NUMERACY

VM 3&4

VCE: VM Units 1&2: From 2023

- ⇨ Literacy VM 1&2: Coursebook & Applied Vocational Booklet
- ⇨ Numeracy VM 1&2: Coursebook & Skills Development Portfolio
- ⇨ Personal Development VM 1&2: Coursebook & Applied Vocational Booklet
- ⇨ Work Related Skills VM 1&2: Coursebook & Applied Vocational Booklet

VPC Units 1&2: From 2023

- ⇨ Literacy VPC 1&2: Coursebook & Applied Vocational Booklet
- ⇨ Numeracy VPC 1&2: Coursebook & Skills Development Portfolio
- ⇨ Personal Development VPC 1&2: Coursebook & Applied Vocational Booklet
- ⇨ Work Related Skills VPC 1&2: Coursebook & Applied Vocational Booklet

VCE: VM Units 3&4: From 2024

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- ⇨ Personal Development VPC 3&4: Coursebook & Applied Vocational Booklet
- ⇨ Work Related Skills VPC 3&4: Coursebook & Applied Vocational Booklet

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Advice to students

You are about to embark on a learning journey into Numeracy Units 3&4 subject of your Vocational Major. Use this coursebook to build and develop knowledge and skills to assist your numeracy development over the year. But also be sure to apply what you are learning in classroom situations to your work placements, your VET course and other applied situations, and vice versa! And of course, you should cross-apply knowledge and skills both to and from Literacy, Personal Development Skills and Work Related Skills.

1. In **Numeracy Unit 3**, you will investigate 4 areas of study through 3 applied numeracies.
2. In **Numeracy Unit 4** you will investigate a further 4 areas of study through 3 more applied numeracies.

You will need to apply the **4-stage Problem-Solving Cycle** for all activities and tasks that you do. In the beginning stages, your teacher will lead you through the application of the problem-solving cycle. Then as you further develop your numeracy skills, you will be expected to apply this cycle independently.

Throughout the year you will also develop applied skills in the use of many mathematics 'tools' and resources, as well as other tools and resources that relate to your own vocational, health and recreational, financial, civic and personal circumstances. These will form part of your 'Maths Toolkit'.

Use this coursebook by completing the tasks in the spaces and pages provided. You will also need to maintain your own work folios to complete some tasks, as well as others given to you by your teacher.

You may need to collect and keep a work folio with copies of resources, handouts and evidence of you applying numeracy skills.

You should also use your Numeracy Skills Development Booklet to help build skills for various topics throughout the year. Look for the icon to show the corresponding topic.

You might be directed to complete some or even all of the assessment tasks, as well as others supplied by your teacher.

Throughout this coursebook there are a number of quick-reference **Numeracy Superskills**. Use the table opposite to locate these.

When dealing with problems related to visual numeracy it is a good idea to draw a diagram.

Remember that your development of numeracy skills will provide you with the tools for a more successful personal, social and vocational life. So best wishes with your numerical journey.

Numeracy Super Skills

2023 into 2024 DELIVER Education: Order form for Semester 2 2023. All prices are (GST inc.)

2024 VM & VPC

VCE: Vocational Major

*Note: 3&4 due Nov & Dec '23	Printed Coursebook	Applied Vocational Booklet	Master license PDFs	e-version Master license PDFs	3&4 Interim masters
*Literacy VM: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	- Available now
*Numeracy VM: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	- Available now
*Personal Development VM: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	- U3 Available now, U4 Oct
*Work Related Skills VM: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	- Available now
Literacy VM: 1&2	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	
Numeracy VM: 1&2	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	
Personal Development VM: 1&2	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	
Work Related Skills VM: 1&2	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	

Vocational Pathways Certificate

** Print Lit/WRS due Dec 23 & Jan 24* *^ Print Num & PDS due Mar '24*	Printed Coursebook	Applied Vocational Booklet	Master license PDFs	e-version Master license PDFs	3&4 Interim masters
* Literacy VPC: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	U3 Available from Nov, U4 Jan '24
^ Numeracy VPC: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	U3 Available from Dec, U4 Feb '24
^ Personal Development VPC: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	U3 Available from Nov, U4 Jan '24
* Work Related Skills VPC: 3&4	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	U3 Available from Dec, U4 Jan '24
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Personal Development VPC: 1&2	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	
Work Related Skills VPC: 1&2	___ @ $49.50	___ @ $27.50	___ @ $385	or ___ @ $495	

Vocational and Work Education Resources

	Printed Book	e-version Master license PDFs
Work Experience Journal	___ @ $22	or ___ @ $165
Work Placement Journal	___ @ $33	or ___ @ $220
PDS Planner: VPC 1&2	___ @ $33	or ___ @ $220
PDS Planner: VPC 1&2 (exp Mar'24)	___ @ $33	or ___ @ $220
PDS Planner: VM 1&2	___ @ $33	or ___ @ $220
*PDS Planner: VM 3&4 (exp Jan '24)	___ @ $33	or ___ @ $220
Foundation Numeracy	___ @ $44	na
Senior Numeracy	___ @ $44	na

WACE: Career and Enterprise

Career and Enterprise	Printed Text Coursebook	e-version Master PDFs
CAE: General 11 2ed	___ @ $60	or ___ @ $660
CAE: General 12/ATAR 11 2ed	___ @ $62	or ___ @ $660
CAE: ATAR 12 2ed	___ @ $68	or ___ @ $770
CAE: Foundation 11	___ @ $55	or ___ @ $595
CAE: Foundation 12	___ @ $55	or ___ @ $595

VCE: Industry and Enterprise

New editions were released in 2022

I&E Unit 1: Workplace Participation 5ed - book	___ @ $38
I&E Unit 1: Workplace Participation - e-master	___ @ $550
I&E 1&2: Towards an Enterprising You 6ed - book	___ @ $55
I&E 3&4: Towards an Enterprising Australia 5ed - book	___ @ $68

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Doing The Numbers 1

Activities 1: Doing The Numbers		p.	Due date	Done	Comment
1A	**Unit 3 Requirements**	3			
1B	**My maths toolkit**	5			
1C	**Solving Problems**	7			
1D	**Calculations**	9			
1E	**Basic calculations 1**	11			
1F	**Multiplication**	13			
1G	**Division**	15			
1H	**Fractions & decimals**	[illegible]			
1I	**Fractions & decimals II**	[illegible]			
1J	**Fractions, decimals & ratios**	[illegible]			
1K	**Percentages**	21			
1L	**Calculating percentages**	[illegible]			
1M	**Rounding**	[illegible]			
1N	**Powers & roots**	27			
AT1	**Party by the Numbers**	28-31			
PST	**Problem-Solving Cycle and Maths Toolkit**	32			

Comments:

1.01 Unit 3: Introduction

Unit 3 requirements

In order to successfully complete this unit:

- ✓ for Outcome 1 you must demonstrate key **knowledge** and **skills** in the **4 areas of study** through applied activities related to **3 numeracies**
- ✓ for Outcome 2 you must use and apply the **4-stage Problem-Solving Cycle**
- ✓ for Outcome 3 you must develop, use and apply a **mathematical 'toolkit'**.

4 Areas of Study for Unit 3

1. Number
2. Shape
3. Quantity & Measures
4. Relationships

6 Numeracies for Units 3 & 4

a. Personal Numeracy
Includes travel, transport, organising, planning, commitments, education, life scheduling.

b. Civic Numeracy
Includes data, information, issues, society, economy, government, institutions, media and environment.

c. Financial Numeracy
Includes money, prices, shopping, income, wealth, banking, saving, debt, tax and budgets.

Image: adapted from MAJIVECKA/ Depositphotos.com

d. Health Numeracy
Includes food, nutrition exercise, fitness, data, information, medical, care, systemic measures.

e. Vocational Numeracy
Includes jobs, working, job tasks, pay rates, training, safety, time & travel, and industry-specific skills.

f. Recreational Numeracy
Includes sport, hobbies, games, arts, crafts, life balance, wellbeing, social media and fun.

3 Outcomes for Unit 3

Outcome 1
Use and apply numeracy skills and capabilities across the 6 numeracy foci; and through the 4 Areas of Study.
Unit 3: 4 Areas of Study
Unit 3: 3+ Numeracies

Outcome 2
Use and apply numeracy skills as part of the 4-stage Problem-Solving Cycle.
1. Identify the Maths
2. Act & Use Maths
3. Evaluate & Reflect
4. Communicate & Report

Outcome 3
Develop, use and apply mathematical 'toolkit' including analogue and digital numerical tools.

Unit 3: Structure of this coursebook		
Areas of Study	**Numeracy/Numeracies**	**Assessment tasks**
1. Number Section 1	Personal (Could be applied to Vocational)	A1: Party by the Numbers pp.28-31 (As well as other ATs for applied examples related to specific numerical skills and knowledge.)
2. Shape Section 2	Personal or Recreational (Could be applied to Vocational)	AT2: Make Me Up pp.58-59
3. Quantity & Measures Sections 3-4	Health or Vocational (Could be applied to Personal) Personal (Could be applied to Vocational)	AT3: Measuring Up pp.84-85 AT4: Your Times are a'Changing pp.108-109
4. Relationships Section 5	Health or Personal or Recreational or (Could be applied to Vocational) Health (Could be applied to Personal or Vocational)	AT5a: The Beat Goes On pp.136-137 AT5b: The Right Proportions pp.138-139

Unit 3 Requirements 1A

Your teacher will inform you of your unit requirements to fill out this table

Areas of Study	Numeracy/Numeracies	Assessment task (s)
1. Number		
2. Shape		
3. Quantity & Measures		
4. Relationships		

1.03 Unit 3: Introduction

Problem-solving cycle

You will need to apply the **4-stage Problem-Solving Cycle** at all times throughout the year, for all activities and tasks you do. In the early part of your studies, your teacher will guide you through the application of the problem-solving cycle. Then as you develop your numeracy skills, you will apply this cycle naturally and independently.

4-Stage Problem-Solving Cycle

1. Identify the maths

Find, identify and interpret the numerical information. Look for:

- ❑ numbers
- ❑ words
- ❑ images
- ❑ quantities
- ❑ symbols
- ❑ measures
- ❑ dimensions
- ❑ shapes
- ❑ sizes
- ❑ directions
- ❑ angles
- ❑ times
- ❑ patterns
- ❑ sequences
- ❑ ratios
- ❑ questions
- ❑ problems
- ❑ data
- ❑ proportions
- ❑ formulae.

2. Act on and use maths

Do the estimates or calculations or actions; and apply suitable technologies. Such as:

- ❑ estimating
- ❑ measuring
- ❑ calculating
- ❑ comparing
- ❑ analysing
- ❑ solving
- ❑ making
- ❑ sketching & drawing
- ❑ designing
- ❑ rendering
- ❑ constructing
- ❑ building.

3. Evaluate and reflect

Check and review to make sure that the right information is being used and that appropriate maths has been performed.

- ❑ Did I perform the appropriate steps?
- ❑ Does my answer seem correct?
- ❑ Is the result close to my estimate?
- ❑ How can I double-check?
- ❑ Did I apply the correct tools?
- ❑ What did I do well?
- ❑ What do I need to improve?

4. Communicate & report

Communicate the results and findings using a range of different methods and media. Consider:

- ❑ selecting
- ❑ explaining
- ❑ describing
- ❑ summarising
- ❑ graphing
- ❑ evaluating
- ❑ words
- ❑ numbers
- ❑ format
- ❑ method
- ❑ media
- ❑ technologies.

Mathematics Toolkit: Analogue // Digital // Technological

Throughout the year you will develop skills in the use of many mathematics 'tools' and resources, as well as other tools and resources that relate more specifically to your own vocational, health, recreational, financial, civic and personal circumstances.

- ❑ **Measuring devices**
- ❑ **Calculators**
- ❑ **Timing devices**
- ❑ **Software**
- ❑ **Apps**
- ❑ **Spreadsheets**
- ❑ **Tables**
- ❑ **Graphing**
- ❑ **Mapping**
- ❑ **Counters**
- ❑ **Designing**
- ❑ **Making**
- ❑ **Inputs**
- ❑ **Readers**
- ❑ **Outputs**
- ❑ **Planners**
- ❑ **Organisers**
- ❑ **Rosters**
- ❑ **Monitoring**
- ❑ **Sensors**
- ❑ **Alarms**
- ❑ **Data**
- ❑ **Statistics**
- ❑ **Information**
- ❑ **Collecting**
- ❑ **Computers**
- ❑ **Analysing**
- ❑ **Drawing**
- ❑ **Recording**
- ❑ **Processors**

My maths toolkit 1B

At the start of this year, what do I already bring in my maths toolkit?

Personal maths skills and tools	Work-related maths skills and tools
I can...	I can...
I can...	I can...
I am able to...	I am able to...
I am able to...	I am able to...
I can use...	I can use...
I can use...	I can use...
I can apply...	I can apply...
I can apply...	I can apply...
I...	I...

1.05 Solving Problems

Solving problems

At times life requires dealing with problems. Money problems, time problems, people problems, work problems, customer problems, work/life balance problems and many more problems. And that's where well-developed applied numeracy skills come in.

VM Numeracy 3&4 is aimed at you developing and using skills to deal with problems. But 'doing the numbers' is not the problem. 'Doing the numbers' allows you to use data and information to make more informed decisions, so that you can deal with problems in a better way.

Some problem-solving numeracy skills you can apply include the following.

- **Collecting**, collating, interpreting and analysing data and information, such as transport schedules and travel times.
- Using **measurements** and **formulae** to calculate area and other amounts, such as the number of tiles needed for a kitchen floor.
- Applying or changing **formulae** when cooking, such as working out the amount of time needed to cook a heavier cut of meat than given in a **recipe.**
- Setting up **spreadsheets** and other tools to organise and interpret information, such as personal budgets.
- Calculating **averages** based on various data to see patterns, such as daily sales.
- Developing **flowcharts** and **diagrams** to represent sequences.
- Creating **sketches** and **plans** to represent objects to scale.

Looks a bit raw! Perhaps Ivan should've tripled the cooking time!

Image: LisaA85/ Depositphotos.com

Consider this example. What is the problem? Is it the numbers that are the problem? Or are the actions and behaviours that have led to the numbers, 'the problem'? What do you think?

> Marnie has just started working in an advertising firm after getting her degree in public relations last year. But she finds that she is always broke by the end of the week. Being cool and hooked-in digitally, Marnie uses PayWave, direct debits, apps and online purchases for most everything she buys. But she doesn't know where the money goes! Marnie says that her problem is that she has got no money. But is that the problem?
>
> What do you think?
>
> Marnie's friend Lucinda completed her Vocational Major and is good with practical numbers. Lucinda shows Marnie how to do a budget to track her spending. Lucinda puts all Marnie's income and spending from when she started working into a spreadsheet, and organises the information by various categories.
>
> Marnie sees that each week she is spending, on average, 20% of her income on Uber Eats and MenuLog, 15% on Uber and 15% on mobile, internet and online subscriptions. That's half her take-home pay; gone! She is also spending about 30% a week going out and socialising. So it's lucky she still lives at home!

Solve these problems first by estimating (where appropriate), and then researching relevant information to make accurate calculations.

a. How much would a fish and chip dinner cost for your family?	b. What would you buy to cook a dinner for you and 3 friends for only 10 bucks?
c. How long would it take you to save up for a car? What changes would you need to make?	d. If you got a job with 3 4-hour shifts per week, where would you find the time? What days and times would you prefer and why?
e. How long would it take you to walk 10 kms? In what circumstances would you do this?	f. If you had to use a spreadsheet to calculate a budget, what would be the formulae for an average and for totals? When would these formulae be used in a budget?
g. If you are going for your driving license test what is the sequence of actions you need to do right from the beginning, until you drive off? Develop a diagram or flowchart.	h. You have to cut a length of timber to join a totally straight upright of 1.5m all the way out to the edge of the roof 2m away. What shape would this make and what length would you need?

1.07 Solving Problems

Calculations

By now you are probably familiar with the different types of calculations required to develop, use and apply numeracy skills.

First off you have the basic **addition**, **subtraction**, **multiplication** and **division** functions. You need to be able to do some of these in your head. More complex problems will require you to set the calculations out on paper and/or use a calculator. For many applied situations calculations can involve a combination of different functions. This is governed by **order of operations** and the use of **brackets**.

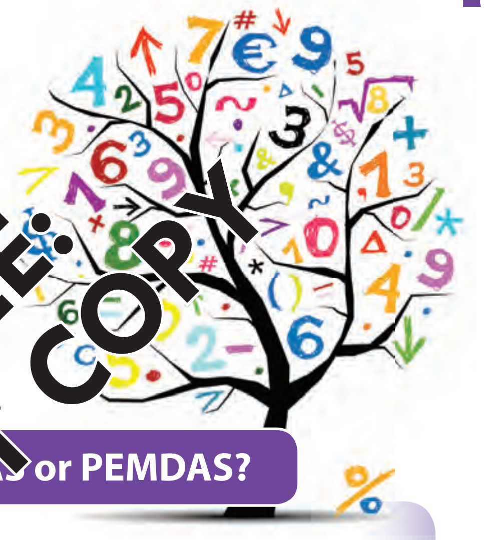
One of the most important skills when performing calculations is to know that your answer is correct. This requires you to be able to carry out **estimates** and **rounding** in your head. By doing this you can tell if your exact answer is close to your estimated amount. This skill is important when you are on the go, such as when shopping, working with materials, preparing customer orders or even providing quotes.

When estimating or calculating you need to be able to work with small and large whole **numbers** (both positive and negative), **fractions**, **decimals** and **percentages**. You also need to be able to **convert** between different **units**, such as when dealing with **quantities** expressed in millimetres, grams, [illegible] kilograms and so on.

You should also have an understanding [illegible] to calculate **rate ratios**, whereby one quantity is expressed in the terms of another, such as kilometres per hour. You also need to understand various **scale ratios** that are used in design diagrams and mapping.

Image: Kudryashka/ Depositphotos.com

How are your numerical skills coming along?



Have you ever heard of BODMAS or PEMDAS?

Order, order:

When performing a calculation the order of operation is as follows.

Firstly, you must always evaluate any brackets before doing anything else:

5 + (10 x 6) = 5 + 60 = 65 (and not 90!!!)

Secondly, you move from left to right performing any multiplication or division. It doesn't matter which of these you do first as long as you move from left to right. Tip: You can show this as a bracket ( ).

6 x 5 + 3 x 13 =

(6 x 5) + (3 x 13) =

30 + 39 = 69 (and not 429, 624 or 1,170!!)

Finally, you move from left to right performing any addition or subtraction.

(Once again it doesn't matter which of these you do first as long as you move from left to right.)

For example:

3 + 9 x 7 = ??

3 + (9 x 7) = 66
do this 1st

3 + 63 = 66

And another:

6 x 9 - 9 ÷ 3 = ??

(6 * 9) - (9 ÷ 3) = ??
do this 1st *do this 2nd*

54 - 3 = 51

And one more:

17 - (15 ÷ 3) + 5 x 25 = ??
do this 1st

17 - 5 + (5 x 25) = ??
do this 2nd

12 + 125 = 137

NUM SUPER SKILLS

1. Had a long summer? Complete these calculations to refresh your numerical skills. We'll start easy and then build up. Try these first without a calculator.

a. 2 + 2.5 = (expressed as a fraction)	b. 3 + 7 + 3 x 7 =
c. 25% of 250 =	d. 1,000 - 17% + 50 =
e. 46 x 72 + 12.5 =	f. 2,000 ÷ 40 ÷ 5 =
g. Change from $100 for purchase of 7 @ $12.50 =	h. Purchase of 4 @ $16.50 and 3 @ $19.95 less 10% total discount =
i. 3/2 x 4/2 =	j. 3/4 + 2/8 + 5/16 =
k. Worked 24 hours at $15 =	l. Worked [illegible]6 hours at $18 and 4 more hours overtime at time and a half =
m. Filled up a 70-litre tank and paid $1[illegible]6. How much was the petrol per litre?	n. Drove [illegible]0 km on the full tank before it was empty. Tank capacity was 70 litres. How many litres per 100km?
o. Drove 500 km in 6 hours. What was the average speed?	p. 2x + y = 20 If y = 10, how much is x?
q. A box has dimensions of 10cm x 40cm x 20cm. What is its volume?	r. Using a ratio of 4:1, will the drawing be bigger or smaller, than its actual size?

2. Your studies of numeracy are about skills development and using and applying these skills. So in your workbooks, describe an example of how you applied numeracy skills during your holiday break for each of these areas.

- ❑ calculating
- ❑ estimating
- ❑ using money
- ❑ budgeting
- ❑ mapping/locating
- ❑ planning time
- ❑ measuring
- ❑ designing and/or drawing

1.09 Addition and Subtraction

Introduction

Over the course of this year, you will investigate a wide range of numeracy topics and undertake varied skills development and applied activities and tasks.

Across units 3&4 you will develop and apply numeracy skills in the 6 areas of:

a. **Personal Numeracy**
b. **Civic Numeracy**
c. **Financial Numeracy**
d. **Health Numeracy**
e. **Vocational Numeracy**
f. **Recreational Numeracy**.

"Easy numbers are easy. But what about when the numbers get harder?"

Image: Arman Zhenikeyexv Hemera, Thinkstock

Making a start

In this first section, you will develop the skills to perform a range of numerical calculations. You will build this mathematical knowledge by:

- ⇨ undertaking some basic mental arithmetic
- ⇨ learning the correct order to perform arithmetic operations
- ⇨ applying these mental numerical skills to solve some life problems
- ⇨ practising how to calculate fractions, decimals and percentages
- ⇨ learning how to interpret words as numbers
- ⇨ interpreting numerical information including digital information
- ⇨ apply the **4-stage problem-solving cycle**
- ⇨ further develop your applied **maths toolkit**.

This section culminates in an assessment task that requires you to use a range of numerical skills for an applied situation involving a party.

Image: Wojciech Gajda iStock/Thinkstock

Basic calculations

Basic calculations are those calculations that you should be able to do in your head; or on paper to more complicated calculations.

You can't just rely on a calculator to do basic calculations. You have to know if the answer that the calculator gives you is correct. A calculator will only calculate based on the numbers you enter, and people often make errors when entering data. So you have to be able to also predict and estimate. That's the problem-solving cycle in action!

Some of the basic functions that you are already likely to know include addition, subtraction, multiplication and division. You might also be able to calculate percentages and fractions, as well as be able to measure area, volume and distance.

In this section, you will recap some of these skills so that you can develop your own skills that rely on numeracy.

Nearly every occupation requires you to have an immediate understanding of basic calculations.

Addition (plus or sum)

...shown by a '+' sign

Addition involves combining two numbers into a sum. e.g.

10 + 10 = 20

5.07 + 190.30 = 196.37

1/2 + 1/4 = 3/4

$1.04 billion + $10 million = $1.05 billion

Addition also involves combining more than two numbers. e.g.

1 + 10 + 20 = 31

27.4 + 2.6 + 12.5 = 42.5

1/2 + 1/3 + 1/6 = 1

25c + 65c + $1.10 = $2

90 + 125 + 57 + 350 = ?

Addition can also involve negatives.

-25 + 15 = -10 // 75 + -50 = 25

NUM SUPER SKILLS

Subtraction (take away or minus)

...shown by a '-' sign

Subtraction involves taking one number away from another, which essentially is finding the difference between 2 or more numbers. e.g.

4 - 2 = 2

4.85 - 2.15 = 2.70

3/4 - 1/2 = 1/4

$100 - $27.95 = $72.05

2 - 1 - 1 = 0

4.5 - 2.25 - 2.50 = -0.25

1/2 - 1/4 - 1/12 - 1/12 = 1/12

$50 - $30 - $40= -$30

-250 + 125 - 72.5 - 10 = ?

Subtraction can also involve negatives.

-40 - 14 = -54 // -10 - (-15) = 5

NUM SUPER SKILLS

Basic calculations 1 1E

1 4 PS 2 3

When making calculations on paper it is good to set out your problem in a way that is easy to read and follow. Use the examples below, then complete the problems.

e.g. What is the sum of the following numbers?

55 + 667.5 + 2,000 + 25 = ?

⇨ Set the problem out clearly.

⇨ Numbers should be right justified at the point of any decimal.

⇨ Here 'carrying' is included at the bottom. This could also be shown at the top. Your teacher will show you a preferred method.

```
     55
  667.5
  2,000
+    25
  1 1
-------
2,747.5
```

1. So what is the sum of the following numbers?

53 + 556 + 3,500 + 11.55 = ?

e.g. What is the sum of the following numbers?

14[illegible] - 56 + 258 - 210 = ?

What might be the best way to set out this calculation? Your teacher will advise you.

2. So what is the sum of the following numbers?

1,000 - 520 + 48.5 - 125 - 90 = ?

1.11 Multiplication and Division

Multiplication

With multiplication you are calculating an answer based on repeated 'adding' of a particular number.

The best way to clearly understand multiplication is by saying the words in the calculation out loud. For example:

- ⇨ Calculate: Five times six.
- ⇨ This means you have to work out the total of five sixes.
- ⇨ Five sixes is just: six plus six plus six plus six plus six. i.e. 5 x 6.
- ⇨ The answer to this, is of course, 30!

Can you hear how saying the words out loud helps make multiplication much easier to understand? Multiplication is simply: <u>something</u> <u>times</u> <u>something else</u>.

- ⇨ Ten times ten? Well ten tens is a hundred.
- ⇨ What about 20 x 15? Well 20 x 15 = 300.
- ⇨ And how about nine by eight? Sometimes people 'say' multiplication this way; i.e. something <u>by</u> something else. The method is (9+9+9+9+9+9+9+9 = 72).

Multiplication (times)

...shown by a 'x' or '*' sign)

Multiplication involves repeated addition of the same number to find the answer (also called the **product**).

In other words, you are adding the same number together for however many times is specified. e.g.

5 x 4 = 20 or

(4 + 4 + 4 + 4 + 4 = 20)

12 * 13 = 156 or

(13 + 13 + 13 + 13 + 13 ...and so on).

10 x -10 = -100 // -10 x -10 = 100

Multiplication of more than two numbers involves finding the answer (or the product) of the first 2 numbers.

Then you multiply that answer by the next number, and so on.

You always move from left to right.

4 x 7 x 2 = ?

(7 + 7 + 7 + 7) x 2 = ?

28 x 2 = 56

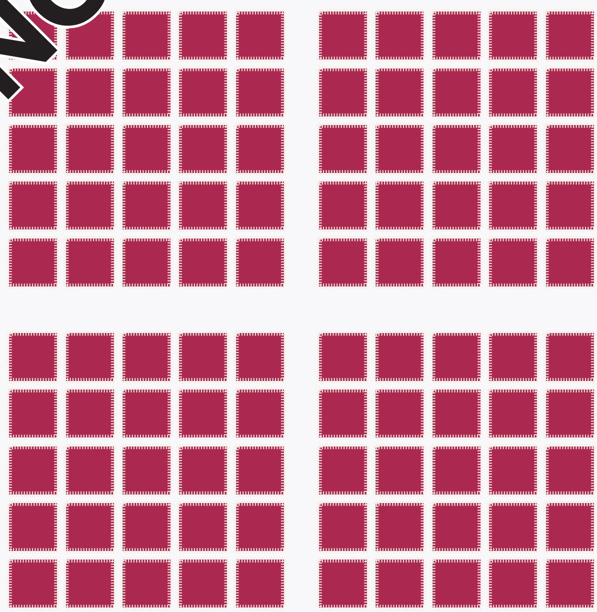
NUM SUPER SKILLS

Multiplication: Using visual data

What is 20 x 5?

Well here we can show this visually.

- ⇨ 5 boxes (in rows) repeated 20 times (and a nice pattern!)
- ⇨ If we count the boxes you find there's 25 in each rectangle.
- ⇨ If you count all of the boxes you will eventually get to 100. But this is going to take a long time. And your eyes will go all funny!



So it's easier just to do multiplication.

- ⇨ Multiplication involves a particular number, multiplied by another number.
- ⇨ So in other words, you count the first number, by the amount of **times** of the second number. i.e. 5 x 20. (And now you can do the calculation both ways because 5 x 20 is the same as 20 x 5!)

Multiplication calculations

When performing multiplication it is important to know these instructions.

- ⇨ You have to set out the question in the proper way. This includes making sure that you **right-align** the numbers.
- ⇨ You might also have to carry a number (or numbers). Your teacher will explain how to do this.
- ⇨ For bigger numbers you might have to include a 0 to show place value for 10s, and another 0 to show place value for 100s and so on. Once again your teacher will explain how to do this.

These might sound a bit confusing written in words. But when your teacher works through examples it will be much easier. This is because most people learn better from watching and doing numerical calculations, rather than from reading how they're done! Do you agree?

Tip: Always perform any calculations in brackets first!

Multiplication: Using calculations

e.g. Calculate the total of:
9 x 6

$$\begin{array}{r} 9 \\ \times\ 6 \\ \hline 54 \\ \hline \end{array}$$

e.g. Calculate the tot[illegible]
110 x 7

11[illegible]
[illegible]
770

e.g. Calculate the total of:
15 x -1[illegible]

(Carry the 2 [illegible]om 5x5 =25)

[illegible]
[illegible]75
-150 (Put a 0 to show place value for tens)
-225

Multiplication 1F

In your workbooks complete the followin[illegible] mult[illegible]plication calculations.
Make sure that you show appropriate w[illegible]rki[illegible]gs out.

a. 9 x 6 =	b. 4 x 8[illegible]	c. 12 x 10 =	d. 14 x 3 =
e. 15 x 5 =	f. 8 * 12 =	g. 13 by 11 =	h. 24 x 6 =
i. 35 by -15 =	j. 0.50 x 20 =	k. -20 * -12 =	l. $25 x $2 =
m. twelve times ninety =	n. one hundred by 20 =	o. seven times forty-six =	p. 10 x 60 mins =

1.13 Multiplication and Division

Division

With division you are calculating an answer based on how many times one number (the **divisor)** goes into another number. You can better understand division by saying the words in the calculation out loud. e.g.

