Analyzing Relationships Between Patterns

Analyzing Relationships Between Patterns: Find, Fix, and Work Backward

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QUICK REVIEW

Step 0 is the start. Each step applies both rules once. Pair values from the same step. In (A, B), A goes across and B goes up. Compare the starts and the increases to see whether one value stays ahead by a fixed amount or is a fixed multiple of the other.

Worked example

A starts at 4 and adds 5. B starts at 10 and adds 3. Give the pairs at steps 0, 1, and 2. What happens to the gap?

1. Pair the starting values to get $(4, 10)$.
2. Add 5 to A and 3 to B each time: $(9, 13)$, then $(14, 16)$.
3. B leads by $10 - 4 = 6$, $13 - 9 = 4$, then $16 - 14 = 2$. A gains $5 - 3 = 2$ more than B each step.
Answer: $(4, 10), (9, 13), (14, 16)$. The gap shrinks by 2 each step shown.

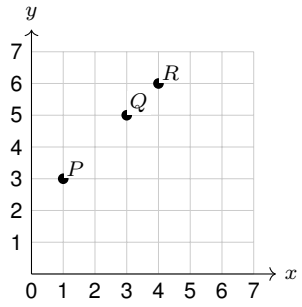
Practice Problems

Show your thinking.

1. A starts at 2 and adds 3 each step. B starts at 5 and adds 6. Imani says B is always twice A because B adds twice as much. Is that true? Describe the actual relationship.

2. The pair (A, B) is $(10, 30)$ at step 2 and $(25, 75)$ at step 5. Each pattern adds a fixed amount. Recover both add rules and the starting pair. How is B related to A?

3. A starts at 1 and B at 3, and both add 2 each step. All three marked points have the same gap between their coordinates. Which cannot be a same-step pair? Explain.



4. Two records show pairs (A, B). Each pattern uses a fixed add rule. Are the add rules the same for both records? What relationship between A and B is the same?

Step	Record 1	Record 2
0	$(2, 6)$	$(1, 5)$
1	$(4, 8)$	$(4, 8)$
2	$(6, 10)$	$(7, 11)$

5. A starts at 4 and adds 3 each step. B starts at 10 and adds 5. A record shows that B is 30, but the matching A value was erased. Recover it and explain how you know the values are from the same step.

6. A starts at 3 and adds 6 each step. Design B to start 4 ahead of A and tie A after one step, using a fixed add rule. Give its start and rule. Which pattern is ahead at step 2, and by how much?

Answer Key

1. No. B is 1 more than twice A.
2. A adds 5, B adds 15; start $(0, 0)$. B is three times A.
3. $R = (4, 6)$. A never takes the value 4.
4. No. Both add 2 in Record 1 and 3 in Record 2. B is 4 more than A in both.
5. A is 16 at step 4.
6. B starts at 7 and adds 2. A is ahead by 4 at step 2.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Twice the starting A-value is $2 \times 2 = 4$, but B starts at 5, which is 1 more.

2. Each time A increases by 3, twice A increases by $2 \times 3 = 6$. B also increases by 6.

3. B therefore stays 1 ahead of twice A. At step 1, A is 5 and B is $11 = 2 \times 5 + 1$.

Problem 2

1. There are $5 - 2 = 3$ additions between the recorded pairs.

2. A gains $25 - 10 = 15$, so it adds $15 \div 3 = 5$. B gains $75 - 30 = 45$, so it adds $45 \div 3 = 15$.

3. Back up two steps: $10 - 2 \times 5 = 0$ and $30 - 2 \times 15 = 0$. Starting at 0, B adds $15 = 3 \times 5$, so B is three times A.

Problem 3

1. B starts $3 - 1 = 2$ ahead, and both add 2, so every valid pair has a gap of 2.

2. $P = (1, 3)$ and $Q = (3, 5)$ are the pairs at steps 0 and 1.

3. A goes $1, 3, 5, \ldots$ and skips 4. The gap at R is right, but no whole step gives $(4, 6)$.

Problem 4

1. In Record 1, A rises by $4 - 2 = 2$ and B rises by $8 - 6 = 2$ per step.

2. In Record 2, A rises by $4 - 1 = 3$ and B rises by $8 - 5 = 3$ per step.

3. The starting gaps are $6 - 2 = 4$ and $5 - 1 = 4$. In each record, equal increases keep B 4 ahead of A.

Problem 5

1. B gained $30 - 10 = 20$. At 5 per step, that is $20 \div 5 = 4$ additions.

2. A has had the same 4 additions, so its value is $4 + 4 \times 3 = 16$.

3. Check the pairing: $10 + 4 \times 5 = 30$ at that same step.

Problem 6

1. B must start at $3 + 4 = 7$.

2. At step 1, A is $3 + 6 = 9$, so B must add $9 - 7 = 2$ to tie.

3. Then A adds 6 and B adds 2 from that tie, so A leads by $6 - 2 = 4$ at step 2.

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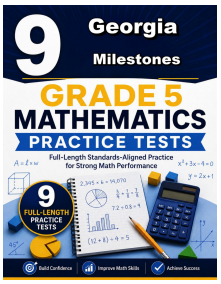

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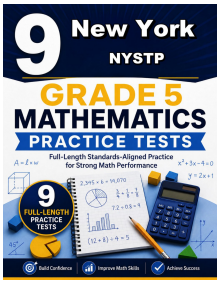

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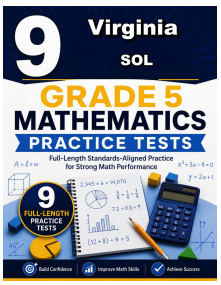

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