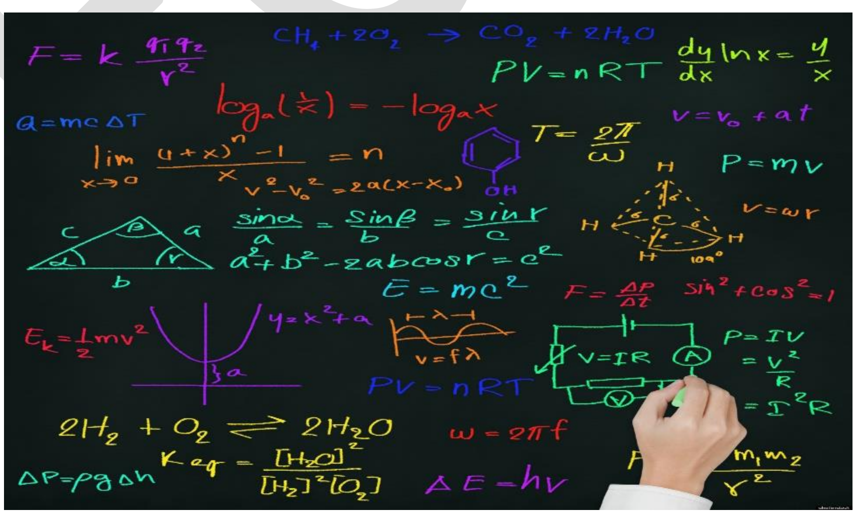
Edexcel

IGCSE

Mathematics

CODE: (4MA1)

Unit 4



Number 04

LEARNING OBJECTIVES
- Find an amount after a repeated percentage change, including compound interest
- Find an original amount after a percentage increase or decrease
- Solve real-life problems involving percentages

BASIC PRINCIPLES

- To calculate x as a percentage of y: $\frac{x}{y} \times 100$
- To calculate x percent of y: 1% of $y = \frac{y}{100}$ so x % of $y = x \times \frac{y}{100} = y \times \left(\frac{x}{100}\right)$
- The $\left(\frac{x}{100}\right)$ part of the last expression is the **multiplying factor**.
- 5% of a quantity can be found by using a multiplying factor of 0.05.
- 95% of a quantity can be found by using a multiplying factor of 0.95 and so on.
- 'Per annum' (p.a.) is frequently used and means 'per year'.
- To increase a quantity by R%, multiply it by $1 + \frac{R}{100}$
- To decrease a quantity by R%, multiply it by $1 - \frac{R}{100}$

PERCENTAGE CHANGE	MULTIPLYING FACTOR
+15%	1.15
+85%	1.85
−15%	0.85
−85%	0.15

COMPOUND PERCENTAGES

The interest (money gained) on savings accounts in banks and building societies is often **compound interest**. In the words of Albert Einstein, a Nobel Prize winning scientist:

'Compound interest is the eighth wonder of the world.
He who understands it, earns it... he who does not ... pays it.'

Compound percentages are used when one percentage change is followed by another in a calculation.
EXAMPLE 01.
SKILLS; ADAPTIVE LEARNING
Stanislav makes an investment of $500 which pays him 8% p.a. compound interest for three years.
Find the value of his investment at the end of this period.

The multiplying factor for an 8% increase is $1+\frac{8}{100}=1.08$
Let the value of the investment be v.

$v = \$500 \times 1.08$ After 1 yr
$v = \$500 \times 1.08 \times 1.08 = \$500 \times 1.08^2$ After 2 yrs
$v = \$500 \times 1.08 \times 1.08 \times 1.08 = \$500 \times 1.08^3$ After 3 yrs

Stanislav's investment is worth $629.86

Note: in the period of the investment, the interest earned has not been removed so that it also earns interest in the next year and the following years.

KEY POINTS

- To increase a quantity by R% p.a. for n years, multiply it by $\left(1+\frac{R}{100}\right)^n$
- To decrease a quantity by R% p.a. for n years, multiply it by $\left(1-\frac{R}{100}\right)^n$

PERCENTAGE CHANGE p.a.	n YEARS	MULTIPLYING FACTOR
+15% (appreciation)	5	$(1.15)^5$
−15% (depreciation)	10	$(0.85)^{10}$

EXAMPLE 02
SKILLS; REASONING
When a cup of coffee at 100°C cools down, it loses 12% of its current temperature per minute.
What will the temperature be after 10 mins?
Let the temperature of the cup of coffee after 10 mins be *t.*

$$t = 100 \times (1 - 0.12)^{10} = 100 \times (0.88)^{10}$$

$$t = 27.9°\text{C}$$

INVERSE PERCENTAGES

Inverse operations can be used to find an original amount after a percentage increase or decrease. If a distance of x km is increased by 10% and its new value is 495 km, finding the original value is simple.

EXAMPLE 03
SKILLS; REASONING
A house in Portugal is sold for €138000, giving a profit of 15%.
Find the original price that the owner paid for the house.
Let €x be the original price.

$$x \times 1.15 = 138\,000 \qquad \text{[Selling price after a 15\% increase]}$$

$$x = \frac{138000}{1.15}$$

$$x = €120\,000$$

EXAMPLE 04
An ancient Japanese book is sold for ¥34000 (yen), giving a loss of 15%.
Find the original price that the owner paid for the book.
Let ¥ x be the original price.

