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NCERT Class 8 Maths Notes Chapter 3 Proportional Reasoning-2

NCERT Notes for Class 8 Maths, Part 2 (2026-27 Syllabus)

Chapter 3: Proportional Reasoning-2

These NCERT Class 8 Maths Notes Chapter 3 Proportional Reasoning-2 cover the full Ganita Prakash chapter: map scales, ratios with many terms, dividing a whole in a given ratio, pie charts and inverse proportion. Every rule comes with a worked example, a diagram and the exact mistake to avoid.

Also see for this chapter: NCERT Solutions | Formula Sheet | Exemplar Solutions

Contents

1 Proportional Reasoning at a Glance

Chapter 3 picks up the ratio ideas you met in Part 1 and stretches them further. You will read map scales, handle ratios with four or five terms, split a whole in a given ratio, draw pie charts and meet a brand new idea called inverse proportion. This first section refreshes the base you need for all of that.

1.1 What Makes a Relationship Proportional

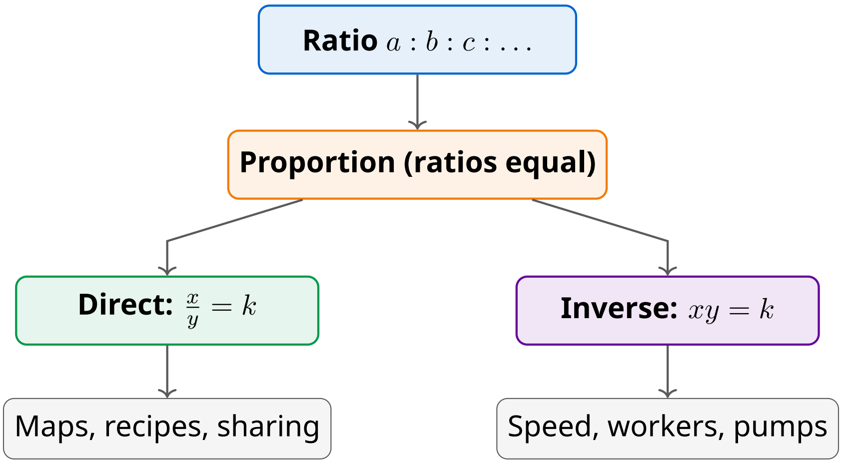
Two quantities are related proportionally when they change by the same factor. Double one, the other doubles. Halve one, the other halves. The idli batter example in the book says it well: 2 cups of rice for 1 cup of urad dal is the recipe, so 6 cups of rice needs 3 cups of urad dal.

Key idea

A ratio compares quantities. A proportion says two ratios are equal.

- Ratio: $2:1$ is a comparison of rice to dal.
- Proportion: $6:3=4:2$ says two mixes taste the same.
- The colon symbol is read as "is to". The symbol $::$ is read as "as".

The whole chapter sits on three branches. Keep this picture in mind.



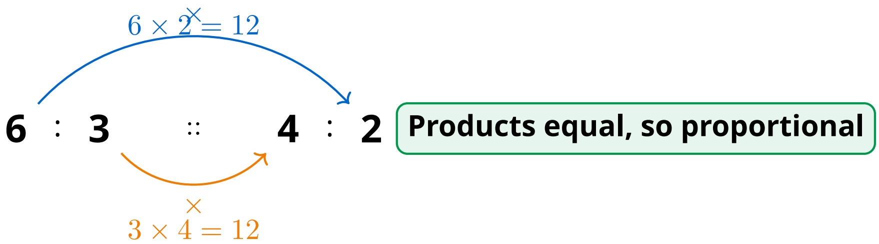
1.2 The Cross Multiplication Test

To check whether two ratios are proportional, multiply across. If both products match, the ratios are proportional. Viswanath used $6 : 3$ and Puneet used $4 : 2$. Cross multiplying gives $6 \times 2 = 12$ and $3 \times 4 = 12$. The idlis taste the same.

Cross multiplication rule

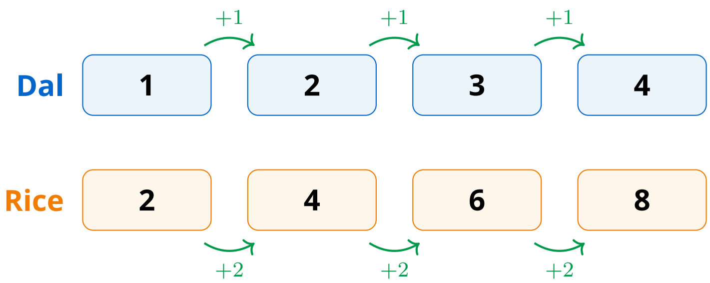
Two ratios $a : b$ and $c : d$ are proportional when

$$a \times d = b \times c, \qquad \text{that is} \qquad \frac{a}{c} = \frac{b}{d}.$$



1.3 Scaling a Ratio Up and Down

Every ratio has a family of equivalent ratios. Multiply or divide all terms by the same non-zero number and the relationship stays the same. This is the single move that solves most of the chapter.



Every column is the ratio $1 : 2$ in disguise

Here is the same family written as a table. Notice how the quotient never changes.

Cups of dal	1	2	3	4	5
Cups of rice	2	4	6	8	10
Rice ÷ dal	2	2	2	2	2

Fastest way to compare two ratios

Turn both ratios into fractions and cross multiply. No need to find a common denominator, and no need to reduce first. One multiplication on each side settles it.