- ⇨ Calculate: 30 divided by 10.
- ⇨ This means you have to work out how many 10s there are in 30.
- ⇨ So if we say "10", "10", "10" we quickly count up to 30.
- ⇨ The answer to this, is of course, 3!

But dividing for 10s is easy, as is working out division for small numbers by counting.

To deal with less uniform numbers, as well as bigger numbers, you will need to learn and apply the skills for calculating division. And you should also know that doing the division calculation is the opposite of doing the multiplication calculation.

- ⇨ Multiplication: 10 x 10 = 100. Division 100 ÷ 10 = 10.
- ⇨ Multiplication: 25 x 4 = 100. Division 100 / 25 = 4 or 100 / 4 = 25.

Division (how many)

...shown by a '÷' or '/' sign)

Division involves finding the **quotient** of 2 (or more) numbers. In other words, how many times one number goes into another. e.g.

28 ÷ 4 = 7

(How many 4s are in 28?; there's 7!)

56 ÷ 2 = 28

250 / 10 = 25

-250/ 10 = -25   -250/ -10 = 25

Sometimes not all numbers are divisible (or go into each other) equally, which leaves a **remainder**.

You might express this remainder as a decimal or as a fraction. e.g.

11 / 2 = 5.5 (Remainder a decimal.)

11 ÷ 2 = 5 1/2 (Remainder a fraction.)

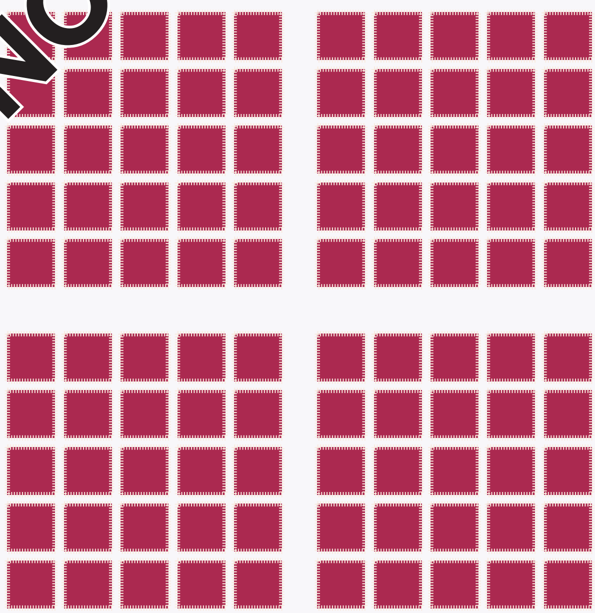
NUM SUPER SKILLS

Can you see the division/ multiplication relationship now?

Division: Using visual data

We can once again use visual data to understand division.

- ⇨ Here are 100 boxes. You can count 20 rows of 5 (or 20 columns of 5).
- ⇨ You can also count 4 squares of 25.
- ⇨ You could even count 100 small squares (if you have time and good eyesight!)



Let's look at the **divisors** for 100 here.

- ✓ 1 is a divisor - there are 100 1s in 100!
- ✓ 2 is a divisor - there are 50 2s in 100!
- ✓ 5 is a divisor - there are 20 5s in 100!
- ✓ 10 is a divisor - there are 10 10s in 100!
- ✓ 25 is a divisor - there are 4 25s in 100!

We can see each of these divisors quite easily on the diagram. You could draw a circle around them.

However, there are other divisors for 100. What are they?

Perhaps you could try drawing 'circles' around the blocks using different colours to work these out.

Division calculations

When performing short division it is important to know these instructions.

- ⇨ You have to set out the question in the proper way. This includes using a division box as shown below.
- ⇨ You set out the **dividend** (the number you are dividing into) by the **divisor** (the number you are dividing by). i.e. 20 (the dividend) divided by 5 (the divisor).
- ⇨ You might also have to carry a number (or numbers) if you get a remainder. Your teacher will explain how to do this.

Remember that most people learn better from watching and doing numerical calculations rather than from reading how they're done! That's why your teacher will do some examples for the class and then get you to try some on your own.

Tip: Always perform any calculations in brackets first!

Division: Using calculations

Calculate the total of: 66 ÷ 6	Calculate the total of: 95 / 5	Calculate the total of: -132 ÷ 11
$\begin{array}{r} 11 \\ 6\overline{)\,66} \end{array}$	$\begin{array}{r} 19 \\ 5\overline{)\,9{}^{4}5} \end{array}$ (Carry the 4 from 9/5 = 1 plus 4 remainder)	$\begin{array}{r} -12 \\ 11\overline{)\,-13{}^{2}2} \end{array}$ (Carry the 2 from 13/11 = -1 plus 2 remainder) (There's a negative so the answer will be a negative)

Division 1G

In your workbooks complete the following **division** calculations.
Make sure that you show appropriate workings out.

a. 20 ÷ 10 =	b. 18 ÷ 6 =	c. 75 ÷ 5 =	d. 64 ÷ 8 =
e. 45 / 3 =	f. 100 ÷ 5 =	g. 160 / 10 =	h. 144 ÷ 12 =
i. 300 ÷ 20 =	j. 1000 / 10 =	k. -75 ÷ 37.5 =	l. 7.5 / 5 =
m. seventy divided by five =	n. -110 divided by minus 11 =	o. one hundred how many twos =	p. how many halves are in 5 =
q. \$25 / \$5 =	r. \$140 ÷ \$7 =	s. 6 hours divided by 2 =	t. how many 15 mins in 2 hours =

1.15 Fractions, Decimals & Ratios

Fractions

You already know that a fraction represents a part or a portion of a whole number. Essentially a fraction divides the top number (**numerator**) by the bottom number (the **denominator**).

Image: ArturVerkhovetskiy Depositphotos.com

For example: Fractions

- ⇨ A cake cut equally in two portions = 1/2 a cake + 1/2 a cake.
  If you eat one of these portions you have eaten 1/2 of the cake.
  And 1 divided by 2 = 1/2. (Or, how many 2s go into 1: a half!)
  Then if you cut the other half equally you have 2 quarters. Eat one of those and you have now consumed 3/4s and have 1/4 left.
- ⇨ 75 cents = 3 quarters of a dollar or 3/4.
- ⇨ A pizza sliced in 8 portions = 8 x 1/8. Each slice is 1/8.

Proper and improper fractions

A **proper fraction** is one where the number on top (**numerator**) is less than the number on the bottom (**denominator**). This means that the number represented by the fraction will always be less than 1. e.g. 1/4, 1/2, 3/5, 2/3, 5/7, 7/10, 19/20 and so on. In money terms this can be related to how many cents in a dollar (50c = 1/2 of a dollar); which is of course 50%!

An **improper fraction** is one where the number on top (**numerator**) is more than the number on the bottom (**denominator**). This means that the number represented by the fraction will always be more than 1 (unless it's negative). e.g. 3/2, 4/3, 5/4, 7/2, 11/3, 27/4 and so on. In money terms this relates to converting cents into dollars (150c = 3/2 of a dollar). This can also be used for rounding, and for comparing big numbers, such as $1,487,000m, which is 1 and 1/2 million (after rounding).

Decimals

A decimal is another way of representing a fraction. Decimals are based on our number system which uses the power of 10s, (i.e. 1, 10, 100, 1,000, 0.1, 0.01, 0.001, 0.0001).

Some numbers include a decimal point. These represent a whole number, such as 9, plus a fraction of a whole number, such as 0.95. Written together this will be 9.95 (or 9 and nineteen twentieths).

For really accurate numbers, such as in medicine, pharmacy and other technical and scientific areas, decimals might go up to the hundredth (i.e. 2 numbers after the decimal point; 0.01); or even to the thousandth, (i.e. 3 numbers after the decimal point 0.001). Numbers to 2 decimal points are important when dealing with money (i.e. dollars and cents); and when converting measurements, such as m, cm, mm, tonne, kg and grams.

1H Fractions & decimals

Calculate to express each of these fractions as a decimal or vice versa.

1/4	11/3		9/10		3/2	2/3		7/2	27/4		5/7		7/10	
0.25		2.50		0.50			1.33			0.60		1.25		0.95

Fractions: Addition and subtraction

If the fractions have the same bottom number (**denominator**) then simply add or subtract the top numbers (**numerator**).

e.g. i $\frac{1}{5} + \frac{3}{5} = \frac{4}{5} = 0.8$ *e.g. ii* $\frac{5}{8} - \frac{3}{8} = \frac{2}{8} = \frac{1}{4}$ *e.g. iii* $\frac{9}{2} + \frac{6}{2} - \frac{3}{2} = \frac{15}{2} - \frac{3}{2} = \frac{12}{2} = 6$

But, if the fractions have different bottom numbers (**denominators**) then you will have to find the lowest common **denominator** (or lowest common multiple).

After this, you can then add or subtract the top numbers.

e.g. i $\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}$

e.g. ii $\frac{3}{2} + \frac{2}{4} - \frac{1}{8} = \frac{6}{4} + \frac{2}{4} - \frac{1}{8}$

$= \frac{12}{8} + \frac{4}{8} - \frac{1}{8}$

$= \frac{15}{8} = 1\ 7/8$ or 1.875

NUM SUPER SKILLS

Fractions: Multiplication and division

Multiplication

Multiply the top numbers (**numerators**). Multiply the bottom numbers (**denominators**). Then if possible, simplify the fraction.

e.g. i $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$

e.g. ii $\frac{4}{5} \times \frac{2}{4} = \frac{8}{20}$

$\frac{8}{20} = \frac{2}{5}$

Step 4: 8/20 can be simplified because both 8 and 20 can be divided by 4.

e.g. iii $\frac{7}{5} \times \frac{3}{2} = \frac{21}{10}$

$\frac{21}{10} = 2\frac{1}{10}$

Division

Now this is a bit trickier; but follow these steps.
Invert all the fractions to the right of the first fraction (or whole number).
Then multiply (yes multiply) the top numbers (numerators).
Then multiply (again, yes multiply) the bottom numbers (denominators).
Then if possible, simplify the fraction.

$\frac{4}{5} \div \frac{2}{5} = \frac{4}{5} \times \frac{5}{2} = \frac{20}{10} = \frac{4}{2} = 2$

Step 1 Steps 2 & 3 Step 4

NUM SUPER SKILLS

Fractions & decimals II 1I

In your workbooks complete the following calculations showing your workings.

a. 1/2 + 0.5 + 50% =	b. 3/7 x 9/7=	c. 0.25 x 3/2 =	d. 1/4 x 0.75 =
e. 4/5 ÷ 5/4 =	f. one 8th of a billion =	g. 46.5 x 7/4 - 20/2 =	h. 0 .5 ÷ 1.5 x 5/2 =

1.17 Fractions, Decimals & Ratios

Proportions and ratios

A **proportion** refers to an amount of something as compared to the total amount. Proportions are often measured in percentages, decimals or fractions.

Example 1: Proportion

What proportion of her weekly pay did Vonda spend?

- ⇨ She spent $233 out of $466, which is 1/2 or 0.50 or 50%. That's not too bad really.
- ⇨ Vonda has shown some financial discipline and can save her money for the future.
- ⇨ Her mate Benny spent all of his $66 pay. That's 100%.

Proportions can also be expressed as ratios. A ratio shows one quantity as expressed in relation to another.

Example 2: Proportion

A cake you are baking requires 0.25 kg of sugar for every kg of flour.

- ⇨ So, the weight ratio of sugar to flour 1:4; and the weight ratio of flour to sugar is 4:1.
- ⇨ Vonda's savings-to-spending ratio is 1:1 (i.e. for every dollar she spends she also saves a dollar).
- ⇨ Her spending-to-earnings ratio is 1:2 (she spends $1 out of every $2).
- ⇨ Alternatively, her earnings-to-spending ratio is 2:1 (for every 2 dollars she earns she spends 1 dollar; or for every $1 she spends 50c).

Proportion and ratios are important for measurements, scale and for dealing with physical quantities.

People doing practical, manual, design and technical tasks in their vocational and personal life, rely on the use of proportions and ratios; and they often estimate these using their own experience, expertise and understanding of practical numeracy. Proportion and ratios are also used to express financial information and statistics in simple sentences.

Consider this applied example and work out the proportions.

Image: Dpimborough/Depositphotos.com

Example 3: Proportion

Maxi or mini?

Sami makes and sells gourmet pies from a food trolley.

- ⇨ He sells the Mini pie for $2 and the Maxi pie for $5.
- ⇨ The 200g mini has 150 grams of meat and gravy.
- ⇨ The 500g maxi has 350 grams of meat and gravy.
- ⇨ Every 50 grams of meat and gravy costs Sami 40c to make.

So what are the 'meat/gravy weight to total weight' ratios for each of the pies?

What are the 'meat/gravy cost to selling price' ratios for each pie?

Which pie is better for Sami to make and sell - or is there other information you need to know before you determine this?

1. Write these money amounts in words, and also say and write these as fraction ratios (e.g. 2 and a half million dollars).

a. \$7 1/2 million	b. \$250,000	c. \$125,000
d. \$10,250	e. \$875	f. \$750m

2. Write these ratios numerically and then convert the ratios into percentages.

a. A 10th of every dollar.	b. One in four dollars.	c. \$7 out of every \$20.
d. 25c in every dollar.	e. A price mark-up of double.	f. A price reduction of a [illegible]th.

A rate is another type of ratio; but a rate compares 2 items or amounts expressed in different units. Rates show how much of one quantity is required, or used up, or spent, or even earned, in relation to another. i.e. Something per something else. Got it? The most common rates you experience use distance and time. e.g. 100 km per hour or 100 kmh. (You'll explore these much more in Section 5.)

3. Calculate these time-based rates using appropriate units.

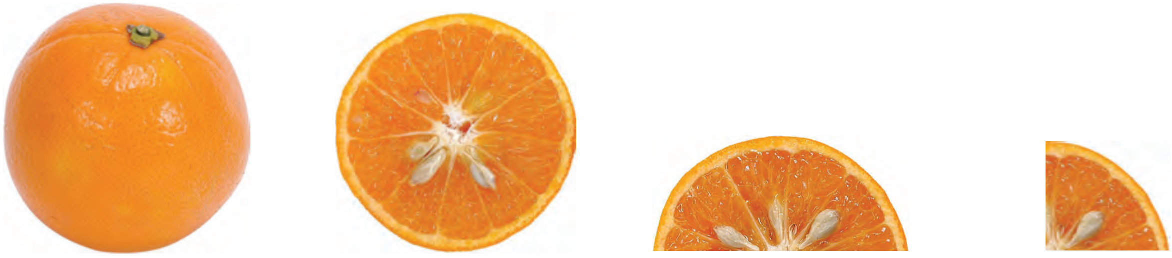
a. Travelled 100km at average of 50kmh.	b. Travelled [illegible]km at average of [illegible]0kmh.	c. Travelled 10km at average of 4kmh.
d. Cooked 5kg of beef over 5 hours.	e. Sold 712 hot dogs over 16 hours of trading.	f. Made 54 coffees over 150 minutes of trading.
g. Ran a half marathon in 3 hrs 32 minutes.	h. Lost \$100 at the pokies in 12 minutes.	i. Saved \$1m in superannuation over 45 years of working.

1.19 Percentages

Percentages

At times people say that they have trouble calculating percentages. But in reality, percentages are one of the most straightforward calculations going around.

A percentage simply represents a proportion of a whole! Just look at this orange.



1 = 100% | 1/2 = 50% | 1/4 = 25% | 1/8 = 12.5%

Percentages

Right now, in your class, put up your hand if you feel that you are OK at calculating percentages.

Count the number of people who put up their hands. This is the number of people in your class who are OK at calculating percentages.

Count the number of people in total in your class.

Now you have all you need to calculate a percentage. What's the answer?

Proportion

A percentage represents a smaller proportion of a whole. Let's consider these examples. (And do you think these are 'real'? How could you find out?)

- 7 out of 10 people prefer Thumper burgers. That's 70%.
- 33 out of 100 people have never been overseas. That's 33%.
- 950 out of 1,000 survey respondents were concerned about climate change. That's 95%
- 26 out of 50 people surveyed agreed that *MAFS* contestants are, "a waste of oxygen". That's 52% (52 out of 100).
- Approximately 60% of all adults in Australia are considered 'overweight or obese'. If there are about 15 million adult Australians then that's about 9 million people.

Six out of ten people are red (or 60%).

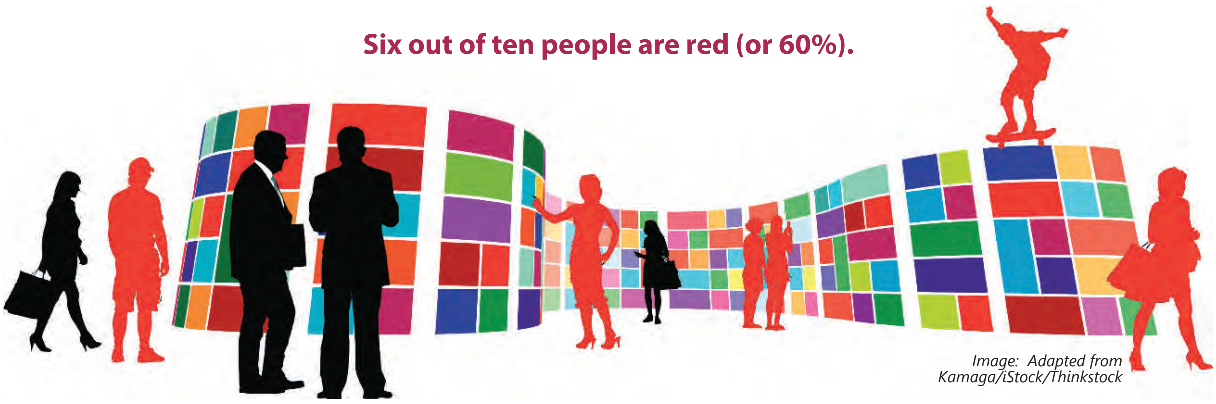


Image: Adapted from Kamaga/iStock/Thinkstock

Making percentages easier

Percentages are calculated as a proportion of 100. You cannot have a percentage greater than 100% nor can you have a percentage lower than 0%. If you have a cake and slice it in two you have two slices each of 50%. You cannot create more than 100% of the cake.

When calculating percentages the easiest to do are the 10%s. It's not that hard to calculate 10% of any number. Quickly, what's 10% of 270? See it's easy!

If you have to work out 5%, then calculate 10% and then halve the amount. If you have to calculate 20% then calculate 10% and then double the number.

You get the picture! Or should we say, the number.

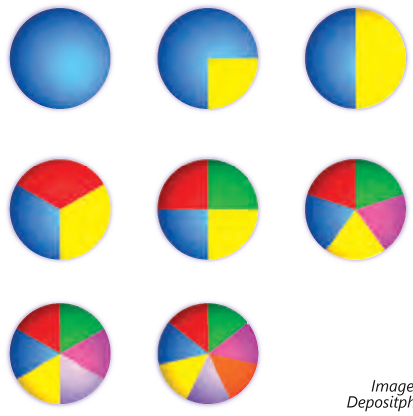
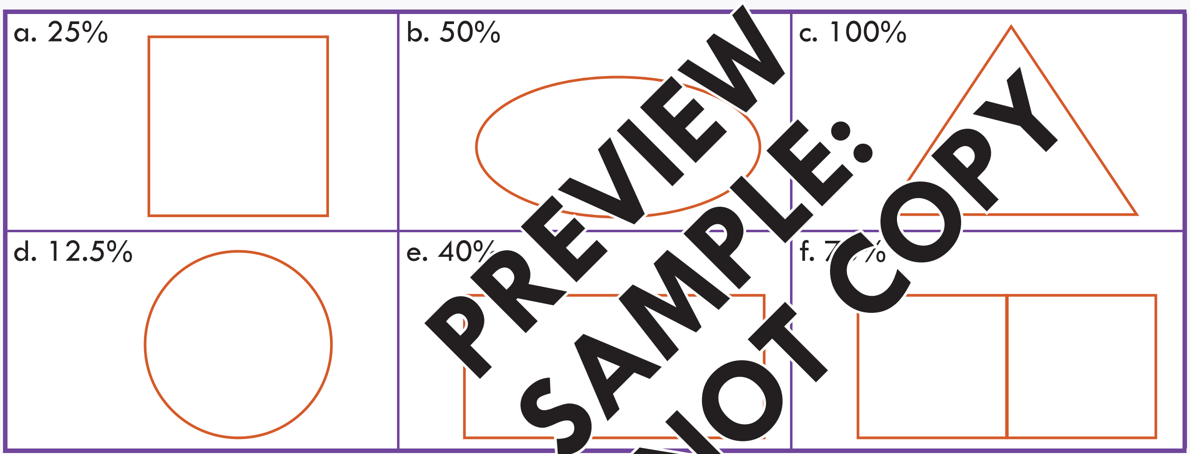


Image: brunoil/ Depositphotos.com

Percentages 1K

1. Colour in the shapes to indicate each percentage.



2. Fill in the table with the correct percentages.

	1%	2.5%	5%	7.5%	10%	20%	25[illegible]	[illegible]%	40%	50%	60%	66%	75%	80%	100%
100															
50															
1,000															
500															
250															
156															

1.21 Percentages

Percentages

When it comes to dealing with quantities or money amounts, one of the most common types of calculations you are likely to have to perform is to calculate a percentage.

Remember that a percentage is just another way of representing a **proportion** (half) or a **fraction** (1/2) of something.

Our monetary system is based on a decimal currency. 100 cents = $1.

This means that proportional amounts of money are very easily converted into percentages, (i.e. 'a half' or '1/2' is '50%'. So half a dollar = 50%, which is of course is 50c).

Image: Vasyl Yakobchuk/ Thinkstock

At this level of your studies, you are expected to be able to do more complex percentage calculations that are likely to involve a number of steps. For money, these could relate to retail discounts, margins (or mark-ups), trade (wholesale pricing), income amounts, bank interest rates, interest rates on credit products (such as credit cards and personal loans), calculation of rates and ratios (such as fuel costs), and many more personal and work situations.

Estimating percentages

- There is a quick and easy way to estimate percentages. This is good if you have to think quickly 'on your feet'. Use the 10% rule.
- What's 10% of 100? 10% of $[illegible]? 10% of [illegible]00? Not too hard.
- Now if you have to work out 5% then halve your 10s answer. 20% then double your 10s answer. 40% then 4 times your 10s answer. Or 2.5% then 1/4 of your 10s answer.
- So the trick is to work out the easy percentage - which is 10% - and then double, or halve, or use whatever ratio you need to estimate the percentage you are after.
- Have a go: 5% of 1,000, 20% of [illegible], 30% of 1,200 and 2.5% of 160?

NUM SUPER SKILLS

Percentage change

Percentage change is one of the common and useful calculations you might need to do when dealing with quantities or money amounts in personal or work-related stations.

Percentage change allows us to measure whether quantities or amounts are growing or reducing. By using a percentage change calculation we can make better comparisons between amounts of different sizes.

For example:

- Gronk has been lifting weights for many years. Over the last 3 months, he has increased his best squat by 30kg from 100kg to 130kg.
- Myron is quite new to working out. In the last 3 months, he has increased his best squat by 15kg from 30kg to 45kg.
- Gronk says that he has made better strength gains, twice as good, than Myron. But Myron doesn't necessarily agree. What do you think?

Percentage change

⇨ Percentage change measures 'how much' a quantity or number has grown or reduced over a given period of time.

⇨ It is calculated by finding out how much the amount has changed by, and then comparing this to the original amount. The answer is then multiplied by 100% to express the answer in % terms to enable better comparisons.

$$\textbf{\% change} = \frac{\textbf{(end value) less (start value)}}{\textbf{(start value)}} \times \frac{\textbf{100\%}}{\textbf{1}}$$

e.g. Based on Gronk and Myron's best squat gains, Gronk's best squat 3 months ago was 100kg and Myron's best 3 months ago was 30kg.

Gronk

$$\% \text{ change} = \frac{130\text{kg} - 100\text{kg}}{100\text{kg}} \times \frac{100\%}{1}$$

$$= \frac{30\text{kg}}{100\text{kg}} \times \frac{100\%}{1}$$

$$= 30\%$$

Myron

$$\% \text{ change} = \frac{45\text{kg} - 30\text{kg}}{30\text{kg}} \times \frac{100\%}{1}$$

$$= \frac{15\text{kg}}{30\text{kg}} \times \frac{100\%}{1}$$

$$= 50\%$$

NUM SUPER SKILLS

Calculating percentages 1L

1. Calculate these amounts in your head or on paper. Check answers with a calculator.

a. 75% of $500 =	b. $10,000 x [illegible]% =	c. $4[illegible]0 - 25% =
d. 10 x $50 + 20% of $150 =	e. $6,000 ÷ 5 [illegible] 2[illegible]% of $1[illegible] =	f. 250 x 10% + 1,500 x 15% x (40/10) =
g. $75 x 15% x 25 =	h. $190 - 4[illegible]% x 50 [illegible] =	i. $64,000 ÷ 20 x 20% - $50 =

j. $100 - 100% =	k. $100 + 10[illegible] =	l. $100 x 100% =	m. $1000 / 100% =

2. Calculate the % change for each of these situations.

a. Sales Year 1 = $40,000 Sales Year 2 = $60,000	b. 2024 wage: $18/hr 2023 wage: $12/hr	c. Height age 12: 140cm Height age 18: 200cm
d. Profit 2024: $125,000 Profit 2023: $105,000	e. House value 2023: $700,000 House value 2022: $770,000	f. 2km time trial May: 9:57 2km time trial June: 9:32

1.23 Rounding, Powers and Roots

Rounding

Rounding is an important Numeracy skill that enables people to turn complex numbers into more **simple** expressions. By using rounding people can **estimate** more easily. This allows them to perform '**in the head**' calculations.

Rounding also enables people to complete calculations faster. This is important when **working** - especially in commercial or practical roles, when **purchasing** goods and services, or when planning and forecasting **budgets**.

The most commonly accepted way to round is to apply the use of rounding up if a number is **halfway** to the next highest, or rounding down if the number is less than halfway to the next highest. In other words, look for 0.5 or half.

For example:

- ⇨ 1.5 becomes 2 (by rounding up). 1.4 becomes 1 (by rounding down).
- ⇨ 1.56 becomes 1.6 (by rounding up). 1.44 becomes 1.4 (by rounding down).
- ⇨ 1.568 becomes 1.57 (by rounding up). 1.442 becomes 1.44 by rounding down).

It's as simple as that!

Sometimes rounding is important when working with **materials** and **converting** between **units**, especially from mm to metres and grams to kilograms.

But many tradespeople and practical workers make sure that when they round measures, they leave a little extra 'on the end'. Why might that be the case?

Money rounding

The use of rounding also applies when dealing with money. Sometimes it is important to make quick estimates of how much an **order** might **cost**, or the **total amount** of loan repayments, or even the **long-term price** of a phone and data plan. So when working with money you should round to nice, **whole numbers**.

With money you should always try round up 'bad things' - such as costs and expenses, and round down good things - such as income.

For example:

- ⇨ A 12-month data plan at $38/per month becomes $40 x 12 = $480.
- ⇨ Potential pay of $62.50 per shift becomes $60.

Money rounding is also important for purchase transactions using **cash** because many items are priced at odd numbers such as $1.99, but the smallest **currency unit** is 5c. This rounding applies to the total of the bill, not each item.

Totals ending in 1c & 2c and 6c & 7c are rounded down to the nearest ten or five.

Totals ending in 3c & 4c, and 8c & 9c are rounded up to the nearest ten or five. As this only applies to cash transactions, digital payments are charged at the exact amount.

Rounding enables you to estimate the cost of contracts and payment plans on the spot.

Image bestpixels/ Depositphotos.com

1. Use appropriate rounding techniques to express these numbers as whole numbers.

a. 1.7	b. 24.9	c. 127.2	d. 57.3	e. -1.9

2. Use appropriate rounding techniques to express these numbers to 1 decimal point.

a. 1.25	b. 20.82	c. 19.82	d. 17.58	e. 11.26
f. -0.75	g. 5.5	h. 158.24	i. 750.51	j. -27.3325

3. Use appropriate rounding techniques to express these numbers to 2 decimal points.

a. 1.255	b. 20.829	c. 15.246	d. 11.117	e. 75.589
f. -4.523	g. 9.875	h. 99.[illegible]	i. [illegible]0.256	j. 1124.499

4. Use appropriate money rounding techniques to round these cash amounts.

a. $7.96	b. $7.99	c. $11.52	d. $250.59	e. $0.83
f. $7.98 x 3	g. $7.99 x 5	h. $11.52 x [illegible]	i. $250.59 x 4	j. $0.83 x 950

5. When dealing with money estimates why should you round up expenses and round down revenue? 1 4 PS 2 3

Applied 1 4 PS 2 3

Your uncle Elmer (who's very careful with money) tells you that you should always put an extra 2 cents of petrol in the tank above an even number, such as $40.02, as you then get that extra fuel for free. Is he correct for all, some, or none of the time?

1.25 Rounding, Powers and Roots

Powers

A number expressed with a power is a simpler way of writing a number that is multiplied by itself a certain number of times.

We see 'powers' when numbers are expressed like this: 4^2 or 10^3 or 7^7. In others words, 4 x 4, or 10 x 10 x 10, or 7 x 7 x 7 x 7 x 7 x 7 x 7.

The number to be multiplied is called the **base**. The number of times it is to be multiplied is called the **exponent**, or more commonly the **power**.

Powers are commonly used in measuring, e.g. area: units squared or ^{2} and volume: units cubed or ^{3}. Powers are used in computing, e.g. for file and drive sizes, in science, finance and many other fields, especially where big numbers need to be simplified.

10000000000000000000000
00000000000000000000
00000000000000000000
00000000000000000000
00000000000000000000

Do you know the name of this number? It can be written more simply as 10^{100}.

e.g. For the first example above:

The base is 4 and the power (or the exponent) is 2.

So: 4 to the power of 2

⇨ or: $4^2 = 4 \times 4 = 16$

⇨ or: 4 squared equals 4 times 4

⇨ or: Four is multiplied twice.

Say these out loud and you'll see it's not too tricky! Which way of expressing these do you prefer? And what about an object that measures 10cm? What shape would that be?

