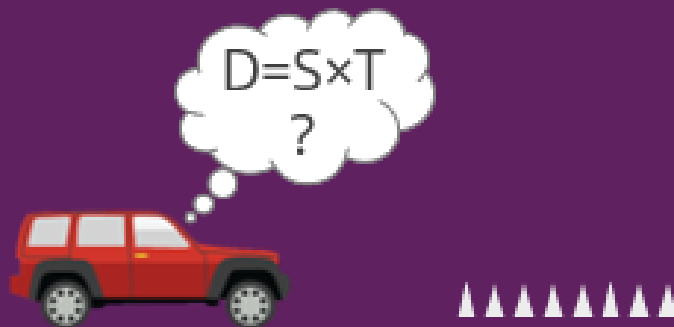
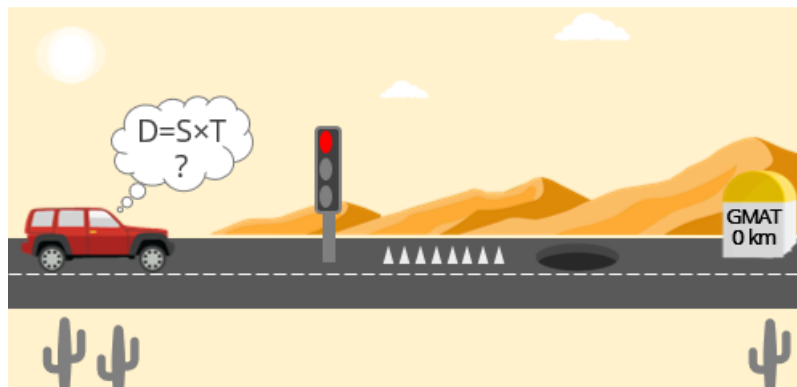




3 common mistakes you must avoid in Distance questions



3 common mistakes you must avoid in Distance questions



This is the 2nd and the final article on the topic Distance, Speed, and Time. If you have not read the previous article, we recommend you read that first before going through this article.

To read the article: [Application of Average Speed in Distance problems](#)

Highlights of the previous article

In the previous article, we discussed:

- Theoretical concepts of Average Speed
- Relevant examples to reinforce the learning of theoretical concepts
- Important formulas and takeaways

Objective of this article

The primary objective of this article is to cite 3 most common mistakes done by students while solving problems on Distance, Time and Speed. We will demonstrate them with different examples on each type.

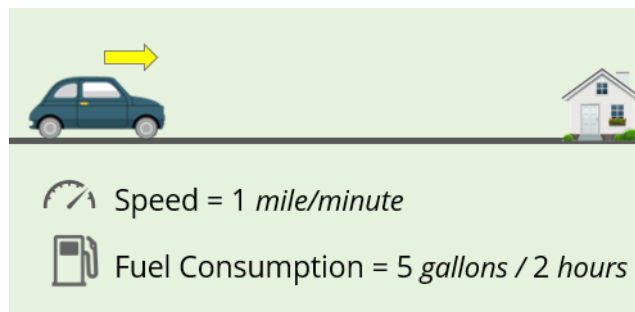
Common mistake type 1: Incorrect or missing unit conversion

Example 1

[e-GMAT](#) example with explanation

- ❓ During a certain time period, Car X travelled north along a straight road at a constant rate of 1 mile per minute and used fuel at a constant rate of 5 gallons every 2 hours. During this time period, if Car X used exactly 3.75 gallons of fuel, how many miles did Car X travel?

⚙️ **Solution:**



Common approach used by students – 1:

In this question, we need to find out how many miles did Car X travel.

To find the distance covered, we have the following information given:

- The Car used exactly 3.75 gallons of fuel in this time period
- The Car used fuel at a constant rate of 5 gallons every 2 hours
- Also, the Car travelled at a constant rate of 1 mile per minute

We already know the fuel consumption rate and the total fuel consumption of the car. Therefore, we can divide the total fuel consumption by the rate of fuel consumption to find out the time taken to complete the journey.

- The journey time = $\frac{3.75}{5} = 0.75$ hrs

Multiplying the journey time by the speed, we can calculate the distance

- Journey distance = $0.75 \times 1 = 0.75$ miles

If you have got 0.75 miles as the answer, then you have solved it incorrectly.

Let's see another approach done by students while solving this question:

Common approach used by students – 2:

In this question, we need to find out how many miles did Car X travel.

