LF LearnFrenzy

QUANTITATIVE APTITUDE · FREE STUDY MATERIAL

Speed, Time and Distance

Formulas & Shortcut Tricks

Every important formula, shortcut and exam trick for Speed, Time and Distance in one place – with solved examples, common mistakes and a one-page revision sheet.

WHAT'S INSIDE

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USEFUL FOR

- Bank PO & Clerk (IBPS, SBI, RBI)
- SSC CGL / CHSL / MTS
- Railways (RRB NTPC, Group D)
- Campus placements (TCS, Infosys, Wipro, Accenture)
- UPSC CSAT & state PSC exams

Practise **Speed, Time and Distance** free on LearnFrenzy – questions with instant explanations →

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1 Topic introduction

What it is, why it matters and how it is asked

Speed tells how much distance is covered in one unit of time. Everything in this chapter comes from one relation: Distance = Speed × Time. Keep two of them fixed and the third follows; keep one fixed and the other two are directly or inversely proportional.

Exams then build on this with average speed, late-and-early problems, relative speed for meeting and chasing, stoppages, circular tracks and escalators. Trains, boats and races are the same ideas applied to special situations, so a strong base here pays off in three more chapters.

Why it matters in exams

- Every bank, SSC and railway paper asks 2–4 questions, and the ideas reappear in trains, boats and races.
- Placement tests love relative speed, the $\sqrt{}$ rule after meeting and average-speed traps.
- Distance–time graphs and route maps appear in data interpretation.

Where it is used

- Travel planning: departure time, speed needed, delays.
- Comparing journeys at different speeds and stoppages.
- Sports and fitness: laps, pace and meeting points.

Common question patterns

Conversions
km/h ↔ m/s, minutes ↔ hours.

Average speed
Equal distances, equal times or mixed parts.

Late and early
Two speeds, one late and one early – find the distance.

Speed change
Faster or slower by a fraction – time saved or lost.

Relative speed
Meeting, overtaking and chases with head starts.

After meeting
The $\sqrt{}$ rule for speeds from times after meeting.

Stoppages
Minutes stopped per hour.

Tracks and escalators
Circular tracks, escalators and wheels.

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2 Important formulas

Cards marked MOST USED are the ones to revise first

The basic relation

Distance, speed and time

MOST USED

Distance = Speed × Time; Speed = Distance ÷ Time; Time = Distance ÷ Speed

Units must match: km with hours, metres with seconds.

EXAMPLE 225 km at 45 km/h takes 225 ÷ 45 = **5 hours**.

Unit conversion

MOST USED

km/h → m/s: × 5/18; m/s → km/h: × 18/5

1 km/h = 1,000 m ÷ 3,600 s = 5/18 m/s.

EXAMPLE 72 km/h = 72 × 5/18 = **20 m/s**.

Proportion rules

Same time: distance ∝ speed. Same distance: time ∝ 1/speed

For a fixed journey, the speed ratio is the reverse of the time ratio.

EXAMPLE Speeds 3 : 4 on the same road → times 4 : 3; if the slower takes 20 min more, it takes **80 min**.

Average speed

Average speed

MOST USED

Total distance ÷ total time. Equal distances: 2xy/(x + y). Equal times: (x + y)/2

Never just average the speeds unless the times are equal.

EXAMPLE Equal distances at 30 and 45 km/h → 2 × 30 × 45/75 = **36 km/h**.

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Late, early and speed changes

Late at one speed, early at another

MOST USED

Distance = $S_1 \times S_2/(S_2 - S_1) \times$ (total time difference)

Add the late and early times to get the time difference.

EXAMPLE At 40 km/h 10 min late, at 50 km/h 5 min early → 40 × 50/10 × 1/4 h = **50 km**.

Walking at a fraction of the usual speed

MOST USED

At (a/b) of the usual speed and late by t → usual time = a × t/(b − a)

Time grows to b/a of the usual; the extra part equals the delay.

EXAMPLE At 3/4 of usual speed, 20 min late → usual time = 3 × 20/1 = **60 min**.

Speed up to save time

Speed increased by 1/n → time reduced by 1/(n + 1)

+25% speed (1/4) cuts time by 1/5 = 20%.

EXAMPLE +25% speed saves 12 min → 12 is 1/5 of the usual time → **60 min**.