Adding instead of multiplying

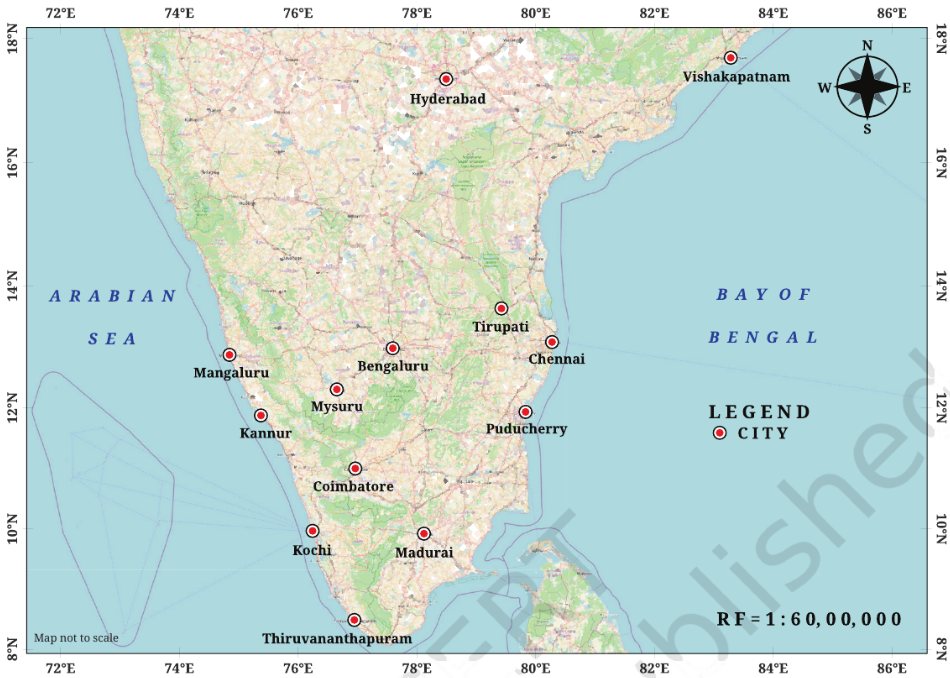
A very common slip is to add the same number to both terms. Adding 2 to each term of $2 : 1$ gives $4 : 3$, which is not the same relationship. Ratios scale by multiplication and division only.

2 Ratios in Maps and Scale Drawings

Open any atlas and look at the bottom right corner of a map. You will see something like $1 : 60{,}00{,}000$. That is a ratio, and it is the reason a whole state fits on one page. This section shows how to read that ratio and turn it into real distances.

2.1 What a Representative Fraction Means

A Representative Fraction, written RF, compares a distance on the map with the matching distance on the ground. The first term is always 1. The second term tells you how many times bigger the real world is.



Map of southern India printed with RF $1 : 60{,}00{,}000$. *Ganita Prakash, Grade 8, Part 2, Chapter 3.*

Reading an RF

RF $1 : 60{,}00{,}000$ means 1 cm on the paper stands for $60{,}00{,}000$ cm on the ground. Both numbers must be in the same unit before you write the ratio.

Two points are worth fixing in your head. First, the distance you get is geographical distance, the straight line between two places. Second, road distance is always more, because roads bend.

2.2 From Map Distance to Ground Distance

Convert the big number to a friendly unit first, then multiply. Since 1 km $= 1{,}00{,}000$ cm, we get $60{,}00{,}000$ cm $= 60$ km. So on this map 1 cm stands for 60 km.

1 cm $\to$ $60{,}00{,}000$ cm $=$ 60 km

Map distance and ground distance

$$\text{Ground distance} = \text{Map distance} \times \text{RF denominator}$$

$$\text{Map distance} = \frac{\text{Ground distance}}{\text{RF denominator}}$$

Keep both distances in the same unit while you multiply or divide.

Worked example. On the map above, Bengaluru and Chennai measure about 5.4 cm apart with a ruler. The geographical distance is $5.4 \times 60 = 324$ km. Mangaluru to Chennai measures about 5.8 cm, so the distance is $5.8 \times 60 = 348$ km.

2.3 From Ground Distance to Map Distance

Working backwards is just as easy. Divide instead of multiply.

Worked example. Two towns are 150 km apart. How far apart are they on a map with RF $1 : 50{,}00{,}000$?

- $50{,}00{,}000$ cm $= 50$ km, so 1 cm on this map is 50 km.
- Map distance $= 150 \div 50 = 3$ cm.

A smaller second term means a larger, more detailed map. RF $1 : 1{,}000$ is a street plan. RF $1 : 60{,}00{,}000$ is a whole region on one page.

RF	1 cm stands for	Typical use
$1 : 1{,}000$	10 m	Classroom or building plan
$1 : 50{,}000$	0.5 km	Trek or survey map
$1 : 10{,}00{,}000$	10 km	District map
$1 : 60{,}00{,}000$	60 km	Multi-state map

Unit trick that saves marks

Divide the RF denominator by $1{,}00{,}000$ once. That single number is how many kilometres 1 cm represents. After that every question becomes one multiplication.

2.4 Scale Drawings in the Classroom

The same idea builds a scale drawing. Choose a scale, measure the real object, divide by the scale, and draw. A classroom sketch at $1 : 50$ means every 50 cm of real length becomes 1 cm on paper.

- A blackboard 4 m long becomes $400 \div 50 = 8$ cm on the sketch.
- A desk 1 m wide becomes $100 \div 50 = 2$ cm.
- Mark fans, lights and doors with simple symbols and add a key.

Where map scales matter

Firefighters plan routes from scaled building plans. Farmers order seed from the scaled area of a plot. Metro planners test a new line on a scaled city map long before any digging starts. In each case the drawing is useless unless the scale is stated.

Remember the direction

Map to ground, go grand. Multiply and the number gets bigger. **Ground to map, take a nap.** Divide and the number shrinks.

3 Ratios with More than Two Terms

Real recipes rarely mix only two things. A spice powder may need coriander, chillies, dal and fenugreek together. A ratio can hold as many terms as you need, provided all of them change by the same factor.

3.1 Reading a Multi-Term Ratio

Viswanath grinds 8 spoons of coriander seeds, 4 red chillies, 2 spoons of toor dal and 1 spoon of fenugreek. The ratio of the four ingredients is $8 : 4 : 2 : 1$.

Making the spice mix powder. Ganita Prakash, Grade 8, Part 2, Chapter 3.

