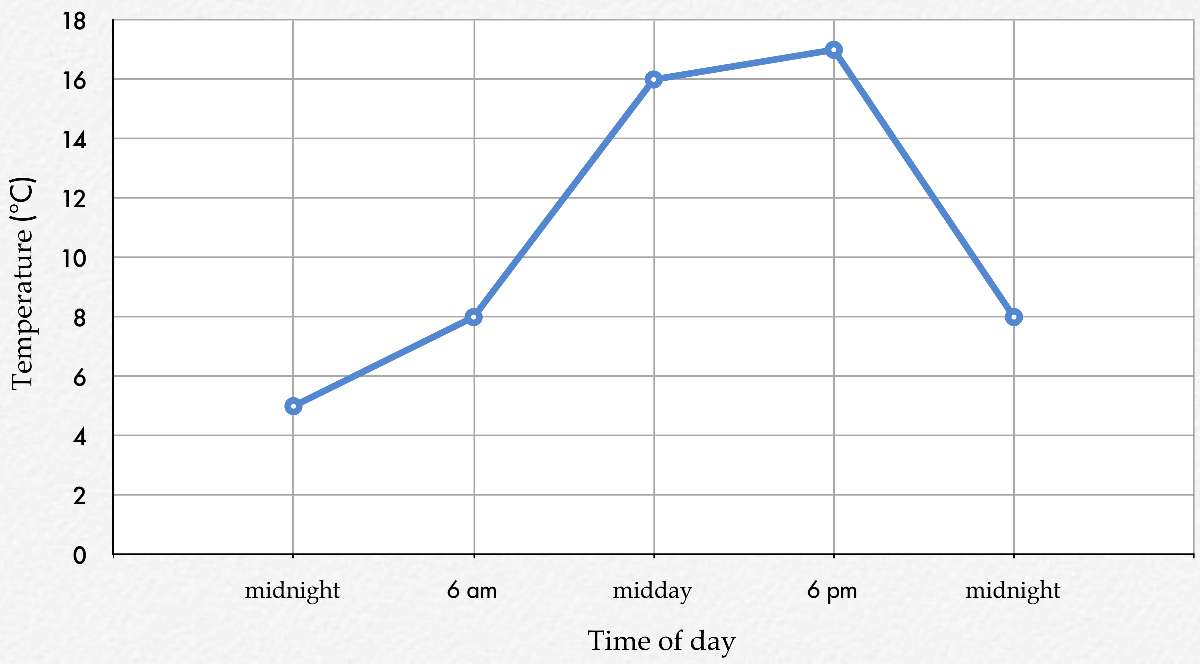
Graphs are used constantly in business: they use straight lines, curves and jagged lines; all of these sometimes cross over each other, if used for comparisons.

A graph (sometimes called a chart) is used to show the relationship between two sets of variables. **What's a variable**, you may wonder? A quantity that changes from place to place or from time to time. It varies.

Here is a graph of the temperature for one May day in London. The time of day (one variable) is written along the x–axis, and the temperature (the other variable) is written up the y–axis, which can be on the left or right of the graph.

If 'time' is to be one of the axes on the graph, it is **always** put along the horizontal axis, the x–axis.

Graph to show the temperature in London on 8th May 2007



The temperature was measured at midnight, **6 am**, midday, **6 pm** and again at the following midnight. The results were plotted on the graph with dots. The dots were joined together with a line, to give a swift, easy picture of temperature changes throughout the day.

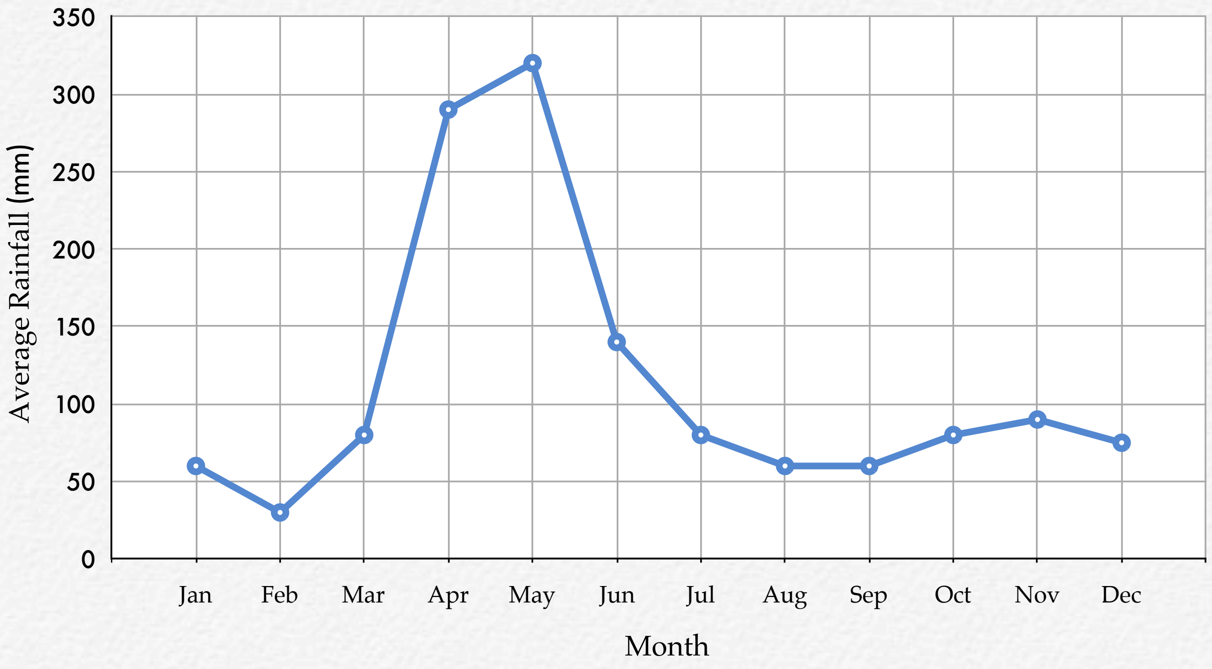
Simple Graphs

First Example

How to read a graph

You want to go to Kenya and don't want to arrive in the wet monsoon season, so you look online for a graph of last year's rainfall in Kenya. Stupidly, I didn't do this before my last trip to Kenya in early May, so I arrived in the monsoon and had to endure torrential rain for 14 days.

Graph of Average Rainfall, Nairobi, Kenya from 1970 to 2000



The graph of the **Average Rainfall, Nairobi, Kenya**, tells you that for most of the year, the Kenya rainfall is less than 100mm a month; in January, February and from July to December. But the 'mountain' in the middle of the graph shows that the rainfall is usually much higher during March to June. These are the months to avoid if you don't want a wet holiday.

You can see that the peak rainfall is in May when, on average, there is about 320 mm of rain. February is usually the driest month in Kenya .

Rainfall is always measured in millimetres; 320 mm is 32 centimetres, which is a bit longer than the length of a 30 cm ruler.

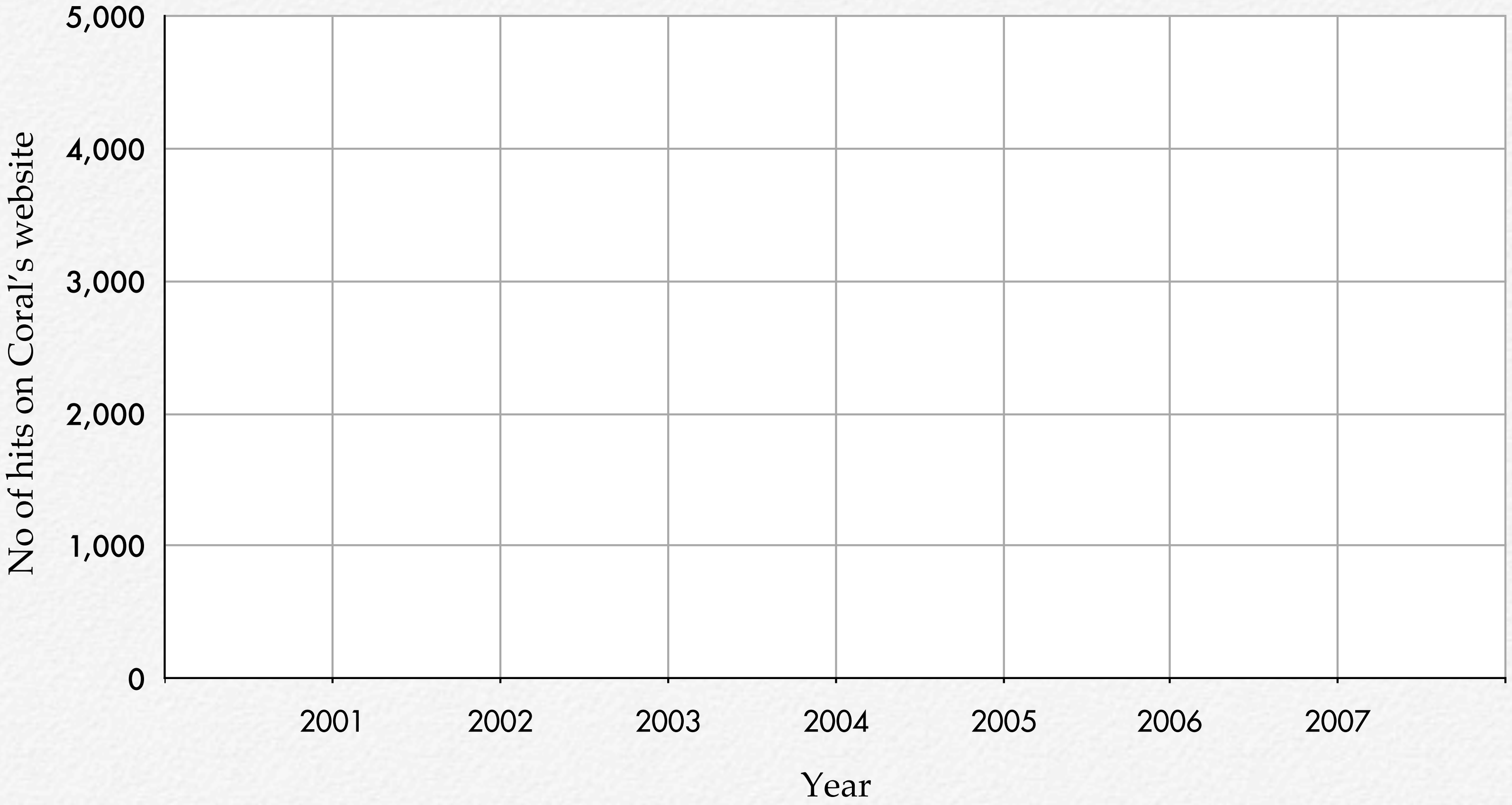
Exercise to plot a graph

1) In 2001 Coral launched her own website to advertise herself as a personal trainer. The approximate number of hits received each year on her website is recorded in the table that follows.

Year	2001	2002	2003	2004	2005	2006	2007
No of hits	1,300	1,500	1,400	4,200	4,600	4,500	4,700

Copy the following grid and plot the points on it to show on the graph how the number of hits on Coral's website have changed:

Graph to show the Hits on Coral's Webpage from 2001 to 2007



Notice a sharp rise in the number of hits received by Coral's website between 2003 and 2004: this was because one of the main search engines listed Coral's website.

The following graph shows gold prices from January 1985 to January 2008. The graph line is jagged because the gold price constantly fluctuates during each day. In Real Life, graphs sometimes need to squash a lot of information into a limited amount of space. That's why (in this example) it's hard to see the position of 1991 – when halfway between 1990 and 1992.

Gold - London PM Fix 1985 - 2008

Exercises

2) From the information given in the chart above, answer the following questions:

a) In which year was the gold price lowest during this period?

b) In which year was the gold price highest during this period?

c) How might you expect the prices of gold to continue in February 2008? Up or down?

Hint: Simply ask yourself, "Based on this graph, should gold continue to rise or plunge in February?"

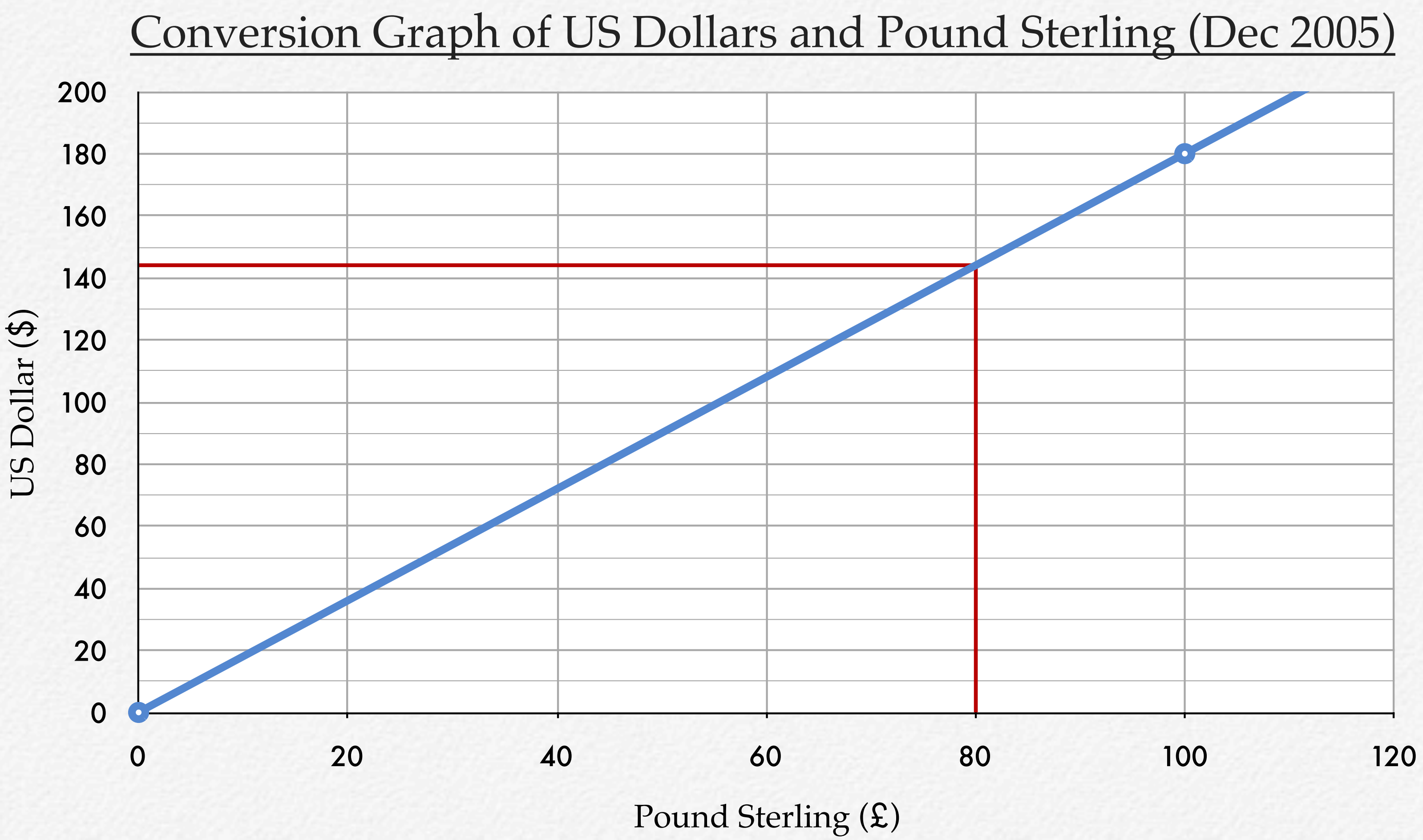
To do this, continue the direction of the gold line on the graph, off the edge of the right hand side of the chart into February.

Conversion Graphs

You will need to print, or copy on paper, the charts in this section that you need to work on.

A conversion graph is useful if you want to find rough equivalents between two currencies or some other units of measure. Below is an example of a **£** and **$** currency conversion graph, assuming **£1 = $1.80**.

The graph is drawn by first plotting the point at which **£100** meets **$180**. This point is then connected by a blue line to zero at the **origin of the graph** (the point at which the y–axis and x–axis meet).



How to use an existing conversion graph

The blue diagonal line on this graph is the conversion line for the **£** to **$** exchange rate at a certain point in time. To know the amount of dollars you would get in exchange for, say **£80**, you find **£80** on the x–axis labelled **pounds**. From this point, place your ruler or pencil vertically up on your page until you hit the existing blue diagonal graph line (see red lines on the **Conversion Graph of US Dollars and Pounds Sterling**). Next, turn left and head towards the y–axis where you will see the dollar reading and know that **£80** is equivalent to a little more than **$140**, approximately **$142**.

You can also use this chart to calculate the equivalent amounts of **£800**, or **£8,000**, simply by adding the same number of extra noughts to **$142**.

If **£80 = $142**, then **£800** will be **$142 x 10 = $1,420**

If **£80 = $142**, then **£8,000** will be **$142 x 100 = $14,200**

Using the same graph, you can convert money the other way around. If you want to know how much **$60** is in **£**, start at **$60** on the vertical axis, then draw a line across to the blue diagonal graph line, then down to the horizontal axis to read the **£** value.

Try it. You should find **$60** equivalent to about **£35**.

Readings from a conversion graph only give you an approximate answer. (The basic chart method will give you accurate answers).

However, the graph is a good, quick guide for converting, especially if you are continually converting between two specific units such as pounds to dollars, which is written **£**/**$** or pounds to roubles, written **£**/roubles.

The graph is also useful for all measurement conversions, such as imperial/metric in all variations.
Examples: feet/metres, pints/litres, miles/kilometres.

