

Parabola Power

Solve, graph, and make context-based decisions with quadratics.

HIGH SCHOOL • MA.912.AR.3.8

MA.912.AR.3.8 "Solve and graph mathematical and real-world problems that are modeled with quadratic functions. Interpret key features and determine constraints in terms of the context."

NAME _____

DATE _____

KEY FEATURES MATTER

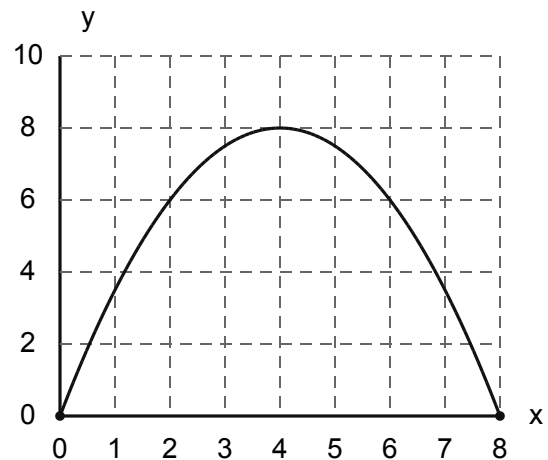
Use the model to calculate zeros and the vertex, then apply the context. Times and lengths may vary continuously; counts take whole-number values. Graph only allowed inputs. Interpret extrema and intercepts with units. A graph window does not itself restrict the domain. Use inequalities or sets for domain and range.

WORKED EXAMPLE

A parabolic arch has $y = -0.5(x-4)^2 + 8$ feet of height for $0 \leq x \leq 8$ feet across its base. Graph it, find its maximum and state domain/range.

1. The vertex (4,8) gives a maximum height of 8 ft.
2. The zeros $x=0$ and $x=8$ are the arch bases.
3. Use only $0 \leq x \leq 8$; heights satisfy $0 \leq y \leq 8$.

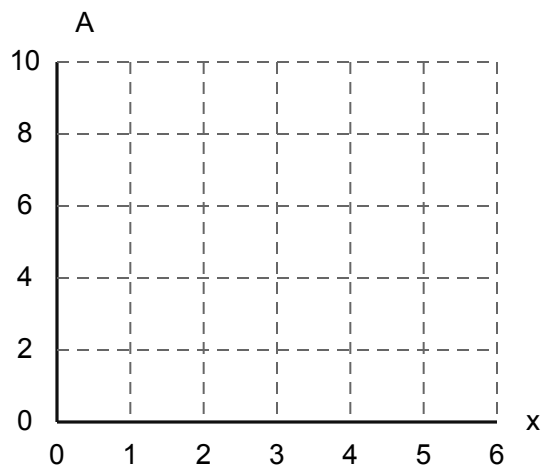
Answer: The arch spans 8 ft and reaches 8 ft; domain $0 \leq x \leq 8$, range $0 \leq y \leq 8$.



PRACTICE 4 problems

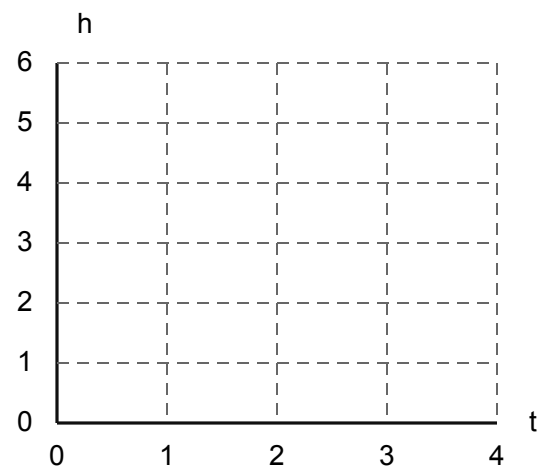
- 1** A rectangular garden uses 12 m of fence. If one side is x meters, its area is $A=x(6-x)$. Graph for $0 \leq x \leq 6$. Find the largest area, its dimensions and the range.