Order is part of the meaning

The ratio $8 : 4 : 2 : 1$ only makes sense with the names attached, in the same order. Always write the names above or beside the numbers:

$$\text{coriander} : \text{chillies} : \text{toor dal} : \text{fenugreek} :: 8 : 4 : 2 : 1$$

3.2 When Two Multi-Term Ratios Are Proportional

Puneet has only 2 red chillies, which is half of what Viswanath used. So every other ingredient must be halved too. He needs 4 spoons of coriander, 2 chillies, 1 spoon of toor dal and half a spoon of fenugreek. That is $4 : 2 : 1 : 0.5$.

	Coriander	Chillies	Toor dal	Fenugreek
Viswanath	8	4	2	1
	$\downarrow \div 2$	$\downarrow \div 2$	$\downarrow \div 2$	$\downarrow \div 2$
Puneet	4	2	1	0.5

$$8 : 4 : 2 : 1 \; :: \; 4 : 2 : 1 : 0.5$$

Proportional multi-term ratios

If $a : b : c : d \; :: \; p : q : r : s$, then every matching pair shares one quotient:

$$\frac{a}{p} = \frac{b}{q} = \frac{c}{r} = \frac{d}{s}.$$

That common value is the scale factor between the two mixes.

3.3 Simplest Form with the HCF

To reduce a multi-term ratio, divide every term by the HCF of all the terms. The relationship stays the same and the numbers get friendly.

Ratio	HCF	Simplest form
$12 : 10 : 8 : 6 : 4$	2	$6 : 5 : 4 : 3 : 2$
$18 : 27 : 45$	9	$2 : 3 : 5$
$8 : 4 : 2 : 1$	1	already simplest
$50 : 30 : 20$	10	$5 : 3 : 2$

When a term is a decimal, multiply every term by 10 or 100 first, then reduce. For $4 : 2 : 1 : 0.5$ multiply throughout by 2 to get $8 : 4 : 2 : 1$.

Decimals in a ratio

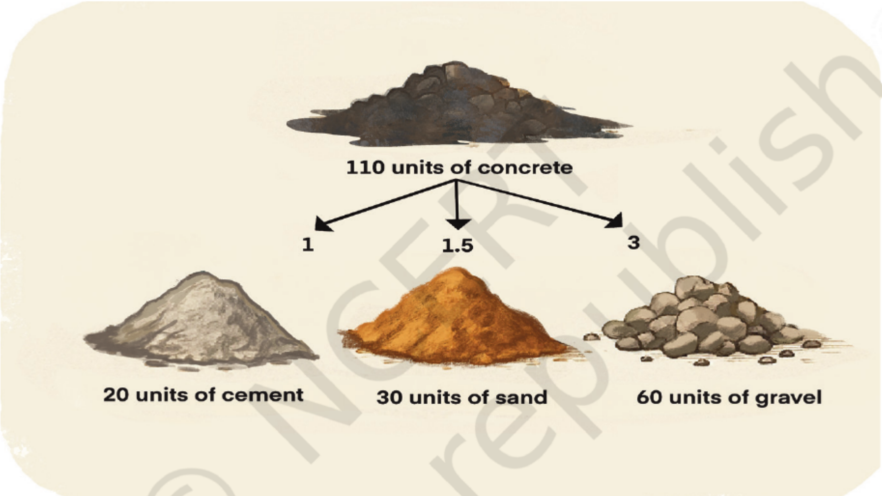
Clear the decimals before you do anything else. Multiply all terms by the same power of 10, then divide by the HCF. Two clean steps beat one messy one.

3.4 Worked Examples: Paint and Concrete

Example 1. Purple paint is mixed as Red : Blue : White $:: 2 : 3 : 5$. Yasmin has 10 litres of white paint. How much red and blue does she add?

- White is 5 parts, and 5 parts $= 10$ litres, so 1 part $= 2$ litres.
- Red $= 2 \times 2 = 4$ litres.
- Blue $= 3 \times 2 = 6$ litres.
- Total volume $= 4 + 6 + 10 = 20$ litres.

Example 2. Cement concrete for pillars and beams uses cement : sand : gravel $:: 1 : 1.5 : 3$. With 3 bags of cement, how many bags of mixture do we get? Multiply every term by 3 to get $3 : 4.5 : 9$. The total is $3 + 4.5 + 9 = 16.5$ bags.



Cement, sand and gravel mixed in the ratio $1 : 1.5 : 3$. Ganita Prakash, Grade 8, Part 2, Chapter 3.

Matching the wrong term

In Example 1 the 10 litres belongs to white, which is the third term. Students often divide 10 by the first term instead. Write the names above the ratio, circle the term you were given, and only then find the value of one part.

4 Dividing a Whole in a Given Ratio

Sometimes you are told the total and asked to split it. A 150 minute practice session across four drills, 110 units of concrete across three materials, or $180°$ across three angles of a triangle. The method is the same every time.

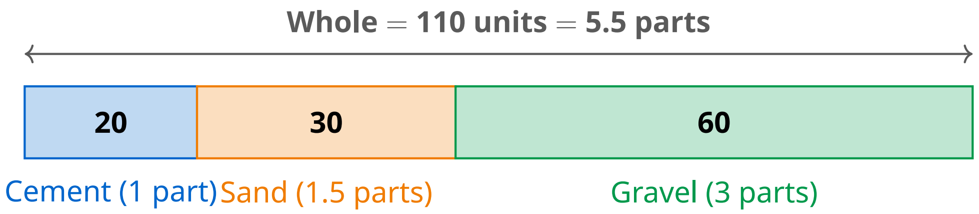
4.1 The Part Value Method

Add the terms of the ratio. That sum tells you how many equal parts the whole is cut into. Divide the whole by the sum to get the value of one part. Then multiply each term by that value.

Example 3. We need 110 units of concrete in the ratio $1 : 1.5 : 3$.

- Sum of terms $= 1 + 1.5 + 3 = 5.5$.
- Value of one part $= 110 \div 5.5 = 20$.
- Cement $= 1 \times 20 = 20$ units.
- Sand $= 1.5 \times 20 = 30$ units.

- Gravel $= 3 \times 20 = 60$ units.



4.2 The Fraction Formula

The same work can be written as one formula. Each share is the whole times that term's fraction of the total.