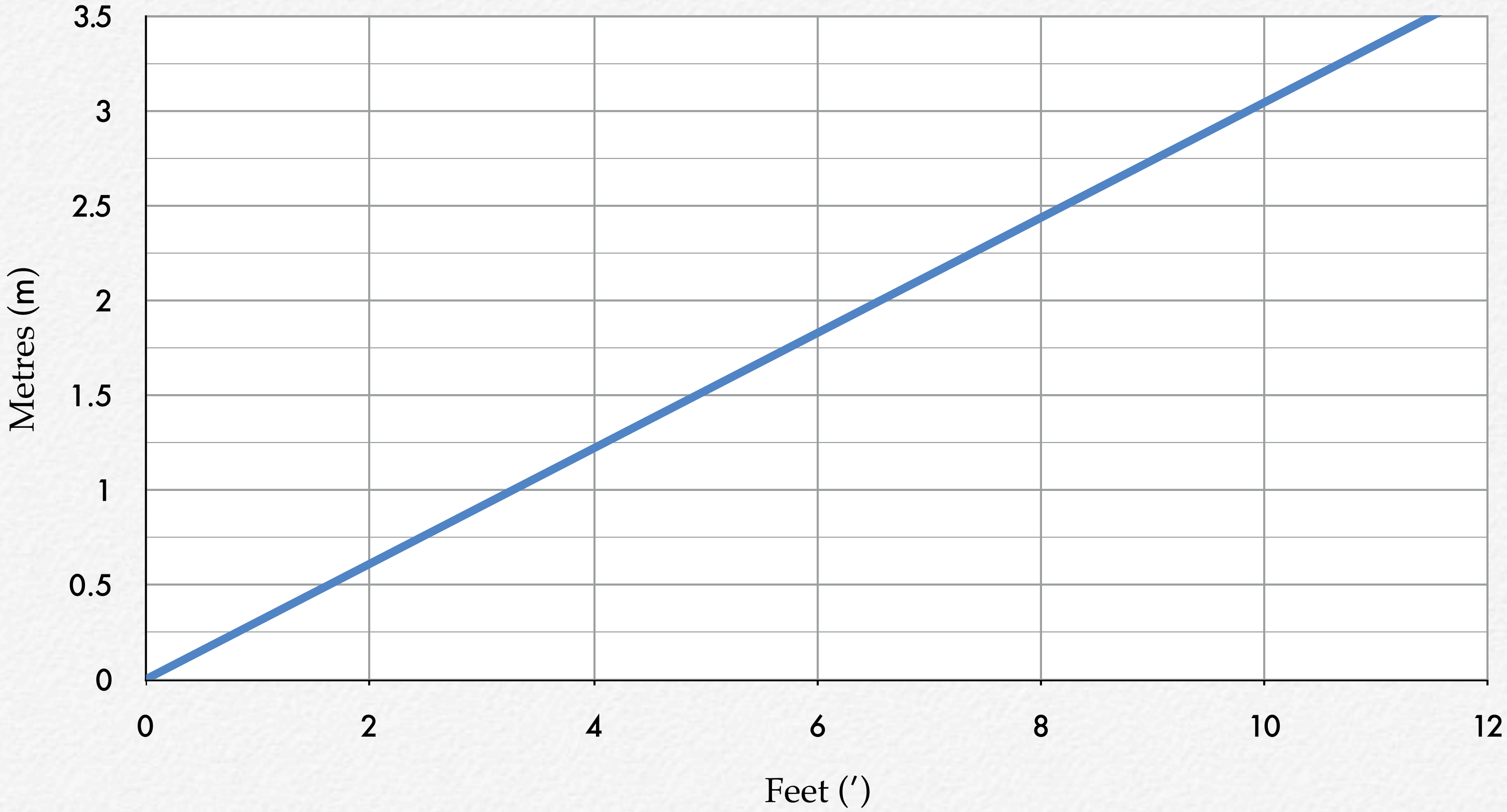
Note

Currency conversion rates change all the time.
So remember this currency conversion chart is exact only for the **one minute** in time that you choose to visit the airport exchange kiosk.

Exercises

3) Use the following graph to answer the following questions about converting between feet and metres.

Conversion Graph for Feet and Metres



a) How many metres are equivalent to 9 feet?

b) How many feet are roughly equal to 3 metre?

c) Using your answer to (a), how many metres would be equivalent to 90 feet?

Comparison Graphs

Plotting two graphs on the same grid will make it easier to compare two sets of data.
The following two charts are for example purposes only, the data is invented.

Chart A compares the number of foxes and rabbits in a wood, over **5** months.
As the rabbit-eating foxes move into the wood, the number of rabbits decreases; as word of these free lunches spreads among the foxes, more foxes move into the wood. The **intersection point**, where the two graph lines cross, shows the point at which there is an equal number of foxes and rabbits in the wood.

Chart A. Graph of Rabbit and Fox Numbers

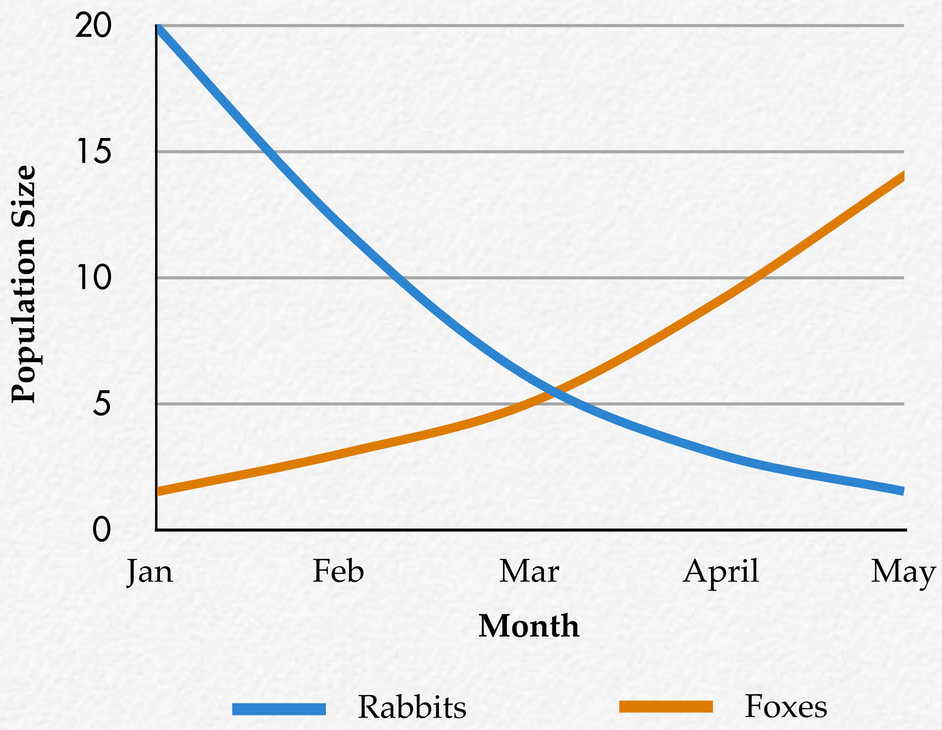
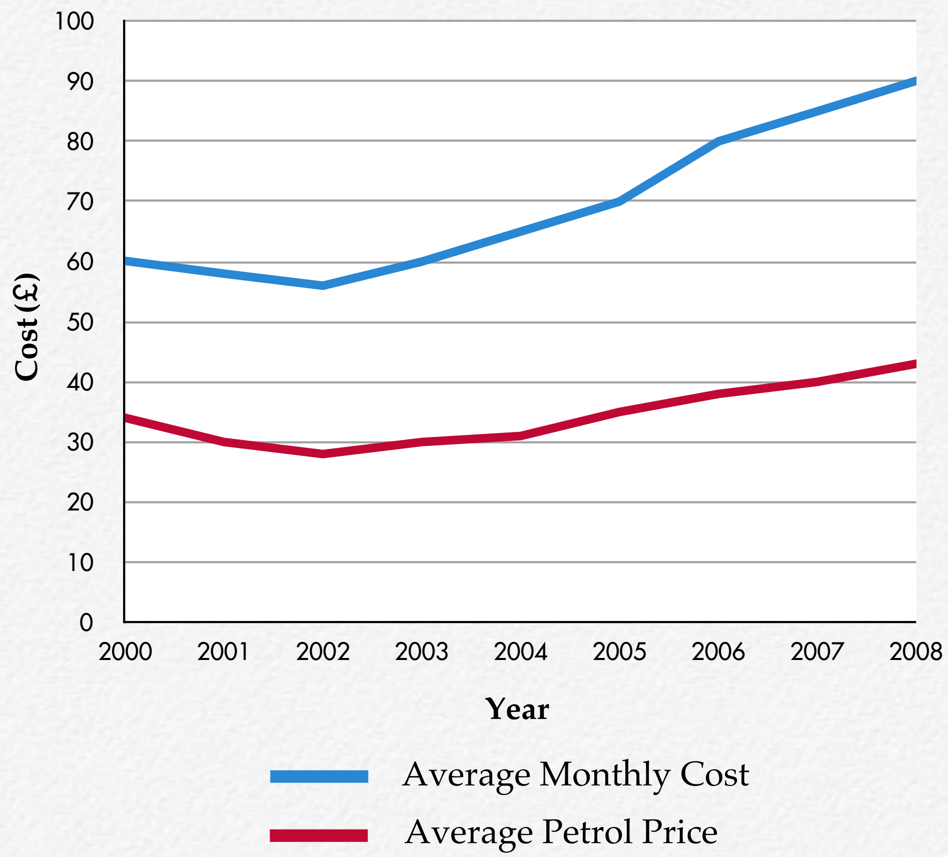


Chart B measures the cost of running a car, as petrol prices increase. As the graph line plotting the price of petrol rises, so does the graph line that shows the cost of running a car.

Chart B. Graph comparing Petrol Prices with the Cost of Running a Car



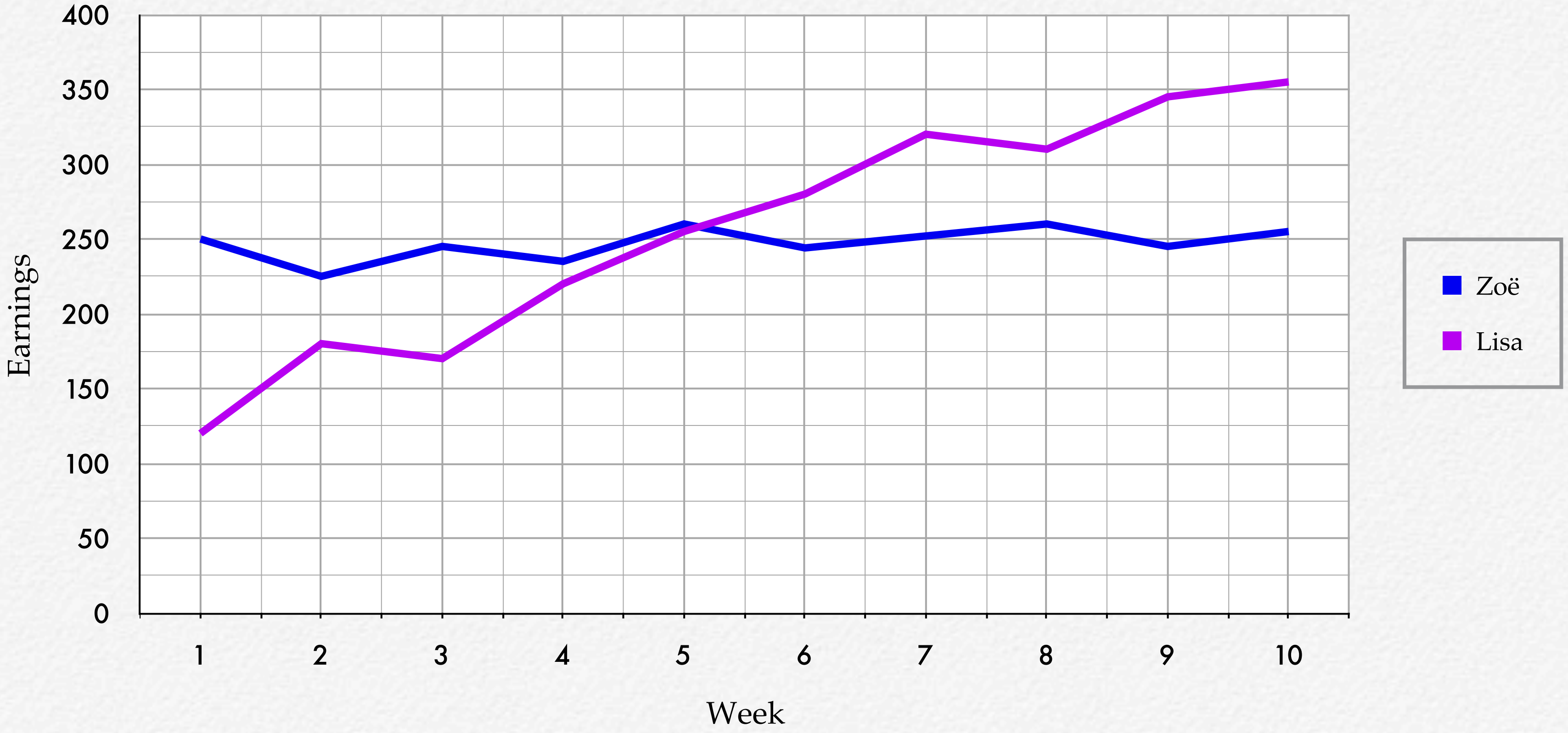
Example

Zoë gets a job for her friend, Lisa, selling designer coats in the famous store, Parrods.

Each sales person gets a very low basic salary, plus **20%** commission on the value of everything that she or he sells.

The earnings of both girls are plotted together on the following graph:

Graph of Zoe and Lisa's Earnings over a Ten Week Period



The graph shows that Zoë earns approximately the same amount for each week in a ten week period, whereas Lisa starts off earning much less than Zoë but soon catches up.

After only **5** weeks, Lisa is earning more than Zoë. Lisa continues to increase her weekly sales.

Will Lisa be promoted and become an assistant buyer? Alas, probably not, because Lisa is such a superb sales person; the store won't want to take her away from customers.

Trends on Time Graphs

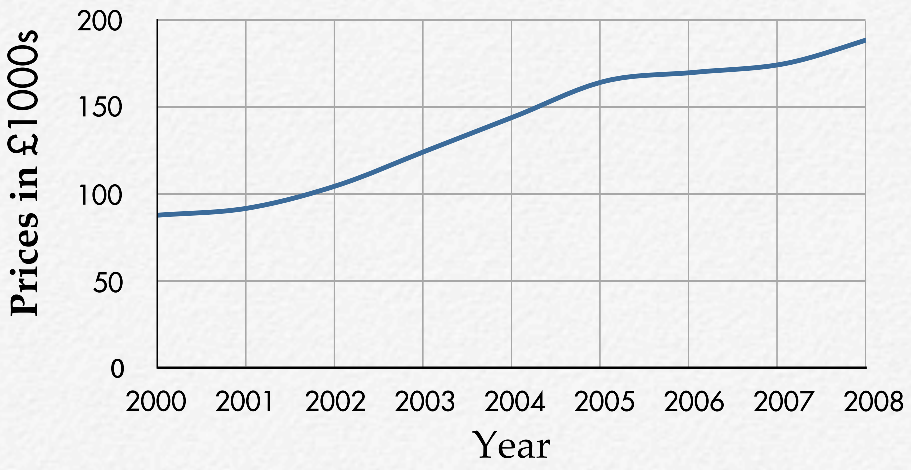
If the line on a graph shows a particular pattern or direction (e.g. upwards, like the next graph), this can be called a **trend**. Extend the trend by projecting the line on the graph and you can predict how that graph will continue into the future, **provided circumstances remain the same**.

She's concentrating on shopping.
Do you look like this after you've been shopping?
Neither do I.

First Example

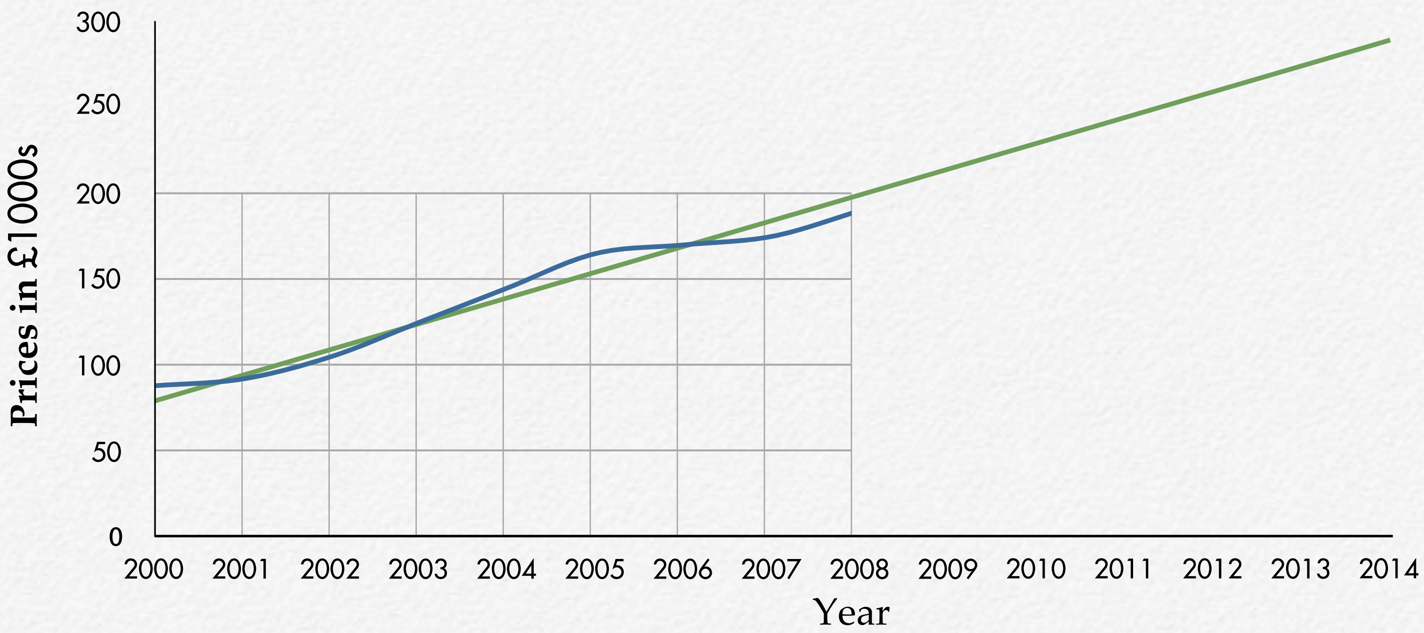
The following graph shows how average house prices in Britain have changed over **7** years.

