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Understanding how to calculate average speed is fundamental in both everyday life and various fields such as transportation, logistics, and physics. Whether you're a student tackling a mathematics problem or a traveler trying to estimate your journey time, knowing how to determine average speed empowers you with practical knowledge. In this article, we will explore the problem: A car travels $30 \frac{1}{5}$ miles in $\frac{2}{3}$ of an hour, and we need to find its average speed in miles per hour. We will provide a detailed step-by-step solution, explain relevant concepts, and offer useful tips for solving similar problems.

Understanding the Problem

The problem states that a car covers a distance of " $30 \frac{1}{5}$ miles" in " $\frac{2}{3}$ of an hour." Our goal is to find the average speed of the car in miles per hour (mph). To do this effectively, it's essential to understand the key components involved:

- Distance traveled: $30 \frac{1}{5}$ miles
- Time taken: $\frac{2}{3}$ hour
- Required: Average speed in mph

Before diving into calculations, let's clarify what each term means and how they relate to each other.

Key Concepts: Speed, Distance, and Time

Understanding the relationship between speed, distance, and time is fundamental:

- Speed (mph): How fast an object is moving, calculated as distance divided by time.
- Distance (miles): The length of the path traveled.

- Time (hours): The duration taken to travel the distance.

The basic formula connecting these quantities is:

$$\text{Speed} = \text{Distance} / \text{Time}$$

Using this formula, if we know any two of the variables, we can find the third.

Step-by-Step Solution to Find the Average Speed

Let's now proceed with the problem step by step.

Step 1: Convert the Distance from Mixed Number to Improper Fraction

The distance given is $30 \frac{1}{5}$ miles. To perform calculations, it is helpful to convert this mixed number into an improper fraction or decimal.

- Mixed Number: $30 \frac{1}{5}$

- Conversion to Improper Fraction:

$$\begin{aligned} \left[\right. \\ 30 \frac{1}{5} &= \frac{(30 \times 5) + 1}{5} = \frac{150 + 1}{5} = \frac{151}{5} \\ \left. \right] \end{aligned}$$

So, the distance is $\frac{151}{5}$ miles.

Step 2: Express the Time in Decimal or Fractional Form

The time given is $\frac{2}{3}$ of an hour, which can be left as a fraction or converted to decimal.

- As a decimal:

$$\begin{aligned} \left[\right. \\ \frac{2}{3} &\approx 0.6667 \text{ hours} \\ \left. \right] \end{aligned}$$

- Or keep as a fraction for precise calculations.

Step 3: Apply the Speed Formula

Using the formula:

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Substituting the known values:

$$\text{Speed} = \frac{\frac{151}{5}}{\frac{2}{3}}$$

Dividing fractions:

$$\text{Speed} = \frac{151}{5} \times \frac{3}{2} = \frac{151 \times 3}{5 \times 2}$$

Calculating numerator and denominator:

$$\text{Speed} = \frac{453}{10}$$

Expressed as a decimal:

$$\frac{453}{10} = 45.3$$

Therefore, the average speed of the car is 45.3 miles per hour.

Final Answer: The Car's Average Speed

The car's average speed is 45.3 miles per hour.

Additional Insights and Tips

Understanding how to work with mixed numbers and fractions is crucial for solving such problems efficiently. Here are some tips to help you handle similar questions:

- Always convert mixed numbers to improper fractions or decimals for easier calculation.
- Keep units consistent throughout the problem to avoid errors.
- Double-check your conversions before plugging the values into formulas.
- Use calculators for fractional multiplication to ensure accuracy.
- Practice with different types of problems involving average speed, distance, and time to build confidence.

Practical Applications of Calculating Average Speed

Knowing how to determine average speed has numerous real-world applications:

- Travel planning: Estimating arrival times based on average speeds.
- Traffic analysis: Understanding vehicle flow and congestion levels.
- Logistics and delivery services: Calculating delivery times and optimizing routes.
- Physics and engineering: Analyzing motion and designing transportation systems.
- Educational purposes: Developing problem-solving skills in mathematics.

Related Problems and Practice Exercises

To reinforce your understanding, consider practicing these problems:

1. A cyclist travels $45 \frac{2}{3}$ miles in $\frac{3}{4}$ of an hour. What is their average speed in miles per hour?

2. A runner completes 20 miles in 2 hours. What is their average speed?
3. A train travels 120 miles in 2.5 hours. Find its average speed.

By tackling these problems, you'll strengthen your ability to work with fractions, convert units, and apply the speed formula effectively.