Power Calculations

If you have to calculate with numbers with powers here are the rules.

Multiplication and Division

If the **base numbers are the same** simply add or subtract the powers.

e.g. $3^2 \times 3^3 = 3^5$ i.e. (3 x 3) x (3 x 3 x 3) = 9 x 27 = 243 which equals the same as 3^5.

e.g. $4^5 / 4^2 = 4^3$ i.e. (4 x 4 x 4 x 4 x 4) / (4 x 4) = 1024 / 16 = 64 which equals the same as 4^3.

If the base numbers are not the same then one way is to work out each power then do the calculation. But your teacher might show you 'easier' ways.

It is important to note that this rule for powers only relates to multiplication and to division (which is the opposite of multiplication). This is because a base with a positive power is how many times you multiply a number (the base) by itself. So these types of calculations using powers (or exponentials) are one particular numeracy train of action. If we want to deal with adding and subtracting with numbers with powers then we need to catch a different train!

Addition and subtraction

To work this out you have to solve for the powers first, because you always do multiplication (and/or division) before adding and subtracting. So after you have 'done the powers' you then add or subtract the numbers as required using basic maths. It makes sense if you stop and think about it!

e.g. $3^2 + 3^3 = ?$ i.e. (3 x 3) + (3 x 3 x 3) = 9 + 27 = 36

NUM SUPER SKILLS

Roots

A root is the opposite of a power. A root is shown by the symbol √ so √25 = 5 (or the square root of 25 = 5). A perfect square is a number whereby the square root is a whole number and not a fraction, i.e. it does not have any decimals after it.

Perfect square roots											
1	4	9	16	25	36	49	64	81	100	121	144
1	2	3	4	5	6	7	8	9	10	11	12
169	196	225	256	289	324	361	400	441	484	529	576
13	14	15	16	17	18	19	20	21	22	23	24

Some imperfect square roots											
2	3	5	6	7	8	10	20	50	200	500	1,000
1.41	1.73	2.24	2.45	2.65	2.83	3.16	4.47	7.07	14.14	22.36	31.62

Pythagoras' Theorem

The ability to calculate a square root is very useful when working with right-angled triangles. You might have heard of Pythagoras before. Well the Pythagoras' Theorem allows you to calculate the length of the longest side of a triangle. This is really useful in construction, tiling, design and when working with areas.

For a right-angled triangle, the length of the longest side (the hypotenuse) will always equal the square root of the sum of the squares of the lengths of the other 2 sides.

It is easier to show this as: $a^2 + b^2 = c^2$

For example

$3^2 + 4^2 = c^2$

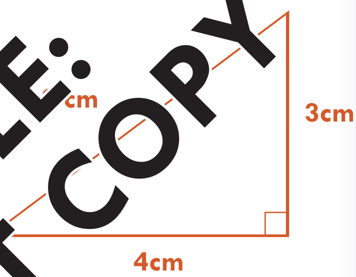
$9 + 16 = 25$

The square root (√) of 25 is 5.

$3^2 + 4^2 = 5^2$

The length of the longest side is 5cm.

Try it by measuring and see for yourself. It always works. Always!



NUM SUPER SKILLS

Powers & roots 1N

1. In your workbooks, calculate the following.

3^2	10^2	50^2	2.5^2	$3^2 \times 3^2$	$4^2 \times$ [illegible]	[illegible] $\times 3^2$	$6^4 / 6^2$	$2^2 \times 3^4$	$2^2 + 3^3$	$3^3 - 2^2$	$10^5 - 10^2$

2. Calculate the square root of these numbers. (Not all will be perfect squares.)

4	400	4,000	10	100	1,000	5	500	5,000	4.8	10,000	1m

3. Draw these right-angled triangles and calculate the length of the longest side.

i. 30mm and 40mm	ii. 12cm and 15cm	iii. 20cm and 10cm	iv. 64mm and 100mm

Applied

1 4 PS 2 3

Jum is an apprentice cabinet maker. His boss is on-site and texts Jum saying to cut 4 doors for a kitchen install. The message says that one door needs to be 2,500cm square, the next is 1,600cm square, the third is 1,200cm square and the last one is a right-angled triangle that has a height of 50cm and a width of 35cm.

Draw sketches to help Jum out. Calculate and show the dimensions of the doors.

1.27 Assessment Task

AT1 Party by the Numbers
Personal Numeracy // or Recreational

1
4 PS 2
3

For this assessment task, you and a partner are required to use and apply numerical skills and tools to help plan a party for your friends.

Of course, parties are not just about eating and drinking. They can also have games, music, dancing and other fun activities to bring everyone together to have a good time. So you also have to plan a range of party activities to keep the fun happening.

Now planning a party is hard work and requires full-on use of numerical tools and techniques, and applied use of the problem solving-cycle at all stages.

Work in pairs and start planning. Complete the following tasks.

1. Predict the likely number of guests that will attend.
2. Identify if you need to cater for special dietary needs, intolerances; and especially allergies.
3. Estimate and calculate the amount of food and drink needed per person, and in total.
4. Estimate and calculate the cost of food and drink needed per person, and in total.
5. Estimate and calculate the amounts and costs of other party favours needed.
6. Estimate, plan and calculate for **Cupcake Delight**.
7. Estimate, plan and calculate for **Pass the Parcel**.
8. Estimate, plan and calculate for **Retro Dance-off**.
9. Estimate, plan and calculate for **one other party activity** or game.
10. Prepare a summary report in point form (as well as your workings) to answer questions 1-9 above. Your teacher might ask you to prepare a report to the class.

Starting drafting your party requirements here.		
Food items & costs	**Drink items & costs**	**Other party favours & costs**

Cupcake Delight

(Surprise version)

You are going to make enough cupcakes so that everyone at the party can have 3.

But you want to add a little 'surprise' to a select few. You are going to insert a super-sour flavour-burstie into some of the cupcakes. But how many should that be to make it a special treat?

So you need to estimate:

- ❑ How many cupcakes you will need to make?
- ❑ The ingredients needed to make these.
- ❑ The cost of the ingredients needed for these cupcakes
- ❑ How many 'surprise' cupcakes to create?

  You will do this by calculating the square root of how many cupcakes you are making.

  e.g. 12 people coming = 36 cupcakes. Square root is 6; so 6 surprise bursties!
- ❑ But keep in mind, most square roots will give a fraction, so you will have to use rounding to get to a whole number.

So consider:

- ❑ What numerical techniques will I apply?
- ❑ What numerical tools will I use?
- ❑ How will I check, evaluate and reflect?

Pass the Parcel

(Sustainable version)

Remember the children's party game, Pass the Parcel?

Well, you're going to bring that back for your party, but with a 2020s twist.

But who's got the time to do all that wrapping? And what about the cost and the waste of paper?

In the old days, they used newspaper - that's not as easy to come by now.

But boxes. Everyone's got boxes now, because they get so many things delivered to their home.

So you need to:

- ❑ Make a home-made gift or choose an item to re-gift.
- ❑ Work out the size of the item
- ❑ Calculate the volume of the box needed to contain that item
- ❑ Calculate the volume of 9 more boxes, each larger than the previous, to create a 10-round game.
- ❑ How many box parcels you could create before the box gets too big to handle.

So consider:

- ❑ What numerical techniques will I apply?
- ❑ What numerical tools will I use?
- ❑ How will I check, evaluate and reflect?

1.29 Assessment Task

The Great Dance-off

(Retro version)

What's a party without dancing? It's fun, it works off the cupcakes and it's groov-ie!

So you want your guests to get up and boogie to some vinyl tunes from the past.

Your uncle is lending you his 7” single of Tina Turner's, *Nutbush City Limits*.

So you need to estimate:

- ❑ How many people will be in the dance-off?
- ❑ What floor area does each person need to get their moves on?

  But some people are bigger dancers than others. Longshanks Larry breaks all over the place, whereas Morticia the Morbid barely moves off her spot.
- ❑ How many total ‘steps’ are in the dance?
- ❑ What total floor area will you need for all the dancers to get their moves on?
- ❑ If you eliminate 2 of the least groovin' dancers each round, for how long will you have to play Tina's song until you decide the dance-off winner?

  What about if you had the 12” EP version?

You choose another fun activity.

So consider:

- ❑ What numerical techniques will apply?
- ❑ What numerical tools will I use?
- ❑ How will I check, evaluate and reflect?

So consider:

- ❑ What numerical techniques will apply?
- ❑ What numerical tools will I use?
- ❑ How will I check, evaluate and reflect?

Name(s):	AOS1: Number
Key dates:	Personal or Recreational Numeracy

Tasks - AT1: Party by the Numbers	Must do?	Due by	Done	Level
Part A: Planning and estimating				
Negotiate the task details with my teacher.	✓			
1. Predict the number of guests.	✓			
2. Describe any special food requirements needed.	✓			
3. Estimate the amounts of main food items needed.	✓			
4. Estimate the amounts of drinks needed.	✓			
5. Estimate the amounts of other items needed.	✓			
⇨ Estimate proportions and ratios.	✓			
Part B: Calculating and analysing				
3. Calculate the amount & cost of food items needed.	✓			
4. Calculate the amount & cost of drinks needed.	✓			
5. Calculate the amount & cost of other items needed.	✓			
⇨ Calculate proportions and ratios.	✓			
Part C: Plan and calculate for party activities				
6. Plan, estimate and calculate for Cupcake Delights.	✓			
7. Plan, estimate and calculate for Pass the Parcel.	✓			
8. Plan, estimate and calculate for The Great Dance [illegible].	✓			
9. Plan, estimate and calculate for:				
Task completion				
Draft your report and submit for feedback.	✓			
1 4 PS 2 3 **Describe applied use of the problem-solving cycle.**	✓			

Identify the maths	Act on & use maths	Evaluate & reflect	Communicate & report

	Must do?	Due by	Done	Level
Develop and apply mathematical tools and techniques.	✓			
⇨ **Prepare and submit your final report and calculations.**	✓			
Present a report to the class (if required).				

1.31 // Problem-Solving Cycle // Maths Toolkit

1
4 PS 2
3

Task: **Names/Dates:**

AT1 -

1. Identify the maths		
Identify problem(s) Done: Level:	Recognise maths Done: Level:	Select information Done: Level:
Interpret information Done: Level:	Choose processes Done: Level:	Done: Level:

2. Act on and use maths		
Perform estimations Done: Level:	Decide techniques Done: Level:	Choose maths tools Done: Level:
Select technologies Done: Level:	Perform calculations Done: Level:	Done: Level:

3. Evaluate and reflect		
Check Estimations Done: Level:	Compare results Done: Level:	Check processes Done: Level:
Review actions Done: Level:	Check calculations Done: Level:	Assess conclusions Done: Level:

4. Communicate and report		
Written processes Done: Level:	Written results Done: Level:	Oral processes Done: Level:
Oral results Done: Level:	Digital processes Done: Level:	Digital results Done: Level:

Mathematical Toolkit					
Analogue tools - What & how?		Digital Devices - What & how?		Software & Apps - What & how?	
Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy

Shape Up 2

Activities 2: Shape Up		p.	Due date	Done	Comment
2A	**Visual Numeracy**	35			
2B	**2D into 3D**	37			
2C	**Transforming objects**	39			
2D	**Combining shapes**	41			
2E	**Compound shapes and objects**	41			
2F	**Measuring angles**	45			
2G	**Angles at play**	46			
2H	**Driving and angles**	[illegible]			
2I	**Sketching**	[illegible]			
2J	**House plan**	[illegible]			
2K	**Modelling**	53			
2L	**Scaling**	[illegible]			
2M	**Mixing scale**	56			
2N	**Technical drawings**	57			
AT2	**Make Me Up**	58-59			
PST	**Problem-Solving Cycle and Maths Toolkit**	60			

Comments:

2.01 Visual Numeracy

Visual numeracy

Visual numeracy involves being able to ‘think’ visually in relation to **shapes** and **objects**. This ability leads to skills development related to designing and interpreting plans, diagrams, flowcharts, sketches, maps and other forms of visual numerical communication, including the manipulation of objects in 2D and 3D and seeing **patterns** in shapes and objects.

We call on visual numeracy in personal situations when we drive, cook, play sport, care for children, renovate, decorate, fix things, move house, as well as many other tasks.

Visual-spatial numerical skills are essential for people who work in design, trades, manual and practical jobs, technical fields, visual arts, ICT and multimedia, construction, hospitality and transport.

So have a read of this description of visual-spatial learners and ‘see’ how much this ‘looks’ like you.

Visual-spatial learners

These people tend to have well-developed observational skills and abilities with images (visual-spatial).

Characteristics include:

☺ reflective and quieter, with active eyes
☺ able to interpret meaning from images and diagrams
☺ prefer visual instructions and manuals
☺ can memorise and interpret concepts as pictures or graphics
☺ likely to draw diagrams and plans, or sketches and concept maps.

However, they:

☹ can become distracted when hearing or reading text-based information
☹ might seem distant and non-communicative
☹ might not understand how other people can't follow visual or written instructions
☹ can have trouble following verbal instructions.

More suited for occupations in fields, such as:

✓ construction, mining and trades (working with equipment and materials)
✓ technical and scientific (researching and applying visual and written information)
✓ ICT & multimedia (developing systems and interfaces)
✓ visual arts and design (by being able to draw, create and design).

Some other possibilities include:

✓ emergency services, such as a police officer paying visual attention to people’s actions
✓ medical, such as physiotherapist visually assessing a patient’s movement
✓ agriculture, such as a farmer surveying their land, crops, stock and the weather.

They might often say:

⇨ “Just show me!”
⇨ “Look here!”
⇨ “Let’s take a look at this”
⇨ “Did you see what happened to so and so?”
⇨ “I can’t see what’s happening!”

Visual numeracy 2A

1. How would you assess your own skills in visual numeracy? Use examples to support this as well as the info from p.34. (Perhaps you should use an image!)

2. Complete the table for these examples of the application of visual numeracy. Add 2 more examples of your own choosing.
   a. Explain how you might apply each in personal situations.
   b. Describe how you (or a worker) might apply each in vocational situations.

Example	Personal example	Vocational example
judging distance		
using maps		
moving objects		
following instructions		
making a sketch		
reading plans		

2.03 3D Objects

3D objects

You might have investigated last year that a key part of visual numeracy is the ability to estimate and manipulate objects in three dimensions. One way to work with solid objects is to use **object nets**.

As an example, consider the 3D properties of a cube. A cube is a solid 3-dimensional item and this shape is used for items such as dice, a block of sugar, a stool, a gift box and even sandstone bricks.

But if you were covering a plain cardboard cube with gift wrapping paper how should you lay out and cut your paper for maximum efficiency? To help you picture this (i.e. to use visual numeracy) you can use an object net.

Visualising the 3D properties of a cube is fairly easy because we interact with cube shapes quite regularly. But how about a pyramid?

Triangular-shaped objects are less common than cubes but can be found in packaging, building materials, furniture and other real-world applications.

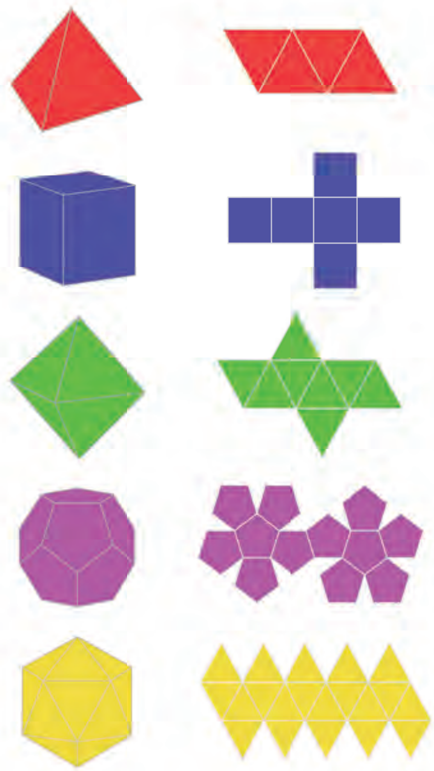


Image adapted from: Furian Depositphotos.com

Other shapes

Some shapes have all of their sides of equal length and all of their angles of equal length. These are called **regular polygons**. Some of these include:

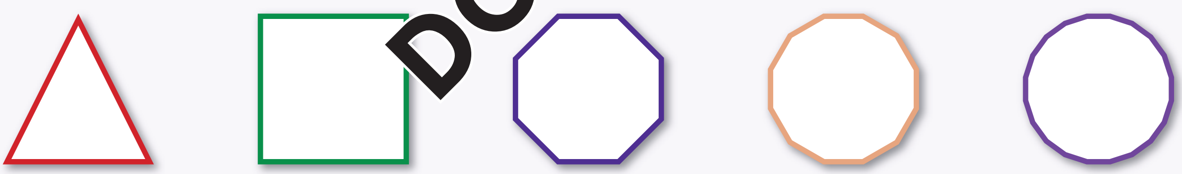
Trigon
(needs to be an equilateral triangle)
It has 3 sides.
As a solid object it becomes a tetrahedron with 4 faces.

Square
(tetragon)
It has 4 sides.
As a solid object it becomes a cube (hexahedron) with 6 faces.

Octagon
It has 8 sides.
As a solid object it becomes an octahedron with 8 faces.

Dodecagon
It has 12 sides.
As a solid object it becomes a dodecahedron with 12 faces.

Icosagon
It has 20 sides
As a solid object it becomes an icosahedron with 20 faces.



Solid objects

Vertex: A vertex is a point where two or more lines, curves or edges meet, i.e. a corner! Of course, this meeting point will form an angle. The plural of vertex is vertices. e.g. A cube has 8 vertices. Vertices are often indicated by a dot.

Edge: An edge is a line segment between faces. e.g. A cube has 12 edges, and these will all be the same length. Edges are shown by lines.

Face: A face is a single flat surface. e.g. A cube has 6 faces. Faces are shown by a 2D shape.

Have a go at counting the number of vertices, edges and faces for the objects on this page.

NUM SUPER SKILLS

Part A

1. Print or create this object net on hard card or using foam core board.
2. Cut, assemble and glue your image to make the object

Image adapted from: Furian
Depositphotos.com

Part B:

1. Make an object net for a cube. Make a sketch.
2. Number the faces from 1 to 6, taking care to orient the numbers so that when assembled, the object will resemble a die, with the numbers 'reading' the right way up.
3. Assemble your net carefully into the object.
4. How did you go with the orientation of your numbers?
5. What does this way of thinking show you about how to form shapes, and how to successfully manipulate visual information in 3 dimensions?

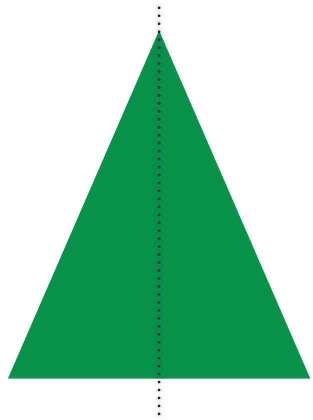
2.05 3D Objects

Transforming objects

We have to make sense of objects in many different situations in our personal, recreational and working lives. To do this we have to transform or manipulate objects using **visual-spatial** skills in our head, in space, on paper, or by using digital design programs.

Some of the key recognition, drawing and design manipulations include symmetry, reflection and rotation.

Symmetry



Symmetry simply means that a shape or object is exactly the same on each side.

You establish symmetry by drawing an imaginary line down the centre of an object

It is important to realise that nothing that occurs in the natural world is perfectly symmetrical. Nature doesn't work that way.

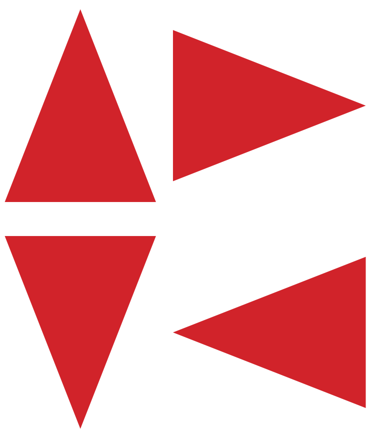
However, many human-made designs, objects and structures aim for symmetry. Humans seem to have a need to place 'order' and 'perfection' on the natural world.

Reflection

Reflection is an important element of science, design and construction. Reflection simply means to 'flip' an object so that the LHS becomes the RHS, and vice versa.

When you look at many Instagram and TikTok influencers, you will see that their pictures and videos are flipped. This is because they are looking at themselves in the camera, rather than looking through the camera. Text in the captures is reversed and makes no sense. So if they are advertising MOM 'n POP on a t-shirt that's ok. Most anything else - not so good!

Rotation



Objects can be rotated by a set amount of degrees. One full rotation is 360 degrees. When rotating a shape or object:

- ⇨ 90^0 is a quarter turn.
- ⇨ 180^0 is a half-turn - and facing the other way.
- ⇨ 270^0 is 3/4 turn.
- ⇨ 360^0 is a full turn - and back to where you started.

Commonly, shapes and objects can be rotated through their centres. However, rotations might also happen at any edge, join or other point, which tends to re-locate the shape or object.

Transforming objects

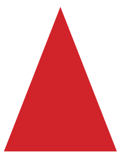
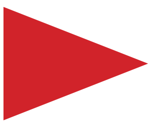
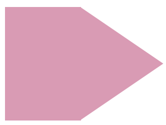
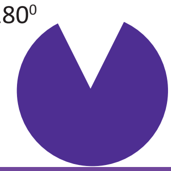
- **Reflection**: Flipping an object. The size and shape of the object do not alter.
- **Rotation**: Change an object by rotating it (or turning it around). The size and shape of the object do not alter.
- **Symmetry**: Something is symmetrical when it is the same on both sides. A shape has symmetry if a central dividing line (a mirror line) can be drawn on it, to show that both sides of the shape are exactly the same.
- **Dilation**: Change the size of the object. The shape of the object does not alter.
- **Translation**: Change the location of an object. The size and shape of the object do not alter.

NUM SUPER SKILLS

Transforming objects 2C

1. Have a look at these image pairs. What type of transformation has been applied to the object in each image?

2. Transform these shapes and objects using a quick sketch, or software.

90^0 left 	Size 2:1 
Flip to RHS 	Reflect 
Size 1:2 	180^0 

1 4 PS 2 3

2.07 3D Objects

Compound shapes and objects

Working with simple and single shapes and objects can be pretty straightforward. However, in the real world, most objects are made up of **compound shapes**, that when formed together, make an entirely new, and **non-uniform** shape. Think of all the **constructed** items such as houses, buildings and skyscrapers. And what about the shape of **vehicles** and other **man-made objects**? This extends to textiles with clothing, to furniture and all of your electrical devices. In essence, nearly every complex human-made object that doesn't resemble a single shape will consist of a series of compound shapes and objects.

You should also consider the role of compound shapes in drawing, art, design and sculpture. **Artists** and **designers** often use their manual skills and/or drawing and design software and apps, to **combine** shapes and render **representations** of complex objects.

So when you are working with compound shapes and objects, always try to visualise the smaller **components** that have been used to make the final compound shape or object.

Image: cosmin4000/Thinkstock

2D Combining shapes

1 4 PS 2 3

Pair up.

In your workbooks, identify and name these household objects.

What shapes would have been used to create each drawing?

Image: Kalava/ Depositphotos.com

Compound shapes and objects 2E

1. Hand draw these shapes in 2D. What compound shapes would you use to create each?

A pyramid	A cone
A cat	A car

2. Turn those shapes into objects by making a quick sketch, and then by using software.

A pyramid	A cone
A cat	A car

Investigation: The corn chip challenge

Many corn chips are triangular in shape. Although when they are cut they do not have 'exactly' straight edges, they still make for an interesting case study in the power of the triangle.

In pairs, get some corn chips and lay them out flat. Record the weight of the chips based on the package weight and using an accurate scale. The class should investigate different packaging sizes and brands.

Arrange the chips carefully into a rectangular 'sheet' to see how much surface area they cover. Calculate the **perimeter** of the most regular shape you can make. Measure the **area** of this shape. (Note: Due to 'gaps' these measurements will be approximates.)

Re-arrange the chips to make different shapes. Photograph these and see who comes up with the most interesting arrangements. Record these in your workbooks. Prepare a multimedia report to the class reporting on your findings. Discuss your findings as a class. (Tip: Handling food = wear gloves and clean up afterwards!)

2.09 Measuring Angles

Angles

An angle measures the 'distance' between 2 **rays**. When drawn these rays might be represented by lines. In the real world, the 'rays' might actually represent the edges of physical objects or components of an object. For example, a carpenter and joiner building the roof for a pergola might have to affix 2 lengths of timber (the 'rays') with the edges at an angle of 90º.

The major directional points on a compass each represent 90°.

Image: kontur-vid/ iStock/Thinkstock

An angle is measured in degrees. One full turn of an angle equals 360º. Therefore a 1/4 turn represents 90º, which is called a **quadrant**. Therefore, four quadrants make up an entire 'turn'. Just like if you face north and turn 90º to face west, turn another 90º to face south, turn 90º again to be facing east, and then 90º once more; you're back facing north. That's 360º in total. And you're back to the same direction you were in the beginning.

One of the most common ways of measuring degrees is to use a **protractor**. You probably are used to seeing them in sets of drawing and writing implements as part of your booklist. You've also probably used a protractor many times in the past.

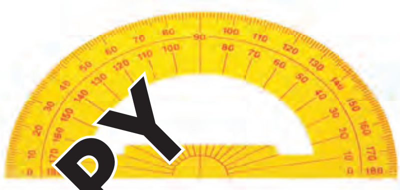


Image: Serhiy Stakhnyk/ iStock/Thinkstock

Personal application

Using angles is a natural part of our lives. It's just that we don't really think about them that much.

From the angle of our pillow (comfort) to the angle of high heels (discomfort), we use visual spatial acuity to assess and accommodate angles on a daily basis.

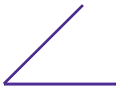
- We use angles to assess how clothing sits on our bodies.
- We open our mouths at different angles depending on how big the burger we are trying to fit in is!
- When singing, a different-angled vocal cavity can change pitch and volume.
- When dancing, angles can be used to articulate line and to drive movement.
- We try to get the best angles when watching screens.
- We angle the cue stick and angle how we hit the cue ball when playing pool.
- Angles are very important when parking a car, such as parallel parking, 45^0 parking (which is called angled parking!) and when making tricky turns.
- Self-obsessed people try out angles when taking selfie after selfie in the mirror!

Using any kind of trailer requires a good sense of angles.

Image: Fab_Vietnam Photography/ iStock/Thinkstock

Types of angles

Acute: An acute angle is less than 90º.

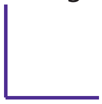


Looking down: Opening a door.

Straight: A straight angle is exactly 180º.

Looking side-on: Laying down flat.

Right: A right angle is exactly 90º.

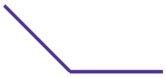


Looking front-on: Wall meeting a floor.

Reflex: A reflex angle is greater than 180º.

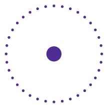
Looking side-on: Doing a hyper-extension on a bench.

Obtuse: An obtuse angle is more than 90º but less than 180º.



Looking side-on: A reclining chair.

Full: A full angle is 360º.



Looking down: Performing a pirouette!

NUM SUPER SKILLS

Work-related applications

Being able to measure angles is very important in many work-related situations. Many experienced and skilled employees actually do this by developing and applying their visual-spatial skills, or through kinaesthetic application and muscle memory.

- Carpenters and joiners assemble timber framing using varied angles.
- Tilers have to cut tiles for geometric patterns based on the calculation of angles.
- Multimedia designers rotate design elements based on angles.
- Clothing makers use angles to determine garment shape and fitting.
- Furniture makers design and build chairs with different sitting angles.
- Nurses and carers have to support patients at different angles, often using a motorised bed, trolley or chair.
- Truck and lorry drivers use angles to make turns and to reverse park their vehicles and loads.
- Hairdressers style and cut geometric hair shapes and patterns.
- Furniture removalists calculate angles when moving large-sized or bulky items through narrow spaces.
- Construction workers use angles for many tasks, including the safe placement of a ladder.
- Sportspeople rely on the use of angles, such as footballers and soccer players kicking for goal, cricketers when bowling and batting, hockey players hitting the ball, soccer goalkeepers making a save; and many more diverse applications in basketball, archery and even darts!

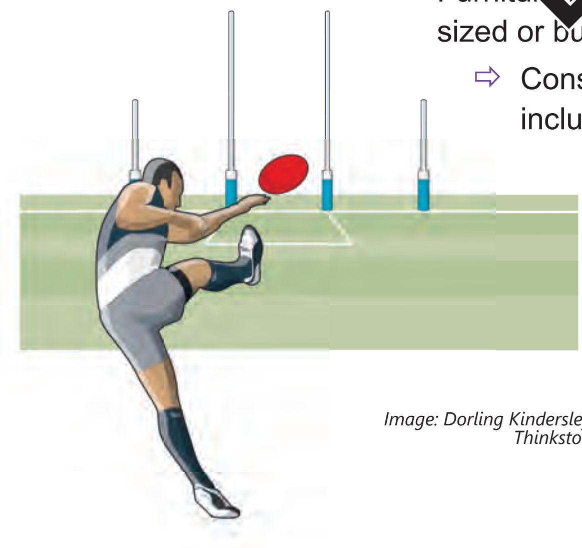


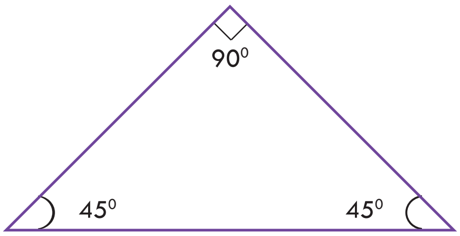
Image: Dorling Kindersley/ Thinkstock

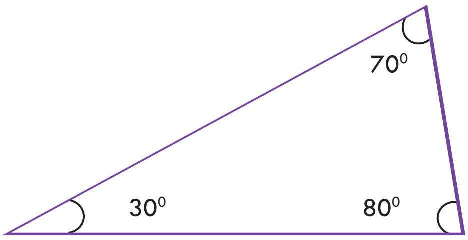
2.11 Measuring Angles

Triangle

A triangle is a plane figure that has three straight lines that are joined. In 2-dimensions (such as when drawn) it is one of many **polygons** because it has more than one 'edge' (in fact it is a **trigon** with three 'edges').

