Two People Are Working Together. They Finish Their Work In 12 Hours. If They Have A Ratio Of 3:2 Together.

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When two individuals work collaboratively, understanding their combined and individual efficiencies becomes crucial in estimating how long it will take them to complete a task. The scenario where these two workers finish the work in 12 hours, and their work ratio is 3:2, offers an insightful example of how ratios and work rates intertwine. Analyzing this situation involves breaking down their combined work rate, individual work rates, and the significance of their work ratio. This article explores the intricacies of such problems — starting from basic concepts to detailed calculations, and finally, practical implications.

Understanding the Basic Concepts of Work and Rate

Work Rate Definition

Work rate refers to the portion of work completed per unit of time. When two workers collaborate, their combined work rate is the sum of their individual work rates.

- **Individual work rate:** The amount of work one person can do in a unit of time.
- **Combined work rate:** Sum of individual work rates when working together.

The Relationship Between Time and Work Rate

The total work done, often denoted as 1 (representing the whole job), can be expressed as:

Work = Work rate × Time

For two workers working together, if their combined work rate is known, their total work completion time can be deduced directly.

Breaking Down the Problem: Given Data and Known Ratios

Given Data Recap

1. The two workers complete the task together in 12 hours.
2. The ratio of their work contributions (or efficiencies) is 3:2.

Implications of the Ratio

The ratio 3:2 indicates that one worker's work rate is 1.5 times that of the other. This ratio is vital in determining individual work rates because it relates their efficiencies directly.

Calculating the Combined Work Rate

Step 1: Determine Total Work

Assuming the total work as 1 complete job, the total work is 1 unit.

Step 2: Find the Combined Work Rate

Since the two work together and complete the task in 12 hours:

Combined Work Rate = Total Work / Total Time = 1 / 12 units per hour

Step 3: Express Individual Work Rates in Terms of a Variable

Let the work rate of the worker with the smaller efficiency be R. Then, the other worker's rate is $1.5R$, based on the ratio 3:2.

Thus, the combined work rate can also be expressed as:

$$R + 1.5R = 2.5R$$

Step 4: Set Up the Equation and Solve for R

$$2.5R = 1 / 12$$
$$R = (1 / 12) / 2.5$$

```
R = (1 / 12) × (1 / 2.5)
R = (1 / 12) × (2 / 5)
R = 2 / (12 × 5)
R = 2 / 60
R = 1 / 30
```

This means:
- The worker with lower efficiency works at a rate of 1/30 of the job per hour.
- The other worker works at a rate of $1.5 \times \frac{1}{30} = \frac{1.5}{30} = \frac{3}{60} = \frac{1}{20}$ per hour.

Individual Work Rates and Time to Complete the Work Separately

Calculating Individual Completion Times

Each worker's time to complete the work individually can now be determined using their work rates:

- Worker 1 (with work rate $R = 1/30$):

  Time = 1 / (Work rate) = 1 / (1/30) = 30 hours

- Worker 2 (with work rate $1/20$):

  Time = 1 / (1/20) = 20 hours

Summary of Individual Times

1. Worker with ratio 3: works alone in 20 hours.
2. Worker with ratio 2: works alone in 30 hours.

Understanding the Significance of the Work Ratio

Why the Ratio Matters

The ratio provides insights into individual efficiencies and helps in planning resource allocation, time management, and productivity analysis.

Application in Project Planning

- Assigning tasks based on individual capacities.
- Forecasting completion times for varying team compositions.
- Evaluating performance improvements or setbacks based on ratios.

Extended Applications and Real-world Scenarios

Scenario 1: Replacing Workers

If one worker is unavailable, the remaining worker's efficiency alone determines the new completion time. For instance, if Worker 1 works alone, they would take 30 hours.

Scenario 2: Adjusting Workforce Sizes

Knowing individual efficiencies allows managers to decide how many additional workers of similar ratios are needed to meet tight deadlines.

Scenario 3: Cost and Resource Optimization

Understanding individual work rates helps optimize labor costs, especially when workers have different wages corresponding to their efficiencies.

Summary and Key Takeaways

- The combined work rate of two workers who finish a task in 12 hours is $1/12$ units per hour.
- With a work ratio of 3:2, the individual work rates are $1/20$ and $1/30$ per hour.
- Individual completion times are 20 hours and 30 hours respectively.
- Ratios enable precise planning, resource allocation, and efficiency evaluation.