Let ¥x be the original price.

$$x \times 0.85 = 34\,000 \qquad \text{[Selling price after a 15\% decrease]}$$

$$x = \frac{34000}{0.85}$$

$$x = ¥40\,000$$

Algebra 04

LEARNING OBJECTIVES

• Substitute numbers into formulae Change the subject of a formula

BASIC PRINCIPLES

- When solving equations, isolate the unknown letter by systematically doing the same operation to both sides.
- Use your calculator to evaluate expressions to a certain number of **significant figures** or decimal places.

USING FORMULAE

A formula is a way of describing a relationship using algebra.
The formula to calculate the volume of a cylindrical can is V = $\pi r^2 h$ where *V* is the volume, *r* is the radius and h is the height.

EXAMPLE 1

Find the volume of a cola can that has a radius of 3 cm and a height of 11 cm.

SKILLS
PROBLEM SOLVING

Facts: $r = 3\,\text{cm}$, $h = 11\,\text{cm}$, $V = ?\,\text{cm}^3$

Equation: $V = \pi r^2 h$

Substitution: $V = \pi \times 3^2 \times 11$

Working: $\pi \times 3^2 \times 11 = \pi \times 9 \times 11 = 311\,\text{cm}^3$ (3 s.f.)

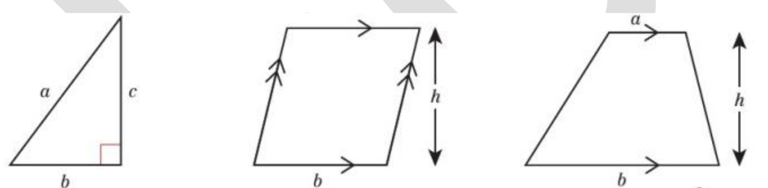
Volume = $311\,\text{cm}^3$ (3 s.f.)

KEY POINTS

When using any formula:
- Write down the facts with the correct units.
- Write down the equation.
- Substitute the facts.
- Do the working.

SOME COMMONLY USED FORMULAE

You will need these formulae to complete the following exercises.



$a^2 = b^2 + c^2$ Area of **parallelogram** = bh Area of **trapezium** = $\frac{h}{2}(a+b)$

Area of a triangle = $\frac{1}{2}$ × base × height

Speed = $\frac{\text{distance}}{\text{time}}$

For a circle of **radius** r: **Circumference** = $2\pi r$

Area = πr^2

CHANGE OF SUBJECT

SUBJECT OCCURS ONCE

It is sometimes helpful to write an equation or formula in a different way. To draw the graph of 2y - 4 = 3x it is easier to make a table of values if y is the subject, meaning if y = ... Example 2 shows how to do this. Example 3 shows how a similar equation is solved.

EXAMPLE 02

Make y the subject of the equation 2y – 4 = 3x

$2y - 4 = 3x$ (Add 4 to both sides)

$2y = 3x + 4$ (Divide both sides by 2)

$y = \frac{3x+4}{2}$ (**Simplify**)

$y = \frac{3}{2}x + 2$ (y is now the subject of the equation)

EXAMPLE 03

Solve 2y – 4 = 2

$2y - 4 = 2$ (Add 4 to both sides)

$2y = 6$ (Divide both sides by 2)

$y = 3$

KEY POINT

- To rearrange an equation or formula, apply the same rules that are used to solve equations.

POWER OF SUBJECT OCCURS OR SUBJECT OCCURS TWICE

EXAMPLE 4

Make x the subject of the equation $ax^2 + b = c$.

$ax^2 + b = c$ (Subtract b from both sides)

$ax^2 = c - b$ (Divide both sides by a)

$x^2 = \frac{c-b}{a}$ (Square root both sides)

$x = \pm\sqrt{\frac{c-b}{a}}$

EXAMPLE 5

Make x the subject of the equation ax + bx = c.

ax + bx = c

x appears twice in the equation. **Factories** the left-hand side sox appear only once.

$x(a + b) = c$ (Divide both sides by $(a + b)$)

$x = \frac{c}{(a+b)}$

KEY POINT

- When the letter that will become the subject appears twice in the formula, one of the steps will involve factorising.

FURTHER FORMULAE

EXAMPLE 6

SKILLS; PROBLEM SOLVING

The volume V m^3 of a pyramid with a square base of length & m and a height of h m is given by V = 1/3 a^2 h.

a. Find the volume of the Great Pyramid of Cheops, where a = 232m and h = 147 m.

b. Another square-based pyramid has a volume of 853 000 m^3 and a height of 100m. Find the length of the side of the base.

a $V = \frac{1}{3} \times 232^2 \times 147 = 2640000\,\text{m}^3$ to 3 s.f.

b Make a the subject of the formula: $a^2 = 3\frac{V}{h} \Rightarrow a = \sqrt{\frac{3V}{h}}$

$a = \sqrt{\frac{3 \times 853000}{100}} \Rightarrow a = 160\,\text{m}$ to 3 s.f.

