

VCE VM Numeracy Unit 2

Chapter 9 — Formula sheet

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Chapter 9 Formula sheet — all formulas used in this book

This sheet collects **every formula used in this book**, chapter by chapter, so you can look them up in one place instead of guessing (Section 1E). Each formula comes with its symbol definitions: every letter or word stands for one thing, and that thing is written beside it. For example, in $A = L \times W$, A = area, L = length and W = width. Your teacher will tell you when you may use this sheet in tests and assessments.

Numbers, conversions and rounding (Chapter 1)

Metric conversions. These equalities are used all through the book — lengths in Chapter 2 and Chapter 6, mass and capacity in Chapter 1, Chapter 3, Chapter 5 and Chapter 6.

Description	Formula
Kilometres and metres	$1 \text{ km} = 1\,000 \text{ m}$
Metres and centimetres	$1 \text{ m} = 100 \text{ cm}$
Centimetres and millimetres	$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ m} = 1\,000 \text{ mm}$
Kilograms and grams	$1 \text{ kg} = 1\,000 \text{ g}$
Litres and millilitres	$1 \text{ L} = 1\,000 \text{ mL}$
Kilolitres and litres	$1 \text{ kL} = 1\,000 \text{ L}$
Which way to go	Bigger unit to smaller unit: multiply . Smaller unit to bigger unit: divide . Example: $1.25 \text{ m} = 1.25 \times 1\,000 = 1\,250 \text{ mm}$

Time conversions. Used in Chapter 2, Chapter 5 and Chapter 6.

Description	Formula
Hours and minutes	$1 \text{ h} = 60 \text{ min}$
Minutes to hours	hours = minutes $\div$ 60; example: $90 \text{ min} \div 60 = 1.5 \text{ h}$
Hours to minutes	minutes = hours $\times$ 60; example: $1.5 \text{ h} \times 60 = 90 \text{ min}$
Decimal hours worth knowing	$0.25 \text{ h} = 15 \text{ min}$, $0.5 \text{ h} = 30 \text{ min}$, $0.75 \text{ h} = 45 \text{ min}$

Fractions, decimals and percentages. One share can wear three outfits (Sections 1D and 4B). Top = numerator (the count of parts you have); bottom = denominator (how many equal parts the whole is cut into).

Description	Formula
Fraction to decimal	decimal = top $\div$ bottom; example: $\frac{1}{8} = 1 \div 8 = 0.125$
Decimal to percentage	percentage = decimal $\times$ 100; example: $0.125 \times 100 = 12.5 \%$
Percentage to decimal	decimal = percentage $\div$ 100; example: $12.5 \% = 12.5 \div 100 = 0.125$
Percentage to fraction	write the percentage over 100, then simplify; example: $42 \% = \frac{42}{100} = \frac{21}{50}$

The common equivalents used in this book:

Fraction	Decimal	Percentage
$\frac{1}{2}$	0.5	50 %
$\frac{1}{3}$	0.33 (to 2 decimal places)	33 % (to the nearest whole number)
$\frac{1}{4}$	0.25	25 %
$\frac{1}{5}$	0.2	20 %

Fraction	Decimal	Percentage
$\frac{1}{8}$	0.125	12.5 %
$\frac{1}{10}$	0.1	10 %
$\frac{1}{100}$	0.01	1 %

Percentages of an amount. Used from Chapter 1 through to Chapter 6.

Description	Formula
10 % of an amount	amount $\div$ 10; example: 10 % of \$ 60 is \$ 60 $\div$ 10 = \$ 6
Any percentage of an amount	amount $\times$ the percentage as a decimal; example: 15 % of 1 200 = 0.15 $\times$ 1 200 = 180
Building from 10 %	20 % is 2 $\times$ 10 %; 5 % is half of 10 %; 50 % is a half ($\div$ 2); 25 % is a quarter ($\div$ 4)

Scaling amounts up or down (Section 1B — recipes and plans).

