

Speed, Time & Distance

Introduction & Concept

Speed Distance Time is one of the most popular and important topics in the Mathematics or Quants section of any competitive exam. The concept of Speed, Time and Distance is used extensively for questions relating to different topics such as motion in a straight line, circular motion, boats and streams, races, clocks, etc. Aspirants should try to understand the inter-relationship between the factors speed, distance and time.

Relationship Between Speed, Time & Distance

1. **Speed = Distance/Time** - This tells us how slow or fast an object moves. It describes distance travelled divided by the time taken to cover the distance.
2. Speed is directly Proportional to Distance and Inversely proportional to Time, Hence,
3. **Distance = Speed X Time**, and
4. **Time = Distance / Speed**, as the speed increases the time taken will decrease and vice versa.

Using these formulas any basic problems can be solved, however, the correct usage of units is also an important thing to consider while using formulas.

Units of Speed Time & Distance

Each of Speed, Distance and Time can be expressed in different units:

Time: seconds(s), minutes (min), hours (hr)

Distance: (meters (m), kilometers (km), miles, feet

Speed: m/s, km/hr

So if Distance = km and Time = hr, then as Speed = Distance/ Time; the units of Speed will be km/ hr. Now that the units of Speed, Time and Distance is clear, let us understand the conversions related to these.

Interested aspirants can also check the links given below and strengthen their preparation for the quantitative aptitude section:

Data Sufficiency	Data Interpretation	Quadratic Equations
Pipes and Cistern	Mixture & Alligation	Problems on Trains

Speed, Time & Distance Conversions

- To convert from km / hour to m / sec, we multiply by 5 / 18. So, 1 km / hour = 5 / 18 m / sec
- To convert from m / sec to km / hour, we multiply by 18 / 5. So, 1 m / sec = 18 / 5 km / hour = 3.6 km / hour

- Similarly, 1 km/hr = 5/8 miles/hour
- 1 yard = 3 feet
- 1 kilometer = 1000 meters = 0.6214 mile
- 1 mile = 1.609 kilometer
- 1 hour = 60 minutes = 60*60 seconds = 3600 seconds
- 1 mile = 1760 yards
- 1 yard = 3 feet
- 1 mile = 5280 feet
- 1 mph = $(1 \times 1760) / (1 \times 3600) = 22/45$ yards/sec
- 1 mph = $(1 \times 5280) / (1 \times 3600) = 22/15$ ft/sec
- For a certain distance, if the ratio of speeds is a : b, then the ratio of times taken to cover the distance would be b : a and vice versa.

Application of Speed, Time & Distance

Given below are a few subheads under the Speed, Time and Distance topics that tell us the basis of the variety of questions asked in the examination.

1. Average Speed

Average Speed = (Total distance traveled)/(Total time taken)

Case 1 - When the distance is constant: **Average speed = $2xy/x+y$** ; Where, x and y are the two speeds at which the same distance has been covered.

Case 2 - When time taken is constant: **Average speed = $(x + y)/2$** ; Where, x and y are the two speeds at which we traveled for the same time.

Examples:

Q1. A person travels from one place to another at 30 km/hr and returns at 120 km/hr. If the total Time taken is 5 hours, then find the Distance.

Solutions:

Here the Distance is constant, so the Time taken will be inversely proportional to the Speed. Ratio of Speed is given as 30:120, i.e. 1:4

So the ratio of Time taken will be 4:1.

Total Time taken = 5 hours; Time taken while going is 4 hours and returning is 1 hour.

Hence, Distance = $30 \times 4 = 120$ km

Q.2. Traveling at 3/4th of the original Speed a train is 10 minutes late. Find the usual Time taken by the train to complete the journey?

Solutions:

Let the usual Speed be S1 and usual Time be T1. As the Distance to be covered in both the cases is same, the ratio of usual Time to the Time taken when he is late will be the inverse of the usual Speed and the Speed when he is late

If the Speed is $S_2 = \frac{3}{4}S_1$ then the Time taken $T_2 = \frac{4}{3}T_1$ Given $T_2 - T_1 = 10 \Rightarrow \frac{4}{3}T_1 - T_1 = 10 \Rightarrow T_1 = 30$ minutes.