KEY POINT

- When using a formula, rearrange the formula if necessary.

Graphs 04

LEARNING OBJECTIVES

■Recognise and draw graphs of quadratic functions Interpret quadratic graphs relating to real-life situations

■Use graphs to solve quadratic equations

BASIC PRINCIPLES

- You have seen how to plot straight lines of type $y = mx + c$; but, in reality, many graphs are curved.
- Quadratic curves are those in which the highest power of x is x^2, and they produce curves called parabolas.
- Quadratic graphs are those of type $y = ax^2 + bx + c$, where a, b and c are constants.
- They are simple to draw either manually or with the use of a calculator.

quadratic graphs y = ax^2 + bx + c

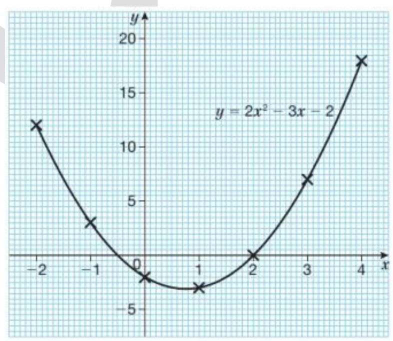
EXAMPLE 01

SKILLS; REASONING

Plot the curve y = 2x2-3x-2 in the **range** -2 ≤ x ≤ 4.

Construct a table of values and plot a graph from it.

x	−2	−1	0	1	2	3	4
$2x^2$	8	2	0	2	8	18	32
$-3x$	6	3	0	−3	−6	−9	−12
−2	−2	−2	−2	−2	−2	−2	−2
y	12	3	−2	−3	0	7	18

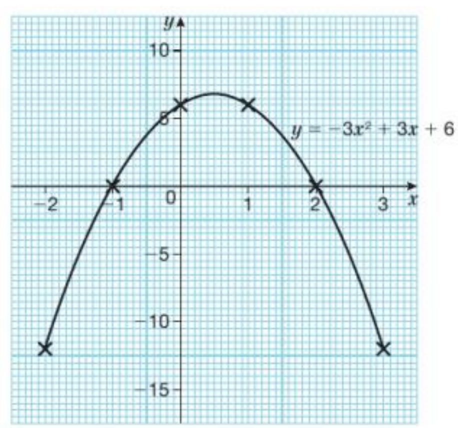


EXAMPLE 2

SKILLS: REASONING

Plot the curve y = -3x2+3x+6 in the range -2 ≤ x ≤ 3. Construct a table of values and plot a graph from it.

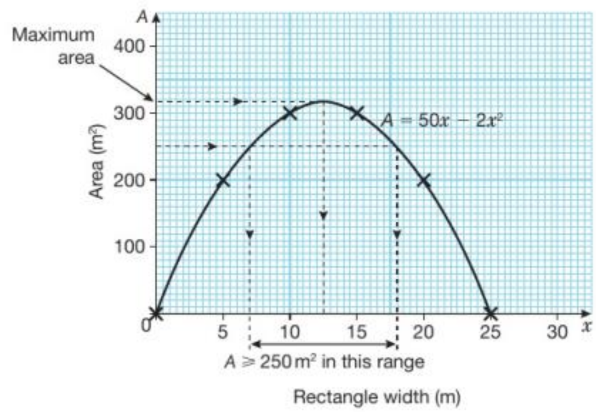
x	−2	−1	0	1	2	3
$-3x^2$	−12	−3	0	−3	−12	−27
$+3x$	−6	−3	0	3	6	9
+6	6	6	6	6	6	6
y	−12	0	6	6	0	−12



Some calculators have functions that enable fast and accurate plotting of points. It is worth checking whether or not your calculator has this facility.

A number of quadratic graphs will have real-life applications.

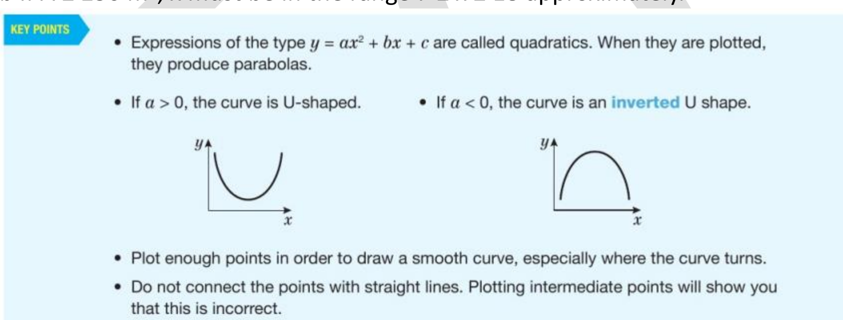
EXAMPLE 3
SKILLS MODELLING
Adiel keeps goats, and she wants to use a piece of land beside a straight stone wall
for the goats. The area of this land must be rectangular in shape,
and it will be surrounded by a fence of total length 50m.
a. What dimensions of this rectangle will provide
the goats with the largest area of land?
b. What range of values can the rectangle width (m) take in order for the enclosed area to be at least 250 m^2 ?