ANSWER _____



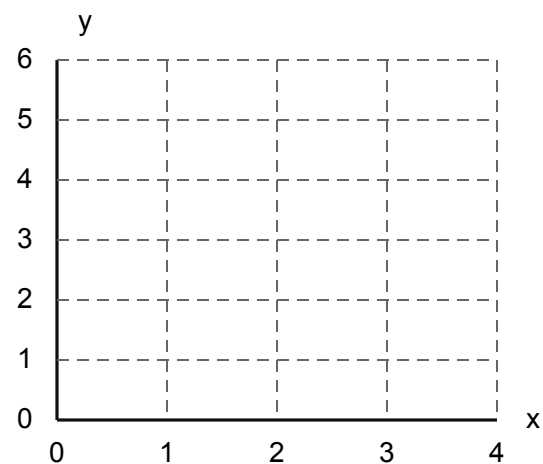
- 2** A simulated jump follows $h=-t^2+4t$ meters, where t is seconds after takeoff, until landing. Graph its physical portion. Find the landing time, maximum height and when $h=3$.

ANSWER _____



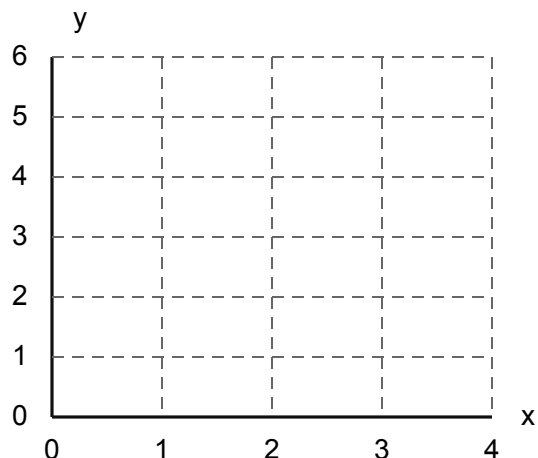
- 3** An arch height $y=4-(x-2)^2$ meters is modeled only for $1 \leq x \leq 3$. Graph this portion and give its domain and range. Are either algebraic zeros included?

ANSWER _____



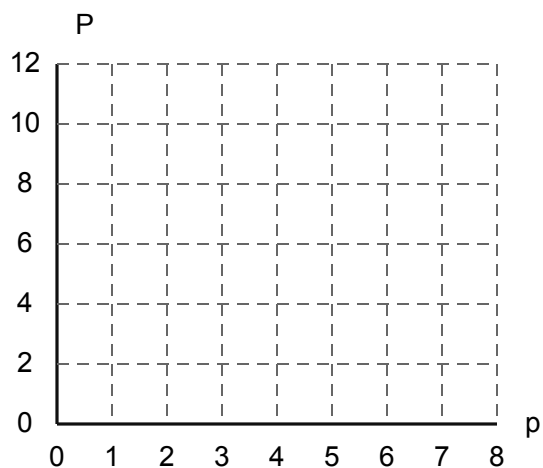
- 4** A design uses $y=(x-2)^2+1$ for a curved channel, with $0 \leq x \leq 4$; x and y are meters. Graph it. Where is the channel lowest, and over which x -intervals does it fall and rise?

ANSWER _____



APPLY IT Show your work

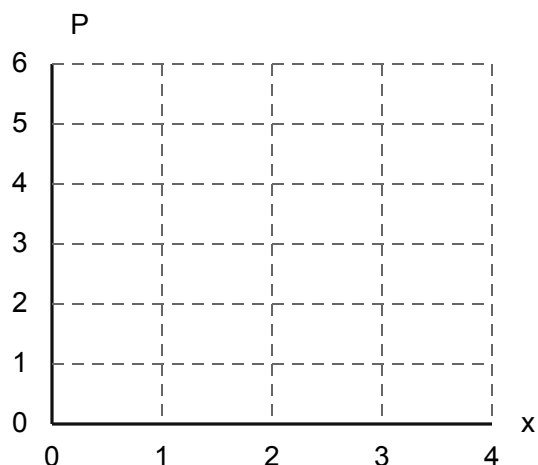
- 1** A fair models profit P in hundreds of dollars by $P=-(p-4)^2+9$, where ticket price p can be any real dollar amount from 1 to 7. Graph it. Find the best price, maximum profit, and break-even prices.



