

Name: .....

Date: .....

Thinking with models \_ Quadratic equations

Investigation Task: Train Motion and Braking Distance

Assessment Criterion: D and C

**Criterion D: Criterion D: Applying mathematics in real-life contexts.**

| Achievement Level | Task Descriptor   | Sample Response   |
|-------------------|---|---|
| 0                 | The student does not identify relevant elements of the train-braking situation and does not use an appropriate mathematical strategy.   | No working shown or response unrelated to the train or quadratic equation.  |
| 1–2               | Identifies <b>limited elements</b> of the real-life context (e.g. mentions train or distance). Attempts a strategy but the quadratic equation is incorrect or incomplete. Little or no justification is provided.   | “The train goes 48 m. I tried to solve the equation but I am not sure.”   |
| 3–4               | Identifies <b>some relevant elements</b> of the situation (distance and time). Selects a quadratic strategy with <b>partial accuracy</b> . Applies the method with errors or incomplete working. Provides a basic statement about whether the answer makes sense. | “I used the formula $-2t^2 + 20t = 48$ and got $t = 4$ and $6$ . I think $6$ seconds is better because it is bigger.”   |
| 5–6               | Identifies <b>most relevant elements</b> of the real-life situation (distance, time, braking). Selects an appropriate strategy and applies it mostly correctly. Justifies accuracy using substitution. Explains why one solution is reasonable in context.        | “I solved $-2t^2 + 20t = 48$ by factorising and found $t = 4$ and $6$ . Substituting $t = 6$ gives $48$ m. The solution $t = 6$ makes sense because the train stops after braking.”         |
| 7–8               | Identifies <b>all relevant elements</b> of the authentic situation clearly. Selects and applies an appropriate quadratic strategy <b>accurately and efficiently</b> . Fully justifies the accuracy of the solution and  | “The braking distance is modeled by a quadratic function. Solving gives $t = 4$ and $6$ . Substitution confirms accuracy. Only $t = 6$ seconds is realistic because the train must complete |

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| clearly explains why only one solution is meaningful in the train context. | braking at the platform, while $t = 4$ represents an intermediate position.” |
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**Criterion C: Communicating**

| Achievement Level | Task Descriptor   | Sample Response   |
|-------------------|---|---|
| <b>0</b>          | The student does not use appropriate mathematical language or representations. Reasoning is unclear or absent, and information is not logically organized.  | Working is missing or consists of unrelated statements with no symbols or explanations.   |
| <b>1–2</b>        | Uses <b>limited mathematical language</b> with frequent errors in notation or terminology. Uses one form of representation incorrectly or unclearly. Reasoning is fragmented and poorly organized.  | “ $-2t^2 + 20t = 48 = 48$ so $t$ is 6. The train stops.”  |
| <b>3–4</b>        | Uses <b>some appropriate mathematical language</b> with occasional errors. Uses a representation (algebraic or numerical) with partial accuracy. Attempts to explain reasoning, but explanations lack clarity or logical flow.  | “I changed the equation to $-2t^2 + 20t - 48 = 0$ and got $t = 4, 6$ . The answer is 6 seconds.”  |
| <b>5–6</b>        | Uses <b>appropriate mathematical language, notation, and symbols</b> correctly. Uses suitable representations (equations, substitution, or graph) to present information. Moves between representations with minor errors. Communicates reasoning clearly with a logical structure. | “Solving $-2t^2 + 20t = 48$ gives $t^2 - 10t + 24 = 0$ . Substituting $t = 6$ confirms the distance is 48 m, so this solution is valid.”  |
| <b>7–8</b>        | Uses <b>precise and consistent mathematical language and notation</b> throughout. Uses and connects multiple representations (algebraic, graphical, numerical) effectively. Communicates <b>complete, coherent, and</b>   | “The quadratic model represents braking distance. Factorisation gives two solutions. Substitution verifies accuracy, and contextual reasoning eliminates the non-physical solution, leading to a justified conclusion.” |

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|  | <p><b>concise</b> lines of reasoning and organizes information logically from start to conclusion.</p> |  |
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