Conclusion

Understanding how ratios influence work rates and completion times is fundamental in project management and productivity analysis. In the case where two workers finish their work in 12 hours with a 3:2 work ratio, detailed calculations reveal their individual efficiencies and times. This knowledge not only facilitates better planning but also provides a framework for solving more complex work-related problems involving multiple workers and varying efficiencies. Recognizing the importance of ratios helps in optimizing workforce management, ensuring timely project completion, and improving overall productivity.

Frequently Asked Questions

What does the ratio 3:2 represent in the context of two people working together?

The ratio 3:2 represents the individual work contributions or work rates of the two people, indicating that one person works at a rate three parts and the other at two parts relative to each other.

If two people finish a job in 12 hours with a work ratio of 3:2, what is each person's individual work rate?

Let the work rates be 3x and 2x. The combined work rate is (3x + 2x) = 5x. Since they finish in 12 hours, total work = 12 5x. To find individual rates, we need more information, but generally, their combined rate is 1/12 of the total work per hour.

How can we determine each person's work rate if they finish together in 12 hours with a 3:2 ratio?

Assuming total work is W, their combined rate is W/12. Using the ratio 3:2, the individual rates are (3/5) (W/12) and (2/5) (W/12). Simplifying, each person's work rate is proportional to their ratio portion.

What is the total work done in terms of the two people's work rates?

Total work (W) can be expressed as the sum of individual work rates multiplied by time: W = (Rate1 + Rate2) 12 hours.

If one person works at 3 units per hour and the other at 2 units per hour, how long will they take to finish the work together?

Their combined work rate is 3 + 2 = 5 units per hour. Total work W is 12 hours 5 units/hour = 60 units. So, they will finish the work in 12 hours, matching the given scenario.

Is the ratio of 3:2 related to their efficiency or

just their work rates?

The ratio of 3:2 typically represents their work rates or contributions, which can be related to efficiency if their work conditions are similar, but it mainly indicates the proportion of work each person does.

Can the work ratio help us find the individual times taken by each person to complete the job alone?

Yes. Knowing the work ratio and combined work rate allows us to calculate each person's individual work rate and hence the time each would take to complete the entire work alone.

What assumptions are made when calculating work ratios like 3:2 for two workers?

It is assumed that both workers work at a constant rate, their efficiencies are proportional to the ratio, and the work is evenly distributed based on their work rates without interruptions or other factors affecting productivity.

How does understanding work ratios improve project planning and resource allocation?

Work ratios help determine each worker's contribution, estimate completion times, and allocate tasks efficiently, ensuring a balanced workload and timely project completion.

Additional Resources

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This scenario presents an interesting opportunity to explore the dynamics of teamwork, work rates, and the mathematical relationships that govern collaborative efforts. Understanding how two individuals combine their efforts to complete a task within a specified timeframe, especially when their work contributions are in a certain ratio, provides valuable insights into efficiency, productivity, and problem-solving strategies. In this article, we delve deeply into the problem, analyze the underlying concepts, and discuss the various implications and applications that extend beyond this specific case.

Understanding the Basic Problem

At the core of this scenario lies a fundamental question: How do two workers, working together, complete a task in 12 hours, given their work ratio of 3:2? To analyze this, we need to interpret the information carefully, translate it into mathematical expressions, and derive meaningful conclusions about their individual work rates.

Key Details Explained

- Total work completed: The combined effort of both individuals results in completing the entire task in 12 hours.
- Work ratio: The ratio of their contributions is 3:2, meaning one worker contributes 3 parts while the other contributes 2 parts of the work.
- Objective: Determine individual work rates and understand their efficiencies.

Breaking Down the Work Rate Problem

Work Rate Concept

Work rate refers to the amount of work completed per unit of time. When two people work together, their combined work rate is the sum of their individual work rates.

Suppose:
- The first person’s work rate = R_1 (work units per hour).
- The second person’s work rate = R_2 (work units per hour).

Total work completed when both work together for 12 hours:
$$
\text{Total work} = (R_1 + R_2) \times 12
$$

Given that the total work is a single complete task, we can normalize this to 1 unit:
$$
(R_1 + R_2) \times 12 = 1
$$
which simplifies to:
$$
R_1 + R_2 = \frac{1}{12}
$$

Incorporating the Work Ratio

The ratio of their work contributions is 3:2, which implies:
$$
\frac{R_1}{R_2} = \frac{3}{2}
$$
or equivalently:
$$
R_1 = \frac{3}{2} R_2
$$