2

A shop makes x display stands, for x in $\{0, 1, 2, 3, 4\}$.

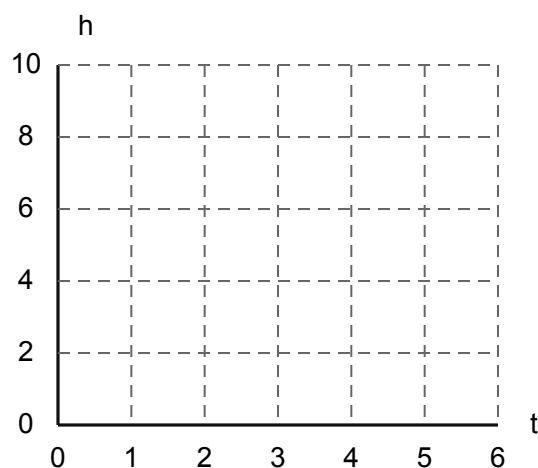
Profit is $P = -x^2 + 4x$ dollars. Plot every allowed outcome as separate points. State domain, range and the best number of stands.



CHALLENGE One step up

A simulated drone has $h = -(t-2)^2 + 9$ meters at time t seconds, with $t \geq 0$, until it lands. Graph its flight. State physical domain/range; find when $h=8$ and explain why one algebraic landing time is excluded.

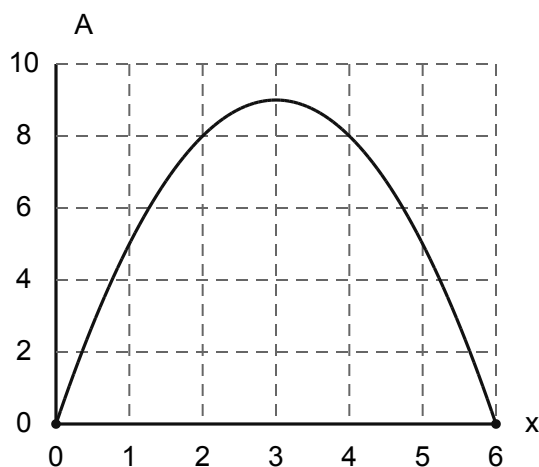
WORK SPACE AND ANSWER



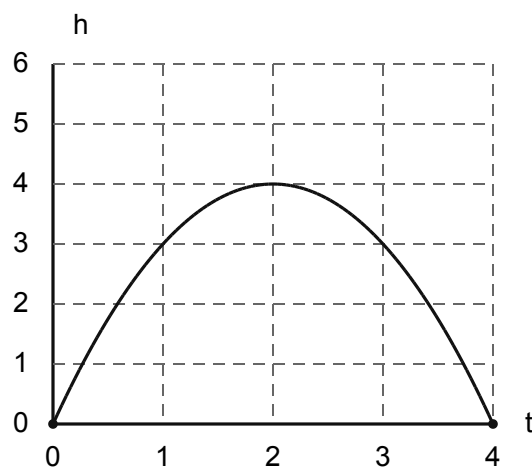
Require contextual units, domain constraints and actual graphs. Continuous models use closed curve portions; the stand-count model uses isolated points. For the garden, endpoint areas are degenerate limiting cases explicitly included in the model. Both algebraic roots may exist even when only one is physically allowed.

PRACTICE 1

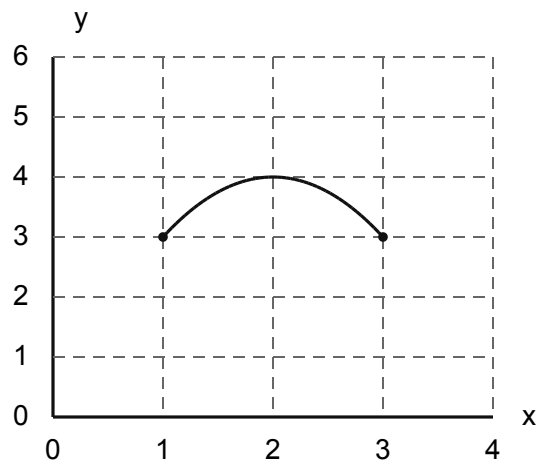
$A = -(x-3)^2 + 9$; maximum 9 m² at 3 m by 3 m; range $0 \leq A \leq 9$.