Conclusion

Calculating the average speed of a vehicle or object is a fundamental skill in mathematics and everyday life. In the problem discussed, a car traveling $30 \frac{1}{5}$ miles in $\frac{2}{3}$ of an hour has an average speed of 45.3 miles per hour. This process involves converting mixed numbers to improper fractions, maintaining consistent units, and applying the basic speed formula. Mastery of these techniques enables you to solve a wide range of problems involving distance, time, and speed with confidence.

Remember, practice makes perfect. Keep working through similar problems, and you'll develop a strong understanding of how to analyze motion and perform these calculations efficiently.

Frequently Asked Questions

How do you convert the mixed number $30 \frac{1}{5}$ miles into an improper fraction for the speed calculation?

Convert $30 \frac{1}{5}$ to an improper fraction: $30 \frac{1}{5} = (30 \times 5 + 1)/5 = (150 + 1)/5 = 151/5$ miles.

What is the total time in hours that the car traveled, given it was $\frac{2}{3}$ of an hour?

The time is already given as $\frac{2}{3}$ of an hour, which is approximately 0.6667 hours.

How do you calculate the average speed of the car from the given distance and time?

Average speed = total distance $\div$ total time. So, convert the distance to an improper fraction, then divide by $\frac{2}{3}$ hours.

What is the step-by-step calculation to find the car's average speed in miles per hour?

First, convert $30 \frac{1}{5}$ miles to $\frac{151}{5}$ miles. Then, divide by $\frac{2}{3}$ hours: $(\frac{151}{5}) \div (\frac{2}{3}) = (\frac{151}{5}) \times (\frac{3}{2}) = (\frac{151 \times 3}{5 \times 2}) = \frac{453}{10} = 45.3$ miles per hour.

What is the final answer for the car's average speed in miles per hour?

The average speed of the car is 45.3 miles per hour.

Additional Resources

Understanding Average Speed Calculation: A Deep Dive into the Problem of a Car Traveling $30 \frac{1}{5}$ Miles in $\frac{2}{3}$ of an Hour

When it comes to everyday scenarios involving travel, understanding the concept of average speed is fundamental. Whether you're a student preparing for a mathematics exam, a driver estimating your journey time, or an enthusiast exploring the intricacies of motion, grasping how to calculate average speed is essential. In this detailed review, we'll analyze a specific problem: A car travels $30 \frac{1}{5}$ miles in $\frac{2}{3}$ of an hour. Our goal is to determine the car's average speed in miles per hour (mph).

This analysis not only aims to solve the problem but also to shed light on the principles and techniques involved in solving such problems, including how to handle mixed numbers, fractional time periods, and unit conversions.

Understanding the Core Concept: Average Speed

Before diving into the problem specifics, it's important to understand what average speed entails.

What Is Average Speed?

Average speed is a measure of the total distance traveled divided by the total time taken. It is a scalar quantity, meaning it only has magnitude and no direction, expressed mathematically as:

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

In the context of our problem:

- Total Distance: The distance the car travels during the trip.
- Total Time: The duration of the trip.

Significance of Calculating Average Speed

- Travel Planning: Estimating travel times.
- Safety: Ensuring compliance with speed limits.
- Physics & Mathematics: Understanding motion, rates, and ratios.

Decoding the Problem Statement

The given problem states:

> A car travels $30 \frac{1}{5}$ miles in $\frac{2}{3}$ of an hour. What is the average speed, in miles per hour of the car?

Let's analyze each component:

- Distance: $30 \frac{1}{5}$ miles
- Time: $\frac{2}{3}$ hour

Key points to consider:

- The distance is expressed as a mixed number.
- The time is a fractional hour.
- The goal is to find the average speed in miles per hour (mph).

Converting Mixed Numbers and Fractions: Preparing for Calculation

To accurately compute the average speed, it's essential to convert all measurements into compatible formats, preferably improper fractions or decimals for ease of calculation.

Converting the Distance: $30 \frac{1}{5}$ Miles

Step 1: Express the mixed number as an improper fraction.

- The mixed number $30 \frac{1}{5}$ can be written as:

$$30 + \frac{1}{5}$$

- To convert to an improper fraction:

$$30 = \frac{30 \times 5}{5} = \frac{150}{5}$$

- Add the fractional part:

$$\frac{150}{5} + \frac{1}{5} = \frac{151}{5}$$

Result:

$$\text{Distance} = \frac{151}{5} \text{ miles}$$

Converting the Time: $\frac{2}{3}$ Hour

The time is already a fraction:

$$\frac{2}{3} \text{ hours}$$

Calculating the Average Speed: Step-by-Step Process

With both measurements converted into improper fractions, the calculation becomes straightforward.

