Thinking with Models _ Gradient

Investigation Task: Gradient Between Points on a Line Assessment Criterion: B and C

Criterion B: Investigating patterns

Achievement Level	Task-Specific Descriptor (Based on Gradient Investigation)	Sample Student Response (According to This Task)
1–2	• Uses basic calculations but shows limited understanding of how to find the gradient. • Identifies simple number changes but does not clearly describe a pattern. • Gives a rule or statement that is incomplete or incorrect and not verified.	"I found some gradients like 2, 3, and 2. The numbers go up, so I think the line is going higher. The rule might be y = 2x. I didn't check if it's right."
3–4	• Selects and applies simple techniques (e.g., uses the gradient formula correctly some of the time). • Recognizes a basic pattern (e.g., the y-values increase when x increases) but explains it with limited reasoning. • Gives a rule that partly fits the data and attempts to verify with some mistakes.	"I used $(y_2-y_1)/(x_2-x_1)$ and got 2 for most of them. So the line seems straight. The rule could be y = 2x, but it doesn't exactly match all points. I tried one more point and it was close."
5–6	• Correctly applies mathematical problem-solving techniques to discover the consistent gradient pattern. • Describes the pattern clearly (y increases by 2 when x increases by 1) and expresses it as a correct rule. • Verifies and justifies the rule with mostly correct reasoning and examples.	"All gradients between the points are 2, which means the line has a constant slope. The pattern is that y goes up by 2 each time x goes up by 1. So the rule is y = 2x + 1. I checked with (6,13) and it fits. This shows the rule works."
7–8	• Efficiently selects and applies accurate mathematical techniques to discover and explain the constant gradient pattern. • Expresses the pattern as a precise general rule consistent with all findings. • Provides strong mathematical reasoning to verify and justify the rule using multiple examples and the definition of gradient.	"The gradient between each pair is 2, showing a constant rate of change. I used y = mx + c, found m = 2 and c = 1, so the equation is y = 2x + 1. I verified it with (6,13) and (8,17) — both satisfy the equation. This proves that the gradient is constant and the relationship between x and y is linear."

Criterion C: Communicating

Achievement Level	Task-Specific Descriptor (Linked to the Gradient Investigation)	Sample Student Response Example
1–2	• Uses limited or incorrect mathematical language (e.g., "rise" or "up" instead of "gradient" or "slope"). • Shows minimal representation (numbers listed but not structured in a table or graph). • Reasoning is unclear or incomplete. • Work is disorganized with missing steps.	"I found some numbers that go up. It looks like the line is straight. Maybe the slope is 2 but I'm not sure how." *(No clear table or working shown.)*
3–4	• Uses some correct mathematical terms (like *gradient*, *x*, *y*) but not consistently. • Presents data in simple forms (table or list) but with occasional errors or unclear labeling. • Provides partial reasoning that lacks full logical flow. • Work has some organization but is not fully clear.	"The gradient $(y_2-y_1)/(x_2-x_1) = 2$ most of the time. The pattern shows a straight line. My rule is y = 2x. I think it works." *(Some table shown but not explained.)*
5–6	• Consistently uses appropriate mathematical language (gradient, coordinates, rate of change, linear equation). • Presents information correctly in different representations (table of values, gradient calculations, and equation). • Moves effectively between forms (numerical → algebraic → verbal explanation). • Provides clear and mostly complete reasoning using logical structure.	"Using the gradient formula $(y_2-y_1)/(x_2-x_1)$, I calculated all gradients = 2. The y-values increase by 2 each time x increases by 1. So, the rule is y = 2x + 1. This shows a constant rate of change." *(Includes a labeled table and logical paragraph.)*
7–8	• Consistently and precisely uses correct mathematical language throughout (gradient, linear relationship, constant rate of change, equation of a line). • Uses multiple, accurate representations (table, formula, equation, and written justification) with correct labeling and structure. • Moves fluently between different forms — numerical, graphical, algebraic, and verbal — to support reasoning. • Communicates through reasoning that is complete, coherent, concise, and logically organized from start to conclusion.	"I calculated the gradient between each pair using $(y_2-y_1)/(x_2-x_1)$ and found m = 2 each time, proving the gradient is constant. Using one point (1,3), I derived y = 2x + 1. I verified it with (6,13) and (8,17) — both satisfy the rule. Therefore, the relationship between x and y is linear. My findings are shown in the table and verified algebraically." *(Well-structured with table, equation, and explanation.)*