House Prices **2000 - 2007**



This trend is easy to follow. Prices nearly doubled. The graph's line-of-best-fit can be **projected** (extended into the future) in order to predict average house prices in the next few years. This is called **extrapolation**.

House Prices **2000 - 2007**



Question: If the current trend in house prices continued, what would the average cost of a house be in 2014?

Answer: **According to that trend, the average UK house price in 2014 will be £270,000.**

Warning!

Just extending a graph to follow the trend must not be the only basis on which you predict the future: **background knowledge is crucial**. Rising graphs may reach a maximum and level off; a particular market may undergo a sudden fall for other reasons which have nothing to do with that particular market.

In fact, sadly for house-owners who had to sell, **circumstances did not remain the same** and in 2007 the British property market started **to fall** from its **historic high**, because of a banking crisis.

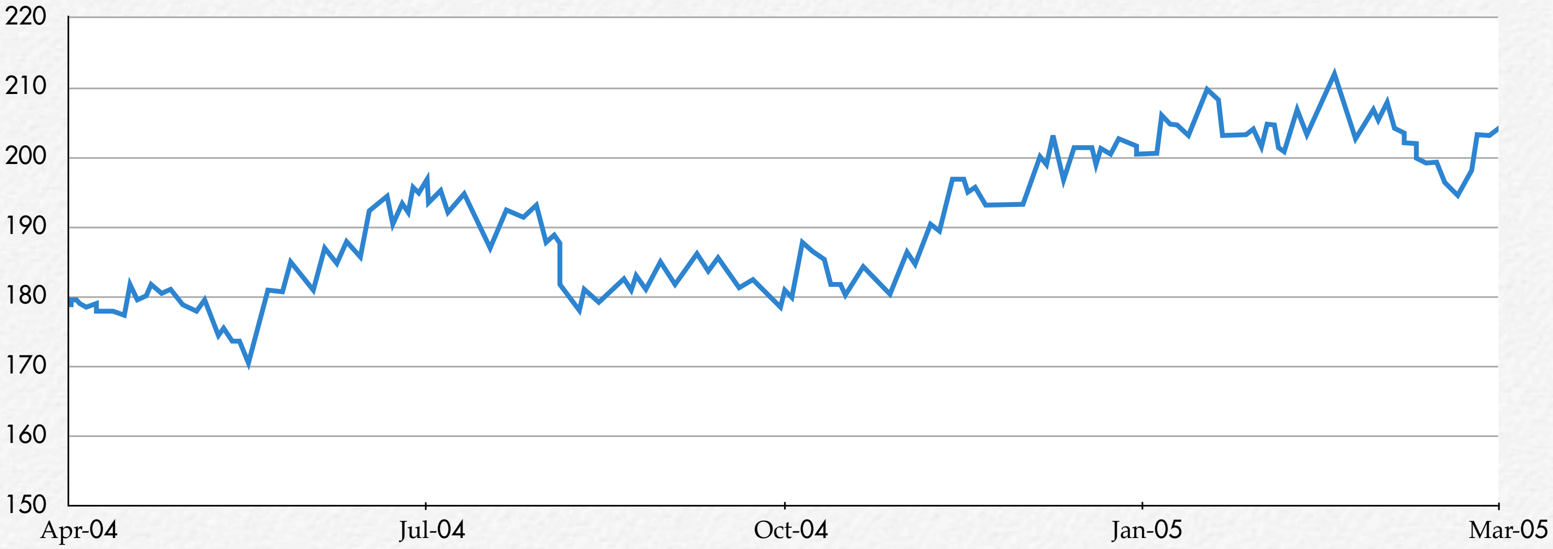
To summarise: a projection is always an informed guess, which is a good guess based on the information you possess at that time.

Resistance and Support Lines

Not everyone will need the following information about resistance and support lines, but it will be useful for some.
With a very jagged graph, I will join the peaks (as near as possible) with a top line (**the resistance line**) and the troughs with a bottom line (**the support line**).

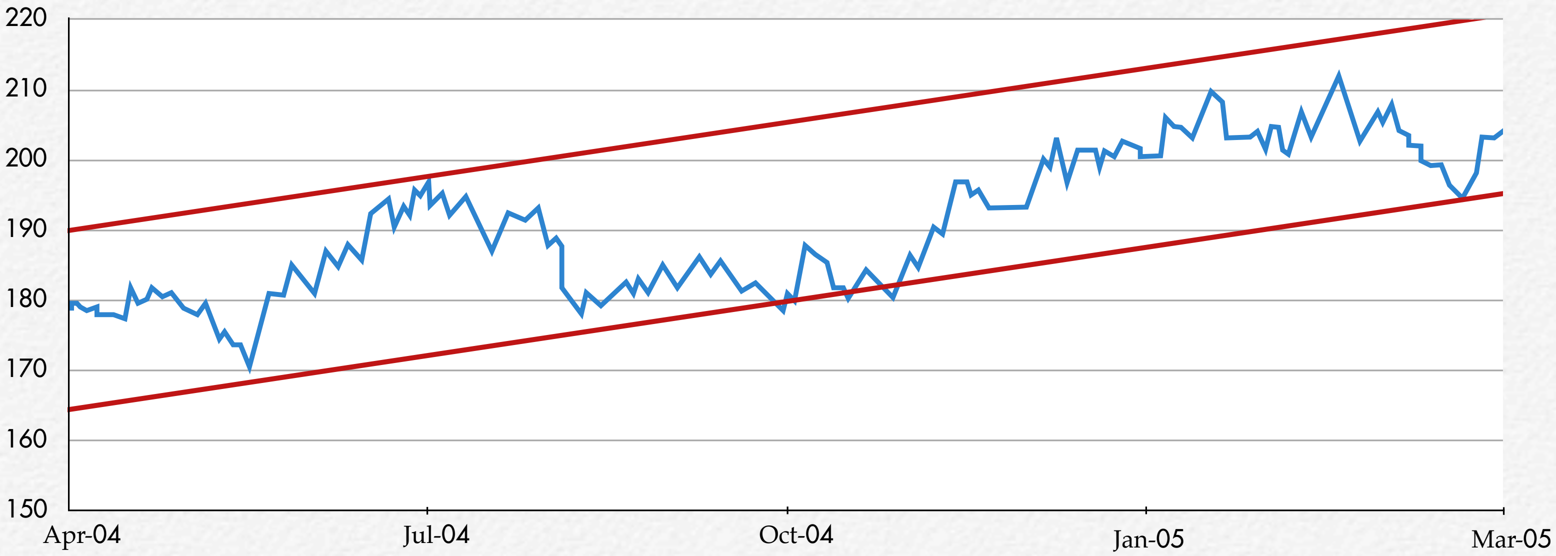
Example

BT's share price (pence) over the financial year ended 31 March 2005



The following graph shows how the price of shares in BT changed between April 2004 and March 2005.

BT's share price (pence) over the financial year ended 31 March 2005



When the resistance-and-support lines are drawn and viewed together, it is clear that they form a trend that shows the price is climbing.

Exercises

4) The following two graphs show the share price of two different supermarket chains. If you print or copy these graphs on paper, you can add resistance and support lines. Add resistance-and-support lines to show the trends more clearly: if you haven't got a ruler, use a book edge to draw your straight lines.

Smoothing Graphs

Moving averages are used to smooth out short-term swings or fluctuations, in order to highlight longer-term trends or **cycles***. A graph plotted with moving averages, smooths the jagged line of the graph.

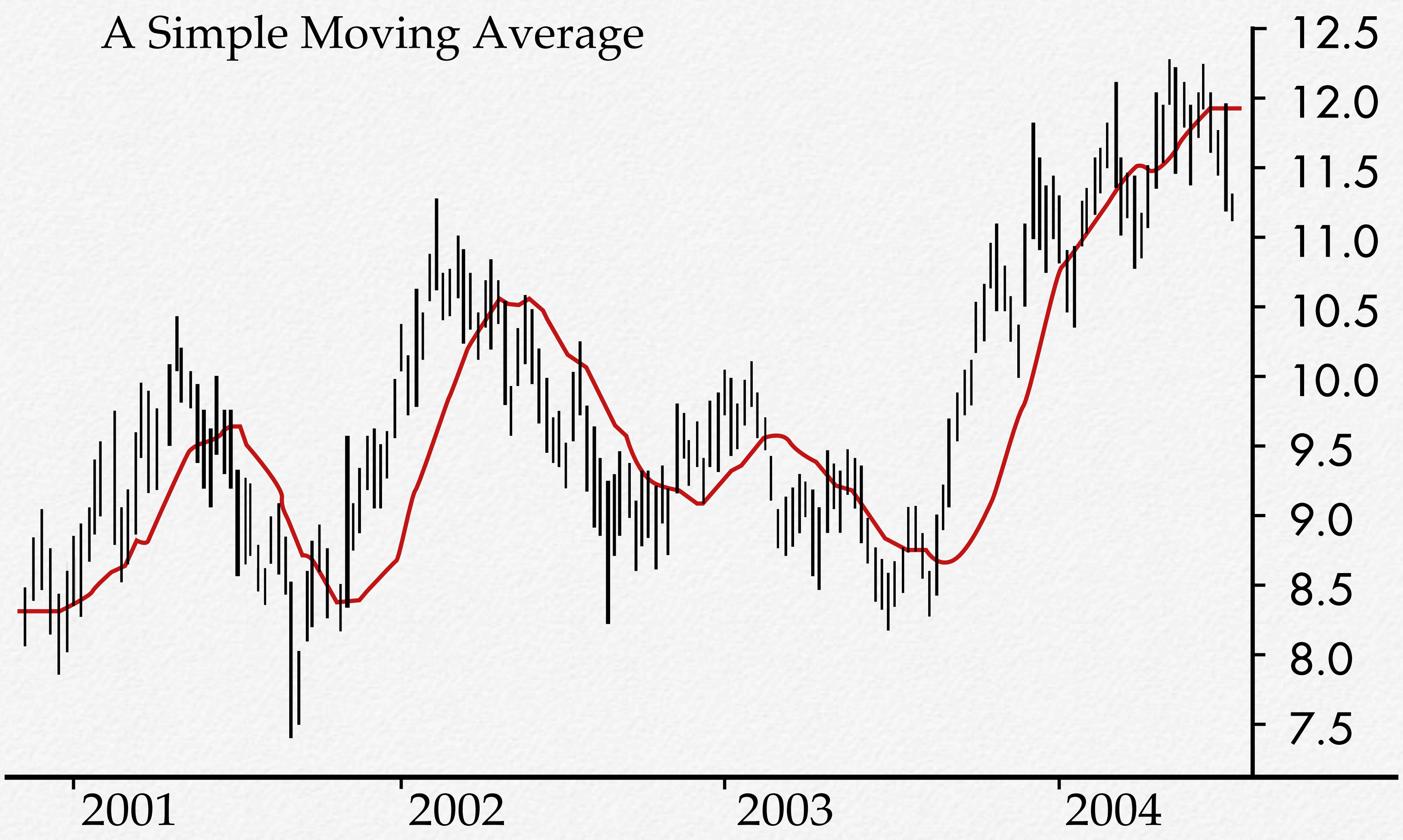
Plotting moving averages is a time-consuming business, but if someone else has done the work for you on a financial page or website, it's well worth your looking at it.

The following graph shows the difference between a graph that plots data for each week (black-jagged line), and a graph that shows the **moving average** (red line).

Extreme highs and lows have been smoothed away and the short-term swings or fluctuations are clarified to reveal a smoother, curved line – the red line.

Don't be alarmed that the red moving average appears to the right of the black original jagged line on the graph.

This is because the moving average is calculated by using the previous weeks' values, so the moving average shows a slower reaction to changes.



Note

*__A cycle__ is a pattern or event which repeats itself at regular intervals. Such a pattern is cyclical.

Examples:

- The four seasons of a year are **cyclical** because they repeat in the same order every year: spring, summer, autumn, winter.

- The **cycle** of the sun is that it rises regularly every morning and sets every evening.

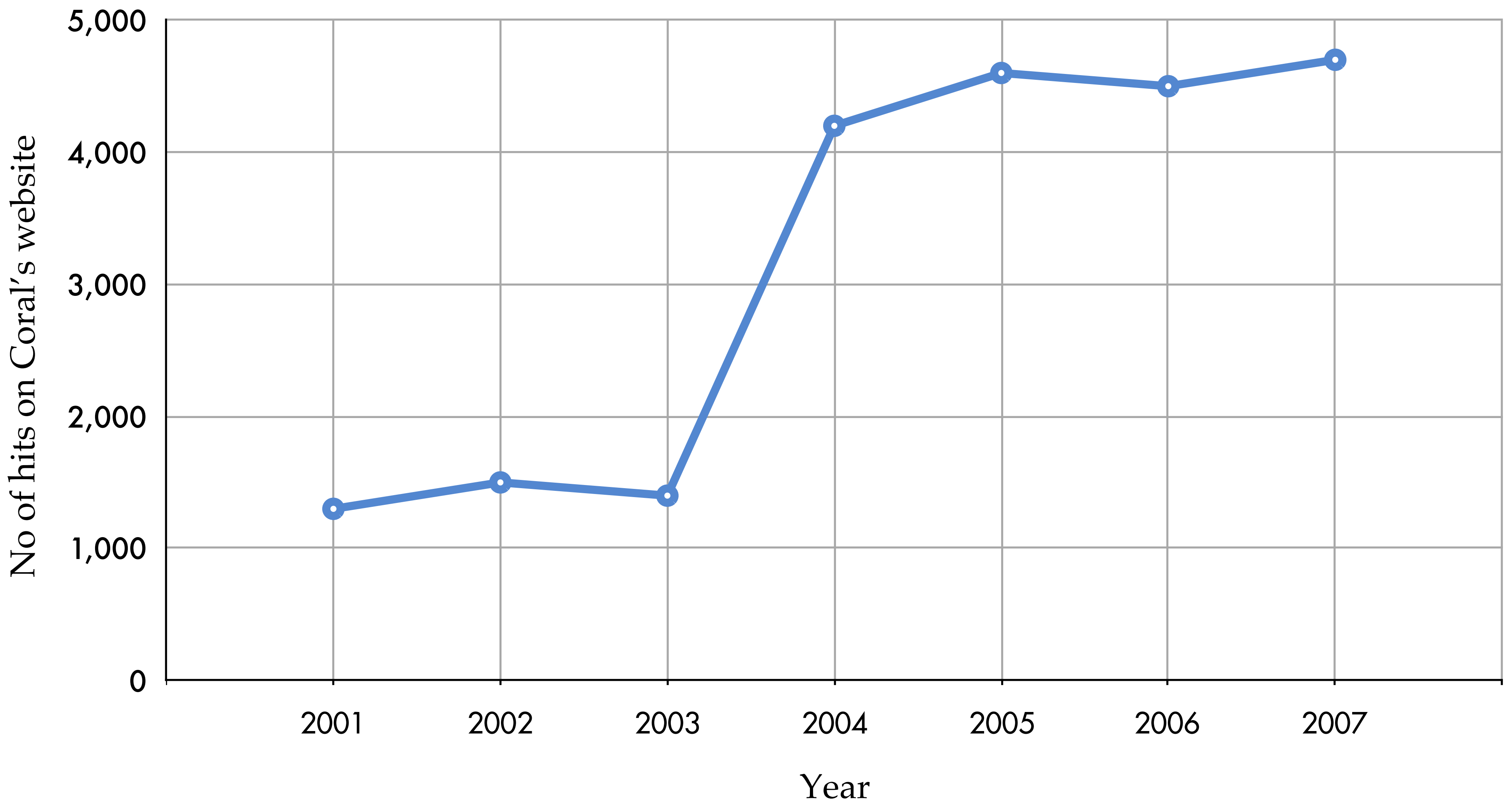
- Gift shops expect a **cyclical** sales pattern that goes up before Christmas and down after Christmas.

She's focused on the ball.
There's a person inside all that protection.
Kazakhstan goal keeper, hockey, Women's Junior Asia Cup.

Answers to Part 23

1)

Graph showing the Hits on Coral's Webpage from 2001 to 2007



2) The following graph shows gold prices from January 1985 to January 2008.

a) When were prices lowest for gold during this period?
Answer: **Gold was cheapest in 1999, when it cost just over $250 per ounce**.

b) When were gold prices highest during this period?
Answer: **Gold was at its highest price in January 2008, when it was $900 per ounce**.

c) How would you expect the prices of gold to continue after January 2008?
Answer: **From this graph you might expect gold to continue to rise**.