Dividing a whole in a ratio

To divide x in the ratio $a : b : c : \ldots$

$$\text{first share} = x \times \frac{a}{a+b+c+\cdots}, \qquad \text{second share} = x \times \frac{b}{a+b+c+\cdots},$$

and so on. The shares always add back to x.

Example 4. Mix 50 ml of purple paint in the ratio $2 : 3 : 5$.

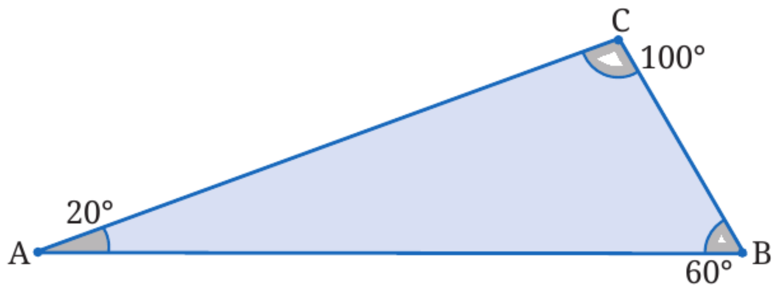
- Red $= 50 \times \frac{2}{10} = 10$ ml.
- Blue $= 50 \times \frac{3}{10} = 15$ ml.
- White $= 50 \times \frac{5}{10} = 25$ ml.
- Check: $10 + 15 + 25 = 50$ ml.

4.3 Angles and Sides in a Given Ratio

Angles of a triangle add to $180°$, so a ratio of angles is a division of $180°$.

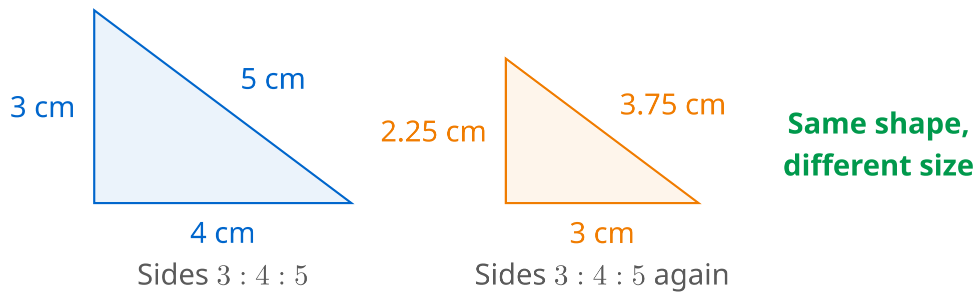
Example 5. Construct a triangle with angles in the ratio $1 : 3 : 5$. The sum of terms is 9, so one part is $180 \div 9 = 20$.

- $\angle A = 1 \times 20 = 20°$
- $\angle B = 3 \times 20 = 60°$
- $\angle C = 5 \times 20 = 100°$



Triangle with angles 20°, 60° and 100°. Ganita Prakash, Grade 8, Part 2, Chapter 3.

Side lengths behave differently. A ratio of sides fixes the shape but not the size, so many triangles fit the same side ratio. Here is $3 : 4 : 5$ drawn at two sizes.



So triangles with sides in the ratio $3 : 4 : 5$ are similar, not congruent. They match in angles but not in length. A ratio like $1 : 3 : 5$ cannot be a triangle at all, because $1 + 3 = 4$, which is less than 5, and the two short sides never meet.

4.4 Practice: Coins, Books and Training Time

Cricket practice. A 150 minute session is split as warm-up : batting : bowling : fielding $:: 3 : 4 : 3 : 5$. The sum is 15, so one part is 10 minutes. That gives 30, 40, 30 and 50 minutes.

Library books. Odiya : Hindi : English $:: 3 : 2 : 1$ with 288 Odiya books. Here 3 parts $= 288$, so one part $= 96$. Hindi has $2 \times 96 = 192$ books and English has $1 \times 96 = 96$ books.

Coins. 100 coins are held as ₹10 : ₹5 : ₹2 : ₹1 coins $:: 4 : 3 : 2 : 1$. The sum is 10, so one part is 10 coins.

Coin	Number of coins	Value each	Value
₹10	40	₹10	₹400
₹5	30	₹5	₹150
₹2	20	₹2	₹40
₹1	10	₹1	₹10
Total	**100**		**₹600**

Always check the sum

After splitting, add your shares. They must give back the original whole. This one line catches almost every arithmetic slip before the examiner does.

Sharing in real life

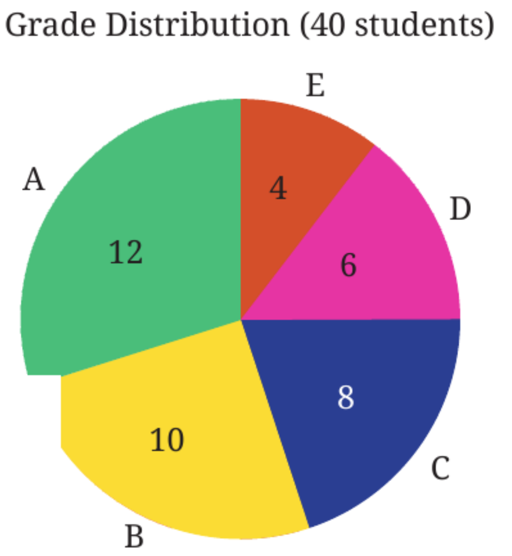
Business partners split profit in the ratio of the money each invested. A recipe scales up for a canteen using the same idea. Even prize money in a team event is often shared in a stated ratio, so this is the maths behind a fair split.

5 Pie Charts: A Slice of the Pie

A pie chart turns a table of counts into a circle of slices. Each slice angle is proportional to its count, so the picture tells the story before you read a single number. Drawing one is simply dividing $360°$ in a given ratio.

5.1 Why the Angles Are Proportional

The full circle is $360°$ and it stands for the whole data set. A group with more members must own a bigger share of that $360°$. So the ratio of angles equals the ratio of counts.



Grades of 40 students shown as a pie chart. Ganita Prakash, Grade 8, Part 2, Chapter 3.