The three angles inside a triangle will always add up to 180^0. By applying this Euclidean principle, you can calculate the value of a missing angle.





Triangle shapes are used in many activities from cutting food, clothing, and craft, through to using a ladder, constructing frames as well as for bracing structures to add strength.

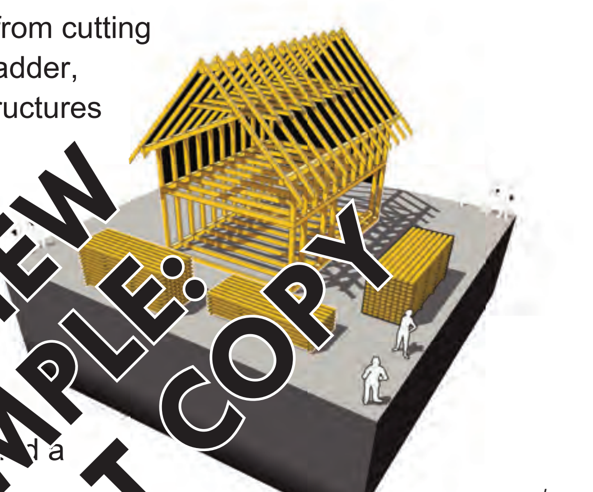


Image: valigursky/ iStock/Thinkstock

Triangular objects in 3D form into **pyramids** with the addition of a base. As an example, think of the pyramids!

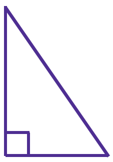
Some pyramids use a rectangular or square base with the apex directly above the centre of the base.

A pyramid with a non-rectangular base is called a **tetrahedron**.

And of course, a triangular object with a circular or ellipse-shaped base is called a **cone**.

Types of triangles

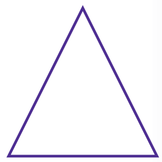
Right-angled: Has a 90^0 angle in it.



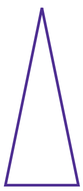
"Are you sure that the ladder will be safe against the wall?"

Equilateral: All 3 sides of equal length, therefore all 3 angles are the same.

"Now that is a very symmetrical hat you are wearing!"



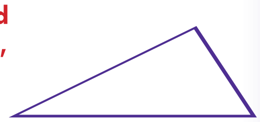
Isosceles: Has 2 sides of equal length, therefore 2 angles will be the same.



"Look at that tall spire on that old church building."

Scalene: All the sides are of different lengths; therefore 3 different angles.

"Don't think you should jump that on your bike, it's too steep!"



NUM SUPER SKILLS

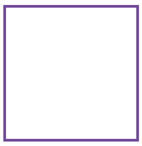
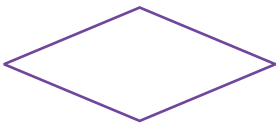
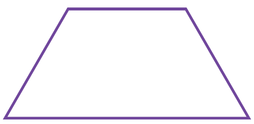
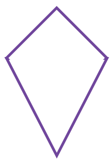
Measuring angles 2F

1 4 PS 2 3

1. Use a protractor to measure each of these angles. Where might you experience, use, or apply these shapes or angles in the real world?
2. If you've measured 2 angles correctly do you have to measure the third? Try and create a formula for this as a shortcut.

You should also be able to estimate and measure the angles of other shapes such as quadrilaterals. A quadrilateral has 4 sides and therefore 4 angles and 4 vertices.

3. Estimate, and then measure, the angles for these quadrilaterals.

	Square	Rectangle	
	Rhombus	Parallelogram	
	Trapezium	Kite	

2.13 Measuring Angles

2G Angles at play

1
4 PS 2
3

Physical activity is good both for your physical health and mental wellbeing. Dancing is fun, hard work but a good workout. Ballet dancers in particular, have to reach the ultimate level of fitness, skill and grace.

Measure the angles made by different body parts of this dancer, Susan, as she demonstrates various moves. Could you do that? Why/why not?

Images: Adapted from Alina Fedorova/iStock/Thinkstock

Applied

Research and explain how angles are important in a physical activity you are interested in, such as working out, a ball sport, swimming, diving, cycling or some other recreational pursuit.

Driving and angles 2H

1
4 PS 2
3

By now some of you might already have your license or be well on the way to building up your hours as part of your 'L's. Driving motor vehicles is one of the most common, and important, ways that we use angles on a day-to-day basis.

If you get the angle wrong when parallel parking for your test - you fail! If you get the angle wrong when reversing into a driveway, you might take down the letterbox and dent your panel. And if you get the angle wrong when turning into a dual-carriageway, you might almost have a head-on! Nobody wants that to happen!

Describe when angles are important as part of motor vehicle use. Trucks, motorcycles, trailers and other specialty vehicles also have their own issues with angles. Explore these if they relate to you. Add some of your own.

Example	Importance/ & type of angles	What should/can you do?
parallel parking		
angle parking		
reversing out of a park		
reversing into a park		
rounding a bend		
turning into a dual carriageway		
U-turn		
hook turn		
3-point turn		
towing a trailer		
driving in the rain		
off-road driving		

2.15 Plans and Diagrams

Sketch

A sketch generally refers to a quick and stylised visual representation of an object or scenario. Sketches often act as the **first stage** in the development of an image-based, or object-based, **project**. The quality of a sketch is not usually reliant on the quality of the drawing; but rather on the ability of the sketcher to clearly illustrate their intentions.

For example, if you are going to build a new deck, you might draw a rough sketch to help visualise its size, its placement and the materials needed as part of your project. Then you take that to Bunnings and get advice on what you need. Bunnings might also supply you with a more technical set of instructions using properly drawn diagrams and plans.

Perhaps you have an **idea** for a new clothing range? Initially, a **designer** will draw quick sketches to get an idea of cut, line, shape, colour and other elements of the clothing. They might then show these sketches to a dressmaker to assess their feasibility. If things seem feasible then they might work with an **illustrator** to **render** the drawing in a finished form.

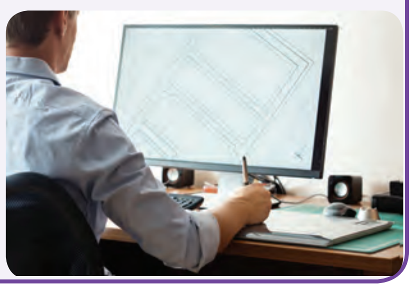
Image: gurita hitam iStock/Thinkstock

Advertisers and media producers use sketches to **storyboard** films and ads. Illustrators and costume designers might sketch drafts as they go through the development phase of a new creative work. **Industrial designers** might sketch new ideas for **prototype** products.

And a **sketch artist**, of course, makes sketches to order; be that a portrait of a loving couple; or a photo-image of a wanted criminal!

Old-school vs nu skUL

- In the 'old days' drawings were done by hand. People worked as draftpersons or commercial artists and made sketches to order.
- Nowadays the use of CAD, multimedia drawing programs, apps and other computerised tools and platforms means that the job of, drafties, illustrators, designers and commercial artists has evolved.
- But which is better; old-school or new-school? Is this a matter of quality, accuracy, aesthetics and/or efficiency?
- What do you think? Discuss as a class using examples sourced online.



Images: (t) Zoonar/N.Okhtin/Zoonar (b) Maxim Kostenko/iStock//Thinkstock

Sketching 2I

1
4 PS 2
3

You are required to develop 2 sketches. One is of a personal item, such as a car, bike, item of clothing, jewellery or a personal effect. The second sketch is of a process such as a home improvement, vehicle enhancement, idea for a project, idea for a product, a design layout, a storyboard, a character or another similar concept idea.

Now this isn't a test of drawing skills, although those of you with good drawing and design skills will produce well-rendered sketches. Rather, this is a test of your ability to communicate information simply, clearly and effectively using a fairly quick sketch to convey your idea.

Sketch: Drafting and planning

2.17 Plans and Diagrams

Visual plans

Plans are generally **technical** in nature and are prepared and used by workers in various industries. **Diagrams** are usually less technical and can include words, symbols, steps and explanations.

Some of you were introduced to plans in VM Numeracy 1&2. Many of you would also have been exposed to plans as part of your day-to-day personal lives, and in vocational and VET situations you have experienced.

Plans are an essential component in developing and communicating numerical information visually.

Plans can take many forms, ranging from a **menu plan** for an event, a **seating plan** for a wedding, a stylised **floorplan** for a house for sale, or an architectural **technical drawing** for a building.

Types of plans

- ⇨ plan
- ⇨ map
- ⇨ diagram
- ⇨ floorplan
- ⇨ blueprint
- ⇨ schematic
- ⇨ diagram
- ⇨ circuit diagram
- ⇨ technical drawing
- ⇨ sketch

On a **macro** level, plans are also used to denote the location of civil **infrastructure** such as sewerage systems, electrical and gas supply lines, road and rail networks, telecommunications systems and many more.

On a more focused **micro** level, plans may denote:

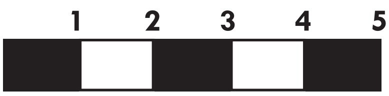
- ⇨ the exact location of underground electrical cables, gas lines and water pipes
- ⇨ circuit diagrams or schematics that show the wiring of a house or electrical device
- ⇨ blueprints and technical drawings for prototype products and designs
- ⇨ maps to show location, travel routes, store layouts and many more.

Image: cosmin400/ iStock/Thinkstock

Scale

- ⇨ When preparing plans and diagrams it is important to make use of a scale.
- ⇨ If a plan is drawn to scale, this means that an allotted distance on the plan corresponds with a distance in real life. (However, not all plans are to scale.)
- ⇨ A scale measures a ratio, such as 1cm = 1m. Scale might be written as 1:100 (e.g. 1cm =1m). So each measurement of 1cm will equal an entire metre in 'real life'!
- ⇨ Scale allows us to make an accurate reproduction of an object either smaller (1:100), larger (5:1) or exact (1:1).
- ⇨ Floor plans usually have a scale of 1:50 or (1:100) of actual size (see below).
- ⇨ Site plans usually have a scale of 1:200 or (1:500) of actual size; because the object is larger, the scale is smaller.
- ⇨ Technical and industrial drawings might use a scale of 2:1 or larger; because some technical objects are very small and need to be drawn oversized for design and instruction purposes.

1:100 cm



NUM SUPER SKILLS

House plan 2J

1
4 PS 2
3

Take some time to study this house plan then complete the following tasks.

1. Does this plan seem to be drawn to scale? Why so/why not?
2. Estimate the size of the overall block and the size of the house (and in 'squares').
3. Apply a reasonable scale and estimate/measure the internal size of each room.
4. List the features shown on the plan. Are they to scale? How do you know?
5. What do you think of this house plan? Would it suit your family; or suit you in your future? Explain your answer.

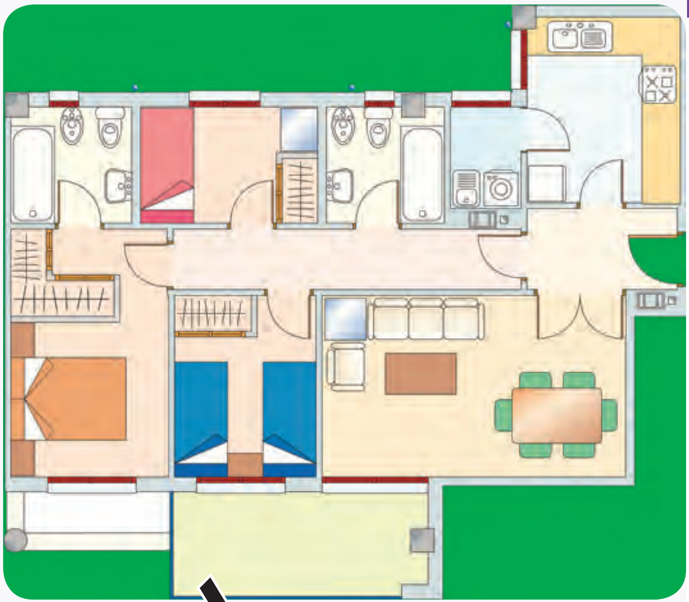


Image: dancingwithvectors iStock/Thinkstock

6. How much might this house cost to build based on current build prices and land prices in your area? How do you feel about this?

1.	
3.	
5.	**6.**

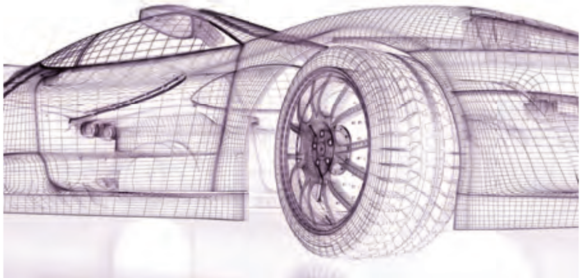
2.19 Models and Prototypes

Models and prototypes

A **prototype** is a physical model of a product in development, and is used for testing and evaluation purposes. Organisations are increasingly making virtual prototypes using **computer-aided design** (CAD) that can be modified quickly and efficiently. This requires a high degree of visual acuity, design skills as well as advanced training on CAD software.

However, many models are still **rendered** in 3D. As humans, we respond to three dimensions. This is, after all, how we live! So people continue to make scale models, dioramas, prototypes, set designs, mini-cities and other 3D models. And seemingly, more adults are playing with Lego than kids are!

Image: UmbertoPantalone/ iStock/Thinkstock



Model-making

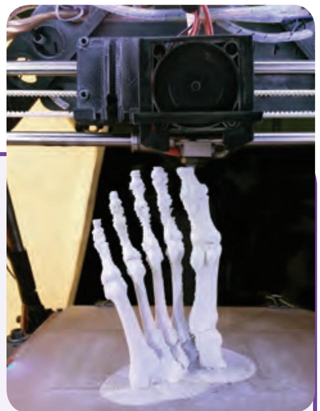
Model-making is a sophisticated occupation that involves highly-developed visual numerical skills. Model-making combines eye-hand coordination, accurate measurements, artistic and craft-based talents and a committed discipline to accuracy, precision and quality.

Model-making involves estimating, measuring, crafting, carving, casting, layering, scraping, baking, setting, colouring and many more skills and activities. Wood-modelling may involve wood-turning, metals modelling - lathing, plastic modelling - casting, fibreglass modelling - moulding, confectionary modelling - shaping and so on.

Many industries still use **model-makers** to create **scale or life-size 3D models** of their products.

- The automotive industry makes scale clay models of concept vehicles and then full-size clay models of new vehicles. I think these, the clay cars, are really cool!
- Industrial designers will work with model-makers to produce prototypes of new products.
- Toy manufacturers will make prototypes from which to develop casts. (This makes Star Wars collectors very happy!)
- Other industrial makers stamp dies, cast moulds or make other shapes from models.

Images: (t) Suljo/ (b) Krezofen/ iStock/Thinkstock



Old-school u skUL

- Have you ever used a 3D printer? Has your school got one?
- 3D printing is an innovation that can help people render their prototypes, designs and products in real-life form. 3D printers have been used to make industrial components, medical components, jewellery, action figures, weapons, household items; and even houses!
- However, a 3D printer can only render what it is told to. It can't make a bad design better nor can it make a dud product sell!
- Quality 3D printing is not yet at a cost-effective stage whereby it can replace mass production, but it is good for niche products, and for hipsters (remember them?!)

PREVIEW SAMPLE: DO NOT COPY

Modelling 2K

1
4 PS 2
3

Draw, render or design a scale model based on a product or object you like. Perhaps you can design a prototype for a new concept or innovation?

- ❑ Include an original image of the object.
- ❑ Make accurate measurements and develop a scale.
- ❑ Produce your 2D image by hand or using multimedia; or render your 3D model.

Drafting, measurements, planning and images.

2.21 Scaling

Representing size

It takes a special set of skills to represent objects accurately.

Both scale and size ratio are important applied design and representational concepts when working with objects.

Of course, large-sized objects get represented as smaller design elements or images, such as the drawing for a concept car, or for the graphics in a computer game.

Smaller shapes and objects are represented bigger, such as multimedia graphics for a biological model.

For this topic it's best to use as few words as possible, so let's get into the drawing!

Scale and ratio

A scale is used to represent the relative distance or size of a map, diagram, shape or object compared to itself in real life.

Scales use quantity ratios, e.g. 1:4, 1:20, 1:10,000 or even 2:1!

A map scale of 1:10 (in cm) means that every 1cm on the map represents 10cm in real life. Or, the map is 1/10th the size of real life.

An action figure might be in 1:6 scale. This means that every 1cm of the action figure represents 6cm in real life. So the action figure is 1/6th the size of the character it is representing.

A small object such as a fly might be drawn at 4:1. This means that the drawing is increasing the real-life size of the fly by a factor of 4.

NUM SUPER SKILLS

Do you like models, miniatures, dioramas and other representations like this? Many people love this old-school style of modelling. Indeed many 'new-skul' designers and computer modellers, who are stuck on their computer screens all day, come home and unwind by doing physical drawing, crafting and modelling!

Image: nelsonart /Depositphotos.com

1. Estimate the dimensions (size) of these objects as shown on the page.
2. Measure these images. How did you go with your estimates?
3. Estimate the depth dimension measurements of these objects.
4. Estimate the scale of the drawings of each icon compared to the object that each represents in real life.
5. Sketch or draw these objects first by hand, and then using multimedia, at 1:1, 1:2, 2:1, 1:4 and 4:1 scale (you don't have to do every scale for each). If you have good drawing and design skills, use perspective to create a sense of depth.

Image: doomu/Depositphotos.com

Image: Dezay/Depositphotos.com

Image: rozelt/ Depositphotos.com

Image: StockerNumber2/Depositphotos.com

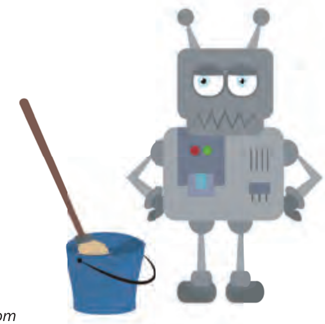


Image: themaka /Depositphotos.com

2.23 Scaling

2M Mixing scale

Sometimes scale may be used to deliberately mix up imagery to create drawings, images or objects that convey greater meaning through using contrast, symbolism and metaphor.

1. What is being communicated by these images?
2. Create an image like these. Consider using a collage of visual effects. Have classmates suggest what they think the image is communicating. Give them feedback about how close they were. You will also have to take feedback from them about your image as well!

Image: unknown/iStock/Thinkstock

Image: Nomadsoul1/iStock/Thinkstock

Technical drawings 2N

1 4 PS 2 3

The ability to read, interpret, communicate and even create technical drawings is an important numeracy skill for a lot of applied work situations.

Designs, floor plans, blueprints, schematics, prototyping/modelling renders and other technical drawings all get created and interpreted by varied users at different stages; such as concept development, design, technical planning and engineering/constructing.

Calculating and communicating accurate measurements are key skills for these processes, especially the ability to turn 2D representations and measurements into 3 dimensions.

1. Carefully estimate the 3D dimensions for this rendering of a house, its rooms and some other key features. Make sure that your estimates are in relative scale to each other.
2. Sketch this house by hand or using multimedia, and add the measurements.
3. Create a sketch or image of your own dwelling (or some other dwelling you like). Add accurate 3D dimensions You could have a go at constructing a model of this as well.

Image: valer /Depositphotos.com

2.25 Assessment Task

AT2 Make Me Up
Personal Numeracy // or Recreational // or Vocational

1 4 PS 2 3

For this assessment task, you are required to use your skills in estimation, shape and design to complete one of these 3 projects. Each project draws on similar skills but you will have to apply your skills in varied ways. You should also use applied measurement skills (from Section 3).

You will be expected to use both hand drawing and modelling skills, as well as digital software rendering techniques.

Your teacher will discuss the suitability of each project for you and your class; and which 'numeracy' your choice will apply to.

The three projects from which to choose are as follows.

a. Develop your ideal house plan to scale and make a 3D model or diorama. (Personal)

b. Accurately measure, draw and render a model of a 'product', such as a motor vehicle, or another object. (Personal or vocational)

c. Accurately measure, draw and render a model of a person or an animal. This could be rendered like a toy, a doll or even an action figure! (Personal or recreational or vocational i.e. a product prototype.)

Note: This task might be an ongoing project completed over a longer timeframe, as you investigate and develop more applied numeracy skills and tools.

a. Ideal house plan	b. Model of product	c. Model of a person/animal
❑ Estimate size of exterior, interior rooms and fixtures and fittings. ❑ Measure and use scale to produce a plan. ❑ Use software to refine sketches and drawings. ❑ Create scale 3D model of exterior and interior rooms; and at least one room with fixtures and fittings. ❑ Research costs, and compare proposed house with actual houses. ❑ Comment on the accuracy of plan and model versus reality; and any issues. ❑ List sources, measuring tools and methods. ❑ House budget = $300,000 Other info:	❑ Estimate size of 'object' and size of model. ❑ Measure and use scale to produce a sketch or technical drawing. ❑ Use software to refine sketches and drawings. ❑ Create scale 3D model of 'object' in material of your choice. ❑ Research and/or outline costs of rendering model in a permanent form. ❑ Comment on the accuracy of plan and model versus reality; and any issues. ❑ List sources, measuring tools and methods. Other info:	❑ Estimate size of the person/animal and size of model. ❑ Measure and use scale to produce a sketch or technical drawing. ❑ Use software to refine sketches and drawings. ❑ Create scale 3D model of the person/animal in material of your choice. ❑ Research and/or outline costs of rendering model in a permanent form. ❑ Comment on the accuracy of plan and model versus reality; and any issues. ❑ List sources, measuring tools and methods. Other info:

Name(s):	AOS2: Shape
Key dates:	Personal or Recreational or Vocational Numeracy

Tasks - AT2: Make Me Up	Must do?	Due by	Done	Level
My project is:				
Stage 1: Estimating and Design				
Negotiate the task details with my teacher.	✓			
i. Research and carry out initial estimates.	✓			
ii. Identify appropriate design tools & techniques.	✓			
iii. Identify and use appropriate scale or ratio.	✓			
iv. Identify, measure and appropriate use of angles.	✓			
v. Use design tools accurately for required units.	✓			
vi. Produce a plan, sketch or diagram.	✓			
vii. Apply appropriate digital tools and techniques.	✓			
Stage 2: Creating a 3D Model				
i. Choose materials for 3D objects.	✓			
ii. Make 3D diorama or model.	✓			
iii. Research costs of rendering model in a permanent form.	✓			
Apply appropriate digital tools and techniques.	✓			
Discuss with teacher and refine if necessary.	✓			
Stage 3: Task completion				
⇨ **Refine and render my 2D and 3D creations.**	✓			
1 4 PS 2 3 **Describe applied use of the problem-solving cycle.**	✓			

Identify the maths	Act on & use maths	Evaluate & reflect	Communicate & report

	Must do?	Due by	Done	Level
Develop and apply mathematical tools and techniques.	✓			
⇨ **Prepare and submit my final designs and models.**	✓			
Present a report to the class (if required).				

2.27 // Problem-Solving Cycle // Maths Toolkit

1
4 PS 2
3

Task: | **Names/Dates:**

AT2 -

1. Identify the maths					
Identify problem(s)	Done: ◯ Level:	Recognise maths	Done: ◯ Level:	Select information	Done: ◯ Level:
Interpret information	Done: ◯ Level:	Choose processes	Done: ◯ Level:		Done: ◯ Level:
2. Act on and use maths					
Perform estimations	Done: ◯ Level:	Decide techniques	Done: ◯ Level:	Choose maths tools	Done: ◯ Level:
Select technologies	Done: ◯ Level:	Perform calculations	Done: ◯ Level:		Done: ◯ Level:
3. Evaluate and reflect					
Check Estimations	Done: ◯ Level:	Compare results	Done: ◯ Level:	Check processes	Done: ◯ Level:
Review actions	Done: ◯ Level:	Check calculations	Done: ◯ Level:	Assess conclusions	Done: ◯ Level:
4. Communicate and report					
Written processes	Done: ◯ Level:	Written results	Done: ◯ Level:	Oral processes	Done: ◯ Level:
Oral results	Done: ◯ Level:	Digital processes	Done: ◯ Level:	Digital results	Done: ◯ Level:

Mathematical Toolkit					
Analogue tools - What & how?		Digital Devices - What & how?		Software & Apps - What & how?	
Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy

Measuring Up 3

Activities 3: Measuring Up		p.	Due date	Done	Comment
3A	Units of measurement	63			
3B	Measuring	64			
3C	Measuring devices	65			
3D	Ye olde measures	66			
3E	Perimeter and area	69			
3F	Volume	70			
3G	Getting it right	71			
3H	Volume - Fluids	73			
3I	Volume - Fluid units	[illegible]4-[illegible]			
3J	Goldilocks	76			
3K	Weight	77			
3L	Temperature in action	78-79			
3M	Measurements	80			
3N	Stop the goats	81			
3O	Combining shapes	82-83			
AT3	Measuring Up	84-85			
PST	Problem-Solving Cycle and Maths Toolkit	86			

Comments:

3.01 Measurement

Units of measurement

When we measure something we use some type of unit to establish size.

You already know about the **metric system** and how it works in 1s, 10s, 100s, 1,000s and 10,000s and so on. Each metric unit measurement is sized **relative** to another unit. For example: 10 mm = 1 cm, 100 cm = 1 metre, 1,000 metres = 1 kilometre.

It is important to be able to **convert** between different units to suit different circumstances. In work-related situations, most trades and practical jobs use millimetres for measuring and not centimetres. But a client might have done the measurements in cm. The tradie will have to convert to mm when ordering the materials.

In other vocational situations, workers need to **convert 'up'**, because they are often dealing with inputs in **bulk** quantities. So, if a chef needs 100 millilitres of oil for each meal they are cooking, they will need to bulk order in litres.

It is important to also understand the measures of time. Time is not a metric measure. Time uses seconds, minutes and hours with a relationship based on 60. Days and years are based on the rotation of the Earth on its own axis, and on the rotation of the Earth around the sun.

Weighing in at 250,000 grams or 1/4 of a tonne is the great Yokozuna!

Image: BNP ... Studio / Depositphotos.com

Metric Measurement Units

Length		
millimetre	mm	1 mm = 1,000 microns
centimetre	cm	1 cm = 10 mm
metre	m	1 m = 100 cm
kilometre	km	1 km = 1,000 m
hectare	m^2	1 ha = 10,000 m^2

Weight		
milligram	mg	1 mg = 1,000 ug
gram	g	1 g = 1,000 mg
kilogram	kg	1 kg = 1,000 g
tonne	t	1 t = 1,000 kg
kilotonne	mt	1 kt = 1,000,000 t

Fluid Volume		
millilitre	ml	1 ml also = 1 cm^3
litre	l	1 l = 1,000 ml
litre	l	1 l =1,000 cm^3
megalitre	ML	1 ML = 1,000,000 l

Time (time is not metric)		
second	s	1 s = 1,000 ms
minute	min	1 min = 60 s
hour	hr	1 hr = 60 min
day		1 day = 24 hr
week		1 week = 7 days
fortnight		1 fortnight = 14 days
year		1 years = 365 days*
decade		1 decade = 10 years
century		1 century = 100 years
* A leap year is 366 days		

Temperature		
Celsius	°C	0 °C freezing point of water 100 °C boiling point of water

1. What units do we most commonly use for these measures? Describe situations.

length	The measure used for building materials is usually millimetres. The measure used for
fluid capacity (volume)	The measure used for a small fluid volume is usually The measure used for
distance	The measure used for close personal distances is usually metres. The measure used for a travel distance is usually
height	The measure used for a human's height is usually The measure used for
weight (mass)	The measure used for a human's weight is usually The measure used for
time	The measure used to calculate a wage is usually The measure used for
temperature	The measure used for heat is usually The measure used for

2. Which of these is correct?

a.	elephant 5 kg or 5 tonnes?	b.	ra[illegible]p [illegible] 1 litre?	c.	small passenger car 1 kg or 1 tonne?
d.	can of soft drink 375 ml or 375 gm?	e.	Olympic swimming pool 2.5 ML or 2.5 ml?	f.	an hour 60 s or 60 min?
g.	cup of coffee 80° or 800°	h.	distance to LA 13,000 m or 13,000 km	i.	AFL men's ruck 2002 cm or 2.02 m

3. Convert these units of measurement.

a.	3.5 kg in grams	b.	750 ml in litres	c.	0.75 km in metres
d.	29.5 cm in mm	e.	1.25 litres in ml	f.	3,500 metres in km
g.	210 secs in minutes	h.	2.5 hours in minutes	i.	100°F in Celsius

Have you heard of the Imperial system?

3.03 Measurement

Measuring up

As part of our day-to-day personal and vocational lives, we have to measure many different things. Measures might include:

- times for cooking, or how much time it might take for a client's hair appointment
- distance for a weekend road trip, or distance to a client's premises
- cost of our petrol bill, or cost of petrol to run a courier business
- mass (weight) of food ingredients, or mass (weight) of a package to be sent to a customer
- depth of a swimming pool, or depth of a foundation hole on a construction site
- area of a house and land package, or area of a field to sow
- volume of a gift package, or volume of a shipping container
- speed of a car, or the speed of a passenger jet.

Measuring units and devices

A measurement unit is a particular and precise unit that is standard. **Standardised measuring units** make it easier to do calculations and comparisons. They also make it easier for people to communicate more effectively in personal and work-related situations by sharing a common language, and by developing technical and professional vocabulary.

Measuring **units** are calibrated to produce standard readings on measuring **devices**. We can use some of these in our personal lives; such as a thermometer for cooking, or to assess health, or to measure our personal comfort. At work we might use a thermometer while working as a chef, or as a vet nurse, or as an air conditioning mechanic.

Image: Shebko/ Depositphotos.com

3B Measuring

1. What measuring devices do you commonly use? How are they calibrated?
2. How do you know just what is an acceptable reading? e.g. Too hot or too heavy?