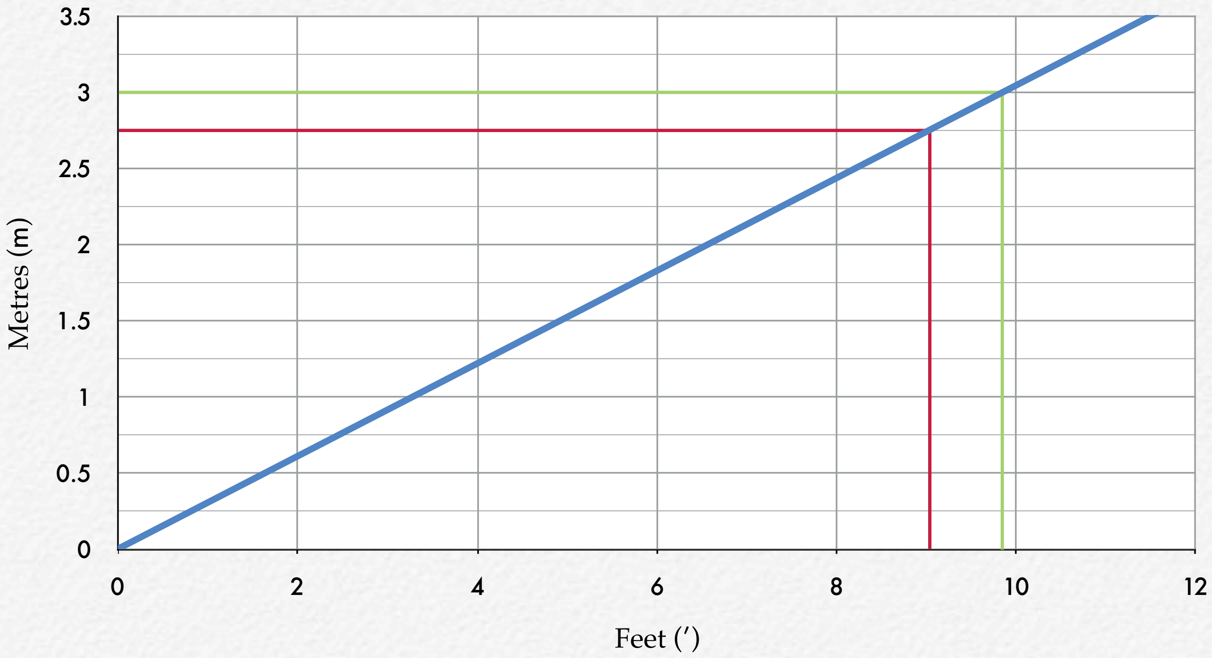
Note

You have just completed a **projection**, which is to continue into the future the trend on the graph (to the right of your graph paper). Remember that a projection is a prediction made from the information you posses. You cannot predict with certainty what will happen to the gold price in February 2008.

What really happened to the gold price was that it continued to rise, for one more month, to reach a high in March 2008. The gold price then fell until November 2008, when the price started to rise again. (You can look up the 2008 gold price chart online at www.kitco.com/charts).

3) Use the following graph to answer the next three questions about converting between feet and metres.

Conversion Graph for Feet and Metres



a) How many metres are equivalent to 9 feet?

Draw a line up from the 9 feet mark on the x-axis that measures imperial feet. When you hit the diagonal conversion line, turn left. Read the value on the y-axis that measures metres, (see red line in the graph.) The red line hits the y-axis, about midway between 2.5 and 3.0 m, so 9 feet is equivalent to about 2.75 m.

Answer: **9 feet is approximately equal to 2.75 m.**

b) How many feet are roughly equal to 3 metres?

Draw a line across from the 3 metre mark on the y-axis, until you meet the given diagonal conversion line. Then go down from the diagonal line to the x-axis, and read the value, (see green line in the graph). This is between 9 and 10, nearer to 10, so 3 metres is roughly 10 feet.

Answer: **3 metres is roughly equal to 10 feet.**

c) Using your answer to (a), how many metres would be equivalent to 90 feet?

You already know 9 feet is approximately equal to 2.75 m. As 90 feet is ten times 9 feet, find ten times 2.75m:

2.75m x 10 = 27.5m

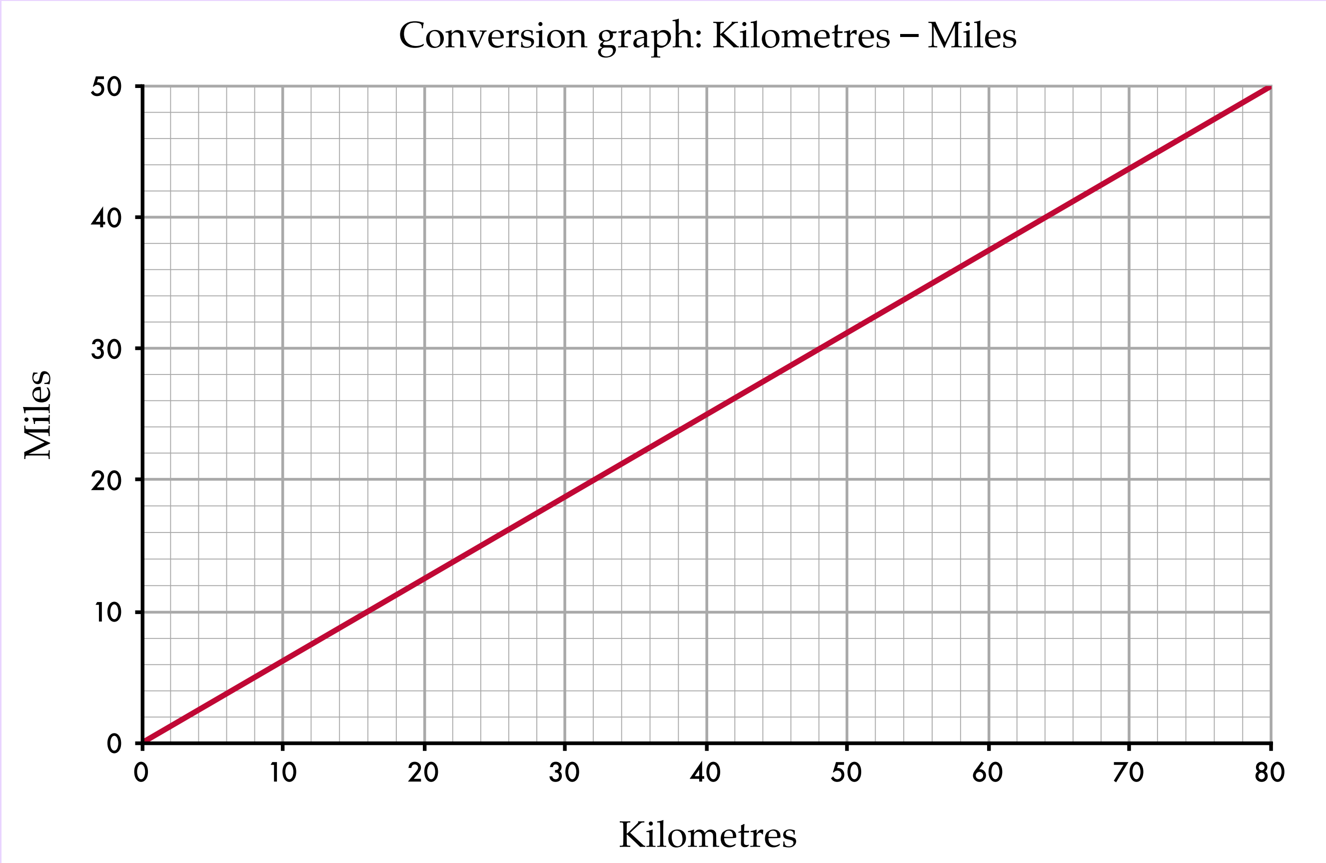
Answer: **90 feet would be equivalent to 27.5 metres.**

3 feet = approx. 1 metre.

4) The following two graphs show share prices of two different supermarket chains. Add resistance and support lines to help the trends more clearly.

Don't invest in Stunning Supermarkets.

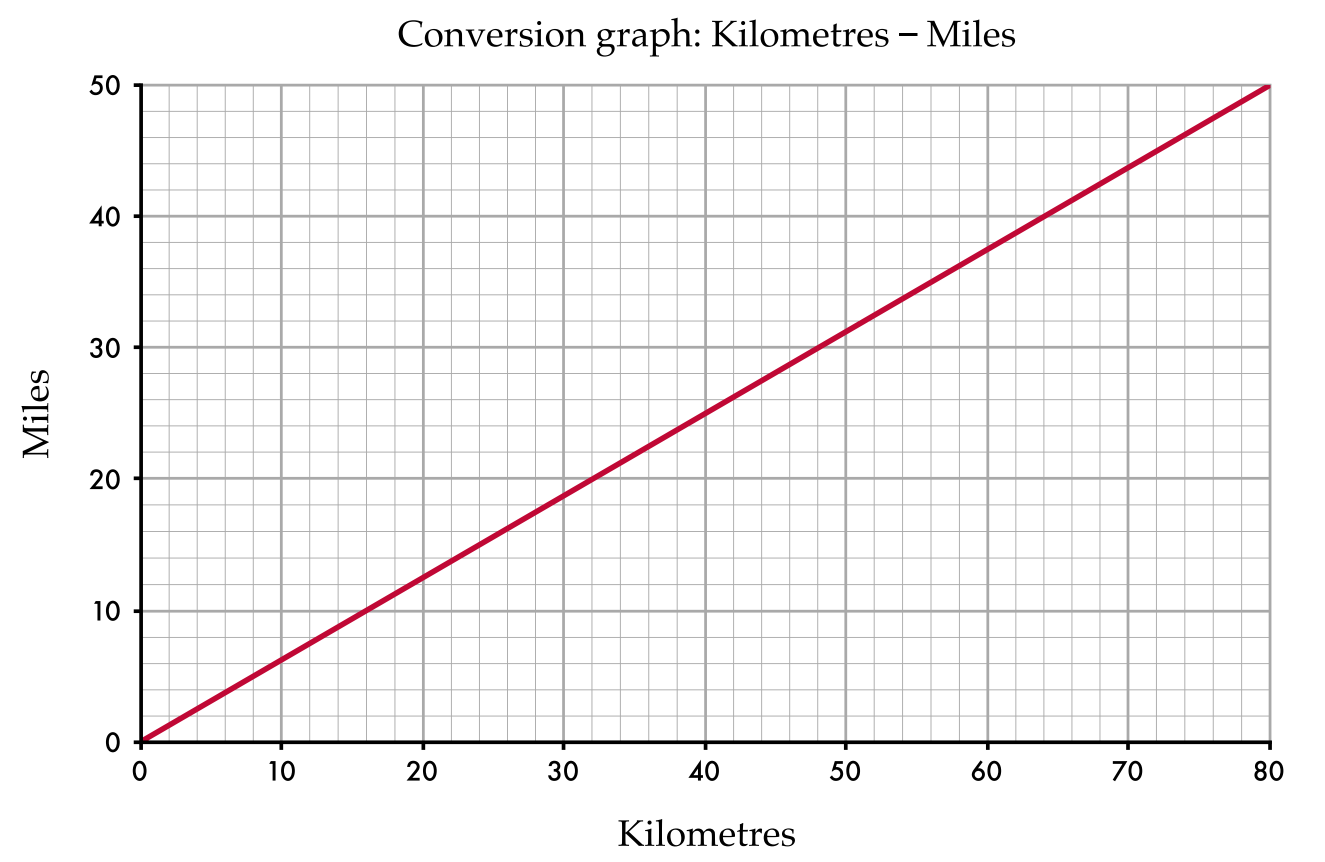
YOUR BRAIN WORKOUT



Q1.

What is 20 miles in kilometres?

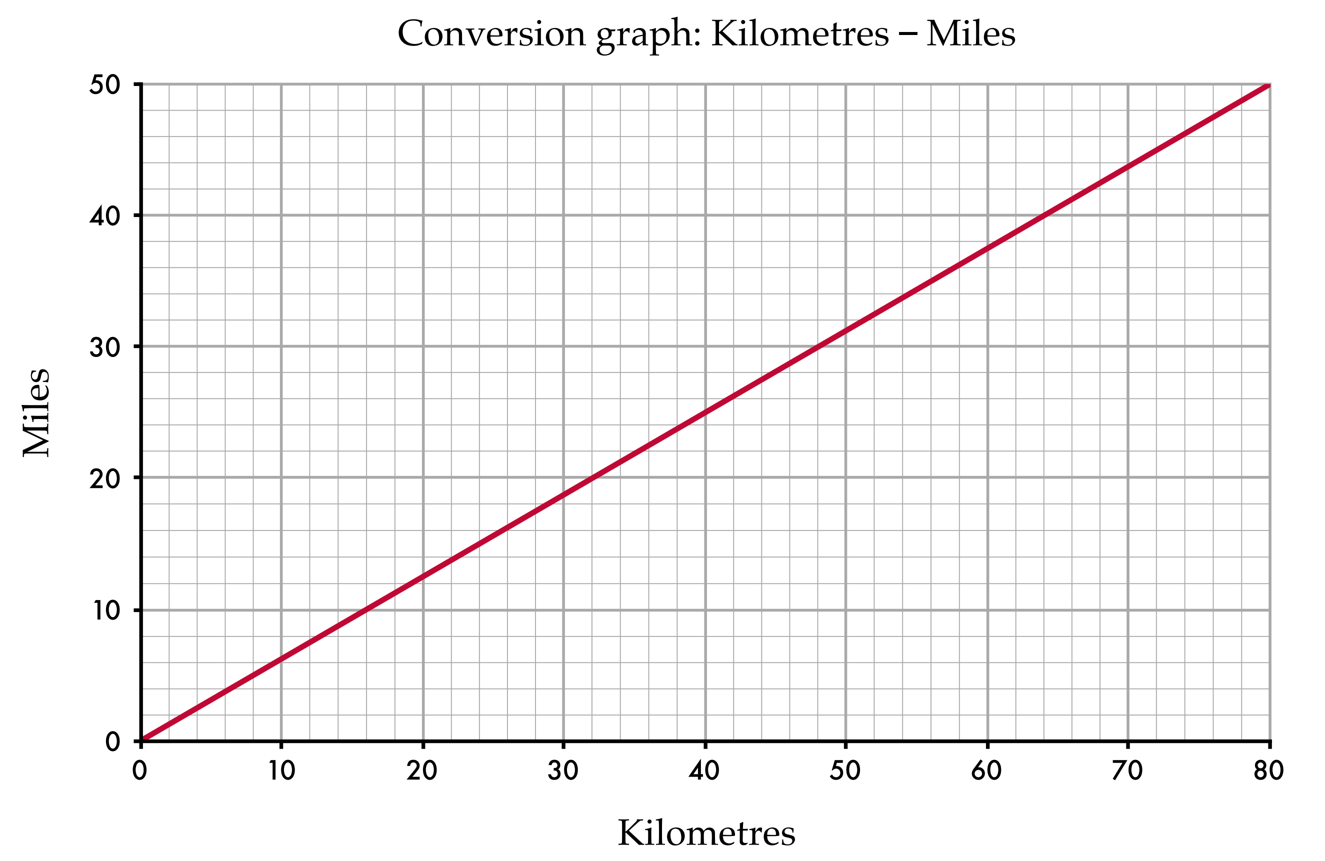
YOUR BRAIN WORKOUT



Q2.

What is 20 kilometres in miles?

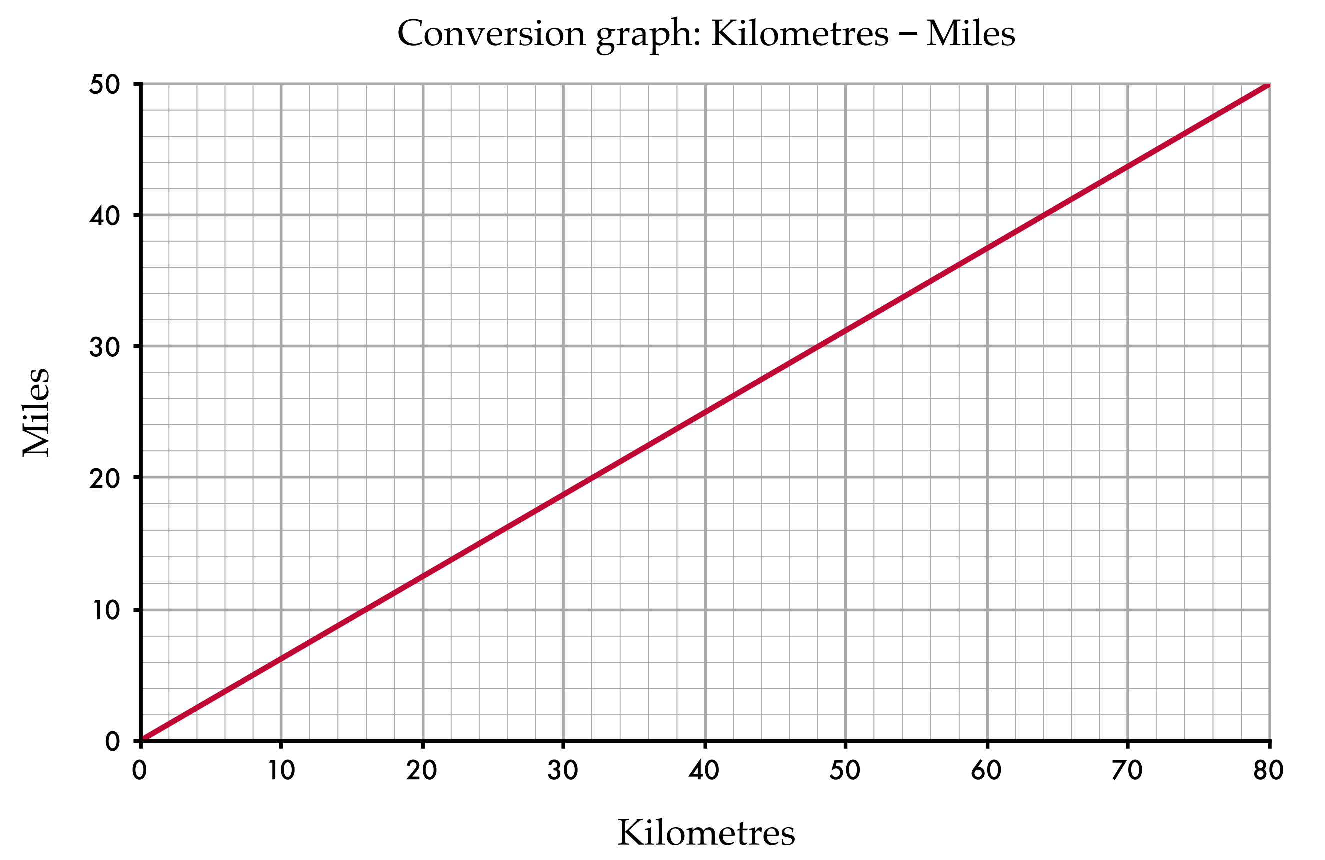
YOUR BRAIN WORKOUT



Q3.

What is 50 miles in kilometres?