To find the distance covered, we have the following information given:

- The Car used exactly 3.75 gallons of fuel in this time period
- The Car used fuel at a constant rate of 5 gallons every 2 hours

This indicates, the rate of consumption is 2.5 gallons per hour

- Also, the Car traveled at a constant rate of 1 mile per minute

We already know the fuel consumption rate and the total fuel consumption of the car. Therefore, we can divide the total fuel consumption by the rate of fuel consumption to find out the time taken to complete the journey.

- The journey time = $\frac{3.75}{2.5} = 1.5$ hrs

Multiplying the journey time by the speed, we can calculate the distance

- Journey distance = $1.5 \times 1 = 1.5$ miles

If you have got 1.5 miles as the answer, then you have solved it incorrectly.

The mistakes and the correct approach

If we observe closely, there have been no difference in terms of the procedures of both the solutions – conceptually both the processes are correct. However, the answers are different because of wrong interpretation of the given values.

Error 1: Given that the Car used fuel at a constant rate of 5 gallons every 2 hours, first we need to calculate the fuel consumption rate per hour.

As the Car used 5 gallons every 2 hours, the rate of fuel consumption (i.e. fuel consumption in every hour) = $\frac{5}{2}$ gallons per hour = 2.5 gallons per hour

- Therefore, the journey time = $\frac{3.75}{2.5}$ hrs = 1.5 hrs

Error 2: In the 2nd approach, the rate of fuel consumption has been calculated correctly. But while calculating the distance, the speed of the car is applied incorrectly in both the methods.

- Given that the speed of the car is 1 mile per minute
 - It means the speed of the car is 60 miles per hour

We need to convert the speed into miles per hour, as the journey time has been calculated in hours.

In an opposite way, we could have taken the speed in mile per minute also, in that case we need to convert the total journey time in minutes.

Final Answer: As we have already calculated the speed as 60 miles per hour and the journey time as 1.5 hrs,

- The total distance traveled = 60×1.5 miles = 90 miles

Key Takeaway

While considering any of the values of speed, distance, and time for calculation, make sure the units of all of them are same. Otherwise, it will lead to incorrect calculation.

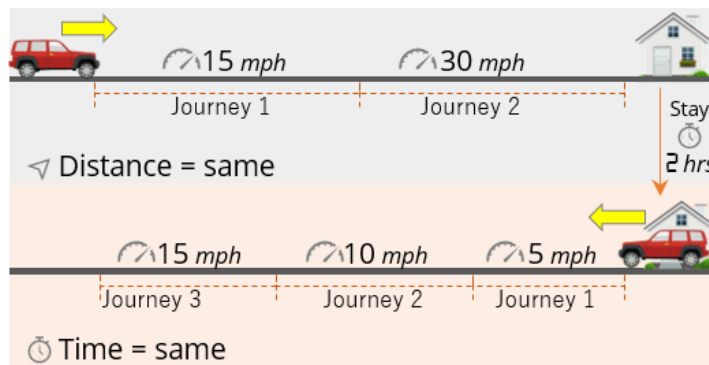
Common mistake type 2: Calculation of Average Speed, without considering everything into account

Example 2

[e-GMAT](#) example with explanation

? Last Sunday, Archie visited his friend Veronica who lives at 90 miles from his place. He divided his onward and return journey in different manner. He reached Veronica's place by dividing the total distance in two equal part, at a speed of 15 mph and 30 mph respectively. He stayed there for 2 hours and took the return journey via the same path by dividing the total journey time in three equal parts, at a speed of 5 mph, 10 mph, and 15 mph respectively. If x , y , and z denote the average speed of his onward, return, and overall journey respectively, what is the value of $x + y + z$?

Solution:



In this question, we need to find out Archie's average speed in his onward journey, return journey, and his whole journey. For that, we need to know the following:

- Total distance traveled, and the total time taken
- Individual distances for both onward and return journey
- Individual time taken for both onward and return journey

Now as it is given that Veronica lives at a distance of 90 miles from Archie's place, we can say for the to-and-fro journey, total distance covered = $(90 + 90)$ miles = 180 miles, whereas the individual distances at onward and return journey will be 90 miles each.

As we already have the value of the total distance, we need to find out the total travel time only.