Measuring device	Calibration	Understanding of reading

Units of measurement

Key measuring units you should be familiar with include:

- ⇨ Temperature: how hot or cold, measured in degrees Celsius, or ^{0}C
- ⇨ Length: how long or short, measured in mm, cm, m or km
- ⇨ Mass: how heavy or light, measured in µg, g, kg, tonne
- ⇨ Perimeter: how far around, measured in m (metres)
- ⇨ Area: how much spread or coverage measured in mm^2, cm^2 or km^2
- ⇨ Volume (fluid): how much, or the capacity, measured in ml^3, l^3 or cc.
- ⇨ Volume (solid): how much, or the capacity, measured in mm^3, cm^3 or m^3.

NUM SUPER SKILLS

Measuring devices 3C

1 4 PS 2 3

1. What do each of these measuring devices measure, and what units do they commonly use? Add 2 of your own.
2. Explain how you might use each of these in personal and/or work-related applications. Find images of these and include them in your work folios.

Measuring device	What does it measure?	Personal or work-related example
thermometer		
calliper		
altimeter		
odometer		
scale		
ammeter		
speedometer		
measuring tape		
barometer		
wind vane		
pedometer		
sphygmomanometer		

3.05 Measurement

Measurement

Useful and accurate measurements rely on the use and application of estimates, calibrated measuring devices, calculations, experience and transferable and work-related skills.

Some measurements rely on estimates and approximates. For example, how much paint to buy to paint a bedroom, what sized clothing to order online, and the distance and duration of a journey to drive to the beach. Other measurements will rely on more accurate calculations, such as lengths of timber needed to build a carport, amount of tiles needed to complete a patterned wall feature, and appropriate temperature at which to safely cook meats, such as chicken, or to heat baby formula.

You might also encounter **macro-measurements** in construction, mining and agricultural industries, such as the mass of concrete needed for an apartment block's foundations, floor and structure, the mass tonnage that a mining dump truck transports each trip from a coal mine, or the area of crop that needs to be sprayed with insecticide.

In some cases you might need to know how to perform accurate **micro-measurements**, such as in precision trades like jewellery making, in health-care for pharmaceuticals and medicaments, and in engineering and the manufacture of components in hi-tech electro-technology devices.

Image: Kuzma/iStock/Thinkstock

3D Ye olde measures

Most of our modern measures are standardised using the metric system. (But not in the US of A). However, there were many olden measures used by people.

1. Find out the meaning of each of these old measures and what they measured.
2. Explain how they compare to a modern unit and if they are still in use today.

Old measure	Definition	Comparison/ & are they still in use?
cubit		
hundredweight		
furlong		
league		
peck		
ell		
chain		
other:		

Investigation

Use online tools to convert between the main **metric** measures and the main **imperial** measures. See if you can create formulae to show these relationships.

Key measurements

Some key measurements that you need to know how to calculate are covered here. Many of you might have already developed your numeracy skills in using some of these, so let's consider this as a recap and upskill activity.

⇨ Length

Length is a simple measurement. How long is that object? Length measures distance. Long distance might be better said as 'how far', e.g. "How far from Melbourne to London?"; or how close, e.g. "Where are you now?", "I'm just a km away". In reality most of the lengths we measure are quite small, such as the length of our body, the length of our clothes and the length of the distance of our eyes from our screens!

⇨ Perimeter

The perimeter is the distance around an object; or in other words, the combined lengths of all the sides or edges. Therefore, to calculate perimeter we simply add up the length of all sides of an object. Note: The perimeter of a circle is called circumference.

⇨ Area

Area is a 'how much' sort of calculation and measures the 2-dimensional coverage of an object or shape. i.e. How much area does that lawn cover? Surface area relates to how much of something is needed in 2D to cover the surface of a 3D object, such as gift wrapping a present.

⇨ Volume

The volume of an object refers to how much space it occupies. Volume is different from area in that it relates to 3 dimensions; length, width and height (or depth). In theory volume is actually measured by how much space an object displaces. However, it is fine to think of an object's volume as how much it holds, or in other words its capacity, like a 600ml bottle of Pepsi Max.

⇨ Temperature

Temperature can be commonly referred to as the intensity of heat of an object, fluid, surface or other substance. Temperature is usually measured using a calibrated thermometer or similar device.

⇨ Mass

Mass is the appropriate term to describe how much matter is in an object. This then determines how 'heavy' an object is.

Objects of the same size might have a different mass depending on the density of the matter from which the object is made. Consider the different mass of a gold bar and a chocolate bar of the same size.

We often use the word 'weight' when describing how heavy an object is. But technically this term is incorrect as weight describes the force of gravity on an object. (Yep; think about astronauts leaping about on the moon - same 'mass' as on Earth but different weight.) But you can use the word weight in most practical applications as long as you understand that what you are really referring to is an object's mass!

We commonly measure weight (mass) in grams (or multiples thereof), but there are other measures of weight (mass), such as carats for gemstones.

3.07 Measuring in Action

Measurement in action

You need to be able to estimate and calculate perimeter, area and volume. These measurements all rely on the use of straightforward formulae that is not necessarily based on mathematical expertise, but rather on the application of logic.

Often these measurements might start as an estimate, even moreso as you become experienced and build your suite of transferable and work-related skills. However, you will have to calculate exact measurements of objects and numeracy scenarios to determine exact perimeters (e.g. fencing), area (e.g. fabric cover), and volume (shipping and transport). Especially when you move from a quote to an actual billing or buying stage.

Perimeter

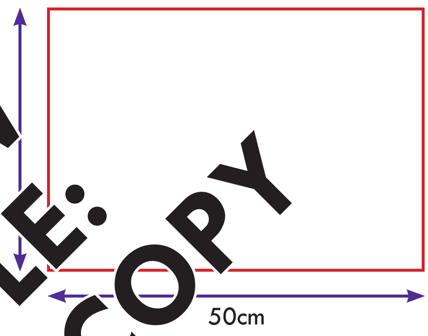
- The perimeter is the distance around an object.
- To calculate perimeter we simply add up the length of all sides of an object.

Perimeter: Rectangle

Perimeter of rectangle
= length + width + length + width
or l + w + l + w ; or (2l + 2w)

Calculate perimeter of rectangle:
= 35cm + 50cm + 35cm + 50cm
= 170cm or (1,700mm)

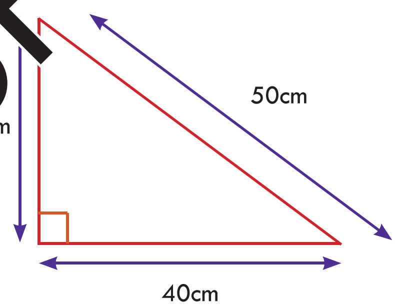
(Note: Nearly all trades use mm as measurements rather than cm.)



Perimeter: Triangle

Perimeter of triangle
= length side 'a' + length 'b' + length 'c'

= 30cm + 40cm + 50cm
= 120cm or (1,200mm)



Circumference (perimeter): Circle

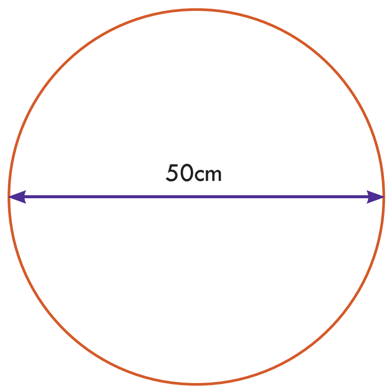
Circumference (perimeter) of circle
= diameter x 3.142
(Note: 3.142 is pi or π) *or* $c = d\pi$

= 50cm x 3.142

= 157.1cm or (1,571mm)

Pi is always used for circles as it is a mathematical constant that measures the ratio of a circle's circumference compared to its diameter.

As the circle gets wider, its circumference gets proportionally bigger!



NUM SUPER SKILLS

Area

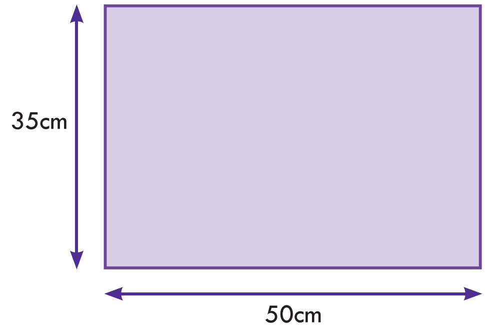
- Area measures the 2D surface coverage of an object.
- To calculate area we multiply the key dimensions; the answer will always be in units^2.

Area: Rectangle

A = length (l) x width (w)

Calculate area of rectangle:
A = 50cm x 35cm
A = 1,750cm^2 (or 0.175m^2)

Note: Here the unit, cm, is squared (^{2}). That's because cm is multiplied two times in the calculation (i.e. cm x cm). And of course you are working in 2 dimensions with area, hence cm^2!



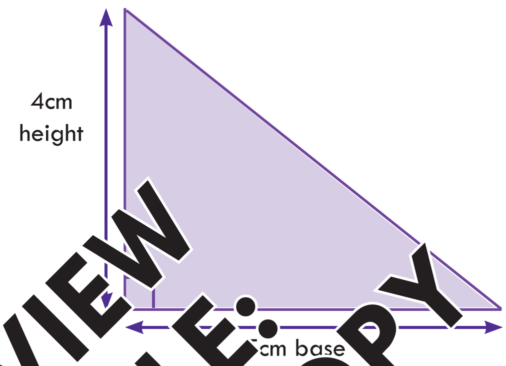
Area: Triangle

A = 1/2 x base x height
(or A = 1/2bh)

A = 1/2 x 5cm x 4cm
A = 1/2 x 20cm^2
A = 10cm^2

Now, this formula makes sense because when you think about it, the right-angled triangle is basically half a rectangle.

So the formula for calculating the area of a right-angled triangle is the same as that for calculating a rectangle, but halved!



Area: Circle

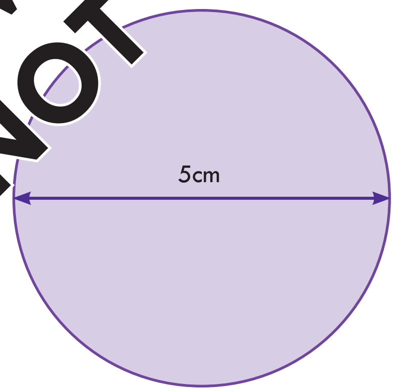
A = π x radius^2
(or A = πr^2)

A = 3.142 x (2.5cm)^2
A = 3.142 x 6.25cm^2
A = 19.6cm^2

The radius is half the diameter, or half the 'width' of the circle.

You know how with circumference that as a circle gets wider, its circumference gets proportionally bigger; well of course so too does its area.

There's that good old pi again!



NUM SUPER SKILLS

Perimeter and area 3E

1 4 PS 2 3

Calculate the perimeter and then the area for each of the following.

i. A circular rug that has a radius of 260mm.	ii. The roof of a rectangular garage that is 4.6m x 270cm.	iii. A triangular sail that has a height of 1,400mm and a base of 0.75m.
iv. The room in which you are sitting/standing right now.	v. Your backyard (or a friend's backyard).	vi. A 4 hectare property.

Volume

- The volume of an object measures its 'capacity' or 'size' in 3 dimensions.
- To calculate volume we multiply the key dimensions; the answer will always be in units³, because now you are working in 3 dimensions!

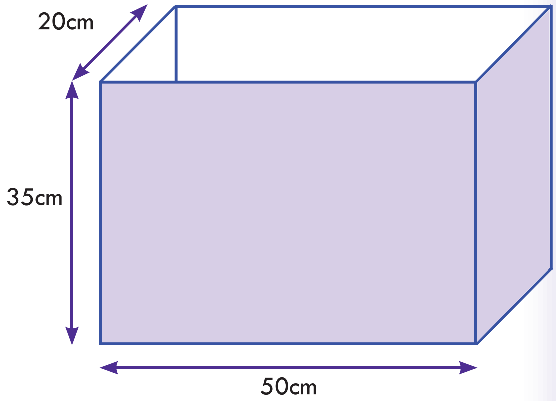
Volume: Rectangular prism (cuboid)

Volume of a cuboid
V = l x w x h

V = 20cm x 50cm x 35cm
V = 35,000cm³ (or 0.035 m³)

Note: Here the unit, cm, is cubed (³). That's because cm is multiplied three times in the calculation (i.e. cm x cm x cm).

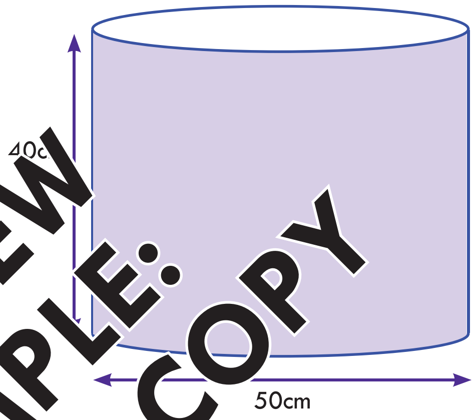
And of course. you are working in 3 dimensions with volume, hence cm³!



Volume: Cylinder

Volume of a cylinder
V = π r² h

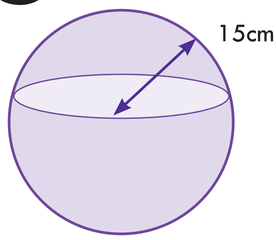
V = 3.142 x (25cm)² x 40cm
V = 3.142 x 625cm² x 40cm
V = 1963.75cm² x 40cm²
V = 78,550cm³ (or 0.079m³)



Volume: Sphere

Volume of a sphere
V = 4/3 π r³

V = 1.333 x 3.142 x 15cm³
V = (4.188)   x 3,375cm³
V = 14,134.5cm³ *(approx due to pi and rounding)*



NUM SUPER SKILLS

3F Volume

1 4 PS 2 3

1. In your work folios calculate the volume based on these dimensions. Draw each.

a. A prism with dimensions of 10, 20 and 40 cm.	b. A cylinder with a radius of 20cm and a height of 100cm.	c. A sphere with a diameter of 50cm.
d. A compound object featuring the prism from 'a' and the sphere from 'c' on top. Draw this - what object might this resemble?	d. A compound object featuring the cylinder from 'b' on a base of a 40cm cube. Draw this - what object might this resemble?	f. A compound object featuring 2 spheres from 'c', 1 cylinder from 'b' and 3 prisms from 'a'. Draw this - what object might this resemble?

2. List and discuss practical examples when you would have to apply volume calculations.

Old-school v nu skUL

- As technology increases we are seeing a growing incidence of digital measuring devices replacing analogue ones. The claims supporting digital devices are that they are more precise and therefore more accurate, faster and safer.
- Many devices use lasers for measuring levels, distances and angles. Others are used in technical and construction activities for locating electrical cables, gas lines, water pipes and other hidden dangers.
- Digital laser rangefinders calculate accurate distances and support one-person operation. These devices can also store information, perform calculations and calculate area and other required measurements.
- If you pay enough to invest in state-of-the-art, industry-standard devices, then the device can also send data to a smart phone app that can be stored in a spreadsheet to save having to transcribe while on the job.

- Old school measures involve the user physically making the measurement and writing the data. This can cause measuring inaccuracies and transcription errors.
- But manuals measures can have the advantage of a hands-on approach, whereby a person uses their physical expertise, 'their eye' and their experience to measure (and estimate) accurately.

Images: (l) nikkitok/ (r) Tuned_In/ iStock/Thinkstock

Getting it right 3G

1
4 PS 2
3

When you use digital devices and online apps for measuring you need to be able to know that the readout that you get is accurate. The device will always give accurate measurements (unless the batteries or charge is low). But when you first start using digital devices you might not be measuring the 'right thing', or perhaps you are not operating the device properly, or you might then record the measurements incorrectly; i.e. mixing up height and width which could cause problems if you start working with materials. So how will you know?

1. Start by **estimating** the dimensions of this room. Calculate its perimeter and its area. Use an app or online calculator to calculate its volume.
2. Use a **digital measuring device** to record the perimeter and area of the room. Use these measurements to calculate the volume of the room.
3. Use **manual measuring instruments** to measure the perimeter and area of the room. Calculate the volume.
4. Compare your initial estimates, the digital measurements and the 'manual measurements. How close are the results? Which are correct? How do you know? And how would you check?
5. Research digital measuring devices and find out usage instructions, tips, guidelines and troubleshooting information. Summarise these and present the information in a short report to the class.

3.11 Measuring Volume

Volume - Fluids

Volume measures abound in our everyday lives for cooking, medicine and of course, for fluid containers.

What was the volume of the last bottle of soft drink you consumed? What volume of sauce is in a bottle? This type of volume is called **capacity**. Or in other words, how much something can hold. e.g. How much liquid in a bottle?

Most fluids are measured in **millilitres** or ml. 1,000ml equal 1 **litre**.

A millilitre is the same volume as a **cubic centimetre** (cc). So therefore a cube that has sides of 1cm will have a volume of 1 millilitre. The measure of cubic centimetres is often used in medical settings and in mechanical and other engineering measures.

You are likely to use fluid volume measures in your personal lives when it comes to hydration, cooking, gardening and various recreational and hobby pursuits.

People also pay particular attention to one common volume measure expressed as a cost. This is the cost of a litre of petrol. How does $1.70 per litre sound? And if your vehicle's fuel tank has a capacity of 60 litres, then at $1.70 per litre, it will cost just over $100 to fill.

Many work-related tasks require a good working knowledge of fluids. Occupations such as chefs, baristas, gardeners, plumbers, painters, nurses, hairdressers, farmers and others need to have a good working knowledge of fluid volumes.

Fluid volumes are extremely important when working with chemicals and mixing chemical ratios; be that when **diluting** concentrates with water (such as bleach and pesticides) or when mixing more than one chemical. This is a key area of workplace safety concern for some workers.

Nurses and doctors have to administer **exact dosages** of medications, otherwise the results might be life-threatening.

So you should always make sure you are on top of fluid measures, read the product manufacturer's instructions, and be accurate with your measurements.

Image: @ emmeci74/ Depositphotos.com

Cooking

Cooking uses metric measurements for volume, but also uses volume measures based on cooking **utensils**.

These measures might vary in different countries, but in Australia we accept these values to be accurate.

Fluids

- 1 teaspoon = 5ml
- 1 tablespoon = 20ml
- 1 cup = 250ml
- 1 fluid ounce = 28.41ml
- 1 pint = 568.26 ml
- 1 gallon = 4.564 litres

Solids

The weights of solids vary so we should not really use 'utensil' measures.

NUM SUPER SKILLS

1 4 PS 2 3

1. In your own words, complete the following questions.

1. What is capacity?	2. Which is bigger, a litre or a millilitre?
3. When might diluting be important?	**4. When will exact fluid measures be vital?**

2. Find out the prices of 4 different-sized cola containers from the same brand, both in a milk bar, and in a supermarket.
3. Complete the following table; and then discuss the results as a class.
4. What volume of container do you recommend, and why? (Think carefully!)

Date:________ Milk Bar: ____________________ Supermarket: ____________________

Size	Milk Bar price	Milk Bar price/litre	Supermarket price	Supermarket price/litre

1 4 PS 2 3

Applied: Treat or threat?

Complete the following tasks in your workbooks

a. If a recipe calls for 4 teaspoons of milk how many ml is this?

b. If a fruit dessert recipe calls for a sauce to be made from 100g of cooking chocolate, 6 tablespoons of cream and 2 tablespoons of icing sugar per person, and you are serving 10 people, what total quantity of cream, in ml, do you need?

c. What weight of both icing sugar (1 tble = 8 gms), and of chocolate, do you need?

d. Find out how much these ingredients might cost.

e. What do you think about this recipe? Discuss this as a class!

3.13 Measuring Volume

3I Volume - Fluid units

1
4 PS 2
3

1. Complete these tasks related to capacity. Some you will have to research.

Note: There are 1,000 millilitres in a litre, and 1 million litres in a megalitre.

a. How many mls of fluid would be in 5 tablespoons?	b. How many mls of fluid would be in 6 teaspoons?
c. How many mls of fluid are in nine x 3 litres bottles?	d. How many litres are in 3.5 megalitres?
e. How much 'bad' fluid do you consume a week? What might be a 'bad' fluid?	f. How much 'good' fluid do you consume in a week? What might be a 'good' fluid?
g. How many litres of water are needed to fill up an average backyard swimming pool?	h. How many litres of water are needed to fill up an Olympic-sized swimming pool?
i. How much does bottled water cost per litre?	j. How much does tap water from home cost per litre?
k. What is the capacity of a fuel tank for a motorbike?	l. What is the capacity of a fuel tank for an SUV?
m. When is a 'cup' measure used for fluid volumes?	n. When is 'cc' used for fluid volumes? Find examples.

2. List situations from your own life when it is suitable to estimate fluid volumes.

3. List situations when you must measure fluid volumes exactly. Why so?

4. Health & Wellbeing	Recreation & Hobbies	Vocational Situations
When is measuring solid volume important for me?	When is measuring solid volume important for me?	When is measuring solid volume important for me?
⇨	⇨	⇨
⇨	⇨	⇨
⇨	⇨	⇨

5. Health & Wellbeing	Recreation & Hobbies	Vocational Situations
When is measuring fluid volume important for me?	When is measuring fluid volume important for me?	When is measuring fluid volume important for me?
⇨	⇨	⇨
⇨	⇨	⇨
⇨	⇨	⇨

3.15 Measurements and Safety

Temperature

Temperature is commonly referred to as the intensity of heat of an object, fluid, surface or other substance. It is usually measured using a scaled mercury-based thermometer using degrees Celsius (°C). Celsius is a comparative scale based on the freezing point of water, which is 0°C, and the boiling point of water, which is 100°C. (However, some slight variations to this definition do exist for scientific purposes.)

It is vital that you are aware of safe temperature ranges for personal and work-related situations. Too hot, and indeed too cold, can result in injury (burns and scalds), illness (food poisoning) and even the risk of death (hypothermia and hyperthermia).

There are so many safe temperature issues, too many to list here. It's better for you to be aware of common safe ranges and others that are relevant to you.

3J Goldilocks

1
4 PS 2
3

Goldilocks never did her VM Numeracy, but if she had, her story might have ended differently; and perhaps she wouldn't be eating porridge! Research the following safe temperature ranges. Add some of your own choice.

Example	Too hot	Too cold	Just right
porridge			
cooking chicken			
baby formula			
baby bathwater			
adult's temperature			
infant's temperature			
dairy food storage			
car radiator			
cuppa' coffee			
iced slushie			

Weight

Weight (mass) is another quantity that also needs to be safely estimated and measured. People get injured in their personal, social and work-related lives by lifting too much weight, lifting weight incorrectly, lifting weight repeatedly, moving weight incorrectly, bending and twisting while carrying weight, and even suffering crush injuries from weighted objects.

Weight is also a safety issue in these situations, as well as many more (suggest some others as a class).

- Cooking, e.g. minimum cooking times for portions.
- Transport, e.g. overloaded and unbalanced loads.
- Caring and nursing, e.g. safely moving and lifting patients.
- Health and medicine, e.g. dosages for body weight and drug micro-measurements.
- Sport, e.g. physical stress injuries to muscles, joints and ligaments.
- Personal life; e.g. too much body weight, straining joints.

"I don't know why I keep doing my back when I bend over to pick up Tiddles?"

Image: L: satinka R: popaukropa/ Depositphotos.com

Weight is also an issue in relation to packing and sending goods for postage and courier services (underpaying for parcel weight), when travelling (excess luggage charges) and even for buying self-pick lollies (people always seem to fill their bags with too much weight!)

Weight 3K

1 4 PS 2 3

Find out limit guidelines related to these statements about weight. You will have to do some research; and you will need to interpret relevant details to apply to some scenarios. Work in pairs. Add 3 of your own.

a. Single-person manual lifting of a package or object.	b. Two-person manual lifting of a package or object.	c. Weight to power ratio of a car for a probationary driver.
d. Transport vehicle tonnage on a normal license.	e. Medical dosage per kg for a child.	f. Medical dosage per kg for a pet.
g. Weight limit on a ladder.	h. Recommended weight based on your height and age.	i. Weight limit(s) for towing caravans.

3.17 Measuring Temperature

Temperature in action

As you know, temperature refers to the intensity of heat of an object, fluid, surface or other substance. The most common unit of measurement for temperature is Celsius using a comparative scale, based on the freezing and boiling point of water.

An awareness of temperature scales, and associated safe temperature ranges, is a vital concept for many personal and work-related situations. Can you think of more?

- Personal health and wellbeing, such as surface air temperature.
- Personal care and safety, such as bathing an infant.
- Household situations such as hot surfaces, heating requirements and clothing needs.
- Health diagnosis and medicine, such as hypothermia, fever and other conditions.
- Food storage and preparation, such as perishables, dairy and meats.
- Employee OH&S such as exposure, heat and cool hazards, and fire risk.
- Cooking, such as temperatures and times to avoid food poisoning.
- Manufacturing, such as engineering, food production and construction.
- Transport, such as refrigerated vans for perishables.
- Exercise, such as energy burning and safe body temperature zones.
- Electrical goods, such as operating heat, cooling systems and radiant heat.

Correct temperature is important in the beauty industry. Why so?

Image: Wavebreakmedia Ltd; Wavebreak media, Thinkstock

3L Temperature in action

1 4 PS 2 3

1. Estimate and then find out the temperature for each of the following.

Item	Estimated temp.	Exact temp.	Item	Estimated temp.	Exact temp.
The temperature in this room.			Hottest temperature ever in Australia.		
The temperature in Moscow today.			Coldest temperature ever in Australia.		
A caffè latte.			Car radiator fluid after a long drive.		
A bath suitable for a baby.			A shop fridge for milk.		
Healthy human temperature.			your choice		
A human with a fever.			your choice		

1
4 PS 2
3

2. You are required to undertake an investigation into safe temperature ranges in a variety of personal, social/recreational and work-related situations. Complete the tasks specified in the table by describing relevant activities/items. You might also need to undertake some online research.

	Describe activity/item	Safe range/ hazard control	Potential hazards
Health & wellbeing situations	Cooking of...		
	Temperature of a child...		
	other...		
	other...		
Recreation & hobby situations	A day at the beach...		
	other...		
	other...		
Work-related situations	Working environment...		
	Storage of perishables...		
	other...		
	other...		

3.19 Measure It Out

3M Measurements

1 4 PS 2 3

1. Perform the following calculations showing all workings. (Tip: It might be a good idea to draw a sketch in your work folios!)
   a. The perimeter of a fence around a rectangular yard measuring 10m x 8.5m.
   b. The surface area of the lawn of this yard (assuming it goes right up to the fence).
   c. The surface area of a right-angled triangular compost structure located in the yard that has a height of 90cm and a base width of 2m.
   d. The area and volume of a rectangular ‘cubby house’ measuring 2m by 3m with a height of 120cm.
   e. The area of a circular concrete fountain with a diameter of 75cm.
2. The owners are thinking of laying a synthetic lawn. Calculate how much surface area of lawn remains uncovered after the compost, cubby house and fountain are incorporated into the yard.
3. How much might a synthetic lawn cost approximately? Go online and find some more exact prices. What about natural turf? Which is cheaper and why?

Calculations

Stop the goats 3N

1
4 PS 2
3

Farmer Tony has been living on his 2.5 acre square patch of land for many years and as a retirement hobby he grows turnips, sprouts and of course his prizewinning onions.

Image: Angela940/iStock/Thinkstock

His peace is shattered when Starlight Moonbeam and her partner Krusty Longshanks take over the vacant plot next to him. Living out of tents and their rainbow Bongo Van they pursue a sustainable lifestyle and as such they allow their goats Marcel, Pablo and Freida to roam free. The problem is that the goats are getting into Farmer Tony's vegie patch and gobbling up all of his hard work.

Tony can't take it any more when he comes out to see all 3 goats greedily devouring his prize onions. He is even more galled that Marcel appears to be smiling at him as he chows down on one particular big bulb that Farmer Tony thought might have a chance at this year's county fair.

Tony has had enough and goes over to 'negotiate' with his neighbours. "Look guys, I'm as reasonable as the next man but we have to stop the goats." They reach agreement to build a fence and share costs.

1. Draw a sketch of the plan to stop the goats.
2. What length of fencing (in metres) would be needed to protect the block's perimeter from the goats? What type of fencing would you recommend? Why?
3. Farmer Tony sees an opportunity in this and thinks he might be able to increase the area of his vegie patch. What is the total area of Tony's block?
4. Tony uses 40% of the block for his house, outbuildings and other amenities. What area would potentially be available for an expanded vegie patch?

Tony notices that his neighbours trap a lot of their water in tanks. Good thinking by these green folks - this could save him some money. He looks online and sees a cylindrical tank that measures about 1.6 metres in height with an internal diameter of approximately 900mm.

5. What would be the approximate capacity (volume) of this tank in litres?
6. How much might a tank like this cost? How much might it save Tony on his water bill?
7. How long do you reckon this could last to water his expanded vegie patch?

Image: Zhe_Vasylieva/Thinkstock

3.21 Measure It Out

Compound shapes and objects

As you know from Section 2, in the real world most objects are made up of **compound shapes**. When combined together these simple shapes make an entirely new, and **non-uniform** shape.

When you are working with compound shapes and objects, always try to visualise the smaller **components** that have been used to make the final compound shape or object.

Use this breaking-down method to help solve any problems associated with measuring compound shapes.

When working with **perimeters** look for the outer edges. Also assess to see if there are any internal edges. You don't want to **double-count** these if you are only focusing on the outer measures.

With **area**, look for where the shapes **overlap**. When measuring, you might have to calculate a whole area of a shape such as a **circle**, and then halve it (or apply some other **fraction**), based on the overlap.