Angle of a slice

$$\text{Angle of a slice} = \frac{\text{count of that group}}{\text{total count}} \times 360^\circ$$

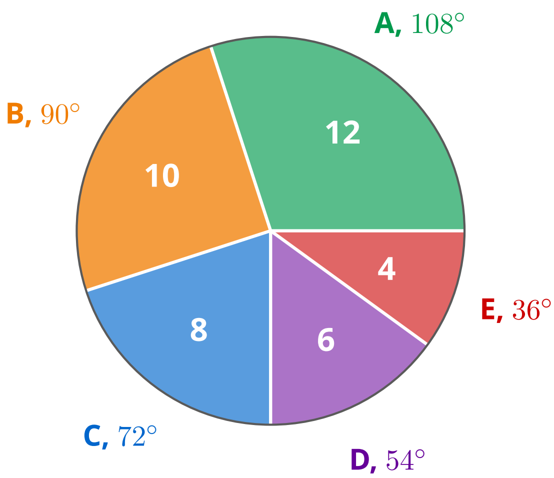
Equivalently, divide 360° in the ratio of the counts.

5.2 Turning a Table into Angles

The 40 students scored grades A to E as $12 : 10 : 8 : 6 : 4$. The HCF is 2, so the simplest form is $6 : 5 : 4 : 3 : 2$. The sum is 20, so one part is $360 \div 20 = 18^\circ$.

Grade	A	B	C	D	E
Students	12	10	8	6	4
Simplest ratio	6	5	4	3	2
Angle	108°	90°	72°	54°	36°

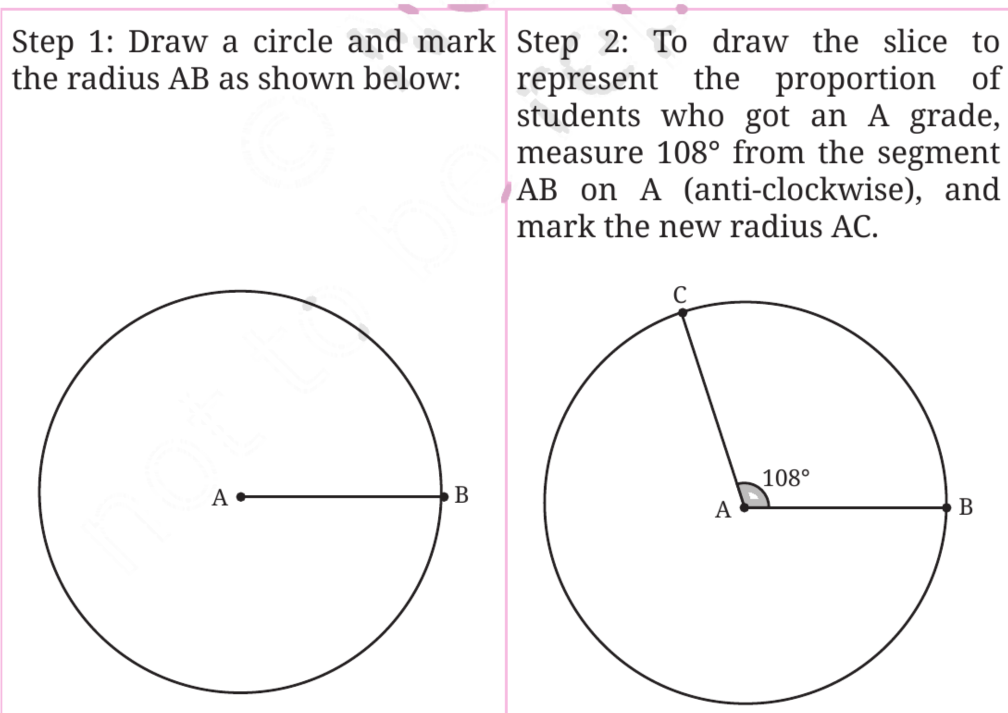
The five angles add to $108 + 90 + 72 + 54 + 36 = 360^\circ$, which confirms the work. Here is the finished chart drawn to those angles.



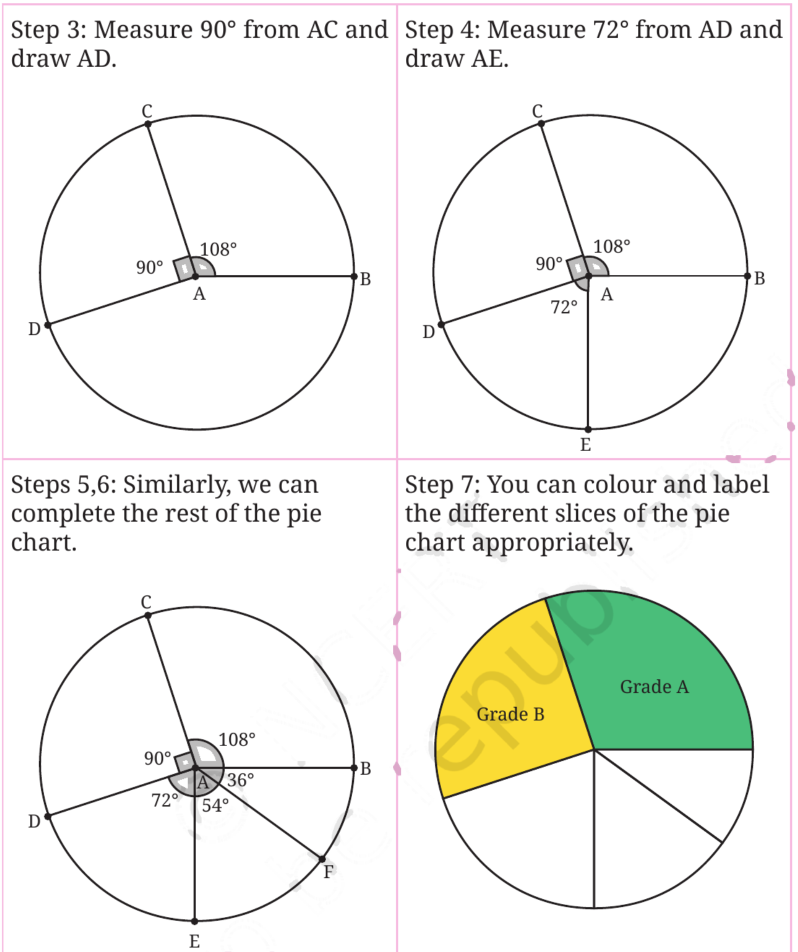
5.3 Constructing the Pie Chart Step by Step

Take a compass, a ruler and a protractor. Work anti-clockwise from one fixed radius so that no angle is measured twice.

