Task: How High Can My Plane Fly?

Student Text Pages
58–59

Suggested Timing
45–75 min

Materials and Technology Tools
- grid paper
- graphing software (optional)

Related Resources
- BLM A-17 Learning Skills Checklist
- BLM 1-18 Chapter 1 Task Rubric

Accommodations

Gifted and Enrichment–have students design more than one problem based on a quadratic function for other students to solve

Motor–encourage the use of technology for graphing

Language–have students work in pairs

Memory–have students use index cards with calculator sequences

Ongoing Assessment

- Use **BLM 1–18 Chapter 1 Task Rubric** to assess student achievement.

Specific Expectations

2.2, 2.3, 2.4, 2.5, 3.3

Teaching Suggestions

- Encourage students to graph the equation using technology, if available.
- Ask students to describe how they found the x-intercepts and the vertex of their graph.
- As students work, you may ask questions such as the following:
  - Does the graph represent the situation at all times?
  - What information do you get from the vertex of your graph?
  - Is there more than one way you can transform the graph of $y = x^2$ to result in the graph of the form $y = a(x - h)^2 + k$?
  - Why do you think the domain and range need to be restricted?
  - What are the advantages of using technology? Are there any disadvantages?
- You may also use **BLM A–17 Learning Skills Checklist** to assist you in assessing the performance of the students.

Hints for Evaluating a Response

Student responses are being assessed for the level of mathematical understanding they represent. As you assess each response, consider the following questions:

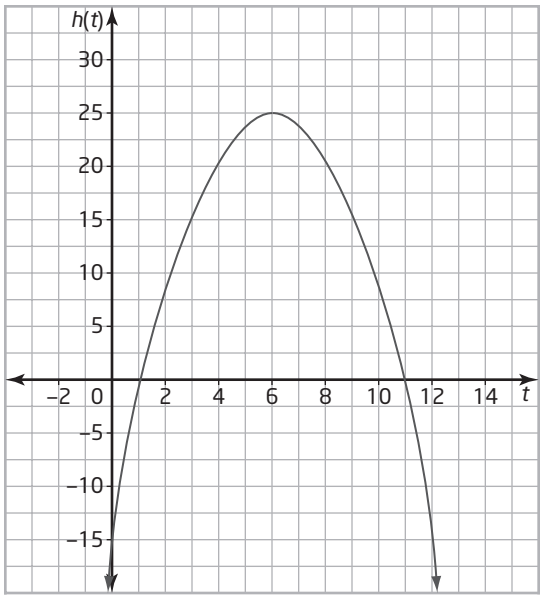
– Is there enough information to answer the questions?
– Does the graph represent the quadratic function correctly?
– Are the calculations correct?
– Are the domain and range appropriate and reasonable?
– Do the transformations of the graph of $y = x^2$ match the resulting graph?
– Do the explanations make sense?
– Does the problem created use a parabola? Is the solution provided complete and reasonable?

Level 3 Notes

- Student gives solutions for all eight questions.
- The graph represents the function correctly.
- Student writes the correct domain and range of the graph and the appropriate restrictions in context of the toy airplane's flight.
- Student makes all calculations correctly.
- Explanations are reasonable and make sense.
- Student gives a quadratic function problem with a complete solution.

Level 3 Sample Response

1.



2. The x-intercepts are at (1, 0) and (11, 0) and the vertex is at (6, 25). The vertex is a maximum.

3. domain: $\{t \in \mathbf{R}\}$; range: $\{h \in \mathbf{R} \mid h \leq 25\}$

4. The equation for the graph is $h = -(t - 6)^2 + 25$. In terms of x and y, the equation is $y = -(x - 6)^2 + 25$. The graph is a result of a reflection of the graph of $y = x^2$ in the x-axis followed by a translation 6 units right and 25 units up.

5. When $t = 0$, the airplane is at height -11 m. This does not make sense because the airplane is underground.

6. I think the plane is on the ground and does not takes off until $t = 1$.

7. domain: $\{t \in \mathbf{R} \mid 1 \leq t \leq 11\}$; range: $\{h \in \mathbf{R} \mid 0 \leq h \leq 25\}$

8. The maximum height that the plane reaches is 25 m. The plane was in the air for 10 s.

9. The profile of a valley at sea level can be modelled by the quadratic function $y = 0.1x^2 - 40x$, where x and y are the horizontal and vertical distances from a reference point, in metres.

a) How wide is the valley?

b) How deep is the valley?

c) How far is the deepest point of the valley from the edge?

Solution

a) The x-intercepts are at (0, 0) and (40, 0), so the valley is 40 m wide.

b) The vertex of the parabola is at (20, −40), so the valley is 40 m deep.

c) The deepest point is at the vertex (20, −40), so I use these numbers and the Pythagorean theorem to find the hypotenuse to approximate the distance:

$h^2 = (20)^2 + (-40)^2$

$h^2 = 400 + 1600$

$h^2 = 2000$

$h = \sqrt{2000}$

$h \doteq 44.7$

The deepest point of the valley is approximately 44.7 m from the edge.

What Distinguishes Level 2

- Student writes the correct domain and range of the graph but not the appropriate restrictions in context of the toy airplane's flight.
- Student makes few errors in calculations.
- Some parts in the explanations do not make sense.
- Student gives a quadratic function problem with incomplete solution.

What Distinguishes Level 4

- Student gives thorough and justified solutions for all eight questions.
- Explanations show insight into the complexity of the solution.
- Student gives complex quadratic problem with a correct solution.