2. Inverse Proportionality of Speed & Time

Speed is inversely proportional to Time when the Distance is constant. S is inversely proportional to $1/T$ when D is constant. If the Speeds are in the ratio $m : n$ then the Time taken will be in the ratio $n : m$.

There are two methods to solve questions:

- Using Inverse Proportionality
- Using Constant Product Rule

Example:

Q1. After traveling 50km, a train is meeting with an accident and travels at $(3/4)$ th of the usual Speed and reaches 45 min late. Had the accident happened 10km further on it would have reached 35 min late. Find the usual Speed?

Solutions:

Using Inverse Proportionality Method

Here there are 2 cases

Case 1: accident happens at 50 km

Case 2: accident happens at 60 km

Difference between two cases is only for the 10 kms between 50 and 60. Time difference of 10 minutes is only due to these 10 kms.

In case 1, 10 kms between 50 and 60 is covered at $(3/4)$ th Speed.

In case 2, 10 kms between 50 and 60 is covered at usual Speed.

So the usual Time " t " taken to cover 10 kms, can be found out as below. $4/3 t - t = 10 \text{ mins} \Rightarrow t = 30 \text{ mins}$, $d = 10 \text{ kms}$

so usual Speed = $10/30\text{min} = 10/0.5 = 20 \text{ km/hr}$

Using Constant Product Rule Method

Let the actual Time taken be T

There is a $(1/4)$ th decrease in Speed, this will result in a $(1/3)$ rd increase in Time taken as Speed and Time are inversely proportional

(A $1/x$ increase in one of the parameters will result in a $1/(x+1)$ decrease in the other parameter if the parameters are inversely proportional) The delay due to this decrease is 10 minutes

Thus $1/3 T = 10$ and $T = 30 \text{ minutes}$ or $1/2 \text{ hour}$

Also, Distance = 10 km

Thus Speed = 20 kmph

3. Meeting Point Questions

If two people travel from two points A and B towards each other, and they meet at point P. The total Distance covered by them on the meeting will be AB. The Time taken by both of them to meet will be the same. As the Time is constant, Distances AP and BP will be in the ratio of their Speed. Say that the Distance between A and B is d .

If two people are walking towards each other from A and B, When they meet for the first Time, they together cover a Distance “d” When they meet for the second Time, they together cover a Distance “3d” When they meet for the third Time, they together cover a Distance of “5d”

Example:

Q1. Amit and Aman have to travel from Delhi to Jaipur in their respective cars. Amit is driving at 60 kmph while Aman is driving at 90 kmph. Find the Time taken by Aman to reach Jaipur if Amit takes 9 hrs.

Solutions:

As the Distance covered is constant in both the cases, the Time taken will be inversely proportional to the Speed. In the problem, Speed of Amit and Aman is in ratio 60: 90 or 2:3.

So the ratio of the Time taken by Amit to that taken by Aman will be in the ratio 3:2. So if Amit takes 9 hrs, Aman will take 6 hrs.

Candidates can go through a few other quantitative aptitude related links given below to excel in the upcoming Government exams:

Problems on Age	Approximation and Simplification	Number Series
Boat and Stream	Shortcut Tricks for Cube, Square and Multiplication	Maths Tricks for Competitive Exams

Sample Questions on Speed, Time & Distance

All the hard work can go in vain if the candidate does not solve questions based on Speed, time and distance on a regular basis and try using the different formulas to solve each question in an even shorter time span.

Hence, discussed below are a few sample questions on Speed, Time and Distance to give an idea as to what type of questions are asked in the competitive exam and what format and pattern is used for the same.

Q.1. A man travels from his home to office at 4km/hr and reaches his office 20 min late. If the Speed had been 6 km/hr he would have reached 10 min early. Find the Distance from his home to office?