Image: cosmin4000/Thinkstock

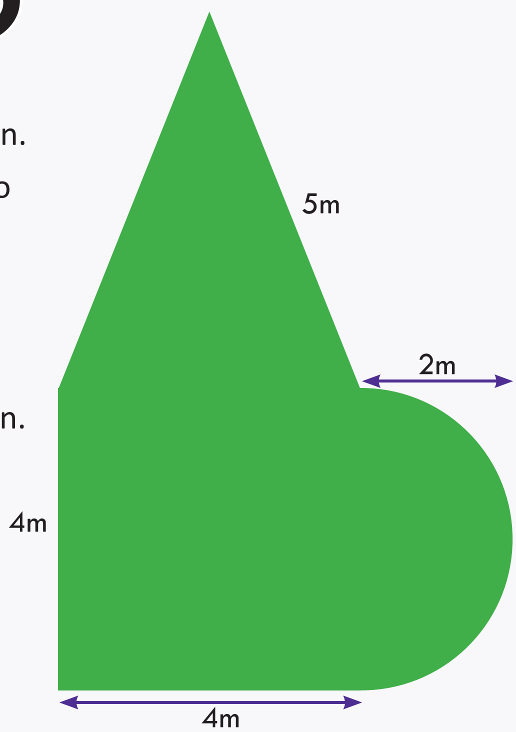
30 Combining shapes

1
4 PS 2
3

Part A: Compound perimeter

When you have to find the perimeter of odd shapes and sizes you should try to break the object into its basic geometric shapes of rectangles, triangles and circles. From this you can calculate the perimeter of each shape and then add them together. But watch out for double counting!

Flo is going to lay a funky shaped lawn and has drawn a diagram. She wants to install a good quality drip system right on the edge of the lawn.



a. In your workbooks, break the lawn down into its basic shapes and label those component shapes with the correct lengths.

b. Estimate how much hosing Flo might need.

c. Calculate how many metres of hosing she needs to go around the perimeter of her lawn.

d. Estimate how much it might cost for Flo to buy the hosing.

e. How much hosing should she buy? (Think carefully.)

f. Do some research online to find out how much the hosing might cost.

Part A: Calculations

1
4 PS 2
3

Part B: Compound area: Combining shapes

If you are calculating the area for odd-shaped objects you should try to break them down into their basic geometric shapes (just as you learned for perimeters).

But there won't be any double-counting this time because each shape covers its own area. But you need to be aware that you might be working with half-circles or other portions or fractions of shapes.

Remember Flo and her funky-shaped lawn? Flo has gone green (ish) and wants to lay a synthetic lawn. She needs to find out the area of 'lawn' she would need to buy, the area of each component shape and at least 2 different price estimates.

a. Will you need to create another sketch or diagram?

b. Estimate what you think the total area of the lawn might be.

c. Calculate the area of each of the component shapes. (Note: triangle h = 4.6m)

d. Calculate the total area of synthetic lawn that Flo would need to purchase.

e. Research prices online from 2 different 'local' suppliers. Prepare cost estimates.

f. Are there any other issues Flo would need to consider when laying the synthetic lawn for this shape? Explain.

Part B: Calculations

3.23 Assessment Task

AT3 Measuring Up
Health Numeracy // or Vocational Numeracy

1 4 PS 2 3

For this assessment task, you are required to investigate, collect, analyse and report on important quantities and measures related to **health situations** in your life, and/ or **vocational work-related situations** related to your career.

You will choose the focus area most relevant to your situation, and identify the most important quantities and measures to investigate at this stage of your life.

You will prepare an investigative analysis that explains relevant quantities and measures, why and how to estimate and measure these, the use of measuring devices and tools and techniques, how to ensure accuracy, and why these quantities and measures are important for your chosen focus area.

Health Numeracy: Quantity and Measures

You might investigate:

- ❑ making recipes healthier by substituting ingredients
- ❑ healthy eating and portion sizes
- ❑ amount of macronutrients, (protein, carbohydrates and fats) in different foods
- ❑ amount of refined sugar in food and beverages
- ❑ general health indicators and measures
- ❑ condition-specific health indicators and measures
- ❑ correct dosages of medications
- ❑ fitness measures
- ❑ amounts of different physical activity needed to balance food intake
- ❑ safe cooking temperatures and times for different foods;

or many other health quantities and measures relevant to [illegible]

Vocational Numeracy: Quantity and Measures

You might investigate:

- ❑ work-related task times
- ❑ work-related measuring of shapes and objects
- ❑ specific work-related measuring tools and devices
- ❑ work-related temperatures including safe operating ranges
- ❑ work-related estimates and measures of quantities
- ❑ work-related estimates and measures of sizes
- ❑ work-related estimates and measures of volume and capacity
- ❑ work-related estimates and measures of materials, ingredients, resources and inputs
- ❑ work-related mixes, proportions and other measures;

or other relevant work-related and vocational quantities and measures.

As part of your investigation, you must explain the importance of numerical knowledge and skills; and an explanation of the applied use of maths tools.

- ❑ measuring units and devices
- ❑ time measures and importance
- ❑ amounts and quantities
- ❑ temperature measures
- ❑ size and distance measures
- ❑ perimeter and area measures
- ❑ volume and capacity measures
- ❑ estimations and accuracy.

As relevant for Vocational Numeracy:

- ❑ work task time measures
- ❑ work temperatures
- ❑ work measuring units and devices
- ❑ work object and materials measures
- ❑ work-related estimations & accuracy.

Note: In the final column, your teacher might also include an achievement level to indicate your level of performance for each part of the task.

Assessment Task 3.24

AOS3: Quantity & Measures
Health or Vocational Numeracy

Name(s):

Key dates:

Tasks - AT3: Measuring Up	**Must do?**	**Due by**	**Done**	**Level**
Focus area:				
⇨ Measuring units, devices and techniques.	✓			
⇨ Time measures.	✓			
⇨ Amounts and quantities.	✓			
⇨ Temperature measures.	✓			
⇨ Size and distance measures.	✓			
⇨ Perimeter and area measures.	✓			
⇨ Volume and capacity measures.	✓			
⇨ Estimations and accuracy.	✓			
⇨ Work-related task time measures.				
⇨ Work-related temperatures.				
⇨ Work-related measuring units and devices.				
⇨ Work-related object and material measures.				
⇨ Work-related estimations & accuracy.				
⇨ Importance of these measures.				
⇨ Other portfolio tasks to satisfy skills & knowledge to AOS3 that are not part of the applied investigation.	✓			
Task completion				
1 4 PS 2 3 **Describe applied use of the problem-solving cycle.**	✓			
Develop and apply mathematical tools & techniques.	✓			
⇨ **Prepare and submit my final investigative analysis.**	✓			
Present a report to the class (if required).				

Identify the maths	Act on & use maths	Evaluate & reflect	Communicate & report

Additional information:

Signed: ______________________________ Date: __________

3.25 // Problem-Solving Cycle // Maths Toolkit

1
4 PS 2
3

Task:		Names/Dates:
AT3 -		

1. Identify the maths					
Identify problem(s)	Done: Level:	Recognise maths	Done: Level:	Select information	Done: Level:
Interpret information	Done: Level:	Choose processes	Done: Level:		Done: Level:

2. Act on and use maths					
Perform estimations	Done: Level:	Decide techniques	Done: Level:	Choose maths tools	Done: Level:
Select technologies	Done: Level:	Perform calculations	Done: Level:		Done: Level:

3. Evaluate and reflect					
Check Estimations	Done: Level:	Compare results	Done: Level:	Check processes	Done: Level:
Review actions	Done: Level:	Check calculations	Done: Level:	Assess conclusions	Done: Level:

4. Communicate and report					
Written processes	Done: Level:	Written results	Done: Level:	Oral processes	Done: Level:
Oral results	Done: Level:	Digital processes	Done: Level:	Digital results	Done: Level:

Mathematical Toolkit					
Analogue tools - What & how?		Digital Devices - What & how?		Software & Apps - What & how?	
Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy

Got The Time? 4

Activities 4: Got The Time?		p.	Due date	Done	Comment
4A	It's about time	88			
4B	Time will tell	89			
4C	You and time	91			
4D	Calculating time	93			
4E	How long?	94			
4F	Time zones	96-97			
4G	Getting around	99			
4H	My timetable	[illegible]			
4I	Timetables in action	101			
4J	Rosters in action	103			
4K	Timesheets in action	105			
4L	In my future	[illegible]			
4M	My transport costs	107			
AT4	Your Times are a'Changing	108-109			
PST	Problem-Solving Cycle and Maths Toolkit	110			

Comments:

4.01 Time

Time

Time is an arbitrary construct that breaks life down into years, hours, minutes, seconds and so on. We use time to govern many facets of our personal, social and work-related lives.

Image: Kudryashka/ Depositphotos.com

People talk about 'making' time, 'juggling' time, 'losing' time, 'gaining' time, 'costing' time, 'biding' time, 'marking' time and various other ways of dealing with time in their lives.

- ⇨ Time is a **counting tool**. e.g. You can count how many minutes it takes you to get ready for work.
- ⇨ Time is also an **estimating tool**. e.g. You can estimate how long it should take you to make a coffee at breakfast.
- ⇨ Time is also a **measuring tool**. e.g. You can measure how long it will take you to travel for a night out.
- ⇨ Time is also a **costing tool**, 'time is money'. e.g. You can measure how much labour work time is involved in doing a job for a customer or a client.

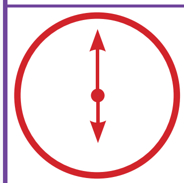
4A It's about time

Use an example from your own experience to explain the meaning of each of these time-related terms. Add 3 more of your own choosing.

Term	Meaning	Your example
24-hour time		
analogue time		
taking your time		
costing time		
time as labour		

People in certain situations, and workers in varied occupations and industries, prefer to use different time methods for displaying time.

1. Complete the table as a refresher on identifying times using analogue and 24-hour time methods. (Don't forget about am and pm).

15:50	17:15	21:45	23:30
06:00	04:25	09:45	19:30
20:00	00:00	12:00	24:00
			

2. Outline different personal and work circumstances where a particular time method might be used. Why so?

3. Which method do you prefer and use? Why so?

4. What about your classmates? Who is wearing an analogue watch? Do you know anyone who communicates using 24-hour time?

4.03 Time

Time for play

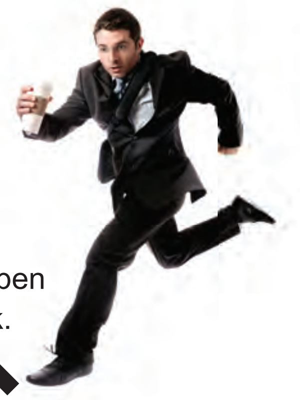
We live our lives according to time, whether we realise it or not. As living beings, the **passage of time** is a constant reminder in our lives. We sleep, clean, eat, love, care, learn, socialise, exercise, relax, travel, visit, watch, listen and play. And of course - there's the time we spend on our digital lives.

If it wasn't for time we could do anything. But time forces us to make **decisions**, and **prioritise** the tasks in our lives. Some things are more important. These **responsibilities** must be met - regardless. As a result, we might have to put off, or give up, something else.

So what are your priorities when it comes to time?

Time for work

Image: focuspocusltd/ Depositphotos.com



The world of work is governed by time. Most **employees** in Australia, about 75-80%, work for **profit-making businesses**. It's a cliché, but **time is money**. That's how most people get **paid**, according to an hourly **wage**.

Even people who work for **not-for-profits** such as government departments, government agencies, and many schools, hospitals and community services, are also governed by the constraints of time.

There's rosters, schedules, timetables, appointments, production times, delivery times, travel times, ETAs, start times, end times, break times, open hours, after-hours and many other measures of time in the world of work.

Two key terms are **productivity** and **efficiency**. And the main determinant of being a productive and efficient worker is how well you perform your work duties - in relation to time!

Are you good at managing your time, or are you more of a 'last minute' person?

Time and the Numeracies

a. Personal Numeracy
- ❑ Estimating time commitments.
- ❑ Organising personal time.
- ❑ Estimating & planning travel times.
- ❑ Using different timetables.
- ❑ Using diaries and calendars.

b. Civic Numeracy
- ❑ Collecting time-based information.
- ❑ Comparing data and statistics.
- ❑ Allocating time to communities.

c. Financial Numeracy
- ❑ Calculating wages and pay.
- ❑ Filling out timesheets.
- ❑ Planning budgets.
- ❑ Developing savings plans.

d. Health Numeracy
- ❑ Measuring biological health.
- ❑ Maintaining work/life balance
- ❑ Organising healthy routines.

e. Vocational Numeracy
- ❑ Understanding rosters.
- ❑ Meeting work commitments.
- ❑ Organising daily routines.
- ❑ Understanding pay and wages.
- ❑ Completing timesheets.

f. Recreational Numeracy
- ❑ Maintaining work/life balance.
- ❑ Sport and recreation measures.
- ❑ Developing an exercise plan.
- ❑ Organising healthy routines.

You and time 4C

1. Which do you think is the best method to use for telling the time in personal, social and in work-related situations? Discuss as a class.

Personal situations	Social situations	Work-related situations

2. Describe examples of when you expect others to be on time, or situations when you need things to be running on time and to schedule.

Situations	Personal	Social	Work-related
When I expect others to be on time.			
When I need things to be running on time and to schedule.			

3. Describe examples of when others expect you to be on time, or situations when others rely on you to ensure that things are running on time or on schedule.

Situations	Personal	Social	Work-related
When others expect me to be on time.			
When others need things to be running on time and to schedule.			

Applied:

What time management strategies do you currently use? What strategies and tools could you apply to improve the management of your own time?

4.05 Time

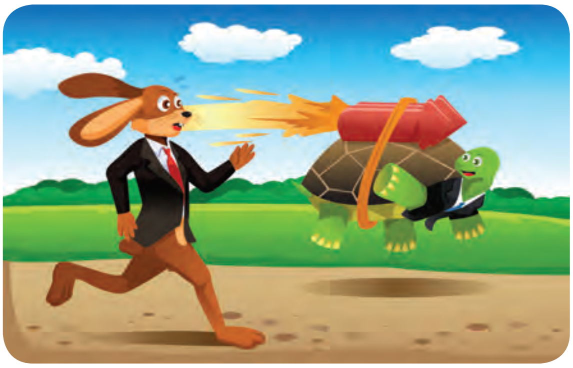


Image: artisticco/ Depositphotos.com

Time travel

Time is one of the most important measures related to travel. We have to estimate travel times and plan our schedules to take account of these times.

We rely on the **timetables** and **schedules** of transport providers so that we can get on with our personal, social, school and work life.

We ‘use’ up time to travel to and from school and work. We ‘spend’ time waiting for a train to arrive. We ‘lose’ time if traffic is heavy. And we ‘waste’ time waiting for others - you know that friend who is always late!

It is also important that we understand different time zones, especially for international travel and for doing business globally. This involves an understanding of **time zones** (based on longitude) and **Greenwich Mean Time** (**GMT**).

Airline tickets are always issued in the destination’s local time and date which means that sometimes you can travel ‘back’ in time; i.e. you arrive at your destination before you even leave! Well sort of anyway. See if you can come up with an example of this.

Converting time

i. Hours to minutes

To convert from hours to minutes we simply **multiply** the number of hours by 60. For example:

- 3 hours = 3 x 60 minutes = 180 minutes.
- 20 hours = 20 x 600 minutes = 1,200 minutes
- 2 and a half hours = ? (So let’s do the calculation)

  = 2 x 60 minutes plus another half of an hour

  = 120 minutes + 30 minutes

  = 150 minutes

ii. Minutes to hours

To convert from minutes to hours we perform a **division** calculation.

We divide the total minutes by 60 (which equals 1 full hour).

- 240 minutes = 240 / 60 = 4 hours
- 540 minutes = 540 / 60 = 9 hours
- 900 minutes = 900 / 60 = 15 hours

ii. Minutes to hours (cont.)

With many time conversions we are likely to get a **remainder**, because few tasks take ‘exact’ hours to complete. For example:

- 150 minutes = 150 / 60

  = 2 hours 30 minutes (or 2 1/2 hrs).

iii. Adding time

To add time we add the hours first and then we add the minutes. e.g.

- 1 hr 30 mins + 1 hr 15 mins = 2 hrs 45 mins

If the total minutes part of the answer is greater than 60 then that is a whole other hour. So we have to take 60 away from this ‘minutes’ total and add it back as 1 hour to the ‘hours’ part of the calculation.

- 1 hr 30 mins + 1 hr 45 mins

  = 2 hrs and 75 mins

  = 2 hrs and (75 - 60 mins)

  = (2 + 1 hrs) and 15 mins

  = 3 hours and 15 minutes

NUM SUPER SKILLS

1. Convert the time for the following situations.

1 hour 50 in minutes	4 hours in minutes	7 hour 15 minutes in minutes	210 minutes in hours
4.5 hours in minutes	20 hours in minutes	72 hours in days	15 minutes in hours
7 minutes in seconds	2.5 minutes in seconds	10 mins & 45 seconds in seconds	1,019 seconds in minutes

2. Estimate and/or find out the travel time for the following situations.

Your home to the CBD by car on a weekday for work.	Your home to the CBD by car on a Sunday night.	Your home to a preferred workplace by public transport.	Your school to the nearest train station (or bus for regional) by walking.
Melbourne to Perth direct flight.	Sydney to L[illegible] direct flight.	Hobart to London flight with stopover.	Melbourne to Tokyo fastest flight.

1 4 PS 2 3

3. Choose 6 activities that you regularly do in your personal life. For each activity:
   a. Estimate the time that the activity takes to complete.
   b. Calculate this time in days, hours, in minutes and in seconds. For shorter activities, you might need to use fractions and decimals, e.g. 1/16th of a day.
   c. Identify any rates that apply to this activity, e.g. travel speeds.
   d. Discuss whether anything associated with doing the activity 'wastes' time. e.g. Waiting for a friend to turn up who is always late.
   e. Describe methods that you use (or could use) to improve the efficiency of this activity. Consider tasks that you could do concurrently, or perhaps how changing the order of doing tasks would make better use of your time.

4.07 Time

Elapsed time (duration)

Elapsed time, which is also called duration, indicates how much time has passed between one time and another.

For example, the elapsed time in 1 hour = 1 hour (or 60 minutes!). That's pretty straightforward! So therefore the elapsed time between 3pm and 4:00pm is 1 hour. Or the elapsed time between 6:45am and 7:45am is 60 minutes. There you go!

Elapsed time or **duration** is used to calculate how 'long' something takes. This is vital for personal situations, such as cooking, for transport and travel times, for work times and rosters, for task times or even for leisure times.

Sporting activities rely on elapsed time such as football, soccer, netball and rugby. The game time dictates how long the play goes for. Other sporting activities use duration (or how long) to record achievement, such as the 100m sprint, the 1,500m freestyle, the marathon and the 200km cycling road time trial. Fastest wins!

We especially need to pay attention to elapsed time when cooking, when doing work tasks, in medical situations, when travelling, and in many other personal and work activities. Duration might be a key safety issue in certain tasks.

One method to work out duration or elapsed time is by using a **visual timeline.** However, you should be able to work out elapsed time in your head; or on paper, or by using a calculator for more complex situations.

Image: wick…wo… Deposi… .com

4E How long?

Calculate how much elapsed time is represented by the clocks.

Image: BravissimoS/ Depositphotos.com

07:15 – 15:15	19:30 – 06:15	15:15 – 02:30
09.30 – 08:30	11:30 – 18:20	05:30 – 05:15

Elapsed time (duration)

To count total **duration** in hours and minutes we need to see how much time has passed (or elapsed) between one period of time and another.

Some calculations are easy. e.g.

3pm to 4pm = 1 hour (or 60 minutes).

7:45pm to 8:30pm = 45 mins (15 mins to the end of the hour, plus another 30 mins).

11:30pm to 2:30am = 3 hours (or 180 mins).

But some calculations are a bit harder. To calculate elapsed time we use 3 steps.

i. e.g. 5:15am to 7:50am **(later time minutes > than earlier time minutes)**

1. First you subtract the hours (later minus earlier).
   = 7 - 5 (hours) = 2 hours
2. Then subtract the minutes (later minus earlier)
   = 50 - 15 (mins) = 35 minutes
3. In this case (because the later minutes are higher (>) than the earlier minutes) you combine the answers as an addition.
   = 2 hours plus 35 minutes

Note: If the earlier time starts as a '12' e.g. 12:30am treat the 12 as a '0'.

ii. e.g. 7:45pm to 8:30pm **(later time minutes < than earlier time minutes)**

1. First you subtract the hours (later minus earlier).
   = 8 - 7 (hours) = 1 hour
2. Then subtract the minutes (later minus earlier).
   = 30 - 45 (mins) = -15 mins
3. In this case (because the later minutes are smaller (<) than the earlier minutes) you combine the answers as a subtraction.
   = 1 hour minus 15 minutes
   = 45 minutes

Note: If the earlier time starts as a '12' e.g. 12:30am treat the 12 as a '0'.

iii. e.g. 8:30am to 4:30pm **(later time crosses over am or pm)**

For times that cross over into am or pm you do 3 steps.

1. Subtract earlier time from the next 12.
   = 12:00am - 8:30am
   = (12 - 8) hours   00 - 30 (minutes)
   = 4 hours   - 30 minutes
   = 3 hours 30 mins
2. Add the time that has elapsed after the 12 (am or pm).
   (This means that you are treating the 12 as '0'.)
   = 4 hours 30 minutes
3. Add these 2 times together.
   = 3 hours 30 mins plus 4 hours 30 mins
   = 7 hours 60 mins
   = 8 hours

Note: If the earlier time starts as a '12' e.g. 12:30am treat the 12 as a '0'.

NUM SUPER SKILLS

4.09 Time Zones

Time zones

Image: Jktu_21 / Depositphotos.com

1. What is Greenwich Mean Time?

2. Use the map to identify the time zones for key cities in the world. Add 4 more.

Sydney & Melbourne (GMT + or -)	London (GMT + or -)	New York (GMT + or -)	Tokyo (GMT + or -)
Beijing (GMT + or -)	Los Angeles (GMT + or -)	Berlin (GMT + or -)	Mumbai (GMT + or -)

3. Calculate the equivalent local time for each of these times. (Assume no local daylight savings). Add 4 more of your own. How many hours difference is there, and is this **forward** or **back**?

Melbourne: 11:00 London?	London: 15:30 Melbourne?	New York: 19:30 Melbourne?	Melbourne? 07:30 Tokyo?
Beijing: 23:15 Perth	Los Angeles: 17:15 Sydney	Berlin: 05:30 Adelaide	Mumbai: 12:00 Brisbane

4. So you fly out to Venice at 17:30 AEST. When are you likely to arrive local time? You have to call home. Will you be waking someone up? Calculate and explain.
5. You leave Venice at 06:15 local time for LA. When do you arrive?
6. You fly back to Oz from LA 21:30 local time. When do you land at the airport, and when do you get home?

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4 PS 2
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4.11 Getting Around

Which way do I go?

Ever been lost? Of course you have. Well a good map would've come in handy.

The growing use of apps, satellite navigation systems and GPS demonstrate that people have trouble reading maps. They would rather be told where to go by a smooth, but insistent voice. Our use of contemporary digital maps is one of the most common ways that we use **systematics**. So how reliant are you on your digital guide?

"Take High Street for another kilometre Marcel. Turn right at 200 metres Marcel. You missed your turn Marcel. Where are you going Marcel? You're not going to Hungry Jacks again are you Marcel? You know that you are trying to lose weight Marcel. Why have you taken your hand off the steering wheel Marcel? Why did you throw me out the window Marcel?" "I am now lying on Ballarat Road. Do a U-turn and..."

Distance

As you already know, distance is a '**how far**' sort of measure.

"How far is it to the Melbourne CBD?"

For some of you, not very far, especially if you live locally in one of the city's nearby inner suburbs!

What about people in Melbourne's expanding outer west? And those living east, west, south, outer east, or north, or north west or south east? What about those in Bendigo, Wangaratta, Benalla, Yarram or Bairnsdale? How about those in Mallacoota, Mildura, Wodonga or Swan Hill? And let's not forget about those of you in another state.

So what do you reckon? How far - from where you are sitting right now - to the city? How will you know?

Travelling: How long?

- Distance of journey from origin to destination.
- Day of week e.g. work day vs weekend.
- Time of day e.g. peak hour vs off peak.
- Mode of transport e.g. public vs private transport.
- Familiarity with journey.
- Weather conditions.

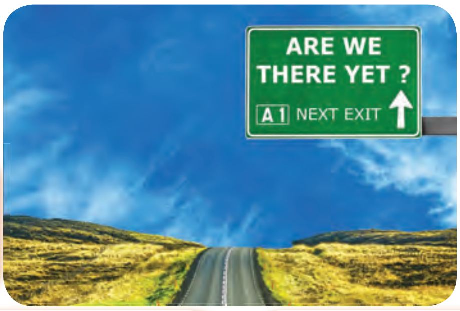

Image: Alexis84/ Depositphotos.com

Time

When we are travelling, knowing the distance of our total journey from our **origin** to our **destination** is only one part of the equation. The more important number that we need to work out, is the **time** it might take to travel that distance.

Sometimes we don't even need to worry about the distance. If you are catching a train to the city for a job interview you don't really worry about how far you have to travel. What you are likely to be more concerned with is how long it takes you to complete the journey.

If you are travelling by public transport you will check **timetables** (using **systematics**).

If you are travelling by car you will rely on someone else's expertise to advise you. They are likely to be able to estimate travel time based on their own **knowledge** and **experience** of travelling at this time of the day.

However, if you are getting there under your own power, such as by cycling, then you <u>will</u> need to know the distance. You will factor in how **fast** you usually cycle - let's say an average of 20km per hour. Then there's the **distance** - let's say 20km. So that's 20km/20kmh which actually equals 1 hour! (You did this in **Relationships**).

You will need to add more time for traffic conditions, traffic lights, getting lost in the city, parking and locking your bike, freshening up, changing clothes, finding the building, getting to the right place in the building and so on.

So what time is the appointment? Better give it another [illegible] minutes at least to do those other things. Also better hope it doesn't rain; and you don't want a puncture. That's lots of things to consider. Especially if you are giving directions to someone else!

Getting around 4G

1. Estimate the distance to each of these destinations. How much time do you think it will take to travel to these destinations using these transport methods?

Journey	Estimated distance	Journey time: by car	Journey time: by public transport	Journey time: by your choice
a. Your school to your home.				
b. Your home to the nearest train station.				
c. Your home to the CBD.				
d. Your home to the airport.				
e. Your home to your workplace.				

2. Research these distances and times using maps, GPS or other resources. Set up another table in your workbooks. How well did you estimate?

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4.13 Timetables, Schedules & Rosters

Timetables, schedules and rosters

Three important time management tools for personal, educational and work situations are **timetables**, **schedules** and **rosters**.

A **timetable** is a plan or schedule that sets out various times and durations for a particular activity. The most common timetables that you use include:

- your school subject timetable
- your VET timetable
- public transport timetables
- work timetables (rosters)
- services appointment timetables such as for a doctor or dentist, hairdresser or barber, and many others
- government services timetables such as 'Centrelink';
- and any other activity that uses set times and time durations.

Image: anze.bizjan/ Depositphotos.com

Airline timetables are non-negotiable. The plane won't wait for you!

One person's timetable is designed to fit in with all the other timetables that are part of the same activity, network or system. This means that timetables must be designed to meet very rigid time schedules.

e.g. Your school timetabler has to balance the needs of students, teachers, classrooms, facilities (such as prac or computer rooms) and many other variables to construct a suitable timetable. Of course, you have to follow that timetable.

And then on your VET or work days you may have to deal with your TAFE timetable, your employer's work roster, transport timetables, your personal or family commitments (such as looking after younger siblings or doing domestic chores) and perhaps even your own personal casual work roster. So it can get quite complex!

4H My timetable

1 4 PS 2 3

So how 'good' is your school timetable?

1. In your workbooks (or using software) reconstruct your timetable based on your preferred times and days for classes.

   You must keep the same classes you are doing now, and the same lesson or period duration - but other than that - redraft your timetable to suit you.

Times	Monday	Tuesday	Wednesday	Thursday	Friday
e.g. Period 1 8:30-9:20am	Numeracy	PDS	Literacy	Work Related Skills	VET

2. See if you can find another classmate who created the same timetable as yours, or one that is close. How many matches did you get? Were there any classmates with totally different timetables from you? Why so? As a class discuss how hard it would be to please everyone; and why compromises need to be made.

Timetables in action 4I

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One of the key types of timetables you might use regularly is public transport timetables. Some people have access to well-developed public transport systems. But those of you in the outer metro, regional or rural areas might find public transport to be quite scarce.

Go online to research information to complete the following tasks. Are there any apps that can help you? Find information for 1 more trip of your own choosing.

a. What time do you need to leave home to get to school? What public transport options are available and what are the associated times and travel durations?	b. What time would you need to catch a train (or bus) to get to the CBD by 9am? What time would you need to leave home?
c. You need to get to Geelong for a friend's birthday on Sunday at 12:[illegible]0pm. Is this trip possible or practical for you by public transport? If so, what will be your travel times and the duration?	
d. You are leaving for a holiday at the Gold Coast tomorrow. The plane takes off at 09:30am. What time do you need to get to the airport? If you used public transport to get to the airport what mode(s) would you use, what time(s) would they leave and how long would the trip(s) take? When would you need to leave home?	
e.	

4.15 Timetables, Schedules & Rosters

Schedules & Rosters

A **schedule** is the general term used to describe planning, organising and doing all the tasks and meeting all the responsibilities and time commitments, of an individual, a team, or some other entity. e.g. "You free for a coffee today?" "Let me check my schedule, and I'll get back to you."

Some people organise their **schedules** using **diaries**, **e-calendars** and **to-do** lists. What 'tools' do you use to plan and organise your daily or weekly schedule?

Rosters

A roster is a planning and organising tool that sets out the labour (worker) needs of an organisation.

Rosters are used to make sure the appropriate amount of staff is available to complete the work roles and responsibilities needed for effective operating.

Rosters set out and communicate employees' scheduled work hours. This includes workers with specific skills to do particular job roles, as well as supervisory and management staff.

- ⇨ Rosters need to be planned well in advance.
- ⇨ Rosters are often drawn up using 24-hour time.
- ⇨ Rosters need to be communicated to all employees involved.
- ⇨ Rosters should ensure that an appropriate balance of skills, training and authority is covered by the workers.
- ⇨ Rosters must be fair, and must not be used to favour or punish particular workers.