1. Draw a circle with centre A and mark a radius AB.
2. Measure $108°$ from AB at A and draw radius AC. That is grade A.
3. Measure $90°$ from AC and draw AD. That is grade B.
4. Measure $72°$ from AD and draw AE. That is grade C.
5. Repeat for $54°$ and $36°$ to close the circle.
6. Colour each slice and label it with the grade and the count.

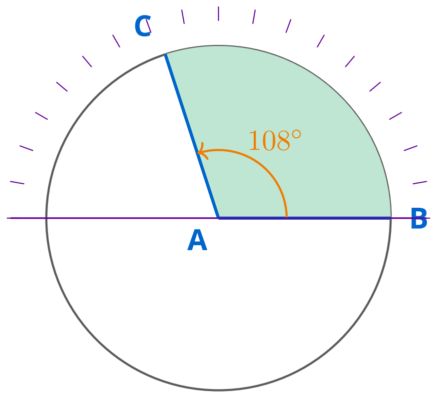


Steps 1 and 2 of the construction. Ganita Prakash, Grade 8, Part 2, Chapter 3.



Steps 3 to 7 of the construction. Ganita Prakash, Grade 8, Part 2, Chapter 3.

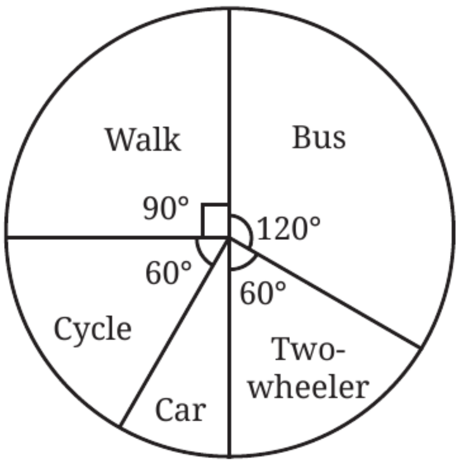
The protractor step is the one that goes wrong most often. Keep the centre hole on A and the baseline along the radius you just drew.



Protractor baseline sits along AB, centre hole on A

5.4 Reading a Pie Chart Backwards

An exam usually gives you the finished chart and asks for the data. Turn each angle into a fraction of $360°$, then multiply by the total.



Modes of transport used by children to reach school. Ganita Prakash, Grade 8, Part 2, Chapter 3.

Read the four marked angles: bus $120°$, walk $90°$, cycle $60°$, two-wheeler $60°$. The remaining slice is the car, so the car angle is $360 - 120 - 90 - 60 - 60 = 30°$.

- Most common mode: bus, because $120°$ is the largest slice.
- Fraction travelling by car: $\dfrac{30}{360} = \dfrac{1}{12}$.
- If 18 children travel by car, the total surveyed is $18 \times 12 = 216$.

- No slice is marked taxi, so the number of children using taxis is 0.
- Cycle and two-wheeler share $60°$ each, so equal numbers use them.

Forgetting the leftover slice

When one slice is unlabelled, do not guess it. Subtract every marked angle from $360°$. In the transport chart the car slice is $30°$, not $60°$, and that single error changes the survey total from 216 to 108.

Pie charts you meet every week

Election result graphics, phone storage screens, budget summaries in the newspaper and nutrition labels all use pie charts. Each one is dividing a whole in a ratio, exactly like this chapter.

6 Inverse Proportion

Until now, when one quantity grew, its partner grew too. This section meets pairs that move in opposite directions. Ride faster and the trip gets shorter. Hire more painters and the job finishes sooner. That behaviour has its own rule.

6.1 Direct Proportion and the Rule of Three

The rule of three finds a missing fourth term when three are known. If $a : b :: c : d$, then $ad = bc$, so $d = \frac{bc}{a}$.

Direct proportion

Quantities x and y are in direct proportion when

$$\frac{x_1}{y_1} = \frac{x_2}{y_2} = k \quad \text{(a constant)}.$$

Both grow together and both shrink together.

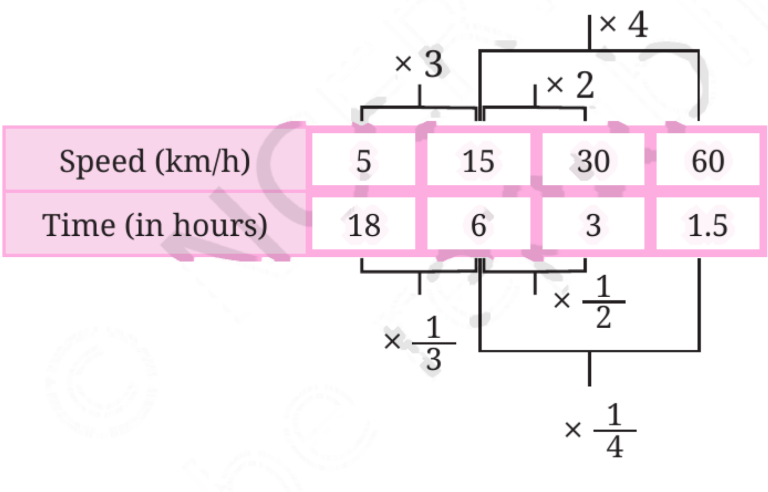
Example 1. If 5 workers move 4500 bricks in a day, how many workers move 18000 bricks in a day? Write $4500 : 18000 :: 5 : x$. Then $x = \frac{18000 \times 5}{4500} = 20$ workers.

6.2 Spotting an Inverse Relationship

Puneeth's father rides from Lucknow to Kanpur in 3 hours at 30 km/h. In a car at 60 km/h the trip is shorter, not longer. So $30 : 60 :: 3 : x$ is the wrong setup. The table below shows what really happens.

