National 5
Applications of Mathematics
Revision Notes
WRITE ON VERSION

Last updated May 2023

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Use this booklet to practise working independently like you will have to in an exam.

- Get in the habit of turning to this booklet to refresh your memory.
- If you have forgotten how to do a method, **examples** are given.
- If you have forgotten what a word means, use the **index** (back pages) to look it up.

As you get closer to the exam, you should be aiming to use this booklet less and less.

This booklet is for:

- Students doing the National 5 Applications of Mathematics course.
- Students studying one or more of the National 5 Applications of Mathematics units: **Numeracy**, **Geometry and Measures** or **Managing Finance and Statistics**.

This booklet contains:

- The most important facts you need to memorise for National 5 Applications of Mathematics.
- Examples that take you through the most common **routine** questions in each topic.
- Definitions of the key words you need to know.

Use this booklet:

- To refresh your memory of the method you were taught in class when you are stuck on a homework question or a practice test question.
- To memorise key facts when revising for the exam.

The key to revising for a maths exam is to do questions, not to read notes. **As well as using this booklet, you should also:**

- Revise by working through exercises on topics you need more practice on – such as revision booklets, textbooks, websites, or other exercises suggested by your teacher.
- Work through practice tests.
- Ask your teacher when you come across a question you cannot answer.
- Use resources online (a link that can be scanned with a Smartphone is on the last page).

Contents

In the grid method, each number is split up according to the place value of its digits (e.g. 58 is split into 50 and 8; 238 is split into 200, 30 and 8) and then a mini 'tables square' grid is produced. All the answers in the grid are then added together.

BASIC SKILL EXAMPLE 5: Multiplying two two-digit numbers

Multiply 78 × 42

Solutions

These methods can be extended to any multiplication sum, including multiplication of three-(or more)-digit numbers, or multiplication of decimals.

Assessment Style Example 1: Multiplying a three-digit number and a two-digit number

It costs £56 to cover one square metre of pathway with concrete. Calculate the cost to cover a path measuring 247m².

BASIC SKILL EXAMPLE 1: Finding the Percentage

Out of 1250 pupils, 475 get to school by bus. Express this as a percentage.

Solution

Without a calculator, the calculation can be found using equivalent fractions. Multiply and divide the top and bottom by the same number to obtain the number 100 on the bottom of the fraction. The number on the top is then the percentage.

BASIC SKILL EXAMPLE 2: Finding the Percentage (non-calculator)

Darren baked 20 cakes. 13 of these cakes are carrot cakes.
Calculate the percentage of cakes that were carrot cakes.

Solution

More difficult questions ask you to find the percentage increase or decrease. In these questions, you must always calculate the percentage of the **original** amount.

Formula: not given on the formula sheet in National 5 assessments

$$\text{Percentage increase/decrease} = \frac{\text{change}}{\text{original amount}} \times 100$$

BASIC SKILL EXAMPLE 3: Finding the Percentage Increase or Decrease

The temperature in an oven was 180°C. It increased to 207°C.
Calculate the percentage increase in temperature.

Solution

For National 5 Numeracy assessment questions, it is likely that the numbers for a percentage question will not be stated in the question. Instead there might be a table, graph or scale to read to determine the numbers.

Assessment Style Example 1

The table on the right shows the numbers of student vets at four Scottish Universities.

Calculate the percentage of the vet students who are women.

University	Men	Women
Edinburgh	110	100
Glasgow	214	223
Dundee	120	197
St Andrew's	132	121

Solution

A common use for this type of calculation is for calculating percentage profit or percentage loss. In these calculations, the 'original amount' will always refer to the original total expenditure. If needed, the formula on the previous page can be adapted:

Formula: not given on the formula sheet in National 5 assessments

$$\text{Percentage profit/loss} = \frac{\text{profit or loss}}{\text{expenditure}} \times 100$$

Assessment Style Example 2 – percentage profit and loss

A supermarket buys 40 000 units of a product at a price of 98p per unit.
The supermarket sells the product for an advertised price of £1.50 per unit.

- **34 000 units are sold at the advertised price.**
- **The remaining units are all sold in a sale for 55% of the advertised price.**

Calculate the percentage profit that the supermarket made.

Solution

Ratios can be simplified. Simplifying a ratio is very similar to simplifying a fraction: divide through all the numbers by the highest common factor.