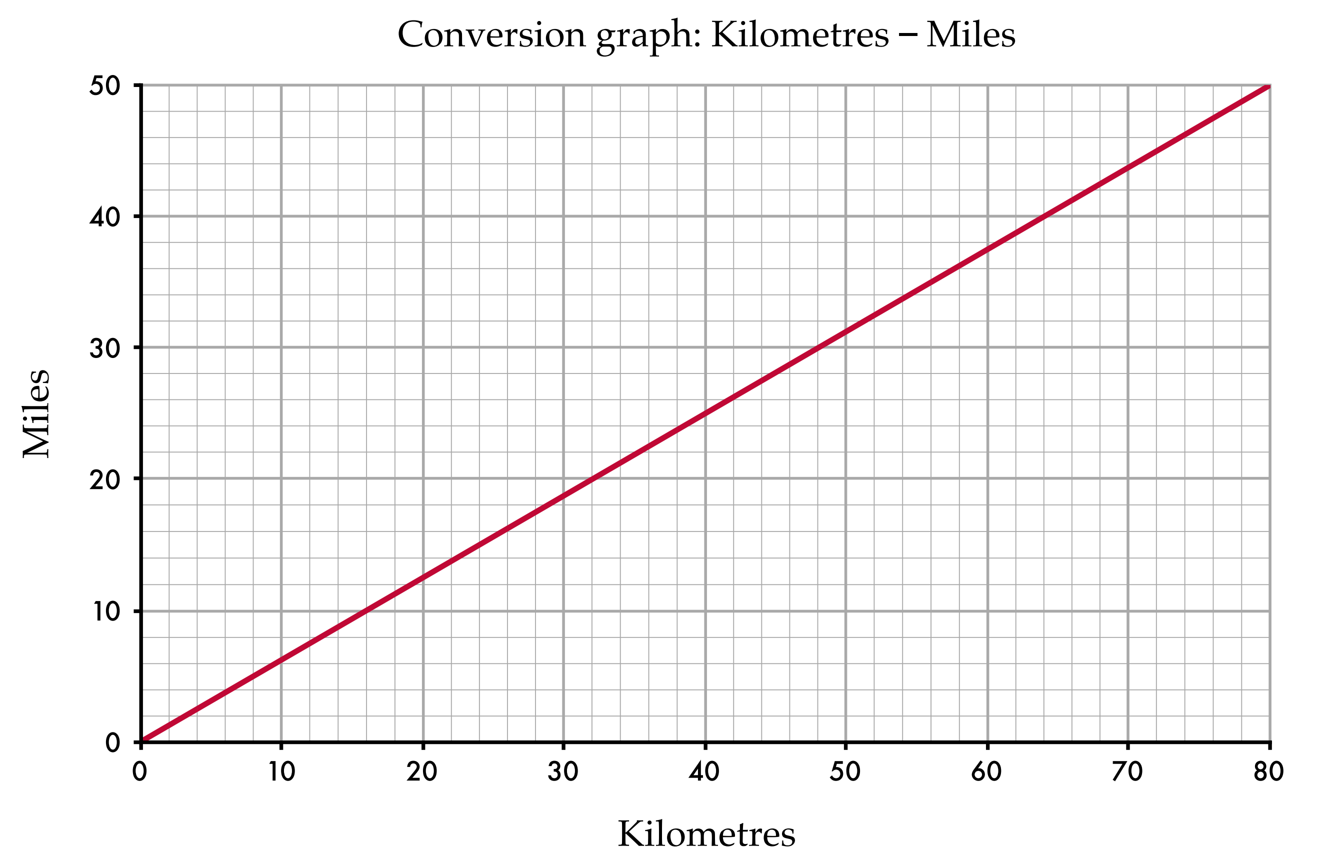
YOUR BRAIN WORKOUT



Q4.

What is 5 miles in kilometres?

YOUR BRAIN WORKOUT



Q5.

What is 60 kilometres in miles?

YOUR BRAIN WORKOUT

Answers

Q1. 32 km

Q2. About 12 miles

Q3. 80 km

Q4. 8 miles

Q5. About 37 miles

PART 24
AVERAGES

Ouch!

Kazakhstan vs. Korea.
Women's Junior Asia Cup.

Quick Quiz

Q1.

Which is a correct sequence from the 20 times table?

- **A.** 30, 50, 70, 90, ...
- **B.** 40, 60, 80, 100, ...
- **C.** 40, 70, 90, 110, ...
- **D.** 30, 60, 90, 120, ...

Quick Quiz

Q2.

What is **4** squared?

- **A.** 16
- **B.** 20
- **C.** 12
- **D.** 8

Quick Quiz

Q3.

What is 30% of £70?

A. £7

B. £14

C. £21

D. £28

Quick Quiz

Q4.

How many millimetres in a metre?

- **A.** 10
- **B.** 100
- **C.** 1,000
- **D.** 10,000

Quick Quiz

Answers

Q1. 40, 60, 80, 100, ...

Q2. 16

Q3. £21

Q4. 1,000

Averages

For all sorts of reasons, it's useful to understand averages. If you know the average of a certain quantity, you will know roughly what to expect: for instance if your guidebook tells you the cost of an average meal at the pretty little French restaurant La Trompette, then you know whether you can afford to treat your friends to a meal there. Looking up the average temperature for Ibiza in May will help you decide what to pack. Calculating average sales for each season will help you run your travel business more efficiently.

There are three different ways of working out an average: **mean**, **mode** and **median**.

QUICK, ROUGH REFERENCE GUIDE:

- **Mean** is the true mathematical average.
- **Median** is the middle value, after listing the values in order from low to high.
- **Mode** is the most common item in a selection. It comes from the French 'à la mode', which means 'fashionable', which means the current most popular way to do something, whether it is cooking a casserole or wearing enormous earrings.

Although **median** and **mode** can be useful in analysing data, in Real Life you are most likely to use the **mean**. Understanding how the **mean** is calculated will help you to interpret and use the average more effectively.

A mean display of formation swimming.

Mean Average

First Example

The head teacher of a junior school in a small town in Iceland is asked to give the mean age of the children in the classes A and B.

Class A:

Ages of children in class A: 5, 4, 2, 6, 5, 5, 2, 3, 4

Number of children in class A = 9

$$\text{Mean age} = \frac{\text{Sum of the ages}}{\text{Number of children}}$$

(Sum of the ages = ages added together:
5 + 4 + 2 + 6 + 5 + 5 + 2 + 3 + 4 = 36)

$$\text{Mean age} = \frac{36}{9} = 36 \div 9 = 4$$

Answer: **The mean age of children in class A is 4 years old.**

Class B:

Ages of children in class B: 7, 6, 6, 8, 6, 9, 6, 8

Number of children in class B = 8

$$\text{Mean age} = \frac{\text{Sum of the ages}}{\text{Number of children}}$$

(Sum of the ages = 7 + 6 + 6 + 8 + 6 + 9 + 6 + 8 = 56)

$$\text{Mean age} = \frac{56}{8} = 7$$

Answer: **The mean age of children in class B is 7 years old.**

Here's class B.

The arithmetical equation is: $\dfrac{\text{sum of values}}{\text{number of values}} = \text{mean}$

The Icelandic school example is: $\dfrac{\text{sum of the } \textbf{ages}}{\textbf{number} \text{ of children}} = \text{mean}$

Since you are looking for the **mean age**, make sure that the top number is the **sum of all the ages**. The bottom number is always the **number** of values you have (children in this case).

If you are looking for the **mean weight** of some items, the top number will be the **sum of all the weights**. The bottom number will be the **number** of items you have. The items might be sacks of potatoes, boxes of tomatoes or some catwalk supermodels.

$$\text{Mean weight of a box of tomatoes} = \frac{\text{sum of values}}{\text{number of values}} = \frac{\text{total } \textbf{weight} \text{ of tomato boxes}}{\textbf{number} \text{ of tomato boxes}}$$

If you are looking for the **mean height** of a group of items, the top number will be the **sum of all the heights**. The bottom number will still be the **number** of items you have.

$$\text{Mean height of a supermodel} = \frac{\text{sum of values}}{\text{number of values}} = \frac{\text{total } \textbf{height} \text{ of the supermodels}}{\textbf{number} \text{ of supermodels}}$$

Remember that the **unit** of the mean you seek, is the same as the **units** that you add together to make the 'sum of', for the number above the line. The number beneath the line is always the **number** of items you have.

Second Example

This silly example is simple to understand and easy to remember.

At their last meeting, members of The Chocolate Club conducted a survey amongst themselves. They asked all female members to count the number of chocolate bars in their handbag. The results for the nine women were:

$3 \quad \frac{1}{2} \quad 0 \quad 1 \quad 3 \quad 1 \quad 4 \quad 2 \quad 1$

What is the mean **number** of chocolate bars in all the handbags?

Since you are looking for the **mean number of chocolate bars**, add up all the chocolate bars to find the **sum of all the chocolate bars**. The bottom number is always the number of values you have (9 handbags in this case).

The sum of the chocolate bars is:

$3 + \frac{1}{2} + 0 + 1 + 3 + 1 + 4 + 2 + 1 = 15\frac{1}{2}$ (or 15.5)

No. of values (count how many values were given) = 9

$$\text{Mean} = \frac{\text{Sum of values}}{\text{Number of values}}$$

$$= \frac{15.5}{9}$$

$$= 1.72$$

Answer: **The mean number of chocolate bars per handbag was 1.72 bars.**

This answer tells you accurately how many bars of chocolate each woman would get if **all the bars were shared out equally** among those nine members.

Third Example

While staying at her aunt's home in Cornwall, Rachel worked as a waitress over the summer months before studying estate management. Rachel's father wants to know what Rachel earned on average per week, including tips, because he will base her allowance for agricultural college on this amount. Rachel's allowance will be half her average earnings.

Rachel's wages are as follows.

Week	Earnings	Notes
1	£210	Beginning of season - few customers
2	£360	
3	£50	Only worked one evening because boyfriend David - already at agricultrial college - came to visit.
4	£350	
5	£340	
6	£370	
7	£390	August bank holiday - busy weekend.
8	£210	End of season - few customers.

Rachel not waitressing.

$$\text{Mean} = \frac{\text{Sum of values}}{\text{Number of values}} = \frac{\text{pay}}{\text{weeks}}$$

$$= \frac{210 + 360 + 50 + 350 + 340 + 370 + 390 + 210}{8}$$

$$= \frac{2280}{8}$$

$$= \mathbf{285}$$

Answer: **Rachel's mean weekly earnings over eight weeks was £285**.

Because boyfriend David happily distracted her for a week, Rachel's **mean** earnings were reduced significantly.

Exercises

1) The heights of eight **14**-year-olds are listed as follows. Find the mean for these heights.

1.46m 1.67m 1.58m 1.65m 1.66m 1.72m 1.59m 1.63m

2) Melanie has a passion for good red wine. Whenever she buys wine to stock up her wine rack, she allows herself to buy some more expensive bottles, as long as her **average** price does not exceed **£9** per bottle. At her local wine shop, Melanie has selected three bottles, one for **£12.99**, one for **£9.45** and one for **£7.89**.

In this question, Melanie needs to know the mean price, since she is interested in how the cost is shared out between the bottles.

a) What is the mean price of the three bottles Melanie has chosen?

b) Melanie wants to buy **4** bottles of wine in total. She has found another bottle that she likes, which costs **£7.80**. If Melanie adds this bottle to the three already chosen, will the mean price of the bottles be less than **£9**?

c) Calculate the highest price that Melanie's fourth bottle of wine should cost if she wants to stick to the mean price of **£9** per bottle. (Hint: work backwards. If the mean price of each bottle is **£9** how much should the four bottles cost in total?)

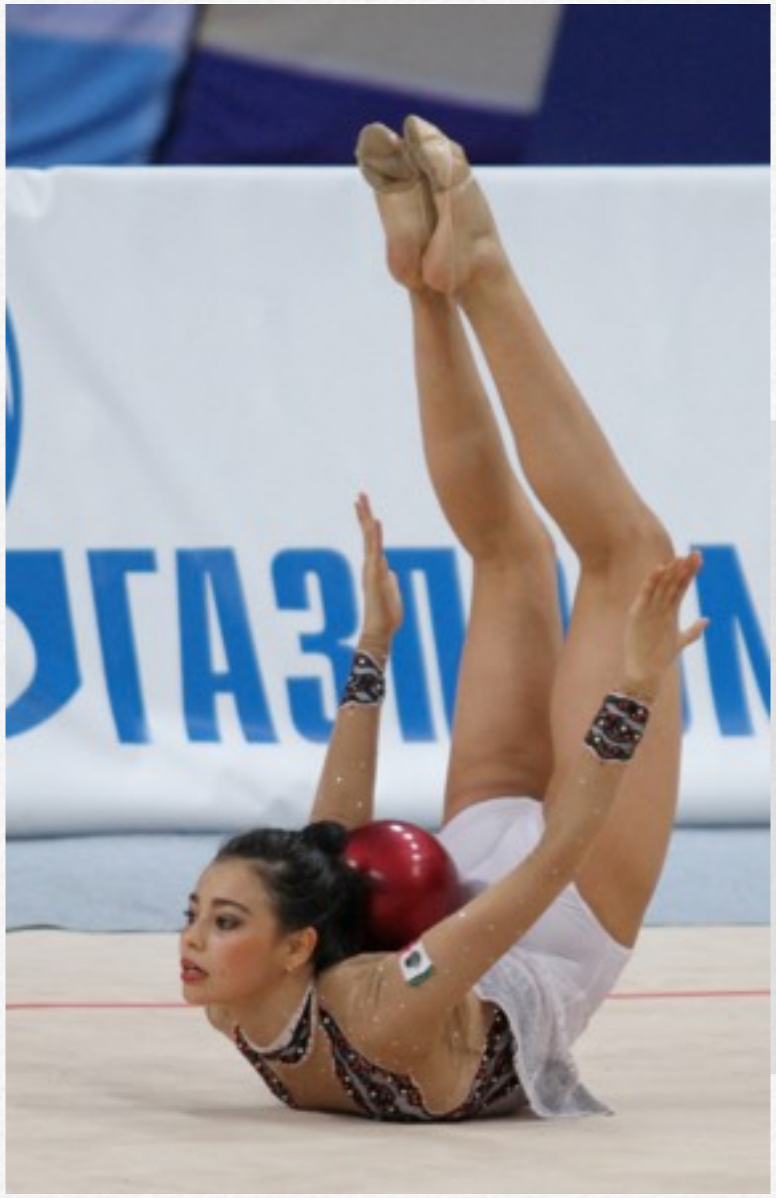
A passion for good wine is expensive, unless you work in the wine trade. Melanie has applied for a job with a Bordeaux wine exporter.

Grapes waiting to be trodden.

The Range

The range is used to give you an idea of how far the actual values stray from the average value. You calculate the range as follows:

Range = the highest value minus the lowest value.



Can't keep her eye on the ball when it's at the back of her head.

Rhythmic Gymnastics competition.

First Example

Ruth's younger daughter, Jemima is 3, her older daughter, Pearl is 17. So the number of years between them is $17 - 3 = 14$. So the age **range** of the sisters is 14 years.

Second Example

Lily has three brothers aged 9, 11 and 12 (poor mother). The **mean** age of the brothers is 11. The number of years between the brothers is $12 - 9 = 3$. The age **range** of the brothers is 3.

Third Example of Range

Back to the chocoholics. Find the range of the number of chocolate bars found in the handbags.

$$0 \quad \frac{1}{2} \quad 1 \quad 1 \quad 1 \quad 2 \quad 3 \quad 3 \quad 4$$

First, pick the largest and smallest values: 4 and 0 here.

Next, subtract the smallest numbers from the largest:

$4 - 0 = 4$

Answer: **The range in the number of chocolate bars in the handbags is 4.**

Exercises

Hint: In the following exercises it is assumed that only twins or triplets are born in the same year.

3) Three sisters, Louisa, Polly and Tessa, have a mean age of 16, and the range of their ages is 6 years. What might their ages be?

4) Three brothers, Jon, Sam and Max, have a mean age of 16, and the range in their ages is 0 years. What does this tell us about Jon, Sam and Max?

Twins, brother and sister.

5) Match up the following three sets of statistics with the groups.

Stats A	Mean age Range	= 15 years old = 1 year
Stats B	Mean age Range	= 15 years old = 4 years
Stats C	Mean age Range	= 15 years old = 37 years

Group 1	Friends invited to Sally's 15^{th} birthday party.
Group 2	Participants at the mother-and-baby group
Group 3	Pupils in year 10

SUMMARY

$$\text{Mean} = \frac{\text{Sum of values}}{\text{Number of values}}$$

It's the meanest of averages because you have to do the most maths to work it out.