Gran[illegible] Newsagency: Weekly Roster

Monday May 1[illegible] - Sunday May 25, 2024

Times	8-10am	10am-12pm	12-2pm	2-4pm	4-6pm	6-8pm
Monday 20/5	Edwina F.	Edwina F.	Edwina F.	Edwina F.		
	Reg. G.	Reg G.				
Tuesday 21/5		Edwina F.	Edwina F.	Edwina F.	Edwina F.	
	Reg. G.	Reg G.				
Wednesday 22/5		Adut N.	Adut N.	Adut N.	Adut N.	
	Edwina F.	Edwina F.	Edwina F.	Edwina F.		
Thursday 23/5			Edwina F.	Edwina F.	Edwina F.	
	Reg. G.	Reg G.				
Friday 24/5		Adut N.	Adut N.	Adut N.	Adut N.	Adut N.
	Edwina F.	Edwina F.	Edwina F.	Jo P.	Jo P.	
Saturday 25/5	Jo P.	Jo P.	Jo P.	Aloysius Z.	Aloysius Z.	Aloysius Z.
	Reg. G.	Reg G.	Frankie F.	Frankie F.	Frankie F.	
Sunday 19/5	Jo P.	Jo P.	Jo P.			
		Edwina F.	Edwina F.	Edwina F.	Edwina F.	

Rosters in action 4J

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Jack Fromage works at Hungry Macs serving customers on the register, and sometimes helping out on one of the kitchen stations. The boss has just texted Jack with the roster for next week.

Jack always thinks it's better to show information visually and he is also going to enter the roster in his e-calendar. He'll also print this out and put it on his fridge as a reminder.

1. Use the information below to show Jack's roster for the upcoming week. How many hours will Jack work for the week?

   Monday: 7am to 5pm, Tuesday: 11am to 7pm, Wednesday: On standby, Thursday: Day off, Friday: 12pm to 9pm, Saturday: 10am to 2pm then 6pm to 10pm, Sunday: 12pm to 4pm.

Name:					**Dates:**	**to**	
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
7:00							
8:00							
9:00							
10:00							
11:00							
12:00							
13:00							
14:00							
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							
22:00							

2. Use the roster on p.102 for Gramble Newsagency to tally the weekly hours for each worker. How many hours do staff work in total? When is the newsagency less busy? How do you know? Which shifts would you prefer? Why so?

4.17 Timesheets

Timesheet

A timesheet is a numerical tool that shows work times and how many hours a worker has worked for a week. Timesheets are used to work out your pay.

Some timesheets are **digital** and some are **hard copy**. Timesheets often use a **24-hour clock**. Many **casual** workers, which is a lot of young people, have to complete timesheets at work.

You may also have to complete a timesheet for any **work experience** or **work placements** that you undertake - including as part of a **diary/journal** record for school or **VET**.

It's your responsibility to make sure your timesheet is correct and complete.

Image: monkeybusiness/Depositphotos.com

Timesheets are used to record:

- **days and dates of work**
- **work start and end times**
- **break times**
- **daily hours worked**
- **rates of pay**
- **weekly hours worked**
- as well as other information relevant to the particular work setting and employee.

Completing a weekly timesheet is often your **responsibility** as a worker. So it is vital that you can fill out your own timesheet correctly.

If your supervisor or **manager** does your timesheet, you need to **check** that it is correct. Otherwise, you might not get **paid** the correct amount for the week.

So that's why it is so important to be able to count and calculate **elapsed time** or **duration**.

Crazy Cracka's Discount World: Weekly Timesheet							
Name: Robbi Grenoble				**Work period:** April 19 - April 25, 2024			
Employee number: 3875698		**Classification:** Retail Worker Level 2					**Age:** 17
	Date	**Start**	**Finish**	**Break**	**Hours Worked**	**Rate**	**Total**
Sunday	19/4	10:00	17:30	na	7.5	$24	$180
Monday	20/4	10:00	19:00	12:30-13:30	8	$12	$96
Tuesday	21/4	____	____	____	____	____	____
Wednesday	22/4	10:00	19:00	13:30-14:00	8.5	$12	$102
Thursday	23/4	10:30	20:00	13:00-14:00	8.5	$12	$102
Friday	24/4	12:00	19:30	16:00-17:00	6.5	$12	$78
Saturday	25/4	12:30	19:00	15:30-16:00	6	$18	$108
Totals					45		$666

Timesheets in action 4K

1. Why is it important to be able to check, or fill out, your own timesheet?

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2. Complete this sample timesheet with the correct calculations for an adult retail employee working a standard, 38-hour week, Monday to Friday.
   - ⇨ Sign-on is 8:15 am.
   - ⇨ Unpaid lunch break is from 1:00 to 1:45.
   - ⇨ The employee is paid $24.73 per hour (as per the General Retail Industry Award 2020, as at Dec. 2023).

	Date	Start	Finish	Break	Hours Worked	Rate	Total
Monday							
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday							
Totals							

3. What other information do you think is missing from this timesheet?

4. Find an example of a timesheet for an occupation or industry you are interested in. Use it to complete questions 2&3.

4.19 Future Travel

Next year and beyond

This time next year, your life is likely to have altered dramatically. Some of you will have made the **transition** to **full-time** work, perhaps as an Australian Apprentice or in some other type of **employment**. Others of you might be working one or two (or even more) **casual** and **part-time** jobs.

Image: andresrimaging/ iStock/Thinkstock

Some of you will be studying at **TAFE** or some other training institute and will be most likely be combining your studies with casual or part-time work. You might also be undertaking **work placements** as part of your studies. Others will be actively seeking work and participating in **volunteer** and/or community work. And a few of you might even be running your own **micro** start-up **enterprise**.

Then there's all the activities that come with being an adult that might include more socialising, more family responsibilities and generally more travel.

Whichever your situation, one thing is for sure; you are going to be clocking up the kms as you travel from one location to another. And that means lots of travel time; and of course lots of travel dollars!

4L In my future

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4 PS 2
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Take a moment to look into your future and see what your most preferred, or most likely personal, vocational (work-related) and study situation might look like.

Do some planning, estimation and research (i.e. apply the problem-solving cycle) and answer these questions.

What am I most likely to be doing this time next year? Why that?	Where are these personal, vocational and study commitments most likely to be located?
What modes of transport will I most likely be using for my personal, vocational and study commitments?	What distances might I be covering for my personal, vocational and study obligations?
What costs might be associated with travelling for my personal, vocational and study obligations?	From where am I going to source money or income to pay for this? Can I foresee any problems?

My transport costs 4M

1 4 PS 2 3

1. List all of the potential costs that you will experience as part of your personal (P), vocational (V) and study (S) commitments. Label these with the letters in brackets. You might incur some of these daily (e.g. daily train fares, tolls or parking), weekly (weekly pass or petrol), monthly, or even annually (student concession, car rego, etc..) Some might even be unexpected, e.g. fines, repairs.
2. Calculate a weekly average and a total weekly average below.
3. How's your travel 'budget' looking? From where might you source this money? What can you do about this?

Travel costs	Daily	Weekly	Monthly	Yearly	Total per week
Totals					

4.21 Assessment Task

AT4 Your Times are a'Changing
Personal Numeracy and/or Vocational Numeracy

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For this assessment task, you are required to project one year into the future and compare your use of time next year, to how you are using your time now. You will need to clearly establish your personal and/or vocational situation next year including full-time, part-time and/or casual work status, your study status and your changed travel requirements.

In your investigation, you should calculate potential differences in time commitments and responsibilities between next year and this year. You will then need to describe the changes you might need to make so that you meet these different time commitments.

Part A: Estimate my personal time

1. Identify the different main activities you do weekly **now**.
2. Estimate the proportion of time you spend on each activity in a normal week **now**.
3. List and rank these, showing your estimated hours and percentages. You could use a bar graph or pie chart.
4. Estimate what these proportions might be like for you this time **next year**.

Part A: Estimate my work time

1. Identify the different main work tasks you do in a day of work **now**.
2. Estimate the proportion of time you spend on each different work task in a normal work week **now**.
3. List and rank these work tasks, showing your estimated hours and percentages. You could use a bar graph or pie chart.
4. Estimate what these proportions of work tasks might be like for you this time **next year**.

Part B: My actual personal time

1. Calculate the actual proportion of time you spend on each activity in a normal week **now**.
2. List and rank these, showing your actual hours and percentages. Use a bar graph or pie chart.
3. Compare your calculations to your projections for **one year into the future**.

Part B: My actual work time

1. Calculate the actual proportion of time you spend on specific work tasks in a normal week **now**.
2. List and rank these, showing your actual hours and percentages. You could use a bar graph or pie chart.
3. Compare your calculations to your work projections for **one year into the future**.

Part C: Improving my time use

1. Explain how 'wisely' you are using your time **now**. Why so?
2. What changes could you make to use your time better? Why so?
3. What changes will you need to make to meet your time commitments **next year**?
4. Describe tools & apps that could help you better use your time.

Part C: Improving my work time use

1. Explain how 'efficiently' you are using your time for work **now**. How so?
2. What changes could you make to better use your work time? Why so?
3. What changes will you need to make to meet your time commitments **next year**?
4. Describe tools & apps that could help you better use your work time.

Name:	AOS3: Quantity & Measures Personal and/or Vocational Numeracy
Key dates:	

	Tasks - AT4: Your Times are a'Changing	Must do?	Due by	Done	Level
	Part A: Estimate my personal and/or my work time now and next year.				
PERSONAL	Identify the main personal activities I do every week now.	○		○	
PERSONAL	Estimate proportion of time spent on personal activities now.	○		○	
PERSONAL	Calculate, rank and show these personal estimates.	○		○	
PERSONAL	Predict how my personal activities & times might change.	○		○	
WORK	Identify the main tasks I do for a day of work now.	○		○	
WORK	Estimate time spent on work tasks for a week now.	○		○	
WORK	Calculate, rank and show these work task estimates.	○		○	
WORK	Predict how my work tasks and times might change.	○		○	
	Part B: Calculate my personal and/or my work time now and next year.				
PERSONAL	Calculate my actual proportion of time on each activity now.	○		○	
PERSONAL	Rank and show my actual times for personal activities now.	○		○	
PERSONAL	Compare my calculations to my projections for next year.	○		○	
WORK	Calculate my actual time spent on work tasks for a week now.	○		○	
WORK	Rank and show these actual work task amounts.	○		○	
WORK	Compare my calculations to my projections for next year.	○		○	
	Part C: Improving my personal and/or my work time now and next year.				
PERSONAL	Explain how 'wisely' I am using my personal time now.	○		○	
PERSONAL	Describe improvements and actions I could take now.	○		○	
PERSONAL	Describe changes in time use I will need to make for next year.	○		○	
PERSONAL	Describe tools and apps I could use to help me.	○		○	
WORK	Explain how 'efficiently' I am using my work time now.	○		○	
WORK	Describe improvements and actions I could take.	○		○	
WORK	Describe changes in time use I will need to make for next year.	○		○	
WORK	Describe tools and apps I could use to help me.	○		○	
	Task completion				
1 4 PS 2 3	**Describe applied use of the problem-solving cycle.**	✓		○	

Identify the maths	Act on & use maths	Evaluate & reflect	Communicate & report

	Task	Must do?	Due by	Done	Level
	Develop and apply mathematical tools and techniques.	✓		○	
⇨	**Prepare and submit your final report and calculations.**	✓		○	
	Present a report to the class (if required).	○		○	

4.23 // Problem-Solving Cycle // Maths Toolkit

1
4 PS 2
3

Task:

Names/Dates:

AT4 -

1. Identify the maths		
Identify problem(s) Done: Level:	Recognise maths Done: Level:	Select information Done: Level:
Interpret information Done: Level:	Choose processes Done: Level:	Done: Level:

2. Act on and use maths		
Perform estimations Done: Level:	Decide techniques Done: Level:	Choose maths tools Done: Level:
Select technologies Done: Level:	Perform calculations Done: Level:	Done: Level:

3. Evaluate and reflect		
Check Estimations Done: Level:	Compare results Done: Level:	Check processes Done: Level:
Review actions Done: Level:	Check calculations Done: Level:	Assess conclusions Done: Level:

4. Communicate and report		
Written processes Done: Level:	Written results Done: Level:	Oral processes Done: Level:
Oral results Done: Level:	Digital processes Done: Level:	Digital results Done: Level:

Mathematical Toolkit

Analogue tools - What & how?		Digital Devices - What & how?		Software & Apps - What & how?	
Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy

Relationships 5

Activities 5: Relationships		p.	Due date	Done	Comment
5A	**Relationships**	113			
5B	**Applied relationships**	114-115			
5C	**Proportions**	117			
5D	**Ratios**	119			
5E	**Rates**	121			
5F	**Working the numbers**	123			
5G	**Common formulae**	125			
5H	**Relationship formulae**	127			
5I	**Applying formulae**	129			
5J	**Developing formulae**	131			
5K	**See for yourself**	133			
5L	**Visualisations**	135			
AT5a	**The Beat Goes On**	136-137			
AT5b	**The Right Proportions**	138-139			
PST	**Problem-Solving Cycle and Maths Toolkit**	140			

Comments:

5.01 Relationships

Relationships

Numbers very really travel alone. In most applied situations, numerical quantities are **linked** in some way, with one **numerical quantity** (or more), **influencing** another numerical quantity (or more). In most cases, the **combination** of these results in a new numerical quantity expressed as a **relationship**.

So in simple terms, a **relationship** is a numerical situation where **two** or more **quantities** or **measures** are connected or **linked** in some way. Therefore, if **change** occurs in one of these quantities or measures, then the **outcome** of the relationship will also change. And that's how you can best understand the applied use of numerical relationships.

Some of the most common relationships are:

- **proportions** (I want half a cake, you two can share the other half; the percentage of young people on TikTok has grown to over 60%)
- **ratios** (he doubled the sugar in the cake and it was too sweet; he played the old DVD at 16:9 when the screen should've been set to 4:3)
- **rates of change** (he sped off doing at least 60 km per hour, but it was a school zone; the DJ played the 12" EP at 33rpm, and it sounded like the singer was half asleep)
- **rates per unit** (he got paid $20 per hour normal time, but time and a half for weekends, that's $30 per hour; they used 2kg of mince for the spring rolls, which meant they were able to make 50, with each having about 40g of mince)
- **comparisons** (the Great Dane weighed 60kg, but the Chihuahua weight only 3 kg, so the big dog was 20 times heavier; she saved $1,000 this year and $2,000 the year before - she only saved half as much this year)
- **averages** (the full forward kicked 27 goals over 9 games, that's an average of 3 goals per game; the gardener was able to mow 35 lawns per week, which was an average of 5 per day).

Rates, proportions and ratios occur in many work-related tasks for just about all employees. Think about using materials, combining inputs and measuring levels of performance by using time as a measure (**productivity**). Just about all workers who do manual, practical, technical, design and other hands-on work naturally apply ratios and proportions.

Percentages are a vital estimation and calculation skill for workers. Percentages are used for money, discounts, pay rates, GST, allocating time and tasks, breaking larger items down into smaller components, doubling, halving and so on; and many other vocational situations.

And time and money relationships govern wage rates and cost inputs - from both the worker's, and the employer's, point of view.

Image: Jupiterimages

In our personal lives we use ratios and proportions for cooking, when budgeting, in sport and recreation activities and in many other day-to-day situations. So, it is important that you develop the ability to apply these skills in different numerical situations.

Can you cook? If so you will have an applied understanding of ratios and proportions.

Relationships

Proportions

Fractions

Rates

Measures

Size

Comparisons

Formulae

Graphs and charts can represent relationships in an easier to understand visual form.

Per

Percentages

Ratios

Variables

Quantities

Change

Contrasts

Variables

Image: vectordreamsmachine/ Depositphotos.com

Relationships 5A

Based on your current level of understanding and experiences, choose 8 of the terms above, and give an example where you would use each in an applied situation.

5B Applied relationships

1 4 PS 2 3

Your teacher will explain and work through some common examples of proportions, ratios and rates with the class.

1. Pair up and describe how proportions, ratios and rates relate to these varied situations. Add 4 more situations.
2. Describe the numerical tools, both analogue and digital, that you could use to measure and calculate these in applied situations.
3. How can an understanding of proportions, ratios and rates help you to deal with and solve problems in each applied situation?

cooking	serving meals	reading maps	exercising
travelling	bicycling	driving	shopping
drawing	taking medicine	designing	building

4. Now, how would you describe your skills in identifying, understanding and calculating proportions, ratios and rates in applied situations? Give examples.

5. Now pair up with someone who you wouldn't usually work with, or someone who has totally different vocational interests from you. Complete the table again. Have you got new or different responses this time?

cooking	serving meals	reading maps	exercising
travelling	bicycling	driving	shopping
drawing	using medicines	designing	building

6. Choose an occupation and describe examples where an understanding of ratios, and/or proportions, and/or rates is an important applied skill.

5.05 Proportions and Ratios

Proportions

A proportion refers to an amount of something, as compared to the total amount. Proportions are often measured in **percentages**, **decimals** or **fractions**.

Proportions show portions or percentages of a whole. Proportions can also indicate one or more quantities or **amounts** as **compared** to others.

We can often estimate or indicate proportions **visually** by comparing size, or by representing **relative proportions** using images or graphics.

Pie charts are good for showing proportions.

Image: DmitryRukhlenko/Depositphotos.com

For example: Proportions

Do you remember Rennie the cake guzzler? Well he's up to his old tricks again. From the family-size pizza he ate 7 out of 8 slices, which is 7/8 or 87.5% or 0.875. That Rennie sure likes to scoff large portions!

What proportion of students in the class have curly hair? Count them. Let's say it's 8 out of 20 students. That's 40%. The proportion of students in the class with curly hair is 40%. The proportion of students in the class who don't have curly hair is 60%.

The total weekly earnings of 20 students in your class might be $2,000. So that's an average of $100 each, which is 0.05 or 5% of the total. This average is a **mean** which only shows, as the word itself says, an average. But Janice worked 40 hours last week and earned $1,500. So Janice earned 75% of the $2,000.

Janice's earnings account for the majority proportion of total weekly earnings for the 20 students. The other students only earned $500 between them. That's a much smaller portion to share and each student worker's proportion might be quite low, or even zero!

The proportion of teenagers who might say that the government needs to phase out coal as an energy source could be 80%. That's 8 out of every 10 teenagers! The proportion of people aged 65+ who might say that the government needs to do more to tackle climate change might be 40%. That's 4 out of every 10 people aged 65+.

But wait a second, that's 12 out of 10 people! How can that be? Because these two proportions are derived from different samples. They are based on two different measures, teenagers and people aged 65+. You can't add them together. Do you remember something about not adding apples and oranges? And when you read closely, they are also responding to two different questions.

What proportion of people in Australia are vegan? Estimates say about 3-5%. That's only a small proportion. But what proportion of people aged under 30 might be vegan? Do you think this would be a larger or a smaller proportion?

95% of students in your class now think that proportions are quite straightforward to understand. Do you agree? Let's try to make it 100%. Can someone wake up Rennie, this time he is sleeping off his pizza!

Image: Issaurinko/Thinkstock.com

1. Express the proportions as a **decimal** and also as a **percentage**.

a. 6 out of ten	b. one in eight	c. 2 for every 5	d. 99 times out of 100

2. Express these decimals in words as a proportion.

a. 0.25	b. 0.75	c. 0.66	d. 0.01

3. Express these percentages in words as a proportion.

a. 50%	b. 12.5%	c. 85%	d. 6.25%

4. Estimate the proportions as percentages from the pie chart on p.116. Give examples of when these proportions might be close to a situation in your own life.

Yellow:	
Red:	
Blue:	
Green:	
Purple:	

Applied

The 3 macro-nutrients are carbohydrates, protein and fat. Our bodies need to source energy from each of these from the food and drinks we consume.

a. What is a healthy balance of these in our diet (and it's not 33% + 33% + 33%)?

b. How can you ensure that you are getting a healthy balance of these?

c. Are there any variations in these proportions based on age, sex or other factors?

1
4 PS 2
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5.07 Proportions and Ratios

Ratios

A ratio shows one quantity as expressed in relation to another. It is another way of showing proportions. Ratios are used for comparison and are expressed in this form 2:1, 1:2; or communicated as “two to one”, “one to two”.

1:2 means that for every 1, you need 2. So this ratio indicates **increasing** size or amount or quantity. So for every person at the BBQ, you need 2 sausages.

2:1 means that for every 2, you only need 1. So this ratio indicates **decreasing** size or amount or quantity. So for every 2 people you only need 1 vegie burger.

e.g. For the cake I am baking I have to use 0.5 kg of sugar for every kilogram of flour. So the weight ratio of sugar to flour is 1:2; and the weight ratio of flour to sugar is 2:1.

Ratios are often used in scale drawings and models. A map might indicate a scale of 1:10,000cm (**reduction** of 10,000). A model for an action figure might be expressed as 1:6 (reduction of 1/6th). A drawing of a very small component might need to be at 4:1 (**enlargement** by 4).

And of course, our devices use specific screen ratios to best display digital content.

Image: Vladru/Depositphotos.com

One of the most common ratios people deal with every day, without even thinking about it, is 4:5. Another ratio related to this is a pixel resolution ratio of 1080 by 1350 px. So when do you [illegible] those ratios?

Proportions and ratios

Proportions and ratios are important for measurements, and for dealing with physical quantities. They are also used to express statistics in simple sentences.

People doing practical, manual, design and technical tasks in their work situations and personal life, often work with and apply proportions and ratios. They estimate these using their own experience, expertise and understanding of practical numeracy. For example:

- chefs estimate, measure and apply ratios of ingredients; and ratios for cooking times based on weight, especially for meats
- farm workers estimate, measure and apply ratios of fluids, stockfeed and chemicals
- hairdressers apply ratios of chemicals for dyes and colouring - this is an important part of OH&S/WHS
- welders use ratios of air to gas, and ratios of metals for welds
- nutritionists, fitness advisers and sportspeople analyse and apply ratios of nutrients to improve diet for better performance
- coaches might calculate ratios to measure outcomes such as scoring from turnovers in AFL and AFLW
- all businesses had to apply density ratios during the COVID-19 pandemic, and to better seat patrons.

Image: katakling er/Depositphotos.com


As a class, you can come up with many more examples relevant to you.

1. Which ratio is bigger, and which is smaller?

a. 1:2 or 2:1	b. 3 to 4 or 4 to 3	c. 3/5 or 5/3	d. 2.5:1 or 1:2.5	e. 1:10 or 10:1

2. Ratios are often expressed as fractions. In fact, fractions are ratios. Express these ratios as a fraction. Then calculate the answer as a decimal and as a %.

a. 1:2	b. 1:3	c. 1:4	d. 2:1	e. 7:8
f. 3:7	g. 4:3	h. 16:9	i. 4:1	j. 1:100

3. Proportions and ratios are very important for applied practical tasks and govern the relationship between different variables and quantities.

1
4 PS 2
3

a i. What proportions and ratios of ingredients constitute this burger?

Image: Erdosain/Depositphotos.com

a ii. What would be your ideal burger ingredient proportions and ratios?

b. What proportions and ratios of ingredients would constitute an ideal cappuccino?

c. What proportions and ratios of ingredients would constitute an ideal mac and cheese?

d. What proportions and ratios of ingredients would constitute a high protein, low fat, vego meal?

5.09 Rates

Rates

A rate is a special type of ratio that allows us to combine two items or amounts expressed in different units. Rates show how much of one quantity is needed or consumed in relation to another. i.e. Something **per** something else. Got it?

The most common rates you experience use distance and time. Many rates are also used in financial situations. Do you recall these examples from last year?

- ⇨ 60 km per hour (60 km/hr). Got it now?
- ⇨ Petrol consumption. How about 7 litres per 100 km? Is that good or bad?
- ⇨ What about a shower? 10 litres of water per minute. Is that a lot?
- ⇨ Dinner cost? $20 per kg of beef. Is that expensive?
- ⇨ Wage of $20 per hour? Is that enough?
- ⇨ Heart rate of 53 beats per minute? Is that healthy?
- ⇨ Run at 10 metres per second? Is that fast?

Rate of change

When we combine different quantities and measurements (i.e. **variables**) we calculate a **rate of change**.

On a speedo, the rate of change is represented by how much distance is being covered in a set unit of time. That's two measures. The change measure is moving from point A to point B. The comparison measure is time - one hour. The rate is expressed in km/hr.

On the fuel gauge, the rate of change is represented by how much liquid (petrol) is being consumed over a set distance. Again that's two measures. The change measure is the quantity of petrol being burned. The comparison measure is distance. The rate is expressed in litres/100 km (we use 100km to make the number easier to interpret).

Rates

Rate of speed

Rate of cost | Rate of use
Rate of power | Heart rate
Economy rate | Breathing rate
Wage rate | Strike rate
Birth rate | Scoring rate
Taxation rate | Inflation rate
Interest rate | Exchange rate
Consumption rate | Unemployment rate

Image: mouse_md/Depositphotos.com

Rate of time

1. What are the 2 measures used in these rates? What might these rates represent?

a. km/hr	b. litres/km	c. litres/min	d. $/hour

2. What might move at these speeds?

a. 10 km/hr	b. 100 km/hr	c. 1000 km/hr	d. 1 km/hr

3. Which vehicle is more fuel efficient?

a. 5 l/100km or 10 l/100km	b. 7.3 l/100km or 7.3 l/100m	c. A car or a motorbike?

4. Calculate these rates. (Refer to p.122)

a. 60 km in one hour	b. 90 [illegible] hours	c. [illegible] in 30 mins
d. $250 in 5 hours	e. $[illegible] in 5 days	f. $78k for a year
g. 10 litres for 100 km (do the answer per 100km)	h. 18 litres for 200 km (do the answer per 100km)	i. 32 litres for 500 km (do the answer per 100km)

Applied

Investigate some efficiency rates such as the fuel efficiency of your family car, the water flow of the shower head, and how much electricity your family consumes per month.

Research ways to improve efficiency, save money and help the environment.

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4 PS 2
3

5.11 Rates

Example: Calculating rates 1

The speed limit on major roads might be expressed as 60 kilometres per hour.

The relationship describes how far a vehicle travels within a specified period of time.

The two numerical measures are distance (measured in kilometres) and time (measured in hours).

Together, the distance and time combine to give a rate.

The new outcome of this combination is a **rate of speed** i.e. 60km/hr.

⇨ $\text{speed} = \dfrac{\text{distance}}{\text{time}}$

⇨ $\text{speed} = \dfrac{60\text{km}}{1 \text{ hour}}$ (We divide the numbers. We also combine the units.)

⇨ speed = 60 km/hr

Example: Calculating rates 2

A chef needs to source some expensive truffles for a catered function. They have estimated that they will need 10 grams of truffle for each of the 20 meals. The wholesaler charges $500 per kg for the truffles. They need to price this delicacy into the menu and submit a quote to the client.

The two numerical measures are weight (measured in kg and grams) and price (measured in dollars). Together, the weight and the price combine to give a rate.

The new outcome of this combination is a **rate of cost** i.e. $/g or $/kg.

⇨ $\text{cost} = \dfrac{\text{price}}{\text{weight}}$

⇨ $\text{cost} = \dfrac{\$500}{1{,}000 \text{ grams}}$

⇨ cost = $0.50/gram

Therefore each meal cost, just for the truffles alone, and nothing else, is:

⇨ = $0.50 x 10 = $5

Example: Calculating rates 3

Fangio drives 30 km across town in 30 minutes. What was his average rate of speed?

$\text{Speed (s)} = \dfrac{\text{distance (d)}}{\text{time (t)}}$

$\text{Speed} = \dfrac{30 \text{ km}}{30 \text{ min}}$

Speed = 1 km per minute

Do we say, 1 km per minute? Sounds a bit odd, we don't normally express this relationship like that!

How about...

$\text{Speed} = \dfrac{\text{distance}}{\text{time (in hours)}}$

$\text{Speed} = \dfrac{30 \text{ km}}{0.5 \text{ hr}}$

Speed = 60 km per hour (approx.)

Now that sounds more like it!

But... 30 kms at 60km/hr, town driving?

Could Fangio achieve this rate - legally?

What do you think? Who was Fangio?

Working the numbers 5F

1 4 PS 2 3

Solve the following problems. Show your workings. Add 1 more situation related to your own personal or vocational life.

Numerical situation	This is an example of...	Workings
e.g. At my job I get paid an extra 50% for working on Saturdays.	- Calculating percentages - Calculating wage rates	I get paid $15 an hour normally. Saturday = $15 + 50% = $15 + $7.50 Saturday pay = $22.50 per hour.
a. Freddie is cooking fish cakes for a dinner party. Their recipe serves 4, but 6 people are coming. So they have to adjust their portions of 750 grams of salmon, 2 eggs, 50 ml milk, 100g Parmesan, 150g rice, 4 spring onions and 2 garlic cloves.	- Using ratios - Estimating amounts - Measuring amounts	
b. Brig is using a ute for his job. He drives about 150 km/week to and from work, and another 150 km while on the job. The ute has a tank of 60 litres and he has to fill it weekly. How many litres/100km, and how much to fill the tank at today's prices?	- Estimating and calculating fuel consumption rates - Estimating fuel costs	
c. The speed limit on most of the city roads near Jo is 40 or 50 kmh. But Jo says she only averages 30 kmh for city driving. Jo is doing a country trip on the highway. It will take her about 15 minutes of city driving, then 90 kms of highway driving. How many kms in total and total time?	- Using rates and/or ratios - Estimating speed and travel time	
d.		