BASIC SKILL EXAMPLE 2: simplifying a ratio

Simplify the ratios:

(a) 15 : 10 **(b) 4 : 2 : 12**

Solution

Assessment Style Example

The table on the right shows the numbers of boys and girls in each year of a Primary School. Calculate the ratio of girls to boys in its simplest form.

	Boys	Girls
P1	25	25
P2	30	25
P3	28	34
P4	15	17
P5	22	24
P6	40	20
P7	30	25

Solution

When we know a ratio and we know any one related quantity, we can work out what the other quantities must be to match. We can do this using the principle of equivalent ratios: multiplying (or dividing) through by a common scale factor.

BASIC SKILL EXAMPLE 3: equivalent ratios

A cake is made using flour, butter and sugar in the ratio 4 : 5 : 2.
785 grams of butter are used. Calculate how much flour and sugar should be used.

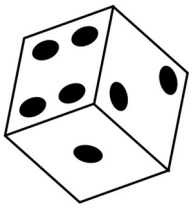
Solution

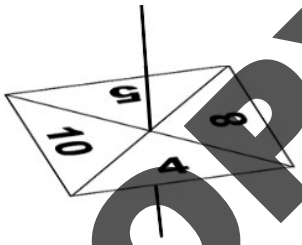
Where a probability question involves two independent events, you need to use a table to organise your working as there will be a lot of possible combinations to consider.

BASIC SKILL EXAMPLE 3: Using a two-way table for two independent events

A game is used to raise money for charity. People spin a spinner and roll a die at the same time.

- **The die is a normal, fair six-sided die showing the numbers 1 to 6.**
- **The spinner is a fair square spinner showing the numbers 4, 5, 8, 10.**





In order to win, the total score must be higher than 13.
Calculate the probability of winning as a fraction in its simplest form.

Solution

Score on spinner	Score on die					

We can use probabilities to provide a best guess for how often a particular event might occur if we know the total number of occurrences. We call this the **expected frequency**.

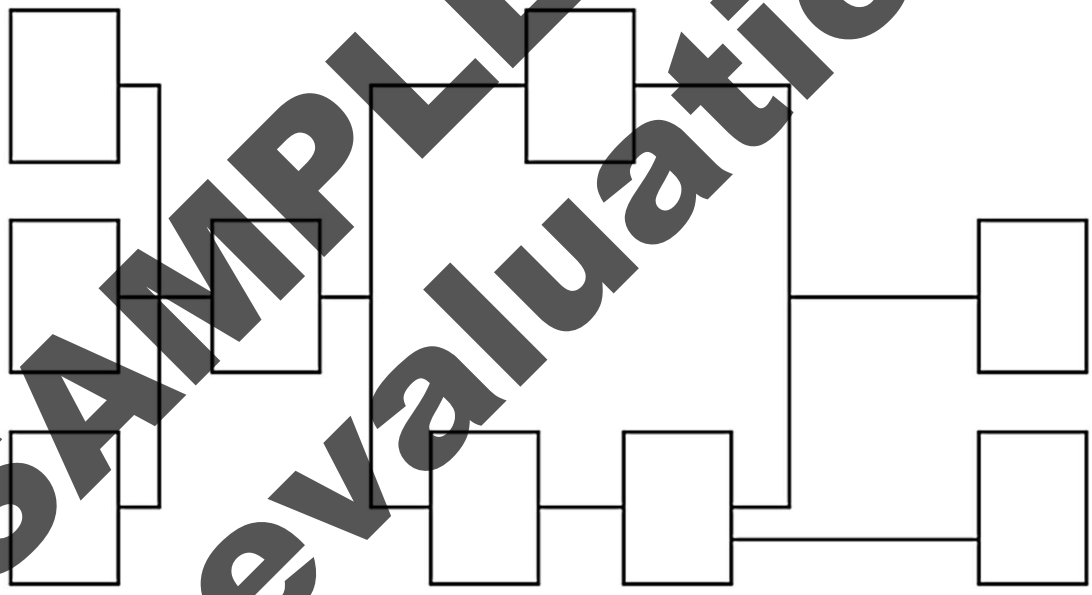
Assessment Style Example (2014 SQA exam question, slightly adapted)

The Clark family are having a new kitchen fitted by a company called Kitease. Kitease provide a team of workers to install the kitchen. The precedence table shows the list of tasks and the time required for each.