Range = The highest value minus the lowest value

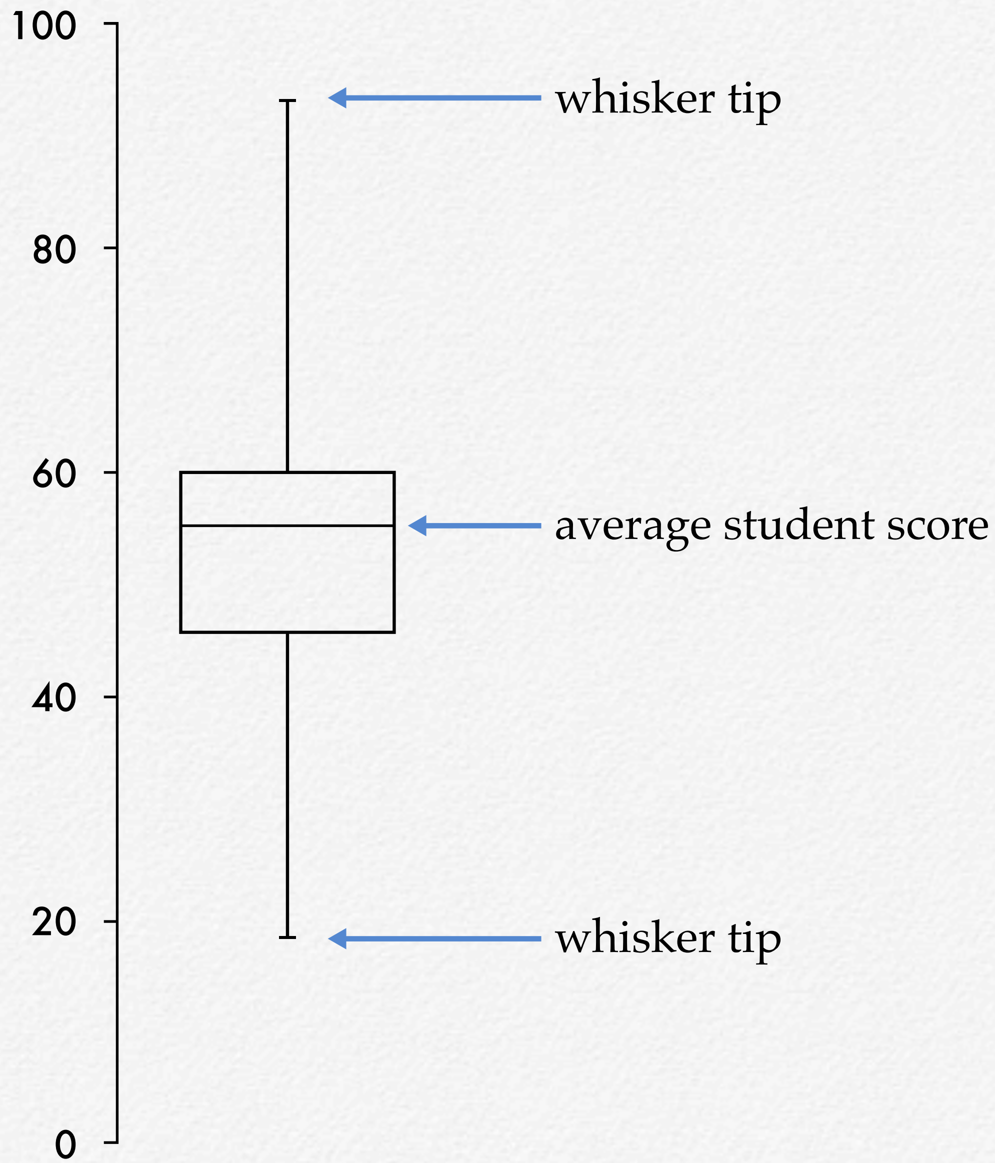
Box Plots

How to read a Box Plot

A box plot is also called a box-and-whisker diagram, because the lines stick out like a cat's whiskers, seen from above. Box plots can be drawn horizontal or vertical. The following example is a vertical box plot.

A **box plot** gives you an average. It also gives you a range, from the highest value to the lowest value of your sample plus the range of the middle of values.

Here's an example which shows the marks of a Japanese language paper, set for 40 students. The maximum possible score was 100 and the lowest possible score was zero, as you can see on the scale to the left.



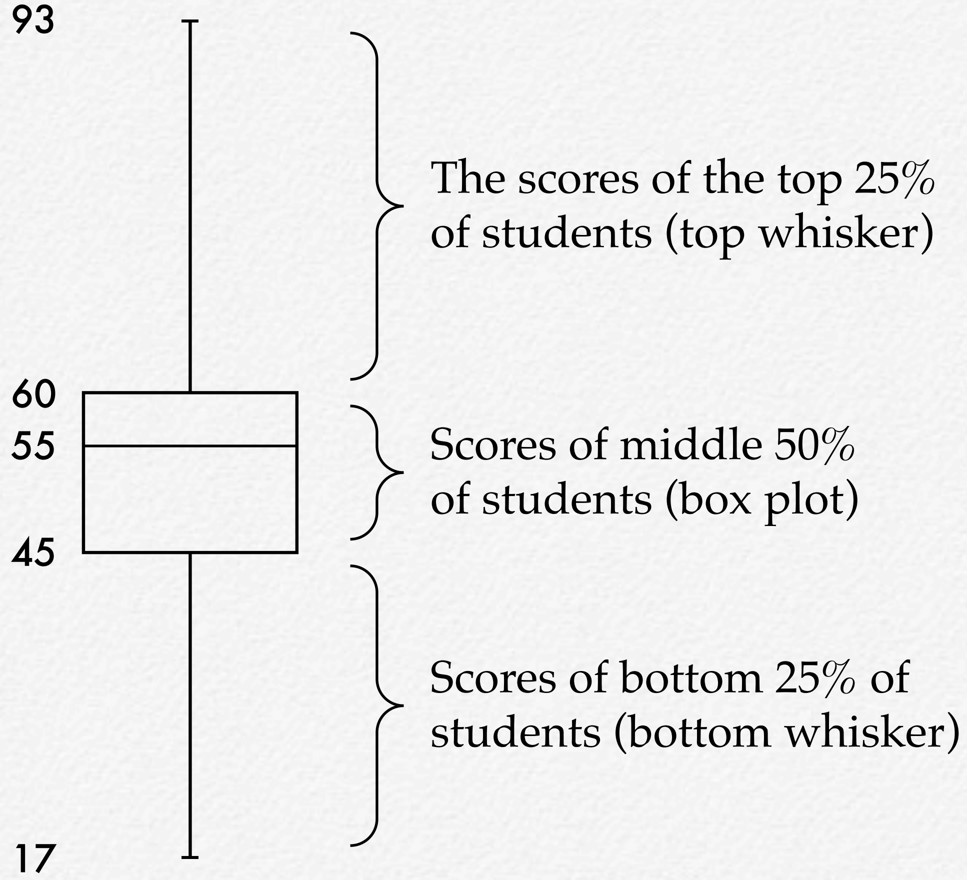
The **average student score** is shown by the line in the middle of the box. In this example, the average student score was just under 60 and in fact was 55.

The tips of the whiskers show that the best score was just over 90 and in fact was 93; the worst score was just under the 20 mark and was in fact 17. The two whisker tips show **the exceptional scores**. (The student who scored 93 has a Japanese mother and the student who scored 17 had done practically no work.)

Above the box, to the top of the whisker, you have the higher **25%** of student scores. Below the box, to the bottom whisker tip, you have the lower **25%** of student scores. This is shown by the next diagram.

In order for the College Principal to check student performance, she needs to look at the box, rather than the exceptional scores (the whiskers). **The box tells you the results of the middle 50% of the sample**. In this box, the middle **50%** of student results ranged from **45** marks to **60** marks.

Box plots can be used to summarise all sorts of information ranging from pollution levels to population heights.



Detail of diagram on previous page

Medieval Kabuki scene on modern theatre wall, Kyoto, Japan.
Count the patterns

Answers to Part 24

Answers to the Mean

1) The heights of eight 14-year-olds are listed as follows. Find the mean for these heights.

1.46 m	1.67 m	1.58 m	1.65 m
1.66 m	1.72 m	1.59 m	1.63 m

Mean = Total of items ÷ Number of values

$$= \frac{1.46 + 1.67 + 1.58 + 1.65 + 1.66 + 1.72 + 1.59 + 1.63}{8}$$

$$= \frac{12.96}{8}$$

$$= \mathbf{1.62}$$

Answer: **The mean height = 1.62m**

2) Melanie has a passion for good red wine. Whenever she buys wine to stock up her wine rack, she allows herself to buy some more expensive bottles, as long as her **average** price does not exceed **£9** per bottle.
At her local wine shop, Melanie has selected three bottles, one for **£12.99**, one for **£9.45** and one for **£7.89**.

In this question, Melanie needs to know the **mean** price since she is interested in how the cost is shared out between the bottles.

a) What is the mean price of the three bottles Melanie has chosen?

Mean = Total of items ÷ Number of values

$= (12.99 + 9.45 + 7.89) \div 3$

$= 30.33 \div 3$

$= 10.11$

Answer: **The mean price of Melanie's three bottles of wine is £10.11.**

b) Melanie wants to buy **4** bottles in total. She has found another bottle of wine that she likes, which costs **£7.80**. If Melanie adds this bottle to the three already chosen, will the mean price of the bottles be less than **£9**?

To calculate the new mean you must start from the beginning again.

Mean = Total of items ÷ Number of values

= (12.99 + 9.45 + 7.89 + 7.80) ÷ 4

= 38.13 ÷ 4

= 9.533

Answer: **No, the mean is still above £9**.

c) Calculate the highest price that Melanie's fourth bottle of wine should cost if she wants to stick to the mean price of **£9** per bottle. (Hint: work backwards. If the mean price of each bottle is **£9**, how much should the four bottles cost in total?)

If the bottles have a mean value of **£9** each, then 4 bottles should cost **4 x £9 = £36**.

Melanie's **4** bottles of wine should cost no more than **£36**.

Melanie's **3** chosen bottles cost:
12.99 + 9.45 + 7.89 = £30.33

How much has Melanie to spend on the last bottle?
£36 – £30.33 = £5.67

Answer: **Melanie's fourth bottle cannot cost more than £5.67**.

Answers to the Range

3) Three sisters, Louisa, Polly and Tessa, have a mean age of 16, and the range of their ages is 6 years. What might their ages be?

The eldest and youngest sister have a difference in age of 6 years.

If the mean of the three ages is 16, then one possible answer is that their ages are **13**, **16 and 19**.

There are two other possible answers, if two of the sisters are twins: **14**, **14 and 20** or **12**, **18 and 18**.

Answer: **The most likely ages of the girls are 13, 16 and 19.**

4) Three brothers, Jon, Sam and Max, have a mean age of 16, and the range in their ages is 0 years. What does this tell us about Jon, Sam and Max?

Since the range is 0, all the boys must be the same age. The brothers must therefore be triplets.

Answer: **Jon, Sam and Max are 16 year-old triplets.**

Folk Dancers.
Tbilisi, Georgia.

5) Match up the following three sets of statistics with the groups.

Stats A	Mean age Range	= 15 years old = 1 year
Stats B	Mean age Range	= 15 years old = 4 years
Stats C	Mean age Range	= 15 years old = 37 years

Group 1	Friends invited to Sally's 15th birthday party
Group 2	Participants at the mother-and-baby group
Group 3	Pupils in year 10

Young dancers listen to the ballet master.

YOUR BRAIN WORKOUT

Q2.

What is the range of the numbers 4, 4, 5 and 7?

YOUR BRAIN WORKOUT

Q2.

What is the mean average of 4, 4, 5 and 7?

YOUR BRAIN WORKOUT

Q3.

What is the range of the numbers 30, 10 and 20?

YOUR BRAIN WORKOUT

Q4.

What is the mean average of 30, 10 and 20?

YOUR BRAIN WORKOUT

Q5.

What is the range of the numbers 21, 20 and 22?

YOUR BRAIN WORKOUT

Q6.

What is the mean average of 21, 20 and 22?

YOUR BRAIN WORKOUT

Q7.

What is the range of the numbers 2, 4, 3 and 3?

YOUR BRAIN WORKOUT

Q8.

What is the mean average of 2, 4, 3 and 3?

YOUR BRAIN WORKOUT

Q9.

What is the range of the numbers 41, 44 and 44?

YOUR BRAIN WORKOUT

Q10.

What is the mean average of 41, 44 and 44?

YOUR BRAIN WORKOUT

Answers

Q1. 3

Q2. 5

Q3. 20

Q4. 20

Q5. 2

Q6. 21

Q7. 2

Q8. 3

Q9. 3

Q10. 43

PART 25
STATISTICS

Ocean, Lights and Palms VIII
by Sarah Butterfield, 2011.
Detail.

Quick Quiz

Q1.

How would you write **12** as a product of its prime factors?

- **A.** 2 x 6
- **B.** 3 x 4
- **C.** 2 x 2 x 3
- **D.** 2 x 3 x 3

Quick Quiz

Q2.

What is **–4 + –2**?

- **A.** –6
- **B.** –2
- **C.** 6
- **D.** 2

Quick Quiz

Q3.

What is **30%** as a fraction?

- A. $\frac{30}{1000}$
- B. $\frac{3}{100}$
- C. $\frac{3}{5}$
- D. $\frac{3}{10}$

Quick
Quiz

Q4.

If the ratio of flour to sugar is **3:2**, which of the following would work out correctly for the recipe?

- **A.** **200 g** flour and **300 g** sugar
- **B.** **150 g** flour and **100 g** sugar
- **C.** **400 g** flour and **100 g** sugar
- **D.** **100 g** flour and **200 g** sugar

Quick Quiz

Answers

Q1. 2 x 2 x 3

Q2. -6

Q3. $\frac{3}{10}$

Q4. 150 g flour and 100 g sugar

Vital Statistics

Statistics are used all the time in business, politics, advertising and in the media. As a result of statistical surveys, decisions are made and millions of pounds are invested. People are employed or fired. Shopping malls are built. Ordinary people may be persuaded to spend more money than they can afford.

Statistics can give you a good idea of a situation, but they are not always precise.

For instance, the country town of Poddleton has **10,000** voters. A survey before the last council election predicted that **20%** of voters would vote for Farmer Giles.

20% of **10,000** voters is **2,000** voters. So **statistically** Farmer Giles would get **2,000** votes. But while the statistics gives you a good idea of the number of votes he might get, in **fact** Farmer Giles is unlikely to get this precise number. He might get a few more than **2,000** votes or a few less than **2,000** votes.

This may be for many reasons.

Some people forget to go to the polls.

Some people decide not to go out because it's raining...

Statistics are often worked out from information gathered in a **survey**. A survey is a general term for collecting information (called **data**). For example, Coleen was asked by Starbucks to organise a survey: what percentage of people in the Salisbury Shopping Mall go into Starbucks on Saturdays?

The resulting statistics might be: 12% of those shoppers go into Starbucks on Saturday.

The accuracy of a statistic depends on the **survey** upon which it was based. The main considerations are:

a) How many people were in the survey (**the sample size**, see later)
b) What sort of people were surveyed.
c) How the statistics were gathered.

A survey can be deliberately misleading. For instance, you might be impressed if a TV advertisement tells you that 9 out of 10 women in a survey found that their wrinkles disappeared within a week, after using Wonder Products Wrinkle Cream.

However, you might **not** feel like rushing out and buying a jar of that cream if you discovered that there were only ten women in the survey, they were all aged under 25, and all of them were recruited from the Wonder Products sales force.

Beauty in action.
Trumpeter swan cygnet.

Lies, Damn Lies and Statistics

"There are three types of lies: lies, damn lies and statistics" Mark Twain's famous quote means that even accurate statistics can be used to back up an inaccurate argument. Advertisers, businesses and governments do this, to camouflage their failures and to emphasise their successes: it's called spin.

If someone quotes an average, or some different statistic, when you need an accurate answer, then ask simple questions in language **you** understand. Good starter questions are (a), (b) and (c) mentioned on the previous page. If you don't understand **everything**, ask someone to explain, step by step, how the finding was calculated. To avoid being misled, write down what you are told. Later, you may want to ask more questions.

However it's safe to assume that many statistics are responsibly gathered and used. How are they gathered? Often with **questionnaires**.


Serious cyclists need maths.

Questionnaires

Many **surveys** rely on collecting **data** in the form of a **questionnaire**. If you ever design a questionnaire, make sure that your questions are simple, and give easy, quantifiable answers that are unbiased. Boxes to tick will make it easier for you to process the answers. Make sure you have tick boxes for all possible answers; occasionally, allow a space for the respondents to answer in their own words, which prevents them getting irritated by not being allowed to explain their answer.

Example

On the next page are good and bad versions of a questionnaire that Henrietta is preparing, in order to obtain information from the customers in her hat shop.

This 4-year old was born above a fish & chip shop in Dagenham, grew up to have amazing powers, as the first female Director of a British national newspaper: Felicity Green Hill.

Bad Questionnaire

Question 1
Did you hear about 'Henrietta's Hats' from our recent radio advertisement? (Please tick)
Yes ☐ No ☐

Question 2
How much do you spend in 'Henrietta's Hats'? (Please tick)
Not much ☐ A lot ☐

Question 3
How would you rate the service on your last visit to "Henrietta's Hats'? (Please tick)
Excellent ☐ Very good ☐ Good ☐

Question 4
What would improve your next visit to "Henrietta's Hats"? (Please tick)
Cheaper hats ☐ More hats ☐
Shop in a better location ☐

Good Questionnaire

Question 1
How did you first hear about 'Henrietta's Hats'? (Please tick)
Radio ☐ Internet ☐ Magazine ☐ Friend ☐
Other ☐ Please specify ....

Question 2
How much did you spend in 'Henrietta's Hats' on your last visit? (Please tick)
£0 ☐ Less than £20 ☐ £20 - £39.99 ☐ £40 - £59.99 ☐
£60 - £79.99 ☐ £80 - £99.99 ☐ More than £100 ☐

Question 3
How do you rate the service you received on your last visit to 'Henrietta's Hats'? (Please tick)
Excellent ☐ Very good ☐ Good ☐ Fair ☐ Poor ☐

Question 4
What would improve a future visit to 'Henrietta's Hats'?

....

....

In the bad questionnaire, **question 1** is too narrow: there are many ways a person may have heard about 'Henrietta's Hats', even if Henrietta is only interested in the success of her radio ad; having comparisons would put her radio ad into perspective. The tick boxes for **question 2** depend on each individual's understanding of 'a lot'. Lady Anne's 'a lot' might be quite different from Zenna's 'a lot'? **Question 3** gives no chance for any negative responses. **Question 4** gives specific suggestions; but **what Henrietta needs are ideas that she, herself, may not have thought of**.

Henrietta should aim to hand out her questionnaire to as many customers as possible, because the more people in Henrietta's **sample**, the better the results will be.

More about Samples

A sample is the **small group** of individuals selected for analysis from a bigger population, in order to give **estimates** about the whole population.

Example

The tropical island of Pampam has **20,000** inhabitants. **3%** of them have blue eyes, a reminder that in the 18th century, HMS 'Bounty' once anchored there for fresh water. In order to get that statistic of **3%**, only **200** inhabitants were interviewed – so the **size of the sample** was **200**. Question: How many people in the sample had blue eyes?