5.13 Using Formulae

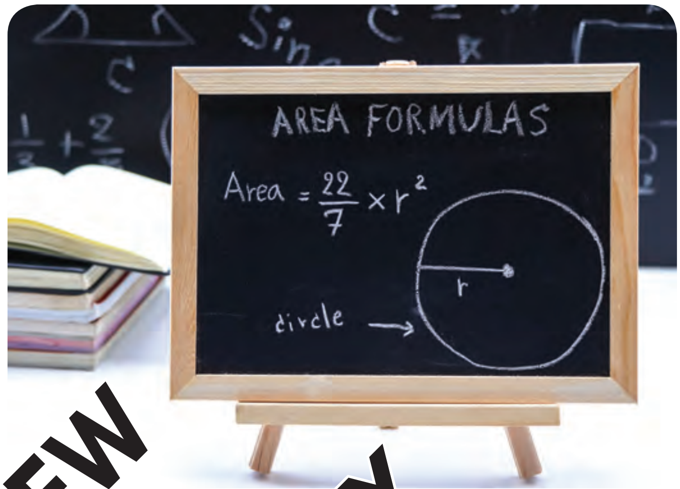
What does X =?

In reality, **formulae** are shortcuts that help you to deal with numerical information and **solve** applied numerical **problems**.

You would have been introduced to formulae before. Many of you doing **VET** courses in technical, practical, manual and other similar vocational fields need to have a working understanding of formulae for **industry-specific applications**.

Some people are afraid of formulae. But just about every numerical problem that you have solved in your past Numeracy studies is based on the use of formulae.

Image: M150photo/ Depositphotos.com



We naturally use formulaic principles when we **cook**, **budget**, **measure** objects, run our **vehicles**, **build** things, **analyse** sporting performances and many other tasks.

And your use of formulae is the **applied problem-solving cycle** in action. The Super Skills below will give you an insight into formulae and how you are going to apply these principles.

You know this one. What's the answer and what type of work might need to apply this formula?

Formulae for success

- Formula = one (singular) whereas formulae (or formulas) = more than one (plural).
- A formula expresses a mathematical problem or a relationship.
- A formula might use algebraic expressions (symbols such as X) in place of words or variables. Symbols can confuse and confound but really all they represent is a short way of writing the variables. e.g. 'amount of fuel needed to get to Geelong' could be just written as 'F'; for fuel (and not Freddie).
- In computing, such as when using a spreadsheet, formulae can do all the adding, subtracting, averaging and other more complex work for us.
- When following recipes for cooking, or mixing chemicals, or brewing beverages we naturally use a formula to apply ideal ratios of ingredients or constituents.

So let's have a go.

- Do you know how to calculate the **mean** or **simple average**? You simply add up all the total values (sum of values) and then divided this by the number (n) of values.

  So for a data set of \$3, \$7, \$11, \$12 & \$17 you would add the 5 data values, which equals \$50, and then divide by the number of data values (which is 5) to get an answer of \$10. (\$50/5 = \$10).

  mean = sum of values/n

- What about calculating the **median average** where the population number is an even number? You have to add the two central values and divide by 2. This would give you a number exactly halfway between the two of these. Well the formula for this is:

  median = (the middle value before + the middle value after) ÷ 2

- So for a data set of 10, you would add the values of data numbers 5 & 6, and then divide by 2, to yield your result.

NUM SUPER SKILLS

Common formulae 5G

1 4 PS 2 3

1. Find out the formulae to calculate each of the following. Some might surprise you.
2. Use the appropriate formula to undertake a calculation for each situation. You supply the variables based on realistic applied situations.

Situation	Formula	Apply the formula
Simple interest rate		
Compound interest rate		
GST to add to a price		
GST already in a price		
Male shoe size based on foot length		
Female shoe size based on foot length		
Fuel economy of a vehicle - city driving		
Fuel economy of a vehicle - country driving		
BMI - Normal person		
BMI - Muscular athlete		
Cat years in 'equivalent' human years		
Dog years in 'equivalent' human years		
Labour participation rate		
Unemployment rate		
Your choice		
Your choice		

5.15 Using Formulae

Establishing a relationship

Formulae are useful because they allow you to express relationships that show ideal ratios. Once developed, you can apply this formula over and over again! This is especially useful in cooking and catering, when quoting and costing practical jobs you do on a regular basis, when estimating and planning time to do tasks, and working out efficiency measures that can save you money around the house.

For example: Recipes

A recipe requires 4 eggs, 1kg of sugar for every 4 eggs, and 250 grams of butter for every 1 kilo of sugar. So we could express this as follows.

Recipe = 4 eggs + 1kg sugar + 250g butter (in plain English)

or R = 4E + 1S + 0.25B (in simple notation)

or A = 4X + 1Y + 0.25Z (in algebraic expressions).

Which of these notations do you better understand?

(Note: It is important that the person following the recipe knows that the whole numbers for sugar and butter represent 1 kilo!)

Image: /Thinkstock

So again, what was 'E'? What was 'S'? And what was 'B'?

Pretty straightforward really!

And just as a matter of interest what do you think about a recipe that uses 4 eggs, 1kg of sugar and a 1/4 a kilo of butter? What other ingredients might be needed?

Other rates

Rates are often expressed per time, such as 100km per hour; or per dollar, such as 0.5kg per $. These rates are often used to measure productivity and efficiency in work-related situations.

Image: kataklinger/ Depositphotos.com

There are also very important biological health rates, such as 70bpm for a heart rate, (what does the bpm stand for?) or 120/80 mmHg for blood pressure readings; but what do these readings actually mean?

Rates are also used in percentage calculations to show proportions of a whole, such as a discount rate (25% of the total), an interest rate (10% of the principal) and even the unemployment rate (5% of the labour force).

Percentage change (see p.23) indicates rates of growth or decline. e.g. Sales were $100K last year and $50K the year before, so sales have grown by 100% for this year. Profit was $20k this year but $25K last year, so profit has declined by 20%.

Is there a more productive way to increase the metreage of trenches dug per hour?

Calculating productivity

Productivity is a measure of the ratio of outputs, compared to the ratio of inputs. Common work-related output/input measures are per/worker, per/$ or per/hour.

e.g. Sal can make 20 burgers per hour at a takeaway.

⇨ Productivity = $\frac{20 \text{ (burgers)}}{1 \text{ hour}}$ = 20 units (burgers) per hour
(i.e. 1 burger every 3 minutes.)

e.g. Sal is paid $20 per hour.

⇨ Productivity = $\frac{20 \text{ (burgers)}}{\$20}$ = 1 unit (burger) per dollar.
(And 1 whole burger 'costs' $1 in Sal's labour.)
(i.e. Labour cost = $1 per burger.)

NUM SUPER SKILLS

Relationship formulae 5H

1
4 PS 2
3

1. Develop relationship formulae for the following situations.

a. 10 parts water to 1 part bleach.	
b. A Big Mac.	
c. 2 cups water for 1st cup of rice, 1.5 cups for each cup of rice thereafter.	
d. 12 screws, 3 brackets, 800mm timber for each shelf. Required 1.6m x 3 layers.	

2. Develop appropriate formulae for the following recipes.

a. 500 ml protein shake	b. 1 litre banana smoothie	c. Club sandwiches for 8 quests

3. Calculate the following rates.

a. Travelled 30km in half an hour.	b. Took 60 minutes to drive 45 kms.
c. Made 41 spring rolls in 1 hour.	d. Did 1,000 push-ups over 1 week.

5.17 Applying Formulae

Solving for X?

Formulae are also very useful problem-solving tools because they can assist you to find out a **missing value**, **variable** or **quantity**. Being able to solve for a missing quantity by **transposing** a formula based on known variables, can assist you to deal with, and solve, personal and work-related problems much more easily.

For example: Formula - How much

Harriut went shopping with $300 in her pocket. She has come home with $56.50. How much did she spend? Some of you will work this out straight away using simple subtraction, and say that she must have spent $243.50. Here's the formula.

- ⇨ X = Y - Z
- ⇨ $ total spent = $ in pocket at start of shopping - $ in pocket at end of shopping
- ⇨ X = $300 - $56.50
- ⇨ X = $243.50

That was very easy, so let's step this up a little.

Harriut has the receipt from the supermarket which reads $122.75 and a receipt from Blandbags which shows $69.95. She bought a $30 download card from Insanity Tunes. She also bought some lunch and coffees but she is not sure how much she spent on these. So let's try again.

- ⇨ S = X - (A + B + C)
- ⇨ $ spent on lunch & coffee = $ total spent - ($ total of supermarket receipt + $ total of Blandbags spend + $ total of Insanity download card)
- ⇨ S = $243.50 - ($122.75 + $69.95 + $30)
- ⇨ S = $243.50 - $222.70
- ⇨ S = $20.80

So Harriut spent $20.80 on food and drink out of $243.50. How much is this as a percentage? Is it too much? In this example notice how we kept X as the notation because we had worked that out earlier. We then used different letters for the other variables because they are new to the calculation. But we could have just used words or even single letters. Whatever works for you.

Harriut's friend Lombago also likes some retail therapy. But he's a bit obsessive and only buys things ending in even amounts. So Lombago bought 4 items at $10, 6 items at $20, 3 items at $30 and 2 items at $40. He has offered you this formula for his own total spend.

- ⇨ X = 4A + 6B + 3C + 2D
- ⇨ X = 4(10) + 6(20) + 3(30) + 2(40)
- ⇨ X = $40 + $120 + $90 + $80
- ⇨ X = $330

So Lombago's total spend, that is, his 'X', was $330.

Because Lombago likes patterns, next week he goes out and buys items of exactly the same dollar amount, but in different quantities.

He presents you this formula: X = 2A + 12B + 4C + 1D. Did he spend more or less than last week? And given that he has bought items of the same price (which means the variables are the same, even though the quantity has changed) are you permitted to add the formulae together to get his total fortnight spend?

Applying formulae 5I

1. Calculate using the following formulae. For each try and suggest what the variables might represent.

i. X = 24 + 47 + 123		
ii. X = 10 + 4 - 2 x 5		
iii. X = 76 - 4^2 x 10		
iv. X = 27 + 33 + 2Y whereby Y = 12		

2. Develop appropriate formulae for the following applied situations.

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Weekly shopping budget = $200. Groceries = $120, cleaners & toiletries = $25, fruit & veg = $55.
Compare barber shop charges of either a flat rate of $25, or $1.50 per minute. Average cut takes 15 minutes.
Describe proportional car running cost per year using at least 5 categories of variables.
Describe the ideal concrete mix for driveway paving. Work out the $ cost of the concrete bags needed to make 1m³.
Jock mows lawns. For a standard lawn he charges a flat rate of $20 plus either $25/hour for regulars or $15/hour for pensioners. Also provide Jock with Excel formulae for his spreadsheet.
If they laid all the hotdogs sold at the AFL Grand Final end-to-end, would that stretch to the moon? (Assume they sell 40,000.)

5.19 Applying Formulae

Shifting things around

Sometimes you might have to shift things around in an equation (based on a formula) in order to find out what you really want to know. This shifting about is called **transposition.**

For example: Formula - Shifting things around

Your friend Rhikkie is a nice guy but he has a funny way with language. But that's no problem, you're used to how he talks. You ask him how he went at cricket yesterday and he tells you that he scored:

⇨ $X - 15 = 43$

So how did he go? While you congratulate him, your other friend Blurtos hasn't got a clue! So we better set him straight.

When solving for 'X' or any other unknown, but that unknown isn't isolated on its own, we have to **transpose** the formula to get it on its own. The rules for transposition are simple. **Equations** have **two sides**. What we do to one side we have to do to the other. It's a very even-handed approach. So we want to get the 'X' on its own, that represents Rhikkie's score.

⇨ $X - 15 = 43$

⇨ $X - 15 + 15 = 43 + 15$ (we add 15 to both sides. That'll leave the X on its own on the LHS) which is what we want to do.

⇨ $X = 58$

Rhikkie made a half century, which is pretty good.

Now Blurtos thinks he has got the hang of this and asks Rhikkie how his score compares to last week. He probably should have chosen his words more carefully because Rhikkie responds with:

⇨ $X = 2Y + 18$

Once again Blurtos is stumped and turns to you for help! Well you know X (it's 58):

⇨ $58 = 2Y + 18$

You can do some transposition to get last week's score, 'Y', on its own:

⇨ $58 - 18 = 2Y + 18 - 18$ (this time we have to take 18 away from both sides to get the variables on their own)

⇨ $40 = 2Y$ (but we are not there yet as we are actually solving for 'Y' this time, which is last week's score)

⇨ $\frac{40}{2} = \frac{Y}{2}$ (we have to divide both sides by 2 to isolate Y on its own)

⇨ $20 = Y$

So last week he made 20. Would have been easy if he just said that, but in life problems don't solve themselves, that's why you have to do the thinking most of the time!

Blurtos thinks this is all a bit too complex so he goes for a final 'easy' question. "Well Rhikkie, what is your lowest score this season?" Rhikkie of course, replies obtusely and says:

⇨ $Z = X^0 - Y^0$

"Oh well", replies Blurtos "me too, you can't win them all!"

So what was Rhikkie's lowest score for the season?

Image: STYLEPICS/ Depositphotos.co

1. Transpose, and then calculate, using the following formulae. For each try and suggest what the variables might represent in an applied situation.

i. X + 15 = 100 Solve for X		
i. X - 15 = 100 Solve for X		
iii. X x 15 = 150 Solve for X		
iv. X / 15 = 15 Solve for X		
v. X = 3Y + 20 X = 50, solve for Y		
vi. 2X = 2Y - (50) Y = 275, solve for X		
vii. X = 3Y - 3(50) X = 900, solve for Y		
viii. X - Y = 2Y + 10,000 Y = 20,000, solve for X		

2. A good way to calculate whether it is worth your while working, based on a particular hourly wage amount, is to use estimation, calculation, comparison and analysis.

1 4 PS 2 3

e.g. Wage = $30 (per hour) Estimate a weekly amount using 40 hours = $1,200 (per week). Calculate an annual estimate using 50 weeks = $1,200 x 50 = $60,000 (per year). Compare to average weekly earnings (Australia for Nov. 2022 about $93,600 full/time). So $60,000/$93,600 x 100% = 63% of average income. Analyse this. I'd say that's a decent, but not great, hourly wage. It is about 2/3s of the annual income (wages and salaries) of all full-time workers. However, this is a good wage if you are a younger worker receiving $30/hour.	
What about $10 per hour?	
What about $40 per hour?	
What about your average wage?	

5.21 Visual Rates

Seeing the change

We can often see when numerical change is happening by looking at **data** in **tables**, and visual representations such as **charts** and **graphs**.

Household electricity, gas and water bills should show your usage over different periods of time. They could do this in a table, but it is usually in the form of a **bar graph**. Why is that?

You could use a **line graph** to represent the change in the price of petrol over an extended period of time. The line of this graph is likely to be quite 'jumpy'. You might also use line graphs to represent and compare personal activities on a weekly basis, such as time spent working vs time spent in social activities.

Pie charts are good for showing relative proportions of a whole quantity. Just think of cutting a pizza or a cake into slices. Those are like the segments of a pie chart.

One way to analyse change is by comparing 2 or more different variables, data sets, tables, charts or graphs, or images over time.

You can also create graphs and charts that include more than one set of numerical information. This enables an easy visual comparison, provided that the graph doesn't become too busy!

For example. the graph on the right might compare total sales in dollars over different months (a **time series**) with a gross profit margin for the same period. Of course, these will be measured using two different numerical scales, $ on the LHS and % on the RHS.

Line graphs are a good way of representing change, but without a heading and labels, we have no idea what the graph is showing.

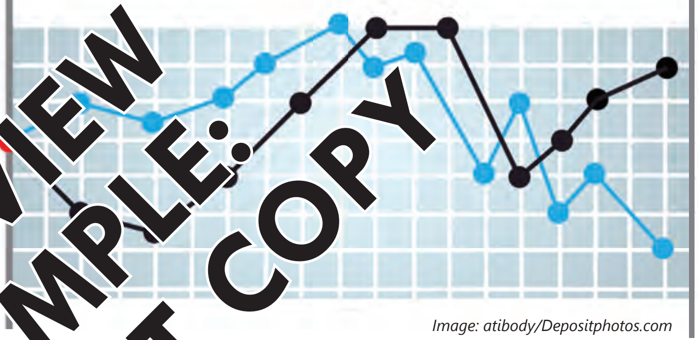


Image: atibody/Depositphotos.com

Conversion charts are a very useful tool to enable users to quickly convert between different **units** (e.g. metres into mm), different measuring **systems** (e.g. metric vs imperial) and other convertible **variables**.

Specific conversion 'calculators' will come up first in a **Google** search. There are also many **apps** that perform the same function. These are especially useful for **applied work-related** tasks in technical, mechanical, engineering, construction, design, cooking, transport, health and other practical vocational situations.

Image: mountainbrothers/ Depositphotos.com

See for yourself 5K

Six Year 12 students were asked to document their time spent on different social media platforms in a week. The results are shown by the pie charts.

Students could choose up to 6 main platforms. Any platforms with under 1 hour of engagement were excluded, as was that time. So there is no 'other' category.

Each colour represents the same social media platform. The size of the portion represents how much time each person spent on that platform in a week, as a proportion of total time spent on social media.

Image: AntartStock/Depositphotos.com

Complete these tasks in your workbooks

1 4 PS 2 3

1. What would be the heading for the pie charts? Assume the data was collected last week.
2. Estimate the relative proportion of the segments for each of the 6 students.
3. Assume they have similar demographic profiles to students at your school. What social media platform might each colour represent?
4. Is there a pie chart that reflects your own balance of social media engagement? Explain your response.
5. When you completed q.3, did you infer any patterns of use based on an assumed gender for each student? Is this sexist, or are there possible relationships between demographic characteristics such as gender (and age) and the types of social media platforms used?
6. Peter does photography. Peta loves cooking. Pietor is a big gamer. Jordun is into politics. Jordan loves social chatting. Jordanne loves performing. Would you change the social media platforms you allocated to each? Why, or why not?
7. Do this survey as a class, develop pie charts, and discuss your patterns of use.

5.23 Visual Rates

Visualisation

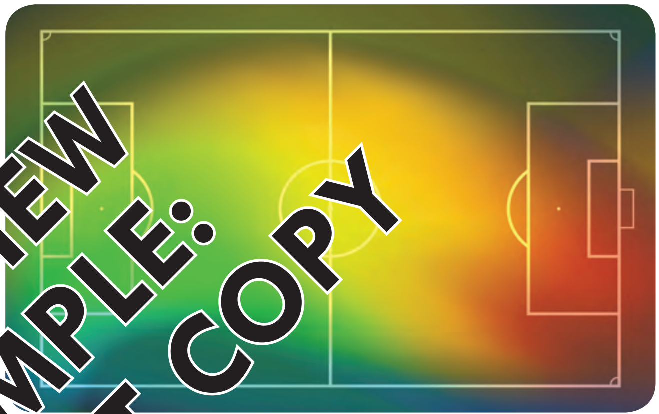
Last year you would have explored how in the contemporary digital world, we now view a lot of rates communicated in **visual** form. And new visualisations are being developed every day. So you have to stay up to speed.

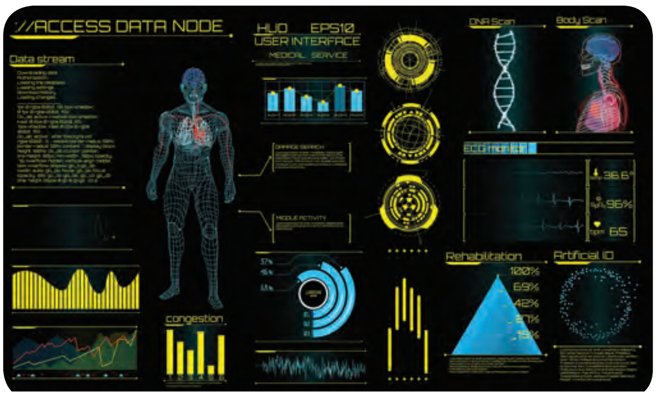
At times these visualisations are combined with **numbers**, such as on a speedo, a temperature gauge, or even a **graph** or **chart** that displays goal progress on a fitness app. At other times they are visual only, such as a **graphic equaliser** or set of **danger zones** and **warning displays** (although those might be accompanied by sound).

So when do you look at and 'read' rates, ratios and relationships communicated visually? And how are these usually **calibrated** and **displayed?**

Now, sit back and create images in your mind of these visual rates, and how they are communicated to you.

- **Power bars** on devices or in gaming.
- **Graphic equalisers** in audio and music recording.
- **Colour**-based **warnings** such as overheating and fire danger.
- **Performance visualisations** in fitness trackers and apps.
- **Vehicle dashboard displays** of speed, fuel economy, rpm and other measures.
- **Heat maps** in sports performance analysis.
- **Travel indicators** on Satnav/e-maps and travel apps.
- **Charts** and **graphs** in banking apps that show your spending and savings ratios.
- **Health indicators**, measures and visualisations of scans.
- **Safety indicators**, measures and warnings such as vehicle proximity.
- **Digital animations** set up as dynamic infographics.
- And many, many more - including a whole range of visualisations used for industry-specific situations to measure and communicate a range of information, including safety information.





Images:
t: kovshik028.gmail.com/
m: JonnyDrake/
b: sergeybitos.mail.ru/
Depositphotos.com

Sometimes it is easier, faster, safer and better to see rates in a visual form.

Visualisations 5L

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1. Find or create images that show rates (or relationships) in the situations below. Start drafting your ideas here and then complete in your work folios.
2. Explain what the image is showing and measuring.
3. Describe how each visualisation communicates numerical information more effectively and/or efficiently.
4. What tools and/or technologies might have been used to create these visualisations?

Sport, recreation or gaming

Vehicles/driving

Health

Risk/danger

Industry/Occupation-specific

Your choice

5.25 Assessment Task

AT5a The Beat Goes On
Health Numeracy // or Personal // or Recreational // or Vocational

1 4 PS 2 3

Context: The Beat Goes On

In life, there are many rates, ratios and relationships that govern how we do various tasks and activities. Do you remember last year when you investigated an important 'Rhythm of Life'? Well the beat goes on. And it's your responsibility to keep marching along!

From beat and rhythm in music and dance through to health measures such as heart rate, blood pressure, respiration and blood glucose levels.

There are also relationships related to food and beverage intake, health and nutrition, cooking, drawing, arts and crafts, hobbies, pet-care, gaming, exercising, sports performance and even safe driving.

For this assessment task, you are required to explore a range of relationships that exist in health situations, and/or in personal situations, and/or in recreational situations and/or in vocational situations - depending upon the applied numeracies you are investigating for Unit 3.

You will negotiate the type of relationships you will investigate with your teacher. Then you will prepare an annotated or multimedia or video report on your findings.

Report: The Beat Goes On

1. Describe your focus area and its importance.
2. Identify and explain the key relationships that exist.
3. Use formulae to express these relationships.
4. Use maths tools and techniques to measure the variables.
5. Explain what might happen to cause changes in the variables, or changes in the outcome of the relationship.
6. Collect visual evidence of relationships and/or change in action.
7. Create a table, chart, or graph to show a key relationship.
8. Summarise how being able to understand and measure these relationships can improve health, or personal or recreational outcomes.

Ren is going to track the evolution of dance rhythms by comparing the Charleston, the Jive and Hip Hop.

Cam is going to develop recipe guides to help turn their special meal creations into dinner party-sized amounts.

Lai is going to investigate the vital life measures in different domestic animals and make comparison charts.

Al and Bo are going to analyse and share how many hits and strikes are needed to beat level bosses in popular games.

Tam is going to investigate optimum heart rate and other measures to achieve safe high-intensity athletic training.

Jay wants to create a range of exotic mocktails so they can help their friends choose to stay alcohol-free.

Jen will compare biking, motor scooter, car and train options, to work out the best way for her to get to work.

Mo is going to create a word meter guide so that he can get the lyrics in his raps to fit better and pop with varied beats.

Lil is analysing which foods might be the best source of essential nutrients for a healthy vegan lifestyle.

Name(s):	AOS4: Relationships
Key dates:	Health or Personal or Recreational or Vocational

Tasks - AT5a: The Beat Goes On	Must do?	Due by	Done	Level
Negotiate the task details with my teacher.	✓			
My focus is:				
Investigation stage				
1. Establish focus area and its importance.	✓			
2. Identify the relationships that exist.	✓			
3. Source or create formulae for these relationships.	✓			
4. Use maths tools and techniques to measure variables.	✓			
5. Propose what might happen to cause change.	✓			
6. Source/create visual evidence of relationships or change.	✓			
7. Draft a table, chart, or graph of a relationship.	✓			
8. Predict how understanding might improve outcomes.	✓			
Annotated report				
1. Describe focus area and its importance.	✓			
2. Explain the relationships that exist.	✓			
3. Use of formulae to express these relationships.	✓			
4. Use of maths tools and techniques to measure variables.	✓			
5. Explain what can happen to cause change.	✓			
6. Describe visual evidence of relationships or change.	✓			
7. Create a table, chart, or graph a relationship.	✓			
8. Summarise how understanding can improve outcomes.	✓			
Task completion				
1 4 PS 2 3 **Describe applied use of the problem-solving cycle.**	✓			

Identify the maths	Act on & use maths	Evaluate & reflect	Communicate & report

	Must do?	Due by	Done	Level
Develop and apply mathematical tools and techniques.	✓			
⇨ **Prepare and submit final annotated report**	✓			
Present a report to the class (if required).				

5.27 Assessment Task

AT5b The Right Proportions
Health Numeracy // or Personal // or Vocational

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4 PS 2
3

Context

In our lives we get bombarded by messages about health and wellbeing and what we should do to look after ourselves better. These messages are amplified through social media. But it really comes down to you to make healthier life decisions. And the use of relationships, rates and proportions can help guide you.

It is important to consider that next year, post-Year 12, your patterns in life will change dramatically. Your work/life balance is likely to alter significantly. You might be spending more time at work and travelling for work. You might be combining TAFE, employment and other activities. And some of you might have to take on more of the responsibilities of being an adult, especially if you move out of home.

Required

This assessment task is a free-form activity whereby you investigate how you can apply your numeracy skills to develop a better 'formula for life'. Then you are required to **compare** your work/study/life **situation now**, with your most likely work/study/life **situation next year**.

To do this you will complete an annotated report which investigates the following.

1. **Food and nutrition: Images - Ratios, proportions, formulae.**
2. **Time: Tables - percentages and formulae.**
3. **Physical activity: Relationships and rates.**

Your teacher will discuss the suitability of these potential approaches.

1. Food and nutrition: Images - Ratios, proportions, formulae.

Create an image that shows recommended ratios of food and drink for health and wellbeing. You can research the Australian Guide to Healthy Eating as a starting point. Develop a formula to show the ratios suggested by the guide.

Then you might analyse your own consumption patterns, and make a diagram or infographic that illustrates your current consumption patterns.

Compare your food and nutrition situation **now**, with your most likely food and nutrition situation **next year**. You can then suggest strategies to make better diet and nutrition choices.

2. Time: Tables - percentages and formulae

The management of time is an important way to achieve health and wellbeing.

Develop a series of formulae to show how you **currently** spend each day doing different activities.

e.g. [illegible]z + 2x + 4s + 7e + 1t + 2o.

(z =sleep, x = exercise, s = screentime, e = education, t = travel, o = other).

Use variables to suit your own life, and develop different formulae for varied 'types' of days, e.g. School day, VET day, work day and weekends. You could also create pie charts.

Develop a series of formulae to show how you are most likely to be spending your time doing different activities **next year**. Analyse your use of time and suggest strategies to help you better manage your time.

3. Physical activity: Relationships and rates

Analyse your **current** daily movement according to sleeping, sitting, strolling, walking (rolling), household chores, and higher-intensity movement such as biking, skating and exercising.

Calculate how much time you spend in these physical states, on an hourly or daily basis. Show these over the course of a usual week. Find out how much physical activity is recommended for your age and ability. Compare this to your own physical activity. Analyse your movement intensity. When you move, what rates of speeds and intensity levels are you achieving?

Compare your physical activity situation **now**, with your most likely physical activity situation **next year**. Suggest strategies to help you improve, or maintain healthy physical activity guidelines.

Name(s):	AOS4: Relationships
Key dates:	Health or Personal or Vocational Numeracy

Tasks - AT5b: The Right Proportions	Must do?	Due by	Done	Level
Negotiate the task details with my teacher.	✓			
1. Food and nutrition				
a. Source and analyse healthy ratios/proportions.	✓			
b. Develop suitable formulae.	✓			
c. Create image of your own ratios/proportions.	✓			
d. Apply numerical skills for improvement strategies.	✓			
e. Comparison and analysis with next year.	✓			
2. Time				
a. Calculate your time spent on activities.	✓			
b. Create tables showing your use of time.	✓			
c. Develop suitable formulae.	✓			
d. Apply numerical skills for improvement strategies.	✓			
e. Comparison and analysis with next year.	✓			
3. Physical activity				
a. Record your patterns of movement.	✓			
b. Calculate your daily/weekly proportions.	✓			
c. Calculate your movement rates and intensity.	✓			
d. Apply numerical skills for improvement strategies.	✓			
e. Comparison and analysis with next year.	✓			
Task completion				
1 4 PS 2 3 **Describe applied use of the problem-solving cycle.**	✓			

Identify the maths	Act on & use maths	Evaluate & reflect	Communicate & report

Develop and apply mathematical tools and techniques.	✓			
⇨ **Prepare and submit final annotated report**	✓			
Present a report to the class (if required).				

5.29 // Problem-Solving Cycle // Maths Toolkit

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4 PS 2
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Task:	Names/Dates:
AT5 -	

1. Identify the maths

Identify problem(s) Done: Level:	Recognise maths Done: Level:	Select information Done: Level:
Interpret information Done: Level:	Choose processes Done: Level:	Done: Level:

2. Act on and use maths

Perform estimations Done: Level:	Decide techniques Done: Level:	Choose maths tools Done: Level:
Select technologies Done: Level:	Perform calculations Done: Level:	Done: Level:

3. Evaluate and reflect

Check Estimations Done: Level:	Compare results Done: Level:	Check processes Done: Level:
Review actions Done: Level:	Check calculations Done: Level:	Assess conclusions Done: Level:

4. Communicate and report

Written processes Done: Level:	Written results Done: Level:	Oral processes Done: Level:
Oral results Done: Level:	Digital processes Done: Level:	Digital results Done: Level:

Mathematical Toolkit

Analogue tools - What & how?		Digital Devices - What & how?		Software & Apps - What & how?	
Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy	Choice & Range	Skill & Accuracy