1. 8 km
2. 12 km
3. 6 km
4. 9 km

Answer (3) 6 km

Solutions:

Let the Distance between home and office =d Suppose he reaches the office on Time, the Time taken = x minutes

Case 1: When he reaches office 20 minutes late,
Time taken = x+20

Case 2: when he reaches office 10 minutes early,

Time taken = $x-10$ As the Distance traveled is the same, the ratio of Speed in case 1 to the Speed in case 2 will be the inverse of the Time taken in both cases Ratio of Speed in both cases = $4:6 = 2:3$ Ratio of Time in both cases = $3:2$ Therefore $(x+20)/(x-10)=3/2$ $2x+40 = 3x -30$ $x= 70$ minutes Taking case 1, $4= d/(90/60) \Rightarrow d= 360/60 = 6$ km

Q.2. Ram can row a boat in still water at 10 kmph. He decides to go boating in a river. To row upstream he takes 2 hours and to row downstream he takes $1\frac{1}{2}$ hours. Find the Speed of the river.

1. $10/7$ kmph
2. $11/5$ kmph
3. $9/7$ kmph
4. $13/5$ kmph

Answer (1) $10/7$ kmph

Solutions:

Suppose the Speed of the river is 'y' kmph.

While rowing upstream he takes 2 hrs and while rowing downstream he takes $1\frac{1}{2}$ hours.

As the Distance covered is constant the ratio of the net Speeds of the boat while going upstream and downstream will be the inverse of the ratio of the Time taken.

Ratio of Time taken (downstream: upstream) = $1.5/2 = 3/4$

So the ratio of Speed of boat (downstream: upstream) = $4/3$

Speed downstream: $10 + y$ Speed upstream : $10 - y$

$(10+y)/((10-y)) = 4/3$

$30+3y=40-4y$. Thus, $7y=10$ & $Y=10/7$

Speed of river = $10/7$ kmph

Q.3. Ram and Shyam are standing at two ends of a room with a width of 30 m. They start walking towards each other along the width of the room with a Speed of 2 m/s and 1 m/s respectively. Find the total distance travelled by Ram when he meets Shyam for the third Time.

1. 110 m
2. 112 m
3. 120 m
4. 100 m

Answer (4) 100 m

Solution:

When Ram meets Shyam for the third time, they together would have covered a Distance of $5d$, i.e $5 \times 30m = 150$ m.

The ratio of Speed of Ram and Shyam = $2:1$, so the total distance travelled by them will also be in the ratio $2:1$ as the Time taken is constant.

So the Distance travelled by Ram will be $2/3 \times 150 = 100$ m

Q.4. A man decided to cover a distance of 6 km in 84 minutes. He decided to cover two thirds of the distance at 4 km / hr and the remaining at some different speed. Find the speed after the two third distance has been covered.

1. 5 kmph
2. 7 kmph

3. 9 kmph
4. 3 kmph

Answer (1) 5 kmph

Solution:

We are given that two thirds of the 6 km was covered at 4 km / hr i.e. 4 km distance was covered at 4 km / hr. Time taken to cover 4 km = $4 \text{ km} / 4 \text{ km / hr} = 1 \text{ hr} = 60 \text{ minutes}$

Time left = $84 - 60 = 24 \text{ minutes}$

Now, the man has to cover remaining 2 km in 24 minutes or $24 / 60 = 0.4 \text{ hours}$

Speed required for remaining 2 km = $2 \text{ km} / 0.4 \text{ hr} = 5 \text{ km / hr}$

Q.5. While going to office, Ramesh travels at a speed of 30 kmph and on his way back, he travels at a speed of 45 kmph. What is his average speed of the whole journey?

1. 45 kmph
2. 36 kmph
3. 32 kmph
4. 42 kmph

Answer (2) 36 kmph

Solution:

When distance travelled is same, then average speed = $2ab / (a+b)$; (where a and b are two different speeds) therefore,

The Average Speed = Therefore, Average Speed = $2 \times 45 \times 30 / 45 + 30$, solving this we get 36 kmph.

Candidates willing to apply for various government exams can check the detailed syllabus of respective exams given below:

[Bank Exam Syllabus](#)

[SSC Syllabus](#)

[RRB Syllabus](#)