Mode	Walk	Bicycle	Motorcycle	Car
Speed (km/h)	5	15	30	60
Time (hours)	18	6	3	1.5
Speed $\times$ time	90	90	90	90

Speed triples from 5 to 15, and time falls to a third, from 18 to 6. The factor is the same but the direction is opposite. The product stays at 90 km, which is the distance.



Speed rises by a factor while time falls by the same factor. Ganita Prakash, Grade 8, Part 2, Chapter 3.

6.3 The Constant Product Rule

That constant product is the whole idea. Direct proportion keeps a quotient fixed. Inverse proportion keeps a product fixed.

Inverse proportion

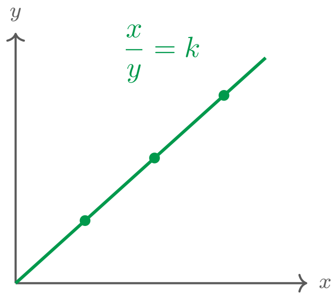
Quantities x and y are in inverse proportion when

$$xy = k \quad \text{(a constant).}$$

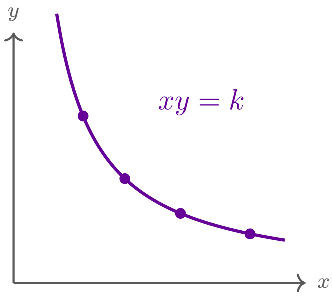
For two pairs of values,

$$x_1 y_1 = x_2 y_2 \qquad \text{and so} \qquad \frac{x_1}{x_2} = \frac{y_2}{y_1}.$$

The graphs make the difference obvious. Direct proportion is a straight line through the origin. Inverse proportion is a curve that never touches either axis.



Direct proportion



Inverse proportion

Quick test before you calculate

Ask one question: if I double the first quantity, does the second double or halve? Doubles means direct, so keep the quotient. Halves means inverse, so keep the product.

6.4 Workers, Pumps and Provisions

Three standard question types use the constant product rule. Each one is a single equation.

Example 3. 20 workers take 4 days to lay a road. How long do 10 workers take? Fewer workers means more days, so this is inverse. From $x_1 y_1 = x_2 y_2$ we get $20 \times 4 = 10 \times y_2$, so $y_2 = 8$ days.

Example 4. 2 pumps fill a tank in 18 hours. How long do 4 pumps take? $2 \times 18 = 4 \times x$, so $x = 9$ hours.

Example 5. Food lasts 80 students for 15 days. 20 more students join. How long does it last now? The new count is 100, so $80 \times 15 = 100 \times x$ and $x = 12$ days.

Situation	Constant k	Equation	Answer
Workers and days	80	$20 \times 4 = 10 \times y$	8 days
Pumps and hours	36	$2 \times 18 = 4 \times x$	9 hours
Students and days	1200	$80 \times 15 = 100 \times x$	12 days
Machines and days	2646	$42 \times 63 = m \times 54$	49 machines

One line solves it

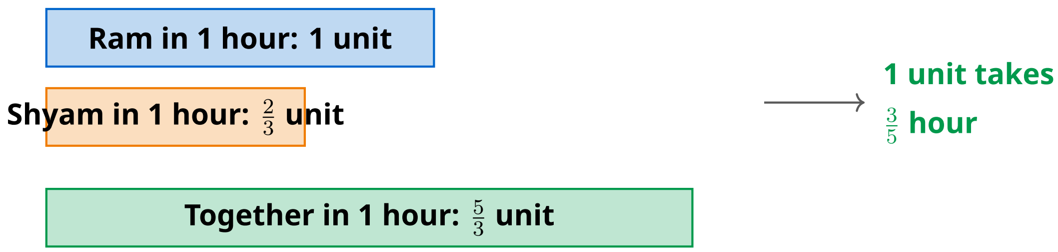
For any inverse question write $x_1y_1 = x_2y_2$ first, fill in the three known numbers, and divide. There is no need to find the factor separately.

6.5 Working Together

When two people work together, add the work each does in one hour. This is the only inverse topic where you must switch to rates first.

Example 6. Ram cuts a quantity of vegetables in 1 hour. Shyam takes 1.5 hours for the same quantity. How long together?

- Ram does 1 unit of work per hour.
- Shyam does $1 \div 1.5 = \frac{2}{3}$ unit per hour.
- Together they do $1 + \frac{2}{3} = \frac{5}{3}$ unit per hour.
- Work and time are directly proportional here, so $\frac{5}{3} : 1 :: 1 : x$.
- Solving gives $x = \frac{3}{5}$ hour, that is 36 minutes.



Direct or inverse in two words

Same way, divide. Direct proportion keeps $x \div y$ fixed.

Opposite way, times. Inverse proportion keeps $x \times y$ fixed.

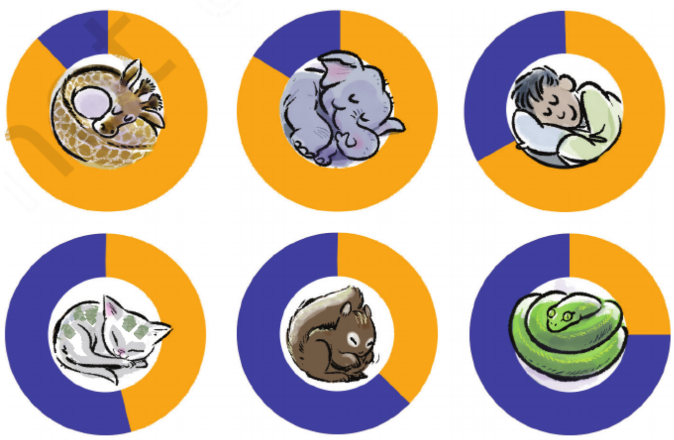
7 Applications and Exam Practice

Proportional reasoning is one of the most used ideas in daily life and in every competitive paper at school level. This section puts the whole chapter to work on the Figure it Out questions and on the traps that cost marks.