Task	Detail	Preceding Task	Time (hours)
A	Plaster walls	B, C, D	8
B	Begin electrics	None	3
C	Build cupboards	None	5
D	Begin plumbing	None	2
E	Fit wall cupboards	A	6
F	Finish electrics	E, I	4
G	Finish plumbing	I	3
H	Fit floor cupboards	A	5
I	Fit worktops	H	3

(a) Complete the diagram below to show the tasks and times in the boxes.
(b) Calculate the minimum time in which this kitchen could be installed.

Solution



Time: Time Zones

Definition: A **time zone** is an area of the world in which all the people use the same time.

The sun rises and sets at different times around the world. For that reason, different countries choose to have different times. The time in another country may be a few hours ahead or behind the time used in the UK.

Definitions

- The Time Zone we use in the UK is called **Greenwich Mean Time** (GMT). Another name for GMT is **Co-ordinated Universal Time** (UTC).
- When we refer to **local time** we are always referring to the time in the specific place being referred to.

A country whose time is 2 hours *ahead* of the UK could be described as GMT+2 or UTC+2.
A country whose time is 11 hours *behind* the UK could be described as GMT–11 or UTC–11.

When working with time zones, if we go past midnight when adding or subtracting times then the date changes as well as the time.

BASIC SKILL EXAMPLE 1: Time Zones

The time in Beijing is 8 hours ahead of GMT (GMT+8). If the date and local time in the UK is 8:30pm on the 1st March, state the date and local time in Beijing.

Solution

BASIC SKILL EXAMPLE 2: Working across more than one time zone

The time in Moscow is 3 hours ahead of time in the UK.
The time in Las Vegas is 8 hours behind UK time.
The local time in Moscow is 1725 on 25th December.
State the date and local time in Las Vegas.

Solution

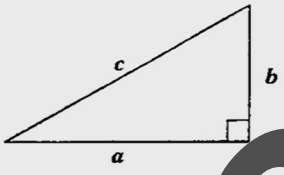
Geometry

Pythagoras' Theorem

At National 4 level you will have learnt that when you know the length of any two sides of a right-angled triangle you can use Pythagoras' Theorem (often just known as **Pythagoras**) to calculate the length of the third side without measuring.

Formula: given on the formula sheet in National 5 assessments

Theorem of Pythagoras:



$$a^2 + b^2 = c^2$$

There are three steps to any Pythagoras question:

Step One: square the length of the two given sides.
Step Two: either add or take away:

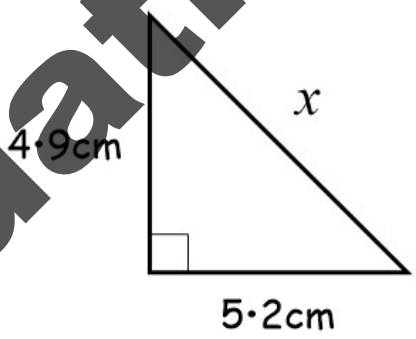
- To find the length of the longest side (hypotenuse), **add** the squared numbers.
- To find the length of a shorter side, **take away** the squared numbers.

Step Three: square root.

BASIC SKILL EXAMPLE 1: Pythagoras for the hypotenuse

Calculate the length of *x* in this triangle.

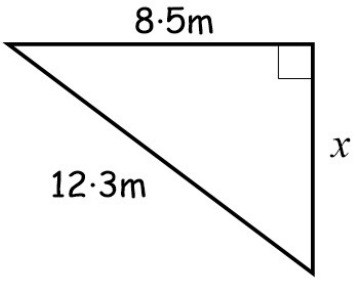
Solution



BASIC SKILL EXAMPLE 2: Pythagoras for a shorter side

Calculate the length of *x* in this triangle.

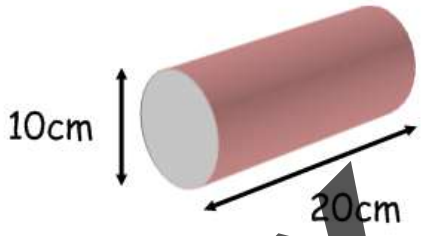
Solution



BASIC SKILL EXAMPLE 2: Volume of a cylinder

Calculate the volume of this cylinder.

Solution

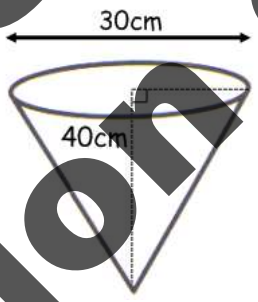


In the cone formula, the 'height' refers to the perpendicular height (the one that goes straight up) and not any sloping heights.