If the total fence length is 50m, the dimensions of the rectangle are x by (50-2x). Let the area enclosed be A m^2
$A = x(50-2x)$
$A = 50x-2x^2$
Construct a table of values and plot a graph from it.

x	0	5	10	15	20	25
$50x$	0	250	500	750	1000	1250
$-2x^2$	0	−50	−200	−450	−800	−1250
A	0	200	300	300	200	0

The solutions can be read from the graph.
a. The maximum enclosed area is when x = 12.5m, giving dimensions of 12.5m by 25m, and an area of 313 m^2 (to 3 s.f.).
b If $A \geq 250$ m^2, x must be in the range $7 \leq x \leq 18$ approximately.


KEY POINTS

- Expressions of the type $y = ax^2 + bx + c$ are called quadratics. When they are plotted, they produce parabolas.
- If $a > 0$, the curve is U-shaped.
- If $a < 0$, the curve is an **inverted** U shape.
- Plot enough points in order to draw a smooth curve, especially where the curve turns.
- Do not connect the points with straight lines. Plotting intermediate points will show you that this is incorrect.

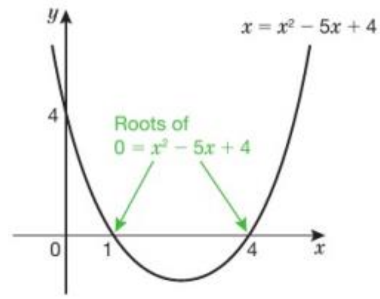
Solution of $0 = ax^2 + bx + c$

Solving **linear simultaneous equations** by graphs is a useful technique. Their solution is the intersection point of two straight lines.

The **quadratic equation** $ax^2 + bx + c = 0$ can be solved by identifying where the curve $y = ax^2 + bx + c$ **intersects** the x-axis (y = 0). The solutions (roots) are the x-**intercepts.**

EXAMPLE 4
SKILLS; PROBLEM SOLVING
Use the graph of $y = x^2 - 5x + 4$ to solve the equation

0 = x2 – 5x + 4.



The curve $y = x^2 - 5x + 4$ cuts the x-axis (y = 0) at x = 1 and x = 4.
Therefore, at these points, $0 = x^2 - 5x + 4$, and the solutions are x = 1 or x = 4.

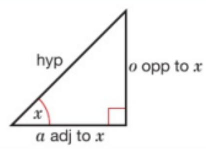
Check: If x = 1, $y = 1^2 - 5 \times 1 + 4 = 0$
If x=4, $y = 4^2 - 5 \times 4 + 4 = 0$

Shape and space 04

LEARNING OBJECTIVES
- ■Use the trigonometric ratios to find a length and an angle in a right-angled triangle
- ■Use angles of elevation and depression
- ■Use the trigonometric ratios to solve problems

BASIC PRINCIPLES

$$\tan x = \frac{\text{opposite side}}{\text{adjacent side}} = \frac{o}{a}$$

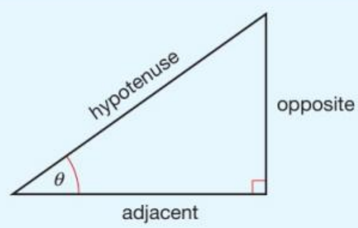


SINE AND COSINE RATIOS

The tangent **ratio** reveals that for a right-angled triangle, the ratio of the opposite side: **adjacent** side is the same for a given angle.
We now investigate the relationship between other sides of a right-angled triangle for a fixed angle.

KEY POINTS

- $\sin\theta = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{o}{h}$ $S\frac{\text{opp}}{\text{hyp}}$
- $\cos\theta = \frac{\text{adjacent side}}{\text{hypotenuse}} = \frac{a}{h}$ $C\frac{\text{adj}}{\text{hyp}}$



CALCULATING SIDES

A boy is flying a kite at the end of a 10m string. The **angle of elevation** of the kite from the boy is 32°. Find the height *p* m of the kite.
SKILLS; PROBLEM SOLVING

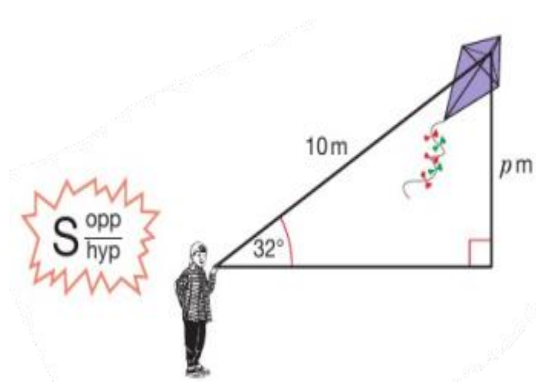
$$\sin 32° = \frac{p}{10}$$

$$10 \times \sin 32° = p$$

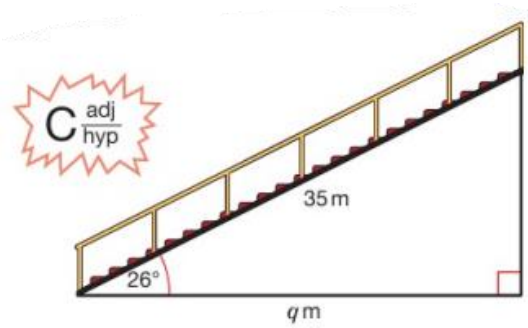
$$p = 5.30 \text{ (to 3 s.f.)}$$

1 0 × sin 3 2 = 5.29919 (to 6 s.f.)