Description	Formula
Scale factor	scale factor = new amount $\div$ original amount; then multiply every quantity by the scale factor. Example: serves 4 becomes serves 14, so the scale factor is 14 $\div$ 4 = 3.5, and 150 g $\times$ 3.5 = 525 g

Rounding (Sections 1C, 3C and 5A). Every question in this book that needs rounding says exactly where to round.

Description	Rule
Round to a stated place	Look at the next digit along: 5 or more, round up ; 4 or less, round down . Example: \$ 3.642 to the nearest cent is \$ 3.64; \$ 9.475 to the nearest cent is \$ 9.48
Round up to fit real life	When leaving any out is not an option (tins of paint, packs, boxes): divide, then round up to the next whole one. Example: 43 $\div$ 8 = 5.375, so order 6 platters
Round down to fit real life	When only complete units count (cuts from a plank): divide, then round down . Example: 250 $\div$ 40 = 6.25, so only 6 full cuts fit

Measurement, shape and angles (Chapters 1–2)

Description	Formula
Perimeter of a rectangle	$P = 2 \times (L + W)$, where P = perimeter, L = length, W = width. Example: $L = 5$ m, $W = 3$ m gives $P = 2 \times (5 + 3) = 16$ m
Area of a rectangle	$A = L \times W$, where A = area, L = length, W = width. Example: $L = 5$ m, $W = 3$ m gives $A = 5 \times 3 = 15$ m ² . Area units are squared: m ² , cm ²
Reading an analogue scale (Section 1E)	one small space = (bigger label – smaller label) ÷ number of spaces between them; reading = smaller label + (spaces × one small space). Example: labels 500 and 1 000 with 5 spaces: one space = $(1\,000 - 500) \div 5 = 100$ g, and a needle 2 spaces past 500 reads $500 + 2 \times 100 = 700$ g

Everyday angles (Section 2D). An angle is an amount of turn, measured in degrees (written °). This book uses four everyday angles — they are easy pieces of one full turn.

Turn	Angle
A full turn (all the way around)	360°
A half turn (a straight line)	180°
A quarter turn (a right angle, a square corner)	90°
An eighth of a turn (half of a right angle)	$45^\circ = 90^\circ \div 2 = 360^\circ \div 8$

Maps, scale and travel (Chapter 2, Chapter 6)

Description	Formula
Map scale (Section 2B)	real distance = map distance $\times$ scale amount. Example: scale 1 cm = 200 m, a leg measures 6 cm, so the real leg is $6 \times 200 = 1\,200$ m
Distance	$D = S \times T$, where D = distance, S = speed, T = time
Time	$T = D \div S$
Speed	$S = D \div T$
Keep the units matching	A speed in km/h wants a time in hours, so change minutes to hours first: 30 min = 0.5 h, 45 min = 0.75 h, 90 min = 1.5 h
Odometer distance (Section 6E)	distance travelled = end odometer reading – start odometer reading. Example: $12\,505 - 12\,340 = 165$ km

Data (Chapter 3)

The two summary numbers of this book are the **mean** (what is typical) and the **range** (how spread out the values are). They are always reported as a pair.