BASIC SKILL EXAMPLE 3: Volume of a cone

Calculate the volume of this cone.

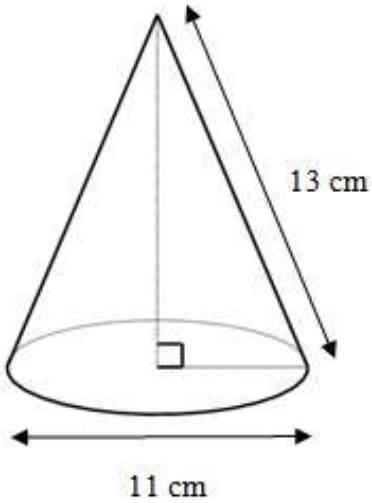
Solution



If a sloping height is given rather than the perpendicular height, Pythagoras must be used to obtain the perpendicular height.

Assessment Style Example 1

Metal parts for a machine are made in the shape of a cone, with diameter 11 cm and slant height 13 cm, as shown in the diagram.
There are 16 litres of (melted) metal. Calculate how many complete metal parts can be made.



Solution

(there is more space on the next page)

Assessment Style Example 1 – household income

David McEwan and Angela Clark have three children: Kayleigh, Taylor and Jack:

- **Angela earns an annual salary of £30 276.**
- **David works part-time and earns a monthly salary of £670.**
- **The family receive Family Tax Credits of £80·20 per month.**
- **They receive child benefit of £68·40 per month for the eldest child (Kayleigh) and £52·10 per month for their other children.**
- **Their monthly expenditure is: £340 for council tax (plus a family discount of 25%), £754 for food and drink, £240 for petrol, £923·50 for their monthly mortgage payment, £370 per child for school fees, £286·25 for gas/electricity and £78 for insurance.**

Determine the financial position of the family each month.

Solution

We begin by drawing up a monthly financial statement and writing in all the **monthly** figures that we already know. Some will still need to be calculated.

MONTHLY INCOME		**MONTHLY EXPENDITURE**	
Item	**Amount (£)**	**Item**	**Amount (£)**
Angela's Wages		Council Tax	
David's Wages	£670·00	Food and Drink	£754·00
Family Tax Credits	£80·20	Petrol	£240·00
Child Benefit		Mortgage Payment	£923·50
		School fees	
		Gas/Electricity	£286·25
		Insurance	£78·00
Total Income		**Total Expenditure**	

BASIC SKILL EXAMPLE 2: best deal

Mohammed is planning a group holiday to Cyprus. He has a choice of three packages:

Package A	**Package B**	**Package C**
7-night holiday: £898 per person. **Special Offer:** When 4 people book, a fifth person can go for free.	£96 per person per night.	10-person package holiday: £1200 per night. **Special Offer:** 22% discount on total price.

Mohammed wants to book a 7-night holiday for ten adults.
Determine which package is the cheapest option.

Solution

Currency Exchange

When converting from one currency to another, an **exchange rate** is used. The exchange rate explains how many units of one currency you get for another. For example, the exchange rate for pounds sterling (£) into Euros (€) might be £1 = €1·27 *(for every one pound you exchange, you get 1·27 Euros in return)*.

In the UK, exchange rates are usually expressed in terms of pounds (i.e. £1 = _____). However, for people in other countries the exchange rate is likely to be expressed in terms of their own currency. For example, in France the exchange rate above would be likely to be expressed as €1 = £0·79 *(for every one Euro you exchange, you get 79 pence in return)*.

Exchange rates change regularly from day to day or even hourly depending on global events.

To do calculations with currencies we must either multiply or divide by the exchange rate. Which operation we choose depends on which way around we are converting.

Statistics

All content relating to the topic of **Probability** is covered in the notes for the *Numeracy* unit starting on page 29.

Scatter Graphs and Line of Best Fit

A scatter graph is a way of d0isplaying information and looking for a connection between two sets of data.

At National 4 level, you learnt to plot points on a scatter graph and to draw a line of best fit. For National 5 Applications of Mathematics, you will need to use the same skills with the difference that the questions will always be set in a context and you will be expected to use your graphs to draw conclusions. At National 4 the axes would usually have been drawn for you. At National 5 level you *may* have to draw the graph from scratch, including the axes.