Relative speed

Moving towards or away

MOST USED

Opposite directions: $S_1 + S_2$. Same direction: $S_1 - S_2$

Imagine one person standing still and the other moving at the relative speed.

EXAMPLE Two cars 360 km apart drive towards each other at 50 and 40 km/h → meet after 360 ÷ 90 = **4 h**.

Chase with a head start

MOST USED

Time to catch = head-start distance/$(S_1 - S_2)$

The gap closes at the difference of the speeds.

EXAMPLE Thief 2 km ahead at 10 km/h, police at 12 km/h → 2 ÷ 2 = **1 h**.

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Speeds from times after meeting

> **If A and B take a and b hours to reach the other's start after meeting: $S_A / S_B = \sqrt{b} / \sqrt{a}$**

The one who takes longer after the meeting is slower.

EXAMPLE After meeting A takes 4 h, B takes 9 h → $S_A : S_B = 3 : 2$.

Stoppages, tracks and wheels

Stoppage time per hour

MOST USED

> **Minutes stopped per hour = (S without stops − S with stops)/S without stops × 60**

The lost speed is the time spent standing still.

EXAMPLE 60 km/h without stops, 45 km/h with stops → 15/60 × 60 = **15 min** per hour.

Circular track

> **First meeting: $L/(S_1 + S_2)$ opposite, $L/(S_1 - S_2)$ same direction. At the start again: LCM of lap times**

On a loop, the faster runner "catches" the slower one after gaining one full lap.

EXAMPLE 400 m track, 5 m/s and 3 m/s in opposite directions → 400 ÷ 8 = **50 s**.

Escalators and walkways

> **Rates add: 1/t(walking on moving) = 1/t(standing) + 1/t(walking on still)**

The escalator and the walker each cover part of the length per second.

EXAMPLE Walking up a moving escalator 20 s, standing 60 s → walking on a stopped one takes **30 s**.

Wheels

> **Distance = revolutions × circumference = revolutions × 2πr**

Use π = 22/7 when the radius is a multiple of 7.

EXAMPLE Radius 35 cm, 1,000 revolutions → 2 × 22/7 × 35 × 1,000 cm = **2.2 km**.

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3 Shortcut tricks & smart techniques

Each trick says when to use it – that matters as much as the trick

Ready conversions

MOST USED

USE WHEN Every question that mixes km/h with metres or seconds.

km/h	m/s	km/h	m/s
18	5	72	20
36	10	90	25
54	15	108	30

EXAMPLE At 54 km/h (15 m/s), 450 m takes 450 ÷ 15 = **30 s**.

Time saved or lost by a speed change

MOST USED

USE WHEN Speed goes up or down by a fraction or percentage.

1. Write the new speed as a fraction of the old: e.g. 6/5 for +20%.
2. Time becomes the reciprocal: 5/6 of the old time.
3. The change in time (1/6 here) equals the minutes saved.

EXAMPLE +20% speed saves 10 min → 1/6 of the usual time = 10 → usual time **60 min**.

Meeting point divides the road in the ratio of speeds

USE WHEN Two people start from opposite ends at the same time.

1. They meet when the total distance is covered.
2. Each covers a share proportional to their speed.

EXAMPLE 450 km apart at 70 and 80 km/h → first car covers 450 × 70/150 = **210 km**.

Relative speed for chases

USE WHEN One starts later or from behind.

1. Find the gap when the chaser starts.
2. Divide by the difference in speeds.

EXAMPLE Thief starts at 8 km/h; police start 15 min later at 10 km/h → gap 2 km → caught after **1 h**, 10 km from the police station.

Square-root rule after meeting

USE WHEN Times taken after the meeting are given.

1. Speed ratio = $\sqrt{}$(time of the other) : $\sqrt{}$(own time).

EXAMPLE After meeting A takes 16 h and B 9 h → $S_A : S_B = 3 : 4$; if A goes at 45 km/h, B goes at **60 km/h**.

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4 Solved examples

The full method on the left, the exam shortcut on the right

1 CONVERSION

A cyclist rides at 54 km/h. How many seconds does he take to cover 450 metres?

STEP BY STEP

1. 54 km/h = 54 × 5/18 = 15 m/s.
2. Time = 450 ÷ 15 = 30 s.

SHORTCUT

54 km/h = 15 m/s (from the table) → 30 s.

Why it works: Metres and seconds need the speed in m/s.

