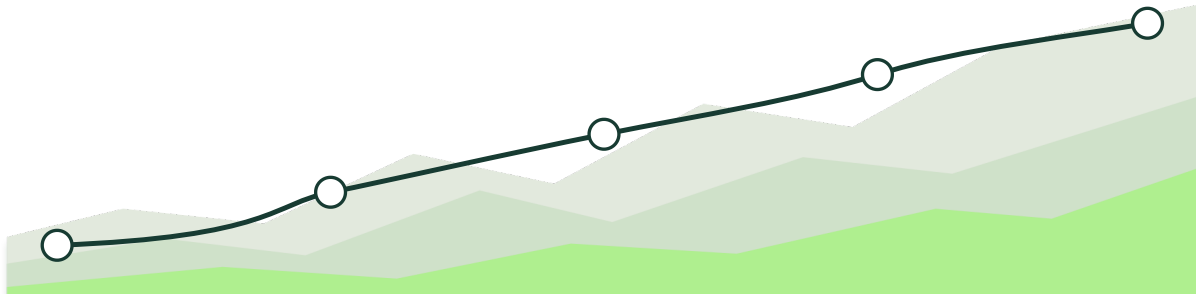


The Desmos road to 1600

Recognize the concept. Choose the move. Finish the problem.



01 · SECURE THE SETUP

Translate familiar questions into the right model.

Pages 2–3

02 · COMBINE THE CLUES

Use data, functions and geometry together.

Pages 4–9

03 · FINISH THE HARD CASES

Control parameters, domains and exact answers.

Pages 10–11

20 questions from Pursu’s math bank. Ten worked examples and ten checkpoints. Each lesson groups the calculator moves needed for one recognizable problem family.

Find your problem type

01	Linear systems • model from context • requested quantity	2
02	Quadratic modeling • vertex form • function evaluation	3
03	Exponential decay • percent change • time conversion	4
04	One-variable data • median • standard deviation	5
05	Exponential functions • unknown parameters • regression	6
06	Circles • perpendicular slopes • checking answer choices	7
07	Similar triangles • tangent-to-sine conversion	8
08	Similar solids • square and cube scale factors	9
09	Linear-quadratic systems • discriminant • parameter values	10
10	Radical equations • domain restriction • minimum parameter	11

Use each page in this order

Attempt the bank question → find its recognition clue → follow the Desmos solution → solve the checkpoint without the walkthrough. Check your answers on page 12.

Two totals. Two unknowns.

CONCEPT Linear systems • model from context • requested quantity

WORKED QUESTION 01

Pursu question bank

A bookstore sells hardcover books for \$15 and paperback books for \$7. If the bookstore sold 50 books for a total of \$550, how much, in dollars, was spent on hardcover books?

A \$150

B \$200

C \$375

D \$425

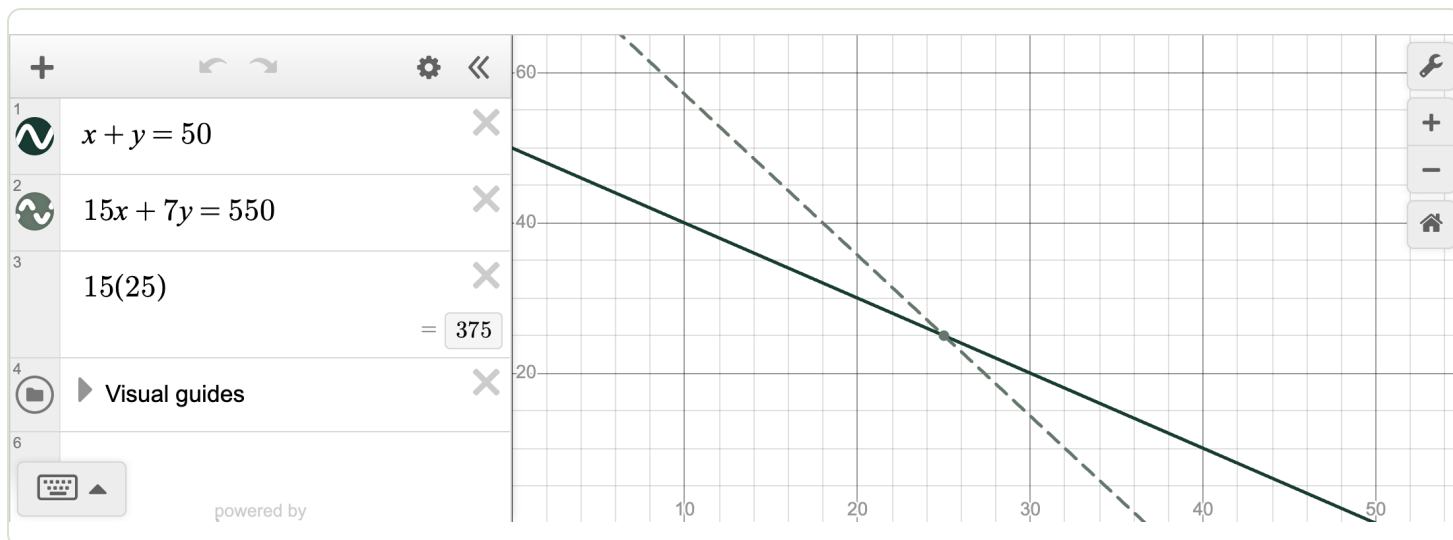
RECOGNIZE

“50 books” and “a total of \$550” give two independent totals.