When drawing a scatter graph:

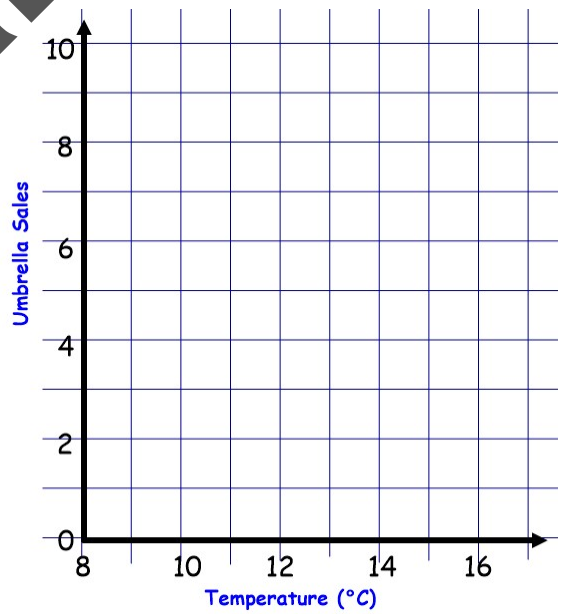
- The top row (or the left-hand column) usually goes on the horizontal axis.
- The bottom row (or the right-hand column) usually goes on the vertical axis.
- The axes must be labelled.
- There is no need for the axes to start from zero, though they can if you wish.
- It is enough to plot the dots. There is no need to label each dot with a name or letter, although you may do so if you wish.

BASIC SKILL EXAMPLE 1: Drawing a Scatter Graph

A gift shop records the temperature each day for 12 days. The table below shows the temperature and the number of umbrellas sold each day. Construct a scatter graph to show this information.

Temperature (°C)	13	12	11	13	15	13	15	9	9	15	10	8
Umbrella Sales	1	6	5	4	3	2	0	8	7	2	6	9

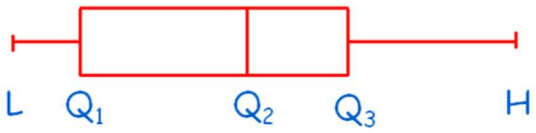
Solution



Definition: a **five-figure summary** of a list of numbers is the lowest (L), lower quartile (Q_1), median (Q_2), upper quartile (Q_3) and highest (H).

Definition: a **boxplot** is diagram used to show five-figure summaries visually.

A boxplot always has this general shape:

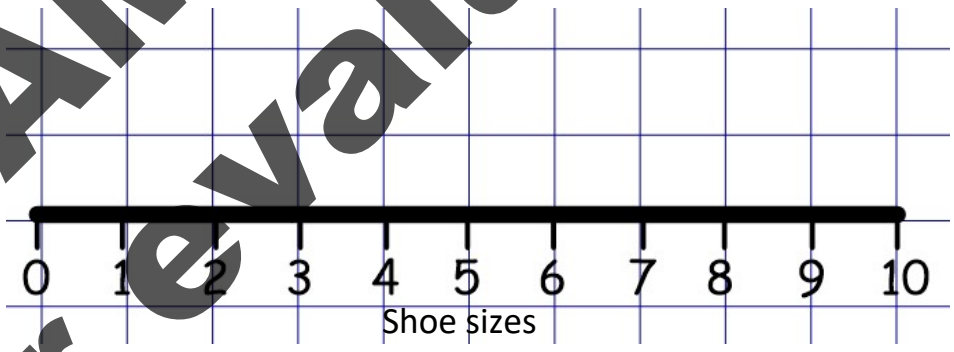


BASIC SKILL EXAMPLE 2: Drawing a Box Plot

Construct a boxplot for the following data about shoe sizes:

2 3 4 4 4 5 5 6 7 8 9

Solution



Index of Key Words

All information in this revision guide has been prepared in best faith, with thorough reference to the documents provided by the SQA, including the course arrangements, course and unit support notes, exam specification, specimen question paper and unit assessments.

These notes will be updated as and when new information becomes available.

We try our hardest to ensure these notes are accurate, but despite our best efforts, mistakes sometimes appear. If you discover any mistakes in these notes, please email us at david@dynamicmaths.co.uk.
An updated copy of the notes will be provided free of charge!
We would like to hear any suggestions you may have for improving our notes.

This version is version 4.0: published May 2023.

Previous versions:
Version 3.1: published July 2021
Version 3.0: published December 2018.
Version 2.2: published May 2017.
Versions 2.1 and 2.0: Published August 2015.
Version 1.1: Published October 2014.
Version 1.0: Published October 2014.

With grateful thanks to **Arthur McLaughlin** and **John Stobo** for proof reading.