So the height of the kite is 5.30 metres.



EXAMPLE 02
Find the length of side q correct to 3 significant figures.
SKILLS; PROBLEM SOLVING



$$\cos 26^\circ = \frac{q}{35}$$

$$35 \times \cos 26^\circ = q$$

$$q = 31.5 \text{ (to 3 s.f.)}$$

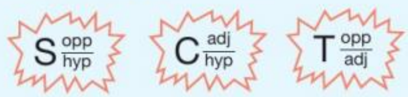
3 5 × COS 2 6 = 31.4578 (to 6 s.f.)

So the length of the side is 31.5 m.

KEY POINTS

When using trigonometrical ratios in a right-angled triangle, it is important to choose the correct one.

- Identify the sides of the triangle as opposite, adjacent or **hypotenuse** to the angle you are looking at.
- Write down the sine, cosine and tangent ratios as:
- Mark off the side you have to find and the side you have been given in the question. The ratio with the two marks is the correct one to use.



EXAMPLE 3
SKILLS
PROBLEM SOLVING
Find the length y cm of the minute hand of a clock correct to 3 significant figures.

$$\cos 43^\circ = \frac{75}{y}$$

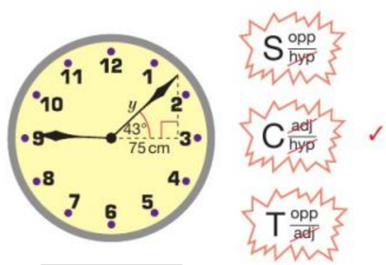
$$y \times \cos 43^\circ = 75$$

$$y = \frac{75}{\cos 43^\circ}$$

$$y = 103 \text{ (to 3 s.f.)}$$

7 5 ÷ COS 4 3 = 102.550 (to 6 s.f.)

So the length of the minute hand is 103 cm.



CALCULATING ANGLES

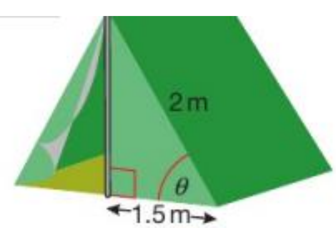
If you know the lengths of two sides in a right-angled triangle, you can find a missing angle using the **inverse** trigonometric functions.

EXAMPLE 4 SKILLS
Find the angle of the tent roof to the ground, e, correct to 3 significant figures.
PROBLEM; SOLVING

$$\cos \theta = \frac{1.5}{2}$$

$$\theta = 41.4^\circ \text{ (to 3 s.f.)}$$

INV COS (1 . 5 ÷ 2) = 41.4096 (to 6 s.f.)

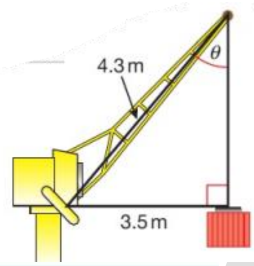


EXAMPLE 5
SKILLS; PROBLEM SOLVING
Find angle of the crane jib (arm) with the cable, ϴ , correct to 3 significant figures.

$\sin\theta = \frac{3.5}{4.3}$

$\theta = 54.5°$ (to 3 s.f.)

INV sin (3 . 5 ÷ 4 . 3) = 54.4840 (to 6 s.f.)

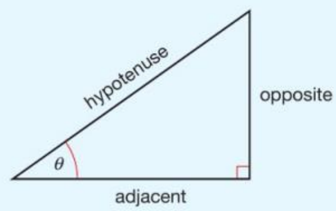


KEY POINTS

To find an angle in a right-angled triangle:

- Write down the sine, cosine and tangent ratios as

$S\frac{opp}{hyp}$ $C\frac{adj}{hyp}$ $T\frac{opp}{adj}$



- Mark off the sides of the triangle you have been given in the question.
- The correct ratio to use is the one with two marks.
- Use the INV and sin, cos or tan buttons on a calculator to find the angle, making sure that the calculator is in degree mode.

MIXED QUESTIONS

The real skill in trigonometry is deciding which ratio to use. The next exercise has a variety of situations involving the sine, cosine and tangent ratios.

Handling data 03

LEARNING OBJECTIVES
- Find the inter-quartile range of discrete data
- Draw and interpret cumulative frequency tables and diagrams
- Estimate the median and inter-quartile range from a cumulative frequency diagram

BASIC PRINCIPLES

It is often useful to know more about data than just the **mean** value.
Consider two social events:

	Guests	Mean age (yrs)	Ages of guests	Age range
Party A	5	16	2, 2, 2, 2, 72	72 − 2 = 70
Party B	5	16	16,16,16,16,16	16 − 16 = 0

It is probable that the additional information about the **dispersion** (spread) of ages in the final column will determine which party you would prefer to attend. The mean does not tell you everything.