7.1 Where This Shows Up Every Day

Ratios quietly run the day. A few examples that match this chapter exactly.

- Cooking: doubling a recipe scales every ingredient by 2.
- Travel: a bus timetable is speed and time in inverse proportion.
- Shopping: unit price is a direct proportion between weight and cost.
- Health charts: sleep hours per animal shown as ring charts.



Average sleep hours for different living beings shown as ring charts. Ganita Prakash, Grade 8, Part 2, Chapter 3.

Each ring is a pie chart of a 24 hour day. A ring that is three quarters shaded means $\frac{3}{4} \times 24 = 18$ hours of sleep. Half shaded means 12 hours, and a quarter means 6 hours.

> **Reading a ring chart**
>
> Ring charts are pie charts with the middle removed, so the angle still carries the meaning. Fitness bands, battery indicators and exam result dashboards all use them. Measure the shaded angle, divide by $360°$, then multiply by the total.

7.2 Solved Practice Set

1. Which pairs are in inverse proportion?

- Taps filling a tank and time taken: inverse.
- Painters hired and days needed: inverse.
- Distance a car travels and petrol in the tank: direct.
- Speed of a cyclist and time for a fixed route: inverse.
- Length of cloth bought and price paid: direct.
- Pages in a book and reading time: direct.

2. If 24 pencils cost ₹120, what do 20 pencils cost? This is direct. One pencil costs $120 \div 24 = ₹5$, so 20 pencils cost $20 \times 5 = ₹100$.

3. Water lasts 20 families 6 days. 10 more families move in. Now 30 families share the same tank, so $20 \times 6 = 30 \times x$ and $x = 4$ days. The assumption is that every family uses the same amount of water each day.

4. Three workers paint a fence in 4 days. One more joins. With 4 workers, $3 \times 4 = 4 \times x$, so $x = 3$ days. We assume all four work at the same rate and never get in each other's way.

5. A pump fills 2 tanks in 6 hours. How long for 5 tanks? More tanks needs more time, so this is direct. One tank takes 3 hours, so 5 tanks take 15 hours.

6. Chairs in 25 rows of 12 are rearranged with 20 per row. The total is $25 \times 12 = 300$ chairs, so the number of rows is $300 \div 20 = 15$ rows.

7. A school of 8 periods of 45 minutes moves to 9 periods. Total teaching time is $8 \times 45 = 360$ minutes. Each new period is $360 \div 9 = 40$ minutes.

8. A small pump fills a tank in 3 hours, a large one in 2 hours. In one hour they fill $\frac{1}{3} + \frac{1}{2} = \frac{5}{6}$ of the tank. So the full tank takes $\frac{6}{5}$ hours, which is 1 hour 12 minutes.

9. A car takes 2 hours at 60 km/h. How long at 80 km/h? The distance is fixed, so $60 \times 2 = 80 \times x$ and $x = 1.5$ hours.

10. Which tables are in inverse proportion? Multiply each pair. A table with one fixed product is inverse. For $x = 40, 80, 25, 16$ with $y = 20, 10, 32, 50$ the products are 800, 800, 800, 800, so it is inverse.

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7.3 Common Mistakes and How to Avoid Them

Most lost marks in this chapter come from six repeat errors. Scan this table the night before the test.

Mistake	Fix
Setting up a direct proportion for an inverse situation	Ask whether the second quantity grows or shrinks before writing anything
Mixing units in a map question	Convert both distances to the same unit first
Dividing the whole by the first term instead of the sum	Add all terms, then find one part
Leaving a pie chart angle unaccounted	Check that all angles total $360°$
Reducing a ratio one term at a time	Divide every term by the same HCF
Adding times instead of adding rates in a work question	Convert to work done in one hour, then add

The 30 second sanity check

Before you write the final answer, ask whether it makes sense. More workers should never give more days. A bigger speed should never give a longer time. If your answer breaks that, you set up the wrong proportion.

8 Quick Reference Summary

Everything in Chapter 3 fits on the next two pages. Use this as your last revision pass before an exam, and check each line against a worked example if you are unsure.

8.1 Formula Sheet

All results in one place

Proportional ratios:

$$a : b :: c : d \iff a \times d = b \times c$$

Multi-term proportion:

$$a : b : c : d :: p : q : r : s \iff \frac{a}{p} = \frac{b}{q} = \frac{c}{r} = \frac{d}{s}$$

Dividing a whole x in the ratio $a : b : c$:

$$x \times \frac{a}{a+b+c}, \quad x \times \frac{b}{a+b+c}, \quad x \times \frac{c}{a+b+c}$$

Pie chart slice:

$$\text{angle} = \frac{\text{part}}{\text{whole}} \times 360^\circ$$

Map scale:

$$\text{ground distance} = \text{map distance} \times \text{RF denominator}$$

Direct proportion:

$$\frac{x_1}{y_1} = \frac{x_2}{y_2} = k$$

Inverse proportion:

$$x_1 y_1 = x_2 y_2 = k$$

8.2 Direct and Inverse at a Glance

Feature	Direct proportion	Inverse proportion
What stays fixed	The quotient $x \div y$	The product $x \times y$
When x doubles	y doubles	y halves
Equation	$\frac{x_1}{y_1} = \frac{x_2}{y_2}$	$x_1 y_1 = x_2 y_2$
Graph	Straight line through origin	Curve away from both axes
Everyday example	Cloth length and cost	Speed and travel time

x **up,** y **up: DIRECT**	x **up,** y **down: INVERSE**
Keep $x \div y$ the same	Keep $x \times y$ the same
Cost, weight, map distance	Speed, workers, pumps

8.3 Last Minute Checklist

Run down this list once. Every tick is a mark saved.

- Ratio terms written in the same order as the names.
- Decimals cleared before reducing to simplest form.
- Map distances and ground distances in matching units.
- Shares added back to check they equal the whole.
- Pie chart angles adding to $360°$.
- Direct or inverse decided before any calculation.
- Work questions converted to work done in one hour.

Five words for the whole chapter

Name, Sum, Part, Multiply, Check. Name the quantities, sum the terms, find one part, multiply each term, then check the total.