**PRACTICE 2**

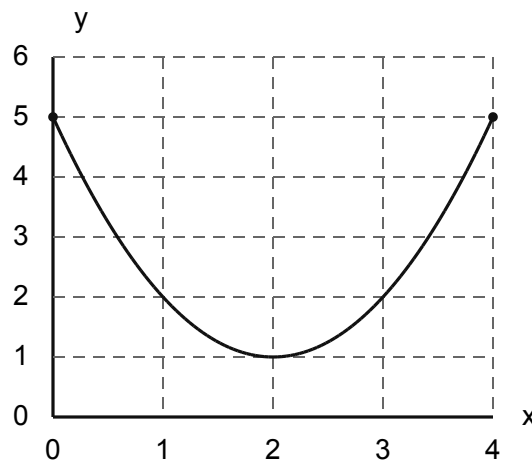
Landing $t=4$ s; maximum 4 m at $t=2$; $h=3$ at $t=1,3$ s. Domain $0 \leq t \leq 4$.

**PRACTICE 3**

$D: 1 \leq x \leq 3$; range $3 \leq y \leq 4$. Zeros 0 and 4 are both excluded.

**PRACTICE 4**

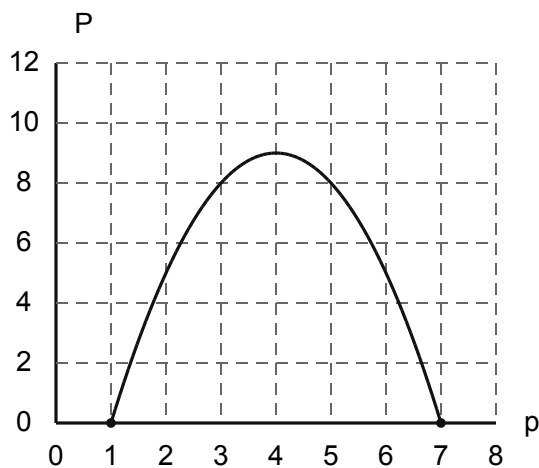
Minimum $y=1$ m at $x=2$; falling $0 < x < 2$, rising $2 < x < 4$. Range $1 \leq y \leq 5$.



APPLY IT 1

Best price \$4; maximum \$900; break-even \$1 and \$7. Domain $1 \leq p \leq 7$; range $0 \leq P \leq 9$.

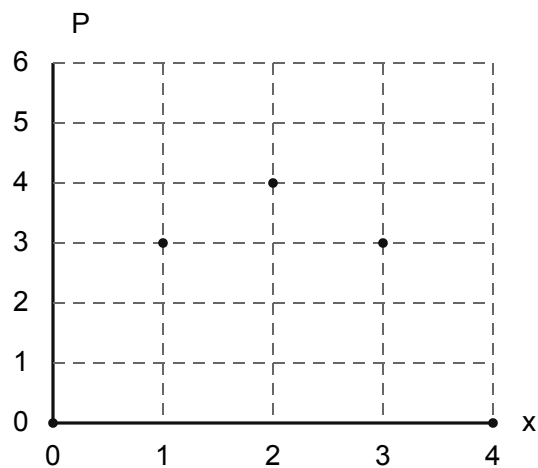
The output scale is hundreds of dollars, not dollars.



APPLY IT 2

Points $(0,0), (1,3), (2,4), (3,3), (4,0)$. $D=\{0,1,2,3,4\}$; $R=\{0,3,4\}$; best 2 stands, \$4.

Do not connect the points because fractional stands are not allowed.



CHALLENGE

$D: 0 \leq t \leq 5$; $0 \leq h \leq 9$. Height 8 m at $t=1, 3$ s. Landing roots -1, 5; negative elapsed time is excluded.