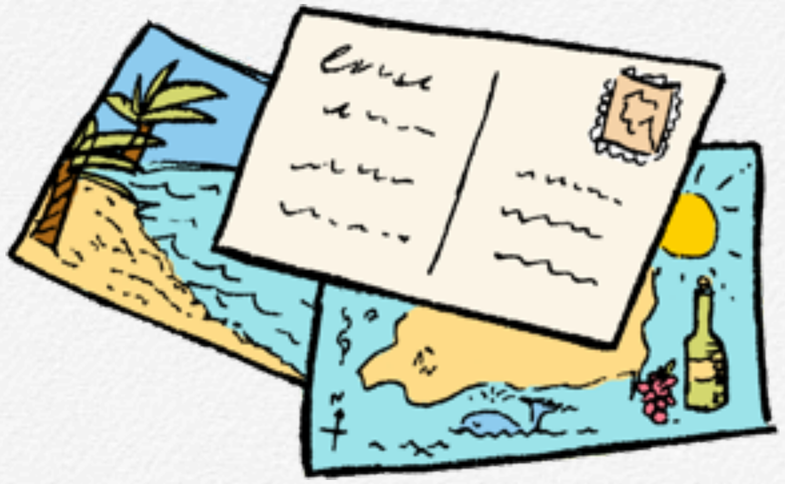
- You know the sample size is **200** people.
- You know that **3%** of the sample have blue eyes.
- So you need to calculate **3%** of **200**.

If necessary, refresh your memory by looking back to the chart method, for **percentages** in STEP 2.

	People	%
200 sampled = 100%	200	**100**
People with blue eyes = 3%	?	3

First, multiply the diagonal numbers

Then, divide by the remaining number



First multiply the diagonal numbers, then divide by the remaining number.

The calculation is then: 200 x 3 ÷ 100 = 6

Answer: **6 people in the sample had blue eyes.**

The size of a sample

The **bigger** the sample the more likely it is to be **accurate**.

There are **20,000** people in Pampam and the sample size in that last example was **200** people, which is **1%** of **20,000**.

Had the **sampling** been larger… not **200** people but **1000** people… that would have been **5%** of the population of **20,000**… and the sample would be more accurate.

Modern Action Woman.

Angelina Jolie plays Lara Croft in Tomb Raider.

Extrapolation

When the results of a small sample are used to estimate the probable results of a bigger sample.

Example

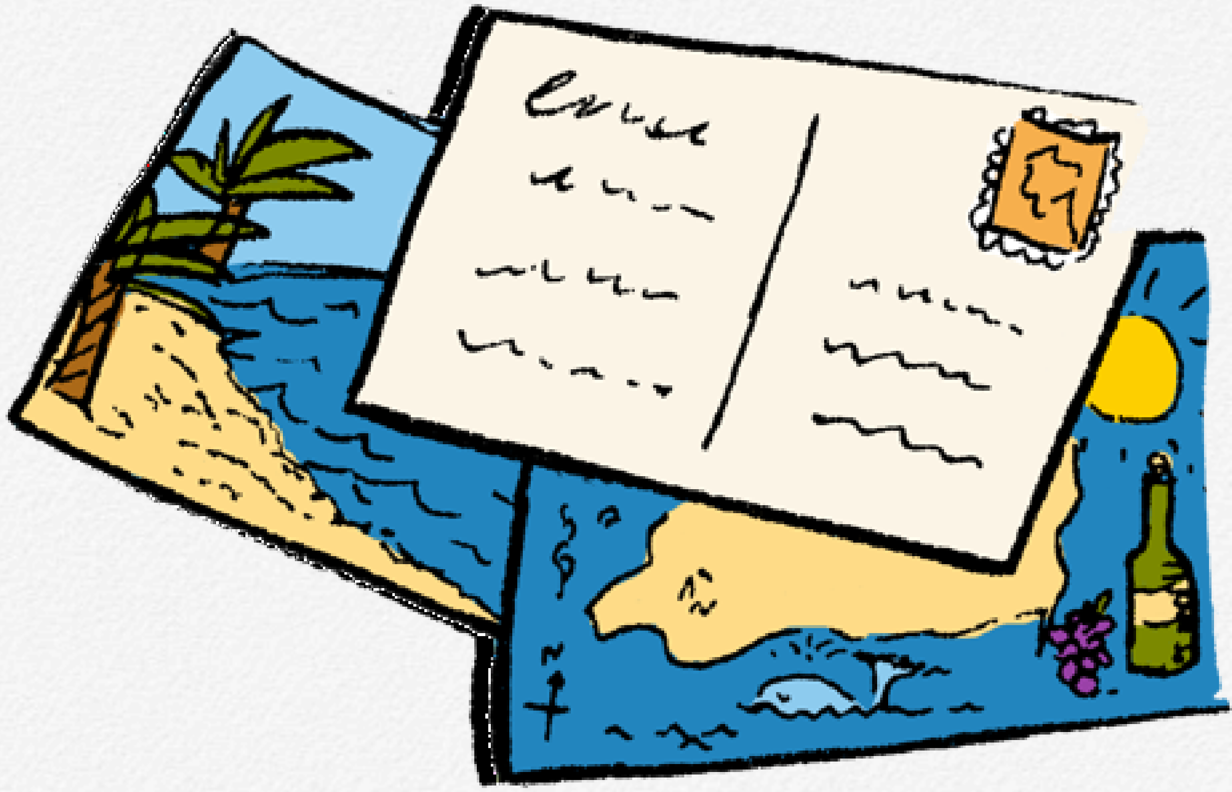
The Pampam Island sample of **200** people showed that **3%** had blue eyes. If **3%** of **200** Pampam islanders have blue eyes (assuming the sample represents the entire population) then **3%** of the entire population should have blue eyes.
The entire population of Pampam is **20,000** people. Estimate how many people on Pampam have blue eye.

So you need to calculate **3%** of **20,000** people.

	People	%
Whole population of 20,000 = 100%	20,000	100
People with blue eyes = 3%	?	3

20,000 x 3 ÷ 100 = 600 people

After **extrapolating** the results of the sample, you can estimate that, **statistically**, **600** people on Pampam have blue eyes.
So the conclusion is that about **600** Pampam islanders have blue eyes.



Biased Samples

What is a **biased sample**? That misleading Wonder Products Wrinkle Cream claim by the manufacturers was based on a biased sample.

A **biased sample** is one in which the people in the sample are chosen – sometimes deliberately – to produce an inaccurate result… which might be used to sell you something, whether it's a face cream or a politician.

Examples of samples that are too small, and so are biased

The claim for Wonder Products Wrinkle Cream was based on a sample of only ten women, all of whom were employed by Wonder Products Plc. That would be a deliberately **biased sample**.

It would be misleading to project the average height of American men by taking a sample of the Harlem Globetrotters because that basketball team consists of a **very small number** of **very tall men**. That would be a **biased sample**.

It would be misleading to project statistics on Britain's favourite foods, from a sample of six people who only eat at smart restaurants and ignore coffee shops. That would be a **biased sample**.

An **unbiased sample** must be carefully organised, so that it can accurately represent the entire population under consideration.

When statistics are used, 'the population' does not necessarily mean the population of a country: 'the population' can describe any entire group of people. i.e. all British teenagers, all soldiers in an army; all potential purchasers of Wonder Products Wrinkle Cream.

Exercises

1) On Pampam, all warriors and **only** warriors shave their head. In a sample of **1000** men, **60** had shaven heads.

What percentage of the men of Pampam have shaven heads? The answer will tell you approximately what percentage of men in Pampam are warriors.

2) On Pampam, every married woman **and no other** has a blue tattoo on the centre of her forehead. There are **10,000** females on the island.

There are **230** blue tattooed ladies.
In a sample of **500** females, what percentage of the female population is married?

Money is power.

Answers to Part 25

1) On Pampam, all warriors and **only** warriors shave their head. In a sample of 1000 men, 60 had shaven heads. What percentage of the men of Pampam have shaven heads? The answer will tell you what percentage of men in Pampam are warriors.

The question is talking about the sample, so the entire sample is 100%.

	Men	%
1,000 men (sample) = 100%	1,000	100
60 with shaven heads = ? %	60	?

Your calculation is: 60 x 100 ÷ 1,000 = 6

Answer: **6% of the sample have shaven heads, therefore approximately 6% of the people of Pampam are warriors.**

2) On Pampam, every married woman **and no other** has a blue tattoo on the centre of her forehead. There are 10,000 females on the island. There are 230 blue tattooed ladies. In a sample of 500 females, what percentage of the female population is married?

The question is talking about the married women found **in the sample** (not in the whole population), so use the entire sample as 100%.

	People	%
500 people (sample) = 100%	500	100
230 with blue tattoos = ? %	230	?

Your calculation is: 230 x 100 ÷ 500 = 46

Answer: **46% of the women sampled have a blue tattoo, so approximately 46% of women on Pampam are married.**

This is a photo of a Pampam beach.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q1. In a survey to find Britain's favourite film of the year, people attending a Star Trek convention were interviewed.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q2. In a survey to find Britain's favourite film of the year, every 5^{th} person exiting a tube station was interviewed.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q3. In a survey to find Britain's favourite film of the year, ten five-year-olds were interviewed.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q4. In a survey to find Britain's favourite film of the year, 500 five-year-olds were interviewed.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q5. In a survey to find Britain's favourite film of the year, 2000 randomly selected households were asked to select their favourite film of the year.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q6. In a survey to find who might win the next election, two randomly selected Labour supporters were asked who they would vote for.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q7. In a survey to find who might win the next election, 400 randomly selected Conservative supporters were asked who they would vote for.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q8.

In a survey to find who might win the next election, 300 randomly selected voters were asked who they would vote for.

YOUR BRAIN WORKOUT

Is the example below based on
biased or unbiased samples?

Q9.

To determine the average weight of women aged 20 to 40 in Nottinghamshire, the weights of 200 ladies from modelling agencies in Nottinghamshire were taken.

YOUR BRAIN WORKOUT

Is the example below based on biased or unbiased samples?

Q10. To determine the average weight of women aged 20 to 40 in Nottinghamshire, the weights of 400 women with names beginning with J were taken.

YOUR BRAIN WORKOUT

Answers

Q1. Biased Sample

Q2. Unbiased Sample

Q3. Biased Sample

Q4. Biased Sample

Q5. Unbiased Sample

Q6. Biased Sample

Q7. Biased Sample

Q8. Unbiased Sample

Q9. Biased Sample

Q10. Unbiased Sample

HOW TO SPEND MONEY

Holiday fashion.


For richer, for poorer,
you need maths.

How to Spend Money

A Basic System has three items.

1. **Pocket diary or organiser,** on paper or smartphone which shows one week at a glance – vital.

2. **Lined index cards**. Use one a day. Business bosses and royalty carry these. It's called a Day Card.

Put date on top right of card. Beneath date, list three telephone calls to make, with any mobile numbers needed.

On left, list three things to do, today.

3. A **little cash book** to list spending.
   (You may prefer to do this on your mobile).

List columns from left to right as follows.

Date – item – the seller's order reference – name of seller (eg Amazon) – cost of item.

Later in life, you may need something a bit more elaborate.

Page from my cash book today

Date	**Item**	**Their order number**	**Ordered from**	**Total**
7 June 13	3 Books	10501	Amazon	£13.94
10 June 13	Food		Waitrose	£15
12 June 13	Clothes for friends new baby	811193	Debenhams	£69
17 July 13	2 Frying pans	202-8375-349	John Lewis	£24

- No need to write down the cost of every lettuce, just write "food" and the total spent.

- Always fill in the date.
(You'll soon find out why, if you don't do this.)

Warning: This system won't show you where you are overspending (see later).


This is what I use
2013
V5
HI-TECPOINT
0.5

Sudden Success.

A famous model and a famous actress, who were both successful in their teens, had to pay far more than necessary in accountant's fees and tax, because in their first year of fame they had kept no receipts for their spending and had no idea what they had spent.

The actress told me, "Now I keep every bit of paper – even parking tickets. Then I know it's all there, somewhere. At the end of the month, I decant it into a big brown envelope, scribble the date and year on it, and shove it in a drawer. At the end of the year I unscrew all the little bits of paper, put them in date order with the most recent date on the top. I put them back in envelopes and it's all in order for the taxman."

DON'T TRY TO DO TOO MUCH.

My favourite cartoon shows a makeshift, little stage at the back of a run-down bar, upon which stands a balding, pony-tailed folk singer, playing electric guitar. He announces, "My next song aims to cure cancer, avert global warming, eliminate poverty, and bring peace to the planet."

At Work.

You might have a **business expenses account**. Carry an index card around with you, to note what you spend. Always keep the bills, when you're spending someone else's money. I have a separate credit card and pay as many business expenses as possible with this.

Sudden success.

On Holiday

You suspect a pickpocket. Or maybe – accidentally – you left your money behind in the hotel? You sit in a café and try to remember what you've spent. You jot it down on the back of the bill for that expensive latte. To your horror, you realise you have spent nearly all your holiday money and can't afford to eat for the next three days.

Having done that many times myself, I now divide my holiday money by the number of days in the holiday. I leave any credit cards in the hotel safe. I only carry basic money for one day at a time.

Before I book my holiday, I plan my holiday budget.

The Holiday Cash Plan.
If you want to know, at the end of the holiday, where the money went, try this system.

Again, I carry a lined index card, plus a pen, in my purse. In the purse goes my cash spending money for that day. When I buy something, I jot it down, either then or at lunchtime, with my purchases still in sight, to remind me.

On holiday.

The Holiday Money Plan.

Fiona had saved £525 to spend on her entire holiday. Here is her money plan on the right hand side of the page.

Fiona's money plan totaled £528, so she reduced her duty-free spend from £20 to £17. The total was then £525, as shown in the chart.

When she returned home from her holiday, Fiona had only spent £15 at the airport, she needed no emergency cash, she spent only £30 on beachwear and she only spent £120 on evening entertainment. So she came home with £67 in hand. (My holidays never end like that.)

That's enough to think about for today. STOP.

Fiona's Spending	Spend Plan	What Fiona Actually Spent
FANTASY HOLIDAY (flight & hotel etc. 10-day package)	£210	£210
Travel insurance, including medical	£25	£25
Bus to home-airport	£4	£4
Additional travel costs	£5	£0
Airport charges (included in package)	£0	£0
Coffees and duty-free purchases at both airports	~~£20~~ £17	£15
At Ibiza: bus from airport to hotel, included in package	£0	£0
Beach clothes	£35	£30
Breakfasts (included in package)	£0	£0
Lunches (food & drink)	£50	£50
Suppers (included in package)	£0	£0
Clubbing, etc.	£150	£120
5% emergency (chemist, sunburn medication, etc.)	£25	£0
Bus from home-airport	£4	£4
TOTAL SPENT	~~£528~~ £525	£458

Holiday clubbing.

Where's the Money Gone?

For my **normal** cash spending, I also use an index card and roughly draw four columns on it: **date, item, OUT, IN**. It sounds weird, but OUT always comes before IN.

Note: In order to keep things simple, the following examples deliberately show unrealistic figures.

Note: In business, when you deduct an amount, you do not use the minus sign. Instead, use brackets **( )** around the sum spent. **(£83)** or **(83)**.

Keep your figures neat and in line.

Date of Entry	Item	Out (money spent)	In (money in purse)
	JULY 2013	£	£
1 July	In £100 from cashpoint		+100 to purse
3 July	Market food	17	(17)
	What's left in purse		+83 in purse
6 July	Lent to Jemima	30	(30)
	What's left in purse		+53 in purse
13 July	Bus to crafts exhibition	3	(3)
	What's left in purse		+50 in purse
	Purchase enormous stuffed animal for cousin's baby	35	(35)
	What's left in purse		+15 in purse
	Taxi home with enormous animal.	9	(9)
	What's left in purse		+6 in purse
19 July	In £50 from cashpoint		+50 to purse
	Now in purse (£6+£50)		56 in purse
25 July	Food for the gang to watch the final on TV	45	(45)
31 July	What's left in purse		11 in purse
	AUGUST 2013	£	£
1 Aug	Still in purse from July.		11
	In £100 from cashpoint.		+100
	Now in purse (£11+£100)		111 in purse

And so on...

Always make two entries when you spend money.

First entry in first column = what you've spent.

Second entry in second column, to subtract what you've spent from the amount in your purse. Then you know how much you have left in your purse.

After a bit, you'll not bother to write 'What's left in purse' or 'in purse'. Just remember to write the brackets and the plus sign, in the **IN** column.

Warning: this system won't show where you are overspending.

Children and pets
Always
Cost a lot more
Than you expected.

Girl in red dress with cat and dog.
Ammi Phillips (1788-1865). Oil on Canvas. 30 x25 in.
American Folk Art Museum, New York.

The Money Tracker

Why should you bother to look at another system?

Because this system WILL show where you are overspending.

It doesn't matter much if you keep a careful record of your holiday spending.

It's controlling your money for the rest of the year that matters.

THE MONEY TRACKER gives you a **monthly statement of your spending**. This is a relatively pain-free way of sticking to your budget, month by month, instead of finding in November that you have no money left to spend.

THE MONEY TRACKER is not only important for one year. It will also help you **the year after that**. How?

If you overspend this year – and get into debt –
THE MONEY TRACKER will show **where** you overspent and it will help you to decide **where** you can save money.

November.

About Fiona's yearly spending.

- Fiona has her tax deducted by the firm she works for.
- Her net pay (after tax) is just over £10,600 a year.
- Fiona shouldn't spend more than £200 a week.
- A season ticket pays for the journey to the shoe shop where Fiona is assistant manager.
- Fiona lives at home and contributes £40 a week to her mum.
- Fiona never carries cash of more than £20.
- Fiona pays her credit card debt in full, every month, so never worries about interest charges.

Read this bit. Then look at The Money Tracker on the next page. Then read this bit again.

To use THE MONEY TRACKER, **you write the cost of each item twice** – once under All costs (the second column) and again in one of the specific columns. For instance, Fiona's new tablet goes in All Costs, then it is repeated in the IT Column, Fiona's new shoes goes in All Costs, then is repeated in the Appearance Column.

