## Problem-Based Task: Is the Glider Safe?

## Coaching Sample Responses

a. What is the minimum height Shin reaches?

The minimum occurs at the vertex. Write the equation in standard form.

| | |
|---|---|
| $y = (x - 4)(x - 6)$ | Original equation |
| $y = x^2 - 6x - 4x + 24$ | Distribute. |
| $y = x^2 - 10x + 24$ | Simplify. |

The vertex is of the form $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$.

Use the equation $y = x^2 - 10x + 24$ to find the values of $a$ and $b$ in order to find the $x$-coordinate of the vertex.

| | |
|---|---|
| $x = \frac{-b}{2a}$ | Formula to determine the $x$-coordinate of the vertex of a parabola |
| $x = \frac{-(-10)}{2(1)}$ | Substitute 1 for $a$ and –10 for $b$. |
| $x = 5$ | Simplify. |

The $x$-coordinate of the vertex is 5.

Substitute 5 into the original equation to find the $y$-coordinate.

| | |
|---|---|
| $y = x^2 - 10x + 24$ | Original equation |
| $y = (5)^2 - 10(5) + 24$ | Substitute 5 for $x$. |
| $y = -1$ | Simplify. |

The $y$-coordinate of the vertex is –1.

The vertex is located at (5, –1). The minimum height that Shin reaches is –1 foot.

b. Does a negative answer make sense in the context of the problem? Explain.

Yes. The value of –1 means 1 foot below the safe height.

c. Find the time at which the minimum height occurs.

The $x$-coordinate of the vertex is 5.

Shin reaches the minimum 5 seconds after the jump.

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d. What are the $x$-intercepts and what do they represent?

The $x$-intercepts can be identified from the original equation written in factored form.

$y = (x - 4)(x - 6)$

The $x$-intercepts are 4 and 6.

The $x$-intercepts represent times when the glider goes from a safe height to an unsafe height or vice versa.

The glider is at the safe height for the first 4 seconds, and then again after 6 seconds.

e. Does Shin stay above the safe height? Explain.

No. Shin is above the safe height for the first 4 seconds after the jump, and again after 6 seconds.

He dips below the safe height between 4 seconds and 6 seconds.

For 2 seconds, the glider is below the safe height.

f. How long will it take for Shin to reach his initial height?

The initial height occurs when $x = 0$.

The axis of symmetry passes through the vertex, $(5, -1)$.

The axis of symmetry is $x = 5$.

Zero is 5 units to the left of the axis of symmetry.

The $y$-value is the same for the point 5 units to the right of the axis of symmetry.

At $x = 10$, the height will be the same as the initial height.

Substitute 0 and 10 for $x$ to check.

| | |
|---|---|
| $y = (x - 4)(x - 6)$ | $y = (x - 4)(x - 6)$ |
| $y = [(0) - 4][(0) - 6]$ | $y = [(10) - 4][(10) - 6]$ |
| $y = 24$ | $y = 24$ |

Shin will reach his initial height of 24 feet above the safe height (or 30 feet above the ground) after 10 seconds.

**Recommended Closure Activity**

Select one or more of the essential questions for a class discussion or as a journal entry prompt.

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