Formula Recap:

$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

Step 1: Write the problem as fractions:

$$\text{Average Speed} = \frac{\frac{151}{5}}{\frac{2}{3}}$$

Step 2: Simplify the division of fractions:

Dividing by a fraction is equivalent to multiplying by its reciprocal:

$$\frac{151}{5} \times \frac{3}{2}$$

Step 3: Multiply numerators and denominators:

$$\frac{151 \times 3}{5 \times 2} = \frac{453}{10}$$

Step 4: Simplify the resulting fraction:

Since 453 and 10 have no common factors other than 1, the fraction is already in simplest form.

Step 5: Convert to decimal (if desired):

$$\frac{453}{10} = 45.3$$

Result:

$$\boxed{\text{Average Speed} = 45.3 \text{ miles per hour}}$$

This indicates the car's average speed is 45.3 mph.

Interpreting the Result

The calculated average speed of 45.3 miles per hour provides a clear measure of the car's pace during the trip. This value is practical and aligns with typical highway speeds, reflecting a moderate and consistent driving pace.

Significance of the Result:

- Real-world application: Helps drivers estimate travel times or plan journeys.
- Mathematical validation: The calculation demonstrates how mixed numbers and fractions can be handled systematically.
- Educational insight: Reinforces the importance of converting mixed quantities into improper fractions for ease of calculation.

Additional Insights and Variations

Understanding the core calculation allows for handling similar problems with different parameters. Let's explore some variations and additional considerations.

Handling Different Distance and Time Units

- If the distance or time is given in different units (e.g., kilometers, minutes), conversions are necessary to maintain consistency.
- For example, converting kilometers to miles (using $1 \text{ km} \approx 0.621371 \text{ miles}$) or minutes to hours (divide by 60).

Dealing with Multiple Segments

- If the journey involves multiple segments with different speeds, average speed over the entire trip requires total distance divided by total time, not an average of individual speeds.
- This emphasizes the importance of total quantities rather than averages of averages.

Using Decimals vs. Fractions

- While fractions are precise, sometimes converting to decimals simplifies calculations, especially when dealing with recurring decimals or more complex fractions.
- For this problem, both methods yield the same result, but clarity is essential.

Common Mistakes to Avoid

While solving similar problems, be cautious of the following pitfalls:

- Incorrect conversion of mixed numbers: Failing to convert mixed numbers into improper fractions before calculation.
- Mismanaging fractional division: Remembering that dividing by a fraction is the same as multiplying by its reciprocal.
- Unit inconsistencies: Ensuring units are compatible; for example, distance in miles and time in hours.
- Ignoring simplification: Not simplifying fractions can complicate calculations unnecessarily.

Practical Applications and Broader Context

Beyond academic exercises, understanding how to compute average speed has real-world applications:

- Navigation and GPS systems: Calculating estimated arrival times.
- Transportation planning: Designing effective routes and schedules.
- Physics research: Analyzing motion and velocity.
- Economics and logistics: Optimizing delivery times and resource allocation.

In everyday life, being comfortable with these calculations helps you make informed decisions, whether you're planning a road trip or analyzing the efficiency of different transportation modes.

Summary and Final Thoughts

Calculating the average speed of a car traveling a certain distance over a fractional period might seem complex at first glance, especially when mixed numbers and fractions are involved. However, by breaking down the problem into manageable steps—converting mixed numbers to improper fractions, applying the fundamental formula for average speed, and simplifying carefully—you can arrive at an accurate and meaningful result.

In the specific case of a car traveling $30\frac{1}{5}$ miles in $\frac{2}{3}$ of an hour, the average speed is 45.3 miles per hour. This value not only provides a quantitative measure of the journey but also exemplifies the power of systematic mathematical techniques in solving real-world problems.

Mastering such calculations enhances your mathematical literacy and prepares you for a wide range of applications, from academic assessments to everyday decision-making. Always remember to double-check conversions, simplify fractions appropriately, and interpret your results in context.

In conclusion, the ability to compute average speed accurately depends on understanding fractions, unit conversions, and the fundamental relationship between distance and time. Whether you're tackling similar problems in class or applying these principles in practical scenarios, a solid grasp of these concepts will serve you well.

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