Answer: 30 seconds

2 AVERAGE SPEED

A man travels from P to Q at 30 km/h and returns at 45 km/h. What is his average speed for the round trip?

STEP BY STEP

1. Let PQ = 90 km: times 3 h and 2 h.
2. Average = 180 ÷ 5 = 36 km/h.

SHORTCUT

2 × 30 × 45 ÷ 75 = 36.

Why it works: He spends longer at the slower speed, so the average is below 37.5.

Answer: 36 km/h

3 LATE AND EARLY

Walking at 5 km/h, a student reaches school 7 minutes late; at 6 km/h he is 5 minutes early. How far is the school?

STEP BY STEP

1. Time difference = 7 + 5 = 12 min = 1/5 h.
2. d/5 − d/6 = 1/5 → d/30 = 1/5.
3. d = 6 km.

SHORTCUT

5 × 6 ÷ 1 × 1/5 = 6.

Why it works: The two travel times differ by the late plus the early minutes.

Answer: 6 km

4 FRACTION OF SPEED

Walking at 4/5 of her usual speed, a woman is 15 minutes late. What is her usual time for the walk?

STEP BY STEP

1. Time becomes 5/4 of the usual → the extra 1/4 equals 15 min.
2. Usual time = 4 × 15 = 60 min.

SHORTCUT

a × t ÷ (b − a) = 4 × 15 ÷ 1 = 60.

Why it works: Speed and time are inverse for a fixed distance.

Answer: 60 minutes

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5 MEETING

Two cars start at the same time from towns 450 km apart and drive towards each other at 70 km/h and 80 km/h. After how long do they meet?

STEP BY STEP

1. Relative speed = 70 + 80 = 150 km/h.
2. Time = 450 ÷ 150 = 3 h.

SHORTCUT

Opposite directions → add speeds → 3 h (meeting 210 km from the first town).

Why it works: Together they close the gap at the sum of their speeds.

Answer: 3 hours

6 CHASE

A thief runs at 8 km/h. A policeman starts chasing 15 minutes later at 10 km/h. How far does the policeman run before catching the thief?

STEP BY STEP

1. Head start = 8 × 1/4 = 2 km.
2. Gap closes at 10 − 8 = 2 km/h → 1 hour.
3. Policeman runs 10 × 1 = 10 km.

SHORTCUT

Gap ÷ difference = 1 h → 10 km.

Why it works: The policeman only gains 2 km every hour.

Answer: 10 km

7 AFTER MEETING

A and B start towards each other at the same time. After meeting, A takes 16 hours and B 9 hours to reach the other's starting point. A's speed is 45 km/h. What is B's speed?

STEP BY STEP

1. $S_A / S_B = \sqrt{(9)} / \sqrt{(16)} = 3/4$.
2. $S_B = 45 \times 4/3 = 60$ km/h.

SHORTCUT

$\sqrt{}$ of the other's time over $\sqrt{}$ of own time → 3 : 4.

Why it works: Each covers, after the meeting, the distance the other covered before it.

Answer: 60 km/h

8 STOPPAGES

A bus averages 54 km/h without stoppages and 45 km/h with stoppages. For how many minutes per hour does it stop?

STEP BY STEP

1. Speed lost = 9 km/h.
2. Time for 9 km at 54 km/h = 9/54 h = 10 min.

SHORTCUT

(54 − 45) ÷ 54 × 60 = 10.

Why it works: In each hour the bus covers 9 km less because it is standing still.

Answer: 10 minutes

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9 CIRCULAR TRACK

A and B run on a 600 m circular track in the same direction at 4 m/s and 6 m/s, starting together. When does B first overtake A? Give the answer in minutes.

STEP BY STEP

1. B gains 2 m every second.
2. To lap A, B must gain 600 m → 300 s.
3. 300 s = 5 minutes.

SHORTCUT

$L \div (S_1 - S_2) = 600 \div 2 = 300$ s.

Why it works: Overtaking on a loop means gaining one full lap.

Answer: 5 minutes

10 SPEED INCREASE

By increasing his speed by 20%, a driver reaches 10 minutes earlier than usual. What is his usual time?

STEP BY STEP

1. New speed = 6/5 of usual → new time = 5/6 of usual.
2. Saving = 1/6 of usual time = 10 min.
3. Usual time = 60 min.

SHORTCUT

+1/5 speed → −1/6 time → 10 × 6 = 60.