Description	Formula
Mean	$\bar{x} = \frac{\text{total of all the values}}{\text{how many values there are}}$, where $\bar{x}$ (said “x-bar”) means the mean. Example: values 3, 4, 2, 7: mean $= (3 + 4 + 2 + 7) \div 4 = 16 \div 4 = 4$
Mean check	The mean must sit between the lowest and highest values. If it does not, re-do the total or the count
Range	range = highest value – lowest value (highest = maximum, lowest = minimum). Example: temperatures 18 to 26: range = $26 - 18 = 8^{\circ}\text{C}$
Reading a graph scale (Section 3B)	value = lower scale number + (spaces $\times$ step); a mark halfway between two scale numbers shows the halfway value. Example: on a scale counting in 10s, halfway between 40 and 50 is 45
Frequency total check (Section 3A)	the frequency column must add to the total number of data points collected; if the two disagree, a tally was missed
Percentage of a group (Sections 6D, 6E)	percentage = $\text{part} \div \text{whole} \times 100$. Example: 17 on-time trucks out of 20: $17 \div 20 = 0.85 = 85\%$
Rate “per 100” (Section 6D)	rate = $\text{count} \div \text{total} \times 100$, read as “per 100 workers” or “per 100 people”. Example: 12 incidents across 240 workers: $12 \div 240 = 0.05 = 5\%$, so 5 incidents per 100 workers
Percentage points (Sections 6B, 6D)	the gap between two percentages = bigger percentage – smaller percentage. Example: from 5% to 7.5% is a rise of $7.5 - 5 = 2.5$ percentage points
Percentage change (Section 6C)	change = new amount – starting amount; percentage change = $\text{change} \div \text{starting amount} \times 100\%$. Example: \$400 000 to \$460 000: change = 60 000, and $60\,000 \div 400\,000 = 0.15$, so 15%

Chance and probability (Chapter 4, Chapter 6)

Description	Formula
Probability of an event	$P(\text{event}) = \frac{\text{favourable outcomes}}{\text{total outcomes}}$ where $P()$ means “the probability of”, the favourable outcomes are the ones that count as a yes, and every outcome is equally likely. Example: an even number on a fair 1-to-6 die: $P(\text{even}) = \frac{3}{6} = \frac{1}{2}$
Probability of not happening	$P(\text{not event}) = 1 - P(\text{event})$ — or count the unfavourable outcomes instead. Example: $P(\text{not red}) = 1 - \frac{2}{5} = \frac{3}{5}$
The chance scale	impossible = 0 = 0 %; even chance = 0.5 = 50 %; certain = 1 = 100 %
Three outfits	The same chance as a fraction, a decimal and a percentage: $\frac{1}{4} = 0.25 = 25\%$. “1 in 5” is a fraction too: $\frac{1}{5} = 0.2 = 20\%$
Payout at decimal odds (Sections 6C, 6F)	payout = stake $\times$ odds, where the stake is the money you put on the bet and decimal odds are what a bet pays per \$1 staked, stake included. Example: a \$10 bet at odds of 4.00 pays $\\$10 \times 4.00 = \\$40$
Implied chance from decimal odds (Sections 6C, 6F)	implied chance = $1 \div \text{odds}$, as a decimal ($\times 100$ for a percentage). Example: odds of 4.00 suggest $1 \div 4 = 0.25 = 25\%$

Time and planning (Chapter 5, Chapter 6)

Description	Formula
The three time facts (Section 5C)	Every job joins a start time, a finish time and a duration (how long the job takes). You always know two and find the third: $\text{finish} = \text{start} + \text{duration}$; $\text{duration} = \text{finish} - \text{start}$; $\text{start} = \text{finish} - \text{duration}$
Adding minutes to a clock time (Section 5A)	Add the minutes; every 60 minutes becomes one more hour. Example: 9:40 am + 35 min: $40 + 35 = 75$ min past 9, and 75 min is 1 h 15 min, so the time is 10:15 am
24-hour time (Sections 5D, 6A)	The afternoon and evening keep counting past 12: for a pm clock time, 24-hour time = clock time + 12 hours. Example: 3:45 pm is written 15:45
Total trip time (Section 5D)	total time = the sum of every leg + every wait — waits count even though nobody is moving. Example: legs of 5, 3, 10, 8, 53 and 3 min total 82 min = 1 h 22 min
Back-planning from a deadline (Section 5C)	latest start = deadline – duration, subtracting each job's duration working backwards. Example: dinner served at 18:30, cooking takes 40 min: latest start is 17:50
Does the plan fit? (Section 5C)	Add all the durations, including wait steps and breaks. Total smaller than the window: it fits, and the difference is spare time. Total bigger: something must move