Measuring of dispersion

ACTIVITY 1

SKILLS
REASONING

a 'The average family in the Caribbean has 2.3 children.'

Does this statement make sense?

What information does this sentence give about families?

Can you say how many families have 4 children?

Who might like to know this information?

b A restaurant uses on average 210 mangoes a day, but how does the restaurant decide how many mangoes to buy each day?

c In a game of cricket, two batsmen have the same mean (average) of 50.

One scored 49, 51, 48, 50, 52 and the other scored 0, 101, 98, 4, 47.

Comment on the difference between the batsmen.

Which batsman would you prefer to be in your team?

QUARTILES

The **median** is the middle of a set of data, dividing it into two equal halves. Half the data is smaller than the median and half is bigger. If the middle falls exactly on a number, that number is the median, if it falls in the space between two numbers than the median is the mean of the two numbers either side of the middle.

Quartiles divide the data into four equal quarters.

To find the lower quartile, take the data smaller than the median and find the middle. Similarly, to find the upper quartile, take the data larger than the median and find the middle.

Follow the same rule if the middle falls on a number or between two numbers.

EXAMPLE 01

15 children were asked how many pieces of fruit they had eaten during the last week, with the following results.

SKILLS
ANALYSIS

17 7 3 12 20 6 0 9 1 15 0 4 11 18 6

Find the quartiles.

First, sort the data into ascending order and find the middle number (the median):

0 0 1 3 4 6 6 7 9 11 12 15 17 18 20

So 7 is the median.

Now find the middle of the left-hand side and of the right-hand side:

L: 0 0 1 3 4 6 6 R: 9 11 12 15 17 18 20

So 3 is the lower quartile and 15 is the upper quartile.

The first quartile is known as the lower quartile or Q_1. So $Q_1 = 3$.

The second quartile is the median m or Q_2. So $Q_2 = 7$.

The third quartile is known as the upper quartile or Q_3. So $Q_3 = 15$.

In Example 1, the three quartiles fell exactly on numbers. This will not always happen, and the mean of two **consecutive** numbers may have to be used.

EXAMPLE 02
SKILLS ; ANALYSIS
16 children were asked how much pocket money they received. The results, in dollars, are shown in increasing order. Find the quartiles.

9 10 12 13 15 15 17 **19** **20** 22 22 25 25 25 27 35

The arrow in the middle falls between 19 and 20, so the median is 19.5 (the mean of 19 and 20).

9 10 12 **13** **15** 15 17 19 20 22 22 25 **25** **25** 27 35

The two arrows show the middle of the left-hand side and of the right-hand side.

The first arrow lies between 13 and 15, so $Q_1 = 14$ (the mean of 13 and 15).

The second arrow lies between 25 and 25, so $Q_3 = 25$ (the mean of 25 and 25).

The **range** is largest data value – smallest data value.

It is possible to have unusual values (also called alien points or **anomalies**) which can give a false picture of the true data set.

The lower quartile (Q_1) is the first quartile or the 25th **percentile**.

The median (Q_2) is the second quartile or the 50th percentile, splitting the data in halves.

The upper quartile (Q_3) is the third quartile or the 75th percentile.

The **inter-quartile range** = upper quartile – lower quartile = $Q_3 - Q_1$.

This is a measure of the range of the middle half of the data. It is not skewed (affected) by outlier points.

Care must be taken when finding these values.

The first step is to arrange the data in increasing order.

KEY POINTS

- Lower quartile (Q_1) = $\frac{1}{4}(n + 1)$th value (25th percentile)
- Median (Q_2) = $\frac{1}{2}(n + 1)$th value (50th percentile)
- Upper quartile (Q_3) = $\frac{3}{4}(n + 1)$th value (75th percentile)
- Range = highest value – lowest value
- Inter-quartile range (IQR) = upper quartile – lower quartile = $Q_3 - Q_1$
  IQR is the range of the middle 50% of the data.
  If the value lies between two numbers, the mean of these values is used.

EXAMPLE 3

SKILLS
PROBLEM SOLVING

Seven children were asked how much pocket money they received each week from their parents.

$10 $4 $12 $6 $6 $7 $15

Find the median and inter-quartile range of their pocket money.

Arrange the data into increasing order.

$4	$6	$6	$7	$10	$12	$15
	Q_1		Q_2		Q_3	

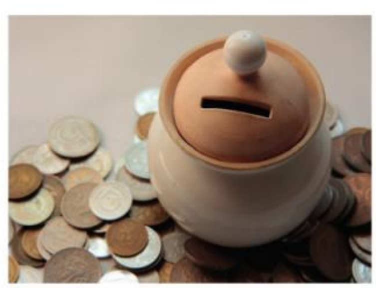
The number of values, $n = 7$.

Q_1 is at $\frac{1}{4}(n + 1)$th value = 2nd value = \$6.

Q_2 is at $\frac{1}{2}(n + 1)$th value = 4th value = \$7.

Q_3 is at $\frac{3}{4}(n + 1)$th value = 6th value = \$12.

Median = \$7 and IQR = \$12 – \$6 = \$6.



EXAMPLE 4

SKILLS

PROBLEM SOLVING

The tail lengths of five baby lizards were measured in cm to study their growth **rates**.