Why it works: Time is inversely proportional to speed.

Answer: 60 minutes

11 WHEELS

A wheel of diameter 1.4 m rolls along a road. How many revolutions does it make in 4.4 km?

STEP BY STEP

1. Circumference = π × 1.4 = 22/7 × 1.4 = 4.4 m.
2. Revolutions = 4,400 ÷ 4.4 = 1,000.

SHORTCUT

Distance ÷ circumference = 4,400 ÷ 4.4.

Why it works: Each revolution moves the wheel forward by one circumference.

Answer: 1,000

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5 Important exam tips

Patterns, traps and habits that save marks

Frequently asked question patterns

- Conversions with average speed of a round trip.
- Late at one speed, early at another.
- Usual time from a fraction of the usual speed.
- Meeting and chasing with relative speed.
- The $\sqrt{}$ rule after meeting.
- Stoppage minutes per hour.
- Circular tracks, escalators and wheel revolutions.

Common mistakes to avoid

- Mixing km/h with metres or seconds.
- Averaging two speeds directly for equal distances.
- Using only the late minutes (or only the early minutes) instead of their sum.
- Adding speeds for a chase in the same direction.
- Writing the $\sqrt{}$ rule upside down – the one with the longer time is slower.
- Forgetting the head start when the chaser starts later.

Points to remember

- D = S × T; km/h × 5/18 = m/s.
- Same distance → time $\propto$ 1/speed.
- Equal distances average speed = 2xy/(x + y).
- Opposite: add speeds; same direction: subtract.
- Speed +1/n → time −1/(n + 1).

Speed and accuracy

- Learn the km/h–m/s table by heart.
- Work with fractions of time instead of equations for speed changes.
- Draw a quick line diagram for meeting and chasing questions.
- Check answers by plugging back into D = S × T.

Preparation strategy

- Master D = S × T, conversions and relative speed before the special cases.
- Practise on LearnFrenzy in order: Easy → Medium → Hard → Exam Pattern Mix → Diagram-Based → Data Sufficiency.
- Aim for 45 seconds per speed question.
- Keep an error log of unit and relative-speed mistakes.
- Read the Quick Revision Sheet (next page) the night before the exam.

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6 Quick revision sheet

Everything on one page for the night before the exam

Formulas

Distance	**speed × time**	km/h → m/s	**× 5/18**
m/s → km/h	**× 18/5**	Same distance	**time ∝ 1/speed**
Average (equal d)	**2xy/(x + y)**	Average (equal t)	**(x + y)/2**
Late / early	**$S_1S_2/(S_2 - S_1) \times \Delta t$**	a/b of speed, late t	**usual = at/(b − a)**
Speed +1/n	**time −1/(n + 1)**	Opposite directions	**$S_1 + S_2$**
Same direction	**$S_1 - S_2$**	Chase	**gap/($S_1 - S_2$)**
After meeting	**$S_A : S_B = \sqrt{b} : \sqrt{a}$**	Stoppage min/h	**$(S_1 - S_2)/S_1 \times 60$**
Track (same dir.)	**$L/(S_1 - S_2)$**	Wheel	**rev × 2πr**

Shortcut tricks

- 18 → 5, 36 → 10, 72 → 20.
- Late + early = time difference.
- Meeting share ∝ speed.
- Chase: gap ÷ speed difference.
- √ rule: longer time → slower.
- Overtake on a loop = gain one lap.

Must-know numbers

km/h → m/s	18 → 5 · 36 → 10 · 54 → 15 · 72 → 20 · 90 → 25 · 108 → 30
Speed up → time down	+25% → −20% · +20% → −16.67% · +50% → −33.33% · +100% → −50%

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7 A message from LearnFrenzy

For everyone preparing for placements, competitive and government exams

Keep going – you are closer than you think

Success in examinations is not just about how many hours you study. It is about how effectively you understand concepts, practise questions, and improve yourself every day.

Every formula you learn, every problem you solve, and every mistake you correct brings you one step closer to your goal.

Whether you are preparing for campus placements, competitive examinations, or government jobs, remember that consistency, confidence, and smart preparation make a real difference.

Don’t just memorize formulas. Understand the concepts, practise smart techniques, and develop the confidence to solve problems independently.

Your hard work today can create the opportunities you dream of tomorrow.

— Team LearnFrenzy

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