GENERAL

arithmetic sequence word problems with solutions

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Introduction

Arithmetic sequences are a cornerstone of elementary and middle school mathematics. They appear in countless real world scenarios—from calculating the cost of a subscription service to predicting the growth of an investment. Yet many students find arithmetic sequence word problems challenging because they require a blend of algebraic manipulation, logical reasoning, and careful reading of the problem statement. In this article, we'll explore the fundamentals of arithmetic sequences, break down common types of word problems, walk through a step by step solution strategy, and provide a collection of detailed, fully worked examples. By the end, you'll feel confident tackling any arithmetic sequence challenge that comes your way.

What is an Arithmetic Sequence?

An arithmetic sequence (or arithmetic progression) is a list of numbers in which the difference between consecutive terms is constant. This constant is called the **common difference** and is denoted by *d*. If the first term of the sequence is *a*,•then the general formula for the nth term (called the **nth term** or *a*)™is:

1. nth term formula: a ™ = a • + (n – 1)d

Because the common difference is the same throughout, arithmetic sequences are predictable and easy to work with once you recognize the pattern.

Key Concepts

- First term (a •): The starting number of the sequence.
- Common difference (d): The amount added (or subtracted) to get from one term to the next.
- nth term (a ™): The value of the term at position n.
- Sum of the first n terms (S ™): When needed, the sum can be found using S ™ = n/2 × (2a • + (n – 1)d).

Why Arithmetic Sequence Word Problems Matter

Word problems transform abstract mathematical concepts into tangible challenges. They test a student's ability to interpret language, extract numerical data, and apply formulas correctly. Mastering arithmetic sequence word problems develops:

- Critical thinking and problem solving skills.
- Confidence in handling algebraic expressions.
- The ability to connect mathematics with everyday life.

In many standardized tests and college admissions exams, arithmetic sequence problems appear frequently. Being proficient in this area can boost overall math performance and reduce test anxiety.

Common Types of Arithmetic Sequence Word Problems

Although the underlying formula remains the same, word problems can vary in context and difficulty. Below are the most common categories you'll encounter.

Increasing Sequences

These problems involve sequences that grow by a fixed amount each step. Typical examples include adding a fixed number of items to a collection or increasing a budget incrementally.

Decreasing Sequences

Here the common difference is negative, so each term is smaller than the previous one. Examples include depreciation of an asset or decreasing temperature over time.

Sequences with Variable Common Differences

Sometimes the problem describes a situation where the common difference changes at a certain point, requiring you to split the sequence into parts or use piecewise reasoning.

Real World Applications

These problems embed arithmetic sequences in practical contexts such as finance (interest rates), construction (layered building plans), or scheduling (timetables).

Step by Step Guide to Solving Arithmetic Sequence Word Problems

While the formula is simple, many students struggle with the interpretation step. Use this structured approach to stay organized.

1. Identify the Sequence

Read the problem carefully to determine if it describes an arithmetic sequence. Look for phrases like “each year,” “every month,” or “increasing by” that suggest a constant change.

2. Determine the Common Difference

Extract the numerical value that represents the change between consecutive terms. Pay attention to whether the change is additive or subtractive.

3. Formulate the General Term

Write down the nth term formula using the first term and the common difference you identified. This becomes your working equation.

4. Apply the Formula to Find the Desired Term

Substitute the known values (first term, common difference, and the term number you’re asked to find) into the formula. Simplify the expression to get the answer.

5. Check Your Work

Verify that the solution makes sense in the context of the problem. If the answer is negative when it shouldn’t be, or if it violates a constraint mentioned in the problem, re evaluate your steps.

Sample Problems with Detailed Solutions

Below are five representative arithmetic sequence word problems. Each problem includes the statement, a step by step solution, and a final answer. Work through them at your own pace and compare your results to the solutions provided.

Problem 1: Classic Increasing Sequence

A gardener plants a row of trees. He starts with 5 trees in the first row and adds 3 more trees to each subsequent

row. How many trees are in the 10th row?

1. Identify the sequence: The number of trees per row increases by 3 each time.
2. Common difference (d): 3 trees.
3. First term (a •): 5 trees.
4. nth term formula: a ™ = a • + (n – 1)d = 5 + (10 – 1) × 3.
5. Compute: 5 + 9 × 3 = 5 + 27 = 32.
6. Answer: There are 32 trees in the 10th row.

Problem 2: Decreasing Sequence

A company offers a discount that decreases by $2 each month. The discount starts at $20 in month 1. What will be the discount in month 7?

1. Identify the sequence: The discount decreases by a fixed amount.
2. Common difference (d): –$2.
3. First term (a •): $20.
4. nth term formula: a ™ = a • + (n – 1)d = 20 + (7 – 1)(–2).
5. Compute: 20 + 6 × (–2) = 20 – 12 = 8.
6. Answer: The discount in month 7 will be $8.

Problem 3: Real World Savings Plan

Emily opens a savings account that earns a fixed $50 deposit every month. She deposits $100 in the first month. After 12 months, how much total money has she deposited?

1. Identify the sequence: Monthly deposits increase by a fixed amount.
2. Common difference (d): $50.
3. First term (a •): $100.
4. nth term formula: a ™ = 100 + (n – 1) × 50.
5. Compute the 12th term: 100 + (12 – 1) × 50 = 100 + 11 × 50 = 100 + 550 = 650.
6. Sum of first 12 terms (S • ,): S • , = 12/2 × (2 × 100 + (12 – 1) × 50) = 6 × (200 + 550) = 6 × 750 = 4,500.
7. Answer: Emily has deposited a total of $4,500 after 12 months.

Problem 4: Advanced Sequence with Multiple Steps

A factory produces a certain model of widget. In its first year, it produces 200 widgets. Each subsequent year, production increases by 15% of the previous year''s output. What is the production in the 5th year? (Assume the increase is applied to the exact number produced in the prior year, not rounded.)

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