Using this relationship, substitute R_1 into the total work rate equation:
\[

$$
\frac{3}{2} R_2 + R_2 = \frac{1}{12}
$$
which simplifies to:
$$
\left(\frac{3}{2} + 1\right) R_2 = \frac{1}{12}
$$
$$
\left(\frac{3}{2} + \frac{2}{2}\right) R_2 = \frac{1}{12}
$$
$$
\frac{5}{2} R_2 = \frac{1}{12}
$$
$$
R_2 = \frac{2}{5} \times \frac{1}{12} = \frac{2}{5} \times \frac{1}{12} = \frac{2}{60} = \frac{1}{30}
$$

Now, find R_1:
$$
R_1 = \frac{3}{2} R_2 = \frac{3}{2} \times \frac{1}{30} = \frac{3}{2} \times \frac{1}{30} = \frac{3}{60} = \frac{1}{20}
$$

Result:
- First person’s work rate: $\frac{1}{20}$ of the work per hour.
- Second person’s work rate: $\frac{1}{30}$ of the work per hour.

Implications of the Calculations

Individual Contribution and Efficiency

- First person: Completes 1/20 of the work every hour, making them slightly more efficient than the second person.
- Second person: Completes 1/30 of the work every hour, indicating a lesser but still significant contribution.

The work ratio aligns with these individual efficiencies:
$$
\frac{R_1}{R_2} = \frac{\frac{1}{20}}{\frac{1}{30}} = \frac{30}{20} = \frac{3}{2}
$$
which confirms the initial ratio assumption.

Time to Complete the Entire Work Individually

- First person: $\frac{1}{R_1} = 20$ hours.
- Second person: $\frac{1}{R_2} = 30$ hours.

This indicates that, working alone, the first person would complete the task in 20 hours, while the second would take 30 hours, emphasizing the difference in their efficiencies.

Real-World Applications and Significance

Understanding such work dynamics is crucial in many fields, from project management to industrial engineering, where optimizing team efforts can significantly impact productivity and resource allocation.

Project Planning and Resource Allocation

- Efficient Team Formation: By understanding individual work rates, managers can assign tasks more effectively, balancing workloads according to each person's capacity.
- Time Management: Accurate estimations of completion times help in setting realistic deadlines and improving scheduling.
- Cost Optimization: Knowing who works faster or more efficiently allows for better budgeting and resource management.

Training and Skill Development

- Identifying differences in work rates can highlight areas for training to improve overall team efficiency.
- Encourages targeted skill improvement, especially for those with lower work rates.

Collaborative Efficiency Analysis

- The problem demonstrates how combining efforts leads to a faster overall completion time.
- It also underscores the importance of understanding individual contributions to maximize productivity.

Pros and Cons of Collaborative Work Based on Ratios

Pros:

- Enhanced Productivity: Combining efforts typically reduces overall time.
- Flexibility: Tasks can be divided based on individual strengths and efficiencies.
- Motivation: Recognizing individual contributions fosters motivation and accountability.
- Scalability: Frameworks like these can be applied to larger teams with multiple ratios and work rates.

Cons:

- Dependency: The overall efficiency is limited by the slower worker.
- Coordination Challenges: Ensuring smooth collaboration may require additional management.
- Unequal Workload: If ratios are not balanced properly, some team members may feel overburdened.
- Complexity in Larger Teams: As ratios and work rates become more complicated, calculations and management become more challenging.

Extensions and Broader Perspectives

The problem of two workers working together with a known ratio opens avenues for various extensions:

- Multiple Workers: How does adding more workers with different ratios affect total time?
- Varying Work Rates: How do changes in individual efficiencies over time influence collaborative outcomes?
- Real-Life Constraints: Considering factors such as fatigue, breaks, and resource limitations can make models more realistic.
- Optimization Algorithms: Using mathematical tools to optimize team compositions for maximum efficiency.

Additionally, the principles involved here are applicable beyond work tasks, such as in:

- Collaborative research projects
- Manufacturing assembly lines
- Software development teams
- Supply chain operations

Conclusion

The scenario of two people working together to complete a task in 12 hours with a work ratio of 3:2 exemplifies fundamental principles of work rate analysis, collaboration, and efficiency optimization. By translating the problem into algebraic expressions, we determined individual work rates and their implications for individual and collective productivity. Such analyses are invaluable in practical contexts, enabling better planning, resource allocation, and performance evaluation.

Understanding the dynamics of teamwork through ratios and work rates fosters more effective collaboration in various domains. Whether in manufacturing, project management, or everyday tasks, recognizing how individual contributions combine to achieve common goals enhances overall efficiency and success. The mathematical insights gleaned from this problem underscore the importance of precise calculations and strategic planning in achieving optimal outcomes in collaborative efforts.

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