3 7 2 10 8

Find the median and inter-quartile range of these tail lengths.

Arrange the data into increasing order.

2 3 7 8 10

Q_1 Q_2 Q_3

The number of values, $n = 5$.

Q_1 is at $\frac{1}{4}(n + 1)$th value = 1.5th value = mean of 2 and 3 = 2.5 cm.

Q_2 is at $\frac{1}{2}(n + 1)$th value = 3rd value = 7 cm.

Q_3 is at $\frac{3}{4}(n + 1)$th value = 4.5th value = mean of 8 and 10 = 9 cm.

Median = 7 cm and IQR = 9 cm − 2.5 cm = 6.5 cm.

CUMULATIVE FREQUENCY

Cumulative frequency is the running total of the frequencies.
A cumulative frequency table shows how many data points are less than or equal to the highest possible value in each **class.**

Cumulative frequency graphs provide a fast way of displaying data and estimating dispersion values as the data is grouped in increasing order.

If the number of data points is large the quartile values of n + 1 can be changed to n.

It is acceptable to find the quartiles: Q_1 at $\frac{1}{4}n$, Q_2 at $\frac{1}{2}n$, Q_3 at $\frac{3}{4}n$ for large n.

The cumulative frequency (*F*) is on the vertical axis and the **endpoints** are plotted on the horizontal axis. The points are then joined by a smooth curve.

EXAMPLE 5
SKILLS REASONING
A large Indian coconut tree drops its fruit over the first 30 days of December.
The weight of the coconuts that fall each day is recorded in the frequency table.
a. Draw a cumulative frequency graph.
b. Use the cumulative frequency graph to find an estimate for the median weight.
c. Estimate the lower quartile and the upper quartile of the weight.
d. Work out an estimate for the inter-quartile range.

KEY POINTS

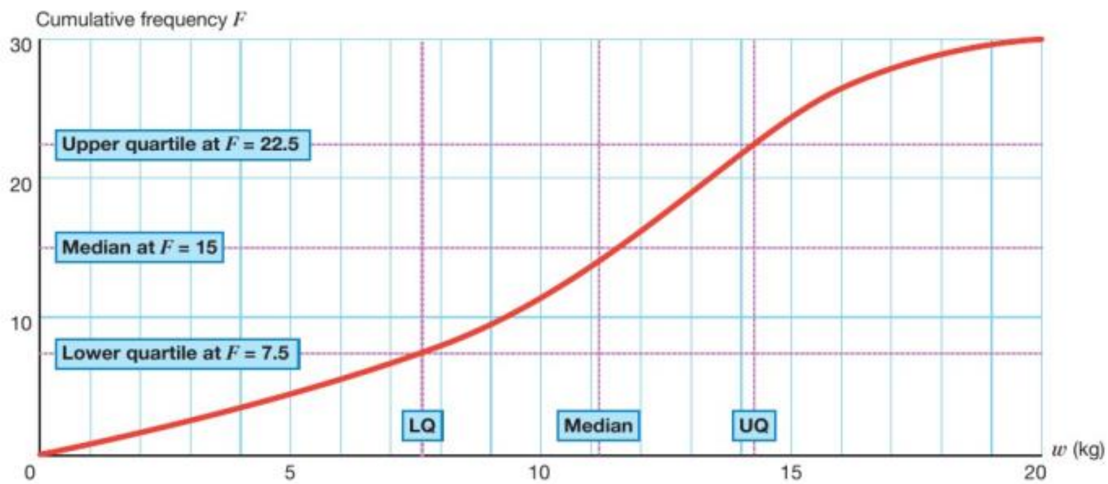
For a set of n values on a cumulative frequency diagram, the estimate for

- the lower quartile (Q_1) is the $\frac{n}{4}$th value
- the median (Q_2) is the $\frac{n}{2}$th value
- the upper quartile (Q_3) is the $\frac{3n}{4}$th value.

a

WEIGHT w (kg)	FREQUENCY	CUMULATIVE FREQUENCY (F)
$0 < w \leq 4$	3	3 total weight was ≤ 4 kg on ≤ 3 days
$4 < w \leq 8$	5	$3 + 5 = 8$ total weight was ≤ 8 kg on ≤ 8 days
$8 < w \leq 12$	9	$3 + 5 + 9 = 17$ total weight was ≤ 12 kg on ≤ 17 days
$12 < w \leq 16$	10	$3 + 5 + 9 + 10 = 27$ total weight was ≤ 16 kg on ≤ 27 days
$16 < w \leq 20$	3	$3 + 5 + 9 + 10 + 3 = 30$ total weight was ≤ 20 kg on ≤ 30 days

The points plotted are (4, 3), (8, 8), (12, 17), (16, 27) and (20, 30).



The results are estimated by drawing lines on the graph as:

b Median = 11.1 kg (at 15th value)

c Q_1 = 7.6 kg (at 7.5th value)

Q_3 = 14.2 kg (at 22.5th value)

d IQR = 14.2 − 7.6 = 6.6 kg

Revision questions

(1)In 2003, Jerry bought a house.
In 2007, Jerry sold the house to Mia.
He made a profit of 20%
In 2012, Mia sold the house for £162 000.
She made a loss of 10%
Work out how much Jerry paid for the house in 2003.