Money, rates and fuel (Chapters 5–6)

Description	Formula
Rate shorthand (Section 1D)	The slash reads as “per”: 60 km/hr means 60 kilometres per hour; \$ 3.20/kg means three dollars and twenty cents per kilogram
Cost by weight (Section 5A)	cost = weight in kg $\times$ price per kg. Example: 0.75 kg of cheese at \$ 9.00 a kilogram costs $0.75 \times \$ 9.00 = \$ 6.75$
Total cost (Sections 1A, 5A)	total = price per item $\times$ number of items; a parking ticket works the same way: cost = rate per hour $\times$ hours paid for
Change (Section 5A)	change = amount paid – total cost. Example: change from a \$ 20 note on a \$ 15.95 total is $\$ 20.00 - \$ 15.95 = \$ 4.05$
Input–output rule (Section 5A)	output = input $\times$ the fixed rule; working backwards, input = output $\div$ the rule. Example: cones at \$ 2.50 each — a \$ 10.00 output came from $\$ 10.00 \div \$ 2.50 = 4$ cones
Unit price and the better buy (Section 6C)	unit price = total price $\div$ number of units; the pack with the lower unit price is the better buy. If the size is in grams, change to kilograms first ($\div 1000$)
Costing a trip (Section 6C)	total trip cost = fares + (nights $\times$ price per night) + food + activities — cost each option fully, add the pieces, then compare with the budget
GST (Section 6C)	GST = 10 % of the price before GST; total = price before GST + GST. Example: on a \$ 200 bill, GST = \$ 20 and the total is \$ 220
Take-home pay (Section 6C)	take-home pay = gross pay – tax withheld, where gross pay is your pay before tax
Superannuation (Section 6C)	super = 10 % of gross pay, paid by your employer on top of your wage. Example: on gross pay of \$ 820.00, super = \$ 82.00. This book uses a made-up rate of 10 % to keep the arithmetic clean — the real rate is set by law and is not exactly 10 %
Pay rise (Section 6C)	new amount = old amount + (the percentage of the old amount). Example: a 2 % rise on \$ 25.00 an hour adds $0.02 \times \$ 25.00 = \$ 0.50$, giving \$ 25.50 an hour
One year of interest (Section 6B)	interest = the rate as a decimal $\times$ the amount. Example: \$ 4 000 at 3.5 % a year earns $0.035 \times 4\,000 = \$ 140$ in one year
Fuel needed (Sections 1F, 5D, 5E)	fuel in litres = (distance in km $\div 100$) $\times$ fuel use in L per 100 km. Example: 260 km at 7.5 L per 100 km: $260 \div 100 = 2.6$, and $2.6 \times 7.5 = 19.5$ L
Fuel cost (Sections 1F, 5D)	fuel cost = litres $\times$ price per litre. Example: $19.5 \text{ L} \times \$ 1.83 = \$ 35.685$, which rounds to \$ 35.69 to the nearest cent

Spreadsheet formulas (Section 1F)

A spreadsheet formula starts with = and works on a **range** of cells (a block like B2 : B6). The four formulas this book uses:

Formula	What it does
=SUM (range)	Adds a block of cells. Example: =SUM (D2 : D6) adds the five pay cells D2 to D6
=AVERAGE (range)	Finds the mean of a block. Example: =AVERAGE (B2 : B6) gives the mean of the five values in B2 to B6
=MAX (range)	Finds the largest value in a block
=MIN (range)	Finds the smallest value in a block; with =MAX, it gives the range: range = MAX – MIN

Type a formula once, then **fill down** to copy it through the rows below — that is how one formula, =B2 * C2 (hours × hourly rate), becomes a whole pay column. Spreadsheets are one tool among many: everything above can also be done with pen, paper and a basic calculator.

End of Formula Sheet