Common approach used by students – 1:

- In the onward journey, the whole distance is covered in two parts, at a speed of 15 mph and 30 mph respectively
Therefore, the average speed in the onward journey = $\frac{(15+30)}{2}$ mph = 22.5 mph
- Similarly, in the return journey, the whole journey time is divided in three equal parts, at a speed of 5 mph, 10 mph, and 15 mph respectively.
Therefore, the average speed of the return journey = $\frac{(5+10+15)}{3}$ mph = 10 mph

Hence the overall average speed = $\frac{(22.5+10)}{2}$ mph = 16.25 mph

If you have got 22.5 mph and 16.25 mph as the average speed in the onward journey and overall journey respectively, then you have solved it incorrectly.

Common approach used by students – 2:

It is given that, in the onward journey the distance is divided into two equal parts.

As the total onward journey distance is 90 miles, each part has a distance of 45 miles.

- The first half of 45 miles distance is covered at a speed of 15 mph, therefore, the time taken to cover that distance = $\frac{45}{15}$ hrs = 3 hrs
- The second half of 45 miles distance is covered at a speed of 30 mph, therefore, the time taken to cover that distance = $\frac{45}{30}$ hrs = 1.5 hrs

Therefore, total journey time in the onward travel = (3 + 1.5) hrs = 4.5 hrs

So, the average speed in the onward journey = $\frac{90}{4.5}$ mph = 20 mph

Similarly, in the return journey, the time taken is divided into 3 equal parts.

Therefore, total time of 4.5 hrs is divided into 1.5 hrs each, which is covered at an individual speed of 5 mph, 10 mph, and 15 mph respectively.

So, the average speed in the return journey = $90/(1.5+1.5+1.5)$ mph = 20 mph

And, also the average speed of the overall journey = $(90+90)/(4.5+4.5)$ mph = 20 mph

Again, if you have calculated 20 mph as the average speeds, then your answer is incorrect.

The mistakes and the correct approach:

In both the examples given above, the calculation of average speed is done with some wrong interpretation of the concept and formula. Let us look at the important formula first which are related to average speed, and the conditions applicable behind the validity of those formula:

$$\bullet \text{ Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken to travel that distance}}$$

We know that, if the **journey distance is divided into two equal parts**, with each part is divided in **individual speeds a and b** respectively, then the overall average speed of the journey = $\frac{2ab}{(a+b)}$

Similarly, If the **journey time is divided into n number of equal time slots**, with each time slot is being covered at different individual speed, then the **average speed** of the journey is calculated by the **arithmetic mean of all the individual speeds**.

	Case 1	Case 2
Distance	Same	Different
Time	Different	Same
Average Speed	$\frac{2ab}{(a+b)}$	$\frac{(x+y)}{2}$

With these understandings, let's look at the errors mentioned in the demonstrated examples:

Error 1: In the 1st onward journey, the onward distance is covered in two equal journey distances, at a speed of 15 mph and 30 mph respectively. Therefore, the average speed should not be calculated by taking the average of their individual speeds. As per point 2 above, we can calculate the average speed by using the $\frac{2ab}{(a+b)}$ formula.

Also, one cannot calculate the overall average speed by taking the arithmetic mean of the individual average speeds.

Error 2: Although it was mentioned that the return journey is divided into 3 equal time slots, it was incorrectly assumed that the total time taken in the return journey was same as that of onward journey.

Error 3: While calculating the overall average speed, none of the time the stay time of 2 hours is taken into account.

Final Answer: Rectifying all the errors mentioned above, we can say:

- Average speed in the onward journey = $x = \frac{2 \times 15 \times 30}{15 + 30}$ mph = 20 mph
- Average speed in the return journey = $y = \frac{5 + 10 + 15}{3}$ mph = 10 mph
- Total travel time in the onward journey = $\left(\frac{45}{15}\right) + \left(\frac{45}{30}\right)$ hrs = 3 + 1.5 hrs = 4.5 hrs
- Total travel time in the return journey = $90 \times \frac{3}{5 + 10 + 15}$ hrs = 9 hrs

As Archie had a stay of 2 hours at Veronica's place, the overall journey time = (4.5 + 2 + 9) hours = 15.5 hours

Therefore, the average speed in the overall journey = $z = \frac{180}{4.5 + 2 + 9}$ mph = $\frac{180}{15.5}$ mph = 11.6 mph

Note that, while calculating the overall average speed, we must consider the 2 hours' stoppage time also. However, if we consider the onward journey and the return journey separately, we don't need to consider the stoppage time as there were no stoppages during the onward or journey.