(2)In a sale normal prices are reduced by 20%.
A washing machine has a sale price of £464
By how much money is the normal price of the washing machine reduced?

(3)Marie invests £8000 in an account for one year.
At the end of the year, interest is added to her account.
Marie pays tax on this interest at a rate of 20%
She pays £28.80 tax.
Work out the percentage interest rate for the account.

(4) (i) make y the subject of the formulae(ii) make v the subject of the formulae(iii) make a the subject of the formulae

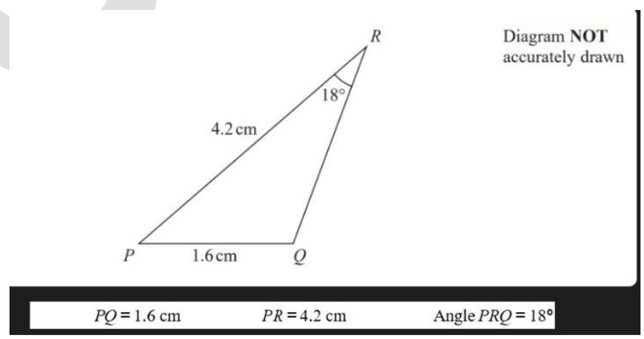
$$t = \frac{2-3y}{y+2}$$

$$w = \frac{15(t-2v)}{v}$$

$$a+3 = \frac{2a+7}{r}$$

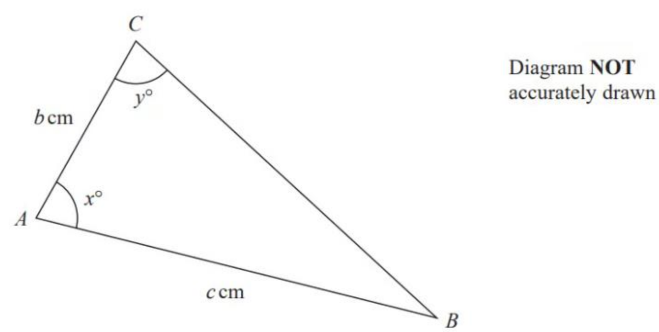
(5) The diagram shows a triangle PQR

Given that angle PQR is obtuse, work out the area of triangle PQR.
Give your answer correct to 3 significant figures.



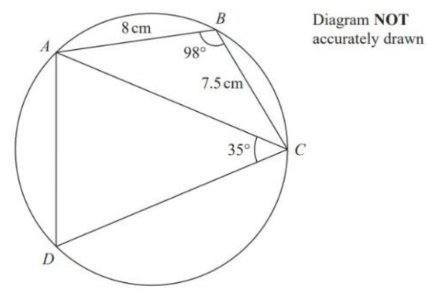
(6) The diagram shows triangle ABC

c = 11.5 correct to one decimal place correct to the nearest whole number
x = 80
y = 75
correct to the nearest whole number
Calculate the upper bound for the value of b Show your working clearly.
Give your answer correct to 3 significant figures.

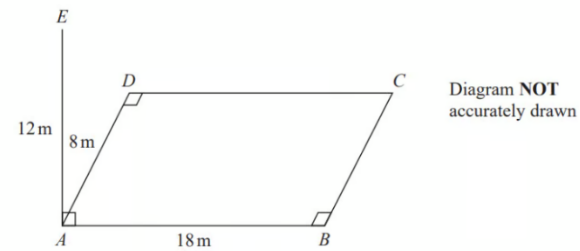


(7) ABCD is a quadrilateral where A, B, C and D are points on a circle.
AB = 8 cm
BC = 7.5 cm
Angle ABC = 98°
Angle ACD = 35°

Work out the perimeter of quadrilateral ABCD. Give your answer correct to one decimal place.

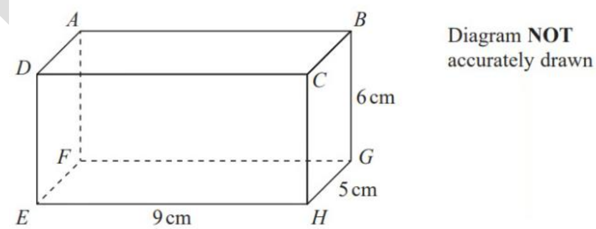


(8) ABCD is a horizontal rectangular field



A vertical pole, AE, is placed at the corner A of the field.
AE= 12m AB=18mAD = 8 m
Calculate the size of the angle between EC and the plane ABCD Give your answer correct to one decimal place.

(9) The diagram shows a cuboid ABCDEFGH



EH = 9 cm, HG = 5 cm and GB = 6 cm.
Work out the size of the angle between AH and the plane EFGH. Give your answer correct to 3 significant figures.

(10) The diagram shows a triangular prism.

AF = 10 cm, AB = · 24 cm and BC = 8 cm.
Angle FAB = angle ADC = angle BCD = 90°
Work out the size of the angle between the line BE and the plane ABCD.
Give your answer correct to 1 decimal place.