Examples:

Item	All Costs
New Tablet	£38
New Shoes (bought at discount)	£29

IT
£38

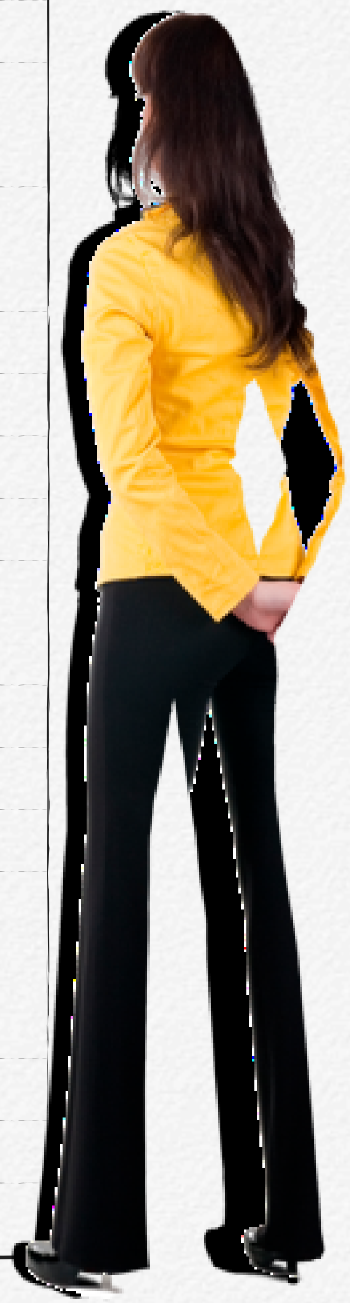
Appearance
£29

GOOD BALANCE.

Remember, THE MONEY TRACKER isn't Fiona's money plan – it is what she actually spent.

THE MONEY-TRACKER

Item	**All Costs**	**Personal Cash**	**Home**	**IT**	**Appearance**	**Food** (inc lunch)	**Savings, gifts, charity**	**Transport**	**Fun stuff**	**TOTAL** of columns
Entry date 1-7 Sept 2015	£									
Personal cash	£20	£20								
Home contribution	£40		£40							
Downpayment for new tablet	£38			£38						
New apps	£2								£2	
New shoes	£29				£29					
Weekly savings	£10						£10			
Winter vest	£2				£2					
Smoothies for self + friends	£5					£5				
Winter scarf	£5				£5					
New hairdryer	£19				£19					
5 lunches	£28					£28				
Contribution to Thelma's leaving gift	£2						£2			
Various buses	£6							£6		
Concert ticket	£10								£10	
TOTAL SPENT	**£216**	**£20**	**£40**	**£38**	**£55**	**£33**	**£12**	**£6**	**£12**	**£216**



Step 1.

Now look **only** at the **Item column** and the **All Costs** entry column.

You can see that Fiona allows herself £**20** a week cash for small items, such as coffee, that she doesn't bother to track.

Look at all Fiona's other purchases and see how much they cost.

Step 2.

Next, see how Fiona duplicated each amount in one of the columns headed **Personal cash, Home, IT** and so on.

Step 3.

Next, add up each column. (I've done the addition in bright pink, to make the amounts easy to spot.)

You can now see how much money Fiona spent in each column.

Step 4.

You can see that the first column from the left – labelled **All Costs** –adds up to £**216**.

Do nothing further to this figure.

Step 5.

Next, on the bottom line, add together the totals of all the other columns (the amounts in bright pink). Put the total sum in **the furthest, right-hand column.**

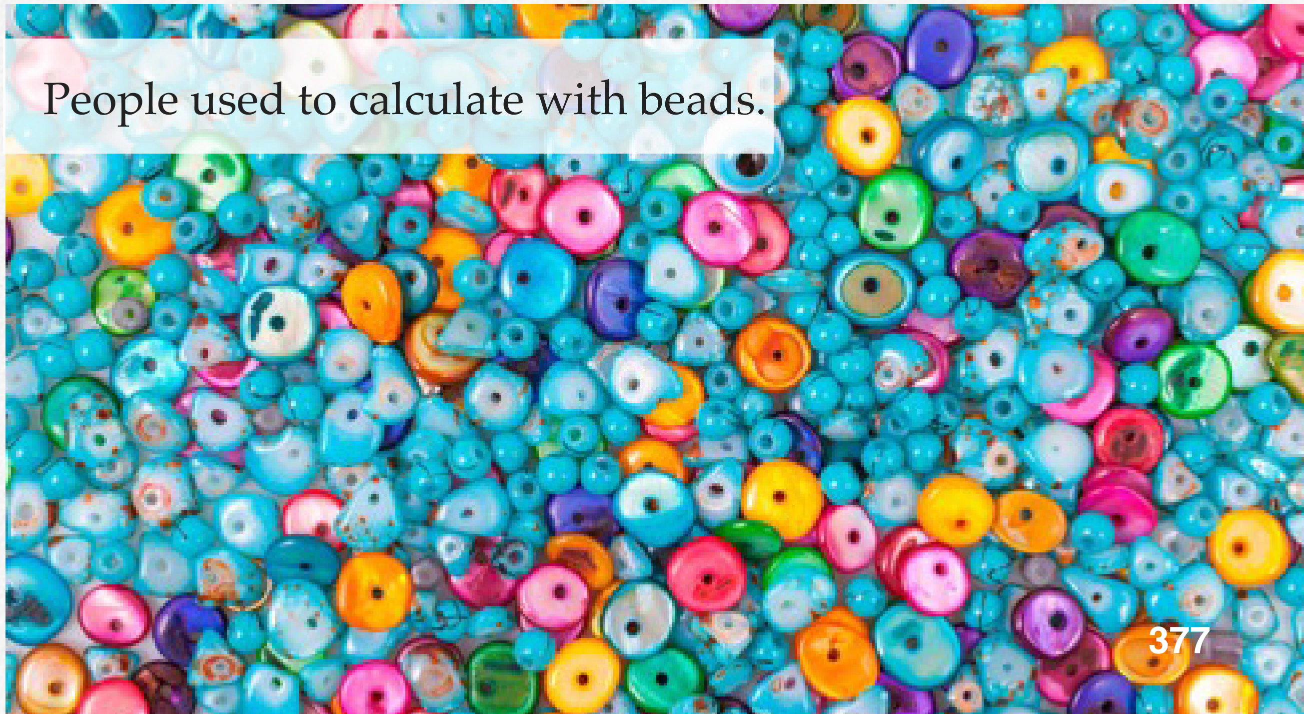
This is how the sum looks.

£20 + 40 + 38 + 29 + 10 + 2 + 5 + 5 + 2 + 19 + 28 + 2 + 6 + 10 = £216.

Write that total of **all the total columns** in the last column on the right of the page, headed **TOTAL of columns**.

Now **look to the left**, to the total amount in the **All-Costs column**. This should **also** total £**216**. If the same sum is not in both of these columns, you have made a mistake.

Check each entry until you see the mistake, which is usually easy to spot.



People used to calculate with beads.

Fiona's decisions

In her first week back at work, Fiona has overspent her weekly budget of £200 by £16 (see All Costs column).

A total of £40 was spent on the **IT** downpayment (the new tablet), but Fiona doesn't regret it.

A total of £55 was spent on **Appearance** – a big overspend – but Fiona needed all the items, especially the hairdryer because her ancient one refused to work.

Fiona decides she will take lunch sandwiches to work next week, to make up for the overspend of £16.

Number of columns

You can have fewer columns than Fiona has, or more.

You can rule the columns on a piece of paper, you can buy a simple bookkeeping book at a stationer or you can use Excel spreadsheet software on computer, and Excel will do the addition for you.

CONGRATULATIONS, you have just learned the basic theory of bookkeeping. Isn't it clever?

I didn't know this theory of bookkeeping – which changed my life – until I had earned millions of dollars. A PA taught me and in that half an hour I went from being a bewildered, financial disaster (if I was earning all that money – where was it?) to being in control of my finances – and in charge of my life.

That's enough to think about for today. STOP.

GET THE WORK - LIFE BALANCE RIGHT.

Grown-up Budgets

You can skip this bit, if it doesn't concern you right now. But I hope you'll read it, to remember if you need it later.

FLAT SHARING

Use a separate bank account for the rent and utilities.

List the rent and utilities. Add up what you think each item will cost per year.

Divide the time periods into cost per week. Decide – in advance – what will happen if you have under-estimated the costs per year. Also, decide in advance what will happen if anyone doesn't pay their weekly share. A fine? A kick-out? If so, how soon after non-payment? What will happen if that contribution is never paid?

Stop trouble before it starts.

WHO SLEEPS WHERE?

Give each bedroom 1-10 points for desirability. Split the rent accordingly. Do this before deciding who has the best bedroom.

Example:

A. Front double bedroom	= 9 points
deduct 1 point for road noise	= 8 points
B. Big rear bedroom	= 7 points
C. Small rear bedroom	= 4 points
deduct 1 point because it's dark	= 3 points
Add 8 + 7 + 3 points	= 18 points

Divide rent total by 18 points. Say the rent is £180 a week, that's 180 ÷ 18 = 10, so each point is worth £10.

A. costs 8 points = £10 x 8 = £80 a week

B. costs 7 points = £10 x 7 = £70 a week

C. costs 3 points = £10 x 3 = £30 a week

A Yearly Budget for One (or Two)

Why should you bother to learn how to plan a budget?

For the same reason you plan a holiday budget – to keep control of your finances and your life. If you're still at pocket-money stage, that's the perfect time to start. You will sail confidently into adult life and breeze into marriage, able to run a budget. (Major causes of marriage difficulties are money problems, not sex, irritation or jealousy.)

A yearly budget is like a holiday budget, only longer. Basically, it is two simple lists.

List 1 is money coming in from different sources over the year = **INCOME** after tax is deducted.

List 2 is money being spent on different items over that time = **EXPENDITURE**.

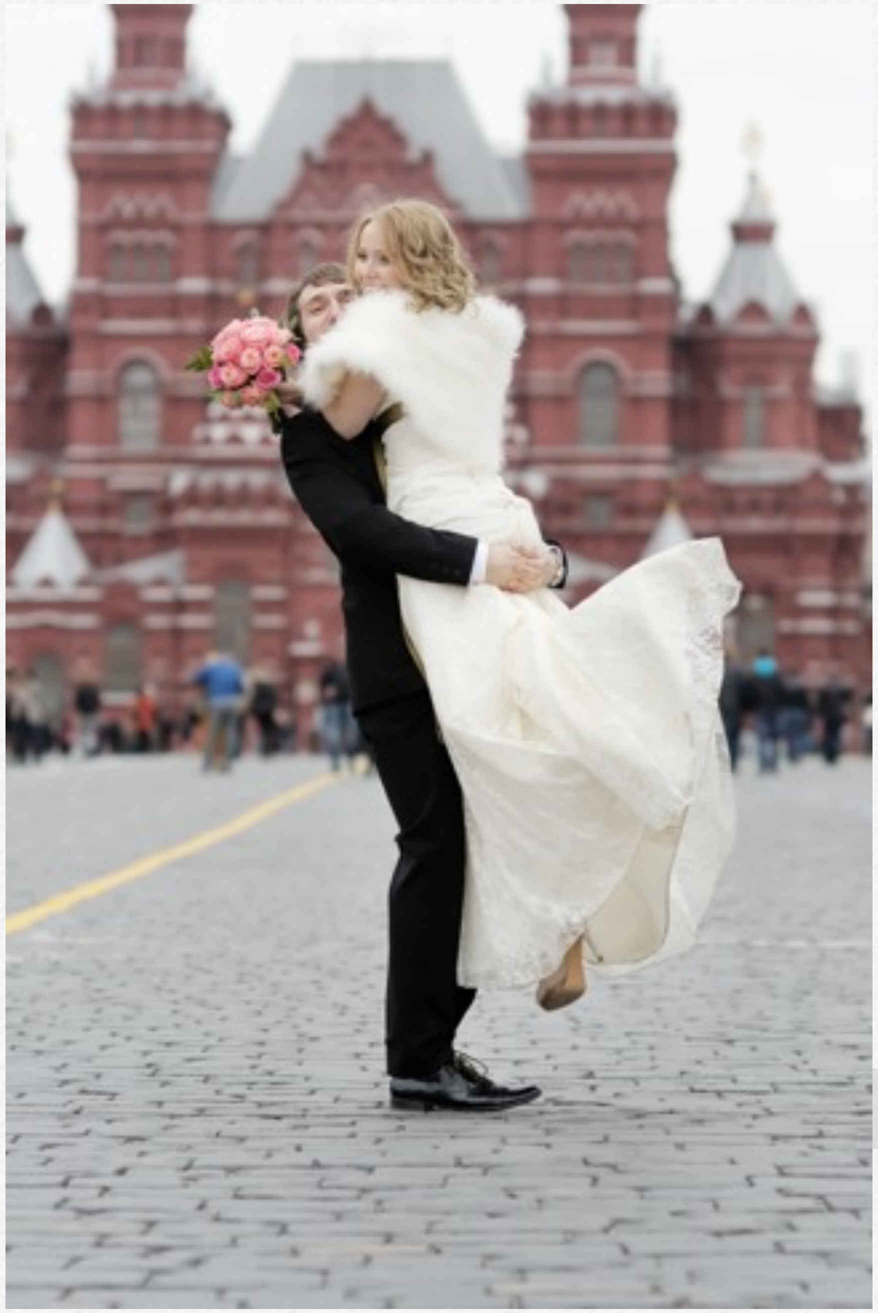
Divide **List 1** by **12** to get the amount you can plan to spend each month.

Divide **List 2** by **13** if you want to split your year into four-week periods.

Divide **List 1** by **52** if you want to budget weekly.

If you get paid weekly, try a weekly money plan. If you are paid monthly, try a monthly money plan. You can use the simple cash book system, or the money tracker, which will immediately show if you overspend.

That's enough to think about for today. STOP.



Budget for two.

How Much to Spend on What??

I think it's unrealistic for anyone to tell somebody else what percentage of their income they should spend on rent or entertainment. Everybody has different priorities at different times in their life. Maybe you don't pay rent, because you're still at school. Maybe you don't pay rent because you paid off your mortgage ten years ago.

Nevertheless – as a vague guide – the following list shows the allocation of a yearly income, suggested by Helen, a home economist.

Percentage of Income	Budget Items
30%	Rent, mortgage repayment, maintenance, insurance, fares to work, etc.
45%	Household expenses (including food, fuel, laundry, telephone, cleaning)
10%	Appearance
5%	Entertainment and holidays
5%	Savings and insurance
5%	Small, odd expenses (including dog license, magazines, subscriptions to clubs, societies, pocket money)

I've included her budget so that you can disagree with it (as I do) and form your own ideas.

Here is an **alphabetical check list** of suggestions for your budget. You decide your own priorities. First, try using percentages, because **100%** is easy to add or subtract from. Then try a money budget:

- Appearance
- Cash, personal
- Charity
- Emergency funds
- Entertainment
- Food
- Health
- Holidays
- Home
- Installment payments
- IT
- Insurance
- Pet
- Tax
- Transport
- Savings
- Subscriptions

Remember, a **budget** is a PLAN only.
The **money tracker** shows FACTS. It shows whether you are sticking to your plan, and, if not, where you are overspending.

Aspirational?
Aston Martin DB9.

Saving

Your emergency fund: If you regularly put aside an amount and don't have a single emergency during the year, a) I should be astonished b) At year end, you can spend it on fun or simply keep it as next year's emergency money. An emergency fund is vital.

Experts advise you to get into **the habit** of **saving** – even if it's only a little – or else **you will probably never manage to save**, never have that nest egg.

You may disagree with Helen, the home economist, so instead of saving **5%**, you decide on **1%**.

At the **start** of the year, decide what to do with your future savings, because you're more likely to save if you have an end goal. If inflation is rampant, you may not want to save cash that's dwindling in value. Instead, consider investing it in a sofa or a better bed or some IT treasure. Or towards a down payment on something that costs a lot more.

Installment payments can be a good, if painful, way to buy something, but only if total payments don't exceed whatever annual amount you allow in your budget. After I had my first baby, I could never have purchased a washing machine, had I not paid in installments. A brilliant investment, because disposable diapers hadn't been invented.

... A better bed?

Birdseye View

Birdseye View

How to work out your financial position TODAY.
Don't do this when you are tired, you need to be alert.

MONEY IN

A – Write down the amount you have in your bank account, or savings account, or china piggy bank.

B – Write down all payments due to be paid to you this month. Add, then add total to amount A.

MONEY OUT

C – Write down the total of bills that haven't yet been paid by you.

D – Add any regular payments due to be paid by you this month, but not yet paid.

A + **B** = your total income for the month.

C + **D** = Your total expenditure for the month.

From amount **A** + **B**, deduct **C** + **D**. This might leave you with an unspent amount in your bank account – a **surplus**. Good news!

If it leaves you with a total **MONEY OUT** to pay that is bigger than your **MONEY IN** total, you have overspent.

Decide which bills you can't pay – hopefully, until next month – and inform the people concerned. (They will be even crosser if you don't tell them).

Alternatively, you may need to borrow money, or to ask the bank for a temporary overdraft loan, which might cost you annually as much as **26%** of the sum you borrow (!!!) so try to avoid an overdraft.

Tip 1. Every month, pay credit card debts first, because the interest charged is horrendous.

Tip 2. Keep credit cards to the minimum. I have two: one for personal spending, one for business.

Tip 3. As soon as you have a credit card, you will have a **credit history**. So keep your money affairs in good order, because a bad credit history could mean that – years later – you suddenly find that you can't borrow to buy a car or a home.

Get STEP4

shirleyconran.com

Nearly finished...
Keep going...

Concept & Design
Author & Publisher
SHIRLEY CONRAN

Mathematics consultant
ELIZABETH FAGERLUND
Illustrator SASHA SPYROU

Editor
LINDSAY NICHOLSON

Final production
Technical drawings
DAVID MOSELEY

Money Stuff

4 STEP MATHS PLAN

I judge myself competent in the following:

UNITS OF MEASURE
Both metric and imperial measuring systems
Converting between both in length, mass, volume, temperature.
Time calculations

STATISTICS
Constructing a fair statistical study.
Interpreting different types of bar charts, pie charts and graphs.
Compiling bar charts and pie charts.
Calculating mean average, a range. Interpreting a box plot.

Signed ....

Date ....

STEP 3

Money Stuff

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