Hence, the value of $x + y + z = 20 + 10 + 11.6 = 41.6$

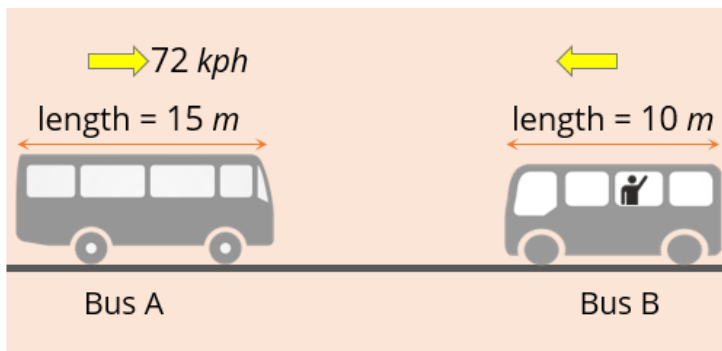
Common mistake type 3: Missing the detail information in the question

Example 3

[e-GMAT](#) example with explanation

- ❓ Two buses A and B are of length 15 m and 10 m respectively, and the speed of bus A is 72 kph. If bus A takes $\frac{1}{2}$ second to cross the sole passenger sitting inside bus B when they are moving towards each other from opposite direction, find the time taken by bus A to overtake bus B?

⚙️ **Solution:**



In this question, we need to find out the time taken by bus A to overtake bus B.

In order to find that out, we need the following information:

- Length of bus A
- Speed of bus A
- Length of bus B
- Speed of bus B

Now, from the information given in the question, we already have length of both A and B as well as speed of A.

- Length of A = 15 m
- Length of B = 10 m
- Speed of A = 72 kph = 20 m/s

Let's assume speed of B is x m/s

Common approach used by students:

- It is given that bus A takes $\frac{1}{2}$ second to cross the sole passenger sitting inside bus B when they are moving towards each other from opposite direction.

We know that if two bodies are moving from opposite direction towards each other, their relative speed should be the sum of their individual speed.

- Therefore, the relative speed of bus A and B = $(20 + x)$ m/s
- Distances covered by them = sum of their individual lengths = $(15 + 10)$ m = 25 m
- We know, speed = distance/time
So, we can write, $20 + x = \frac{25}{(\frac{1}{2})}$
- Or, $20 + x = 50$
Or, $x = 30$ m/s
- Therefore, speed of bus B is 30 m/s

If you also have the same value for the speed of bus B, then your answer is incorrect. You have missed a very small detail in the question statement.

The mistakes and the correct approach:

Error: If you look at the question carefully, you can see it asks the time taken for **bus A to overtake bus B**. It clearly indicates the speed of bus A must be greater than the speed of bus B.

Therefore, speed of bus B cannot be equal to 30 m/s, as it is already given that speed of bus A is 20 m/s.

The error lies in the interpretation of the question statement: "*If bus A takes $\frac{1}{2}$ second to cross the sole passenger sitting inside bus B...*".

Understand that here **bus A is not crossing the whole bus B, but it is only crossing the sole passenger sitting inside bus B**. The length of the passenger is negligible compared to bus's length, but the passenger is moving at the same speed as bus B's speed.

Therefore, when we are calculating the value of x , we need to consider only the length of bus A, and we do not need to consider the length of bus B.

Hence, the correct equation will be as follows:

- Relative speed of bus A and B = $(20 + x)$ m/s
- Distances covered by them = length of bus A = 15 m
- Speed = distance/time
Or, $20 + x = 15/(1/2)$
Or, $20 + x = 30$
Or, $x = 10$ m/s

Therefore, speed of bus B is 10 m/s

$$\text{So, the time taken by bus A to overtake bus B} = \frac{(15+10)}{(20 - 10)} \text{ secs} = \frac{25}{10} \text{ secs} = 2.5 \text{ secs}$$

Key Takeaway

Interpretation of every statement given in the question needs to be done very carefully, as not looking into detailing may lead to different results.

Key Takeaways from the article

- While solving a question, one must look into the units of all the given parameters. In the question, units may be given in different measures, one must convert all of them in same measure before doing the calculation.
- While calculating average speed of a journey, one must consider the stoppage or halt times, if any, within the journey time. The final journey time should include all those components of time within the journey.
- While solving a question, one must look into the details of the given information. Ignoring details may lead into wrong interpretation of the question stem, which may result in incorrect answer.

Upcoming e-GMAT articles on Time and Work

Next week we will come up with a new article in the Time and Work topic.

In that article, we are going to discuss **The application of LCM to solve Time and Work problems**



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