TOOLS TO COMBINE

Graph two equations → read the intersection → evaluate the amount asked for.

SET IT UP Let x be hardcover books and y be paperbacks. Enter $x + y = 50$ and $15x + 7y = 550$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

C • \$375. The intersection is (25, 25). The question asks for hardcover revenue, so calculate $15(25) = 375$.

Trap: 25 is the number of hardcover books, not the amount spent.

YOUR TURN 02

Linear systems • sum of coordinates

$$2y + 3 = 5x$$

$$y - 6x = -9$$

Solve the system of equations for (x, y) . What is $x + y$?

A -6

B -3

C 6

D 7

Turn the story into a parabola.

CONCEPT Quadratic modeling • vertex form • function evaluation

WORKED QUESTION 03

Pursu question bank

The quadratic function h models the height, in feet, of a toy rocket t seconds after it is launched from the ground. The function estimates that the rocket reached its maximum height of 80 feet 4 seconds after launch. The rocket landed back on the ground 8 seconds after launch. Based on the function, what was the estimated height, to the nearest foot, of the rocket 6 seconds after it was launched?

- A 45 feet B 50 feet C 55 feet D 60 feet

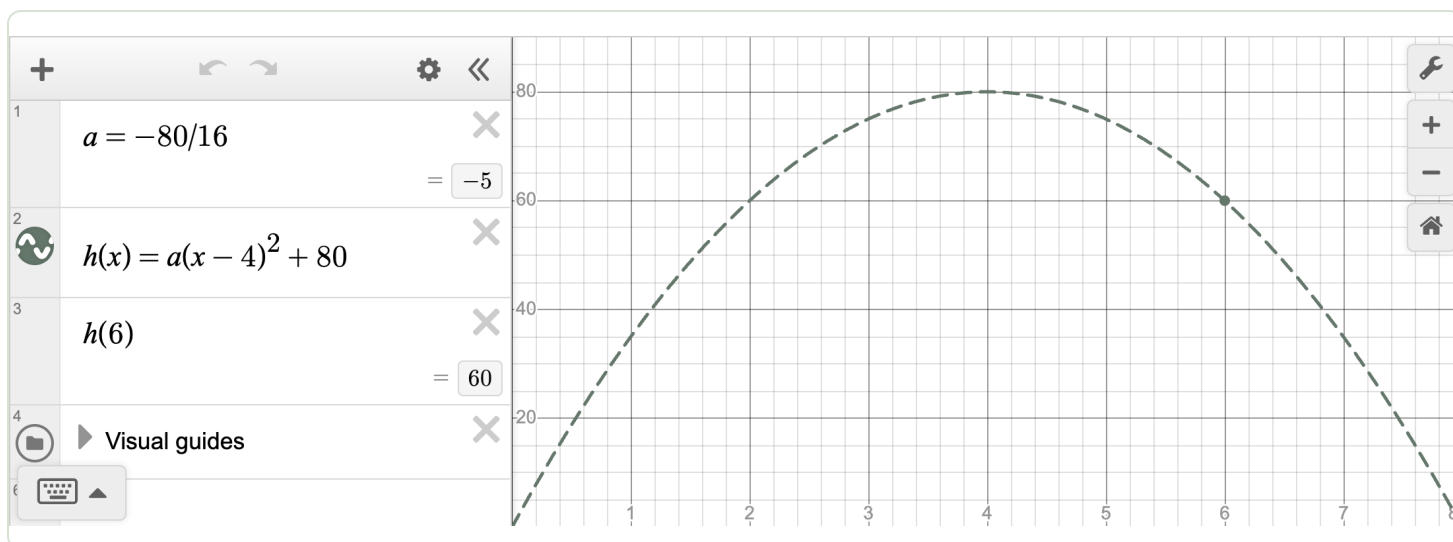
RECOGNIZE

“Maximum height of 80 feet” at “4 seconds” gives the vertex.

TOOLS TO COMBINE

Build vertex form → solve its coefficient → evaluate the function.

SET IT UP Start with $h(t) = a(t - 4)^2 + 80$. At launch, $h(0) = 0$, so $16a + 80 = 0$ and $a = -5$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

D • 60 feet. Define the height function, then enter $h(6)$. Desmos evaluates $-5(6 - 4)^2 + 80 = 60$.

Trap: Do not read 4 or 80 from the vertex; the question asks for height at 6 seconds.

YOUR TURN 04

Quadratic symmetry • equal heights

A quadratic function models a drone's height, in meters, above a lake in terms of the time, in seconds, after it took off. The model estimates that the drone took off from an initial height of 10 meters above the lake and reached a maximum height of 80 meters above the lake 5 seconds after takeoff. How many seconds after takeoff does the model estimate that the drone will return to a height of 10 meters?

- A 7 B 8 C 10 D 12

Match the rate to its time unit.

CONCEPT Exponential decay • percent change • time conversion

WORKED QUESTION 05

Pursu question bank

$$V(t) = 8500(0.92)^{\left(\frac{2}{5}\right)t}$$

The function V models the value, in dollars, of a motorcycle t years after it was purchased in 2015. According to the model, the value is predicted to decrease by $n\%$ every 30 months. What is the value of n ?

A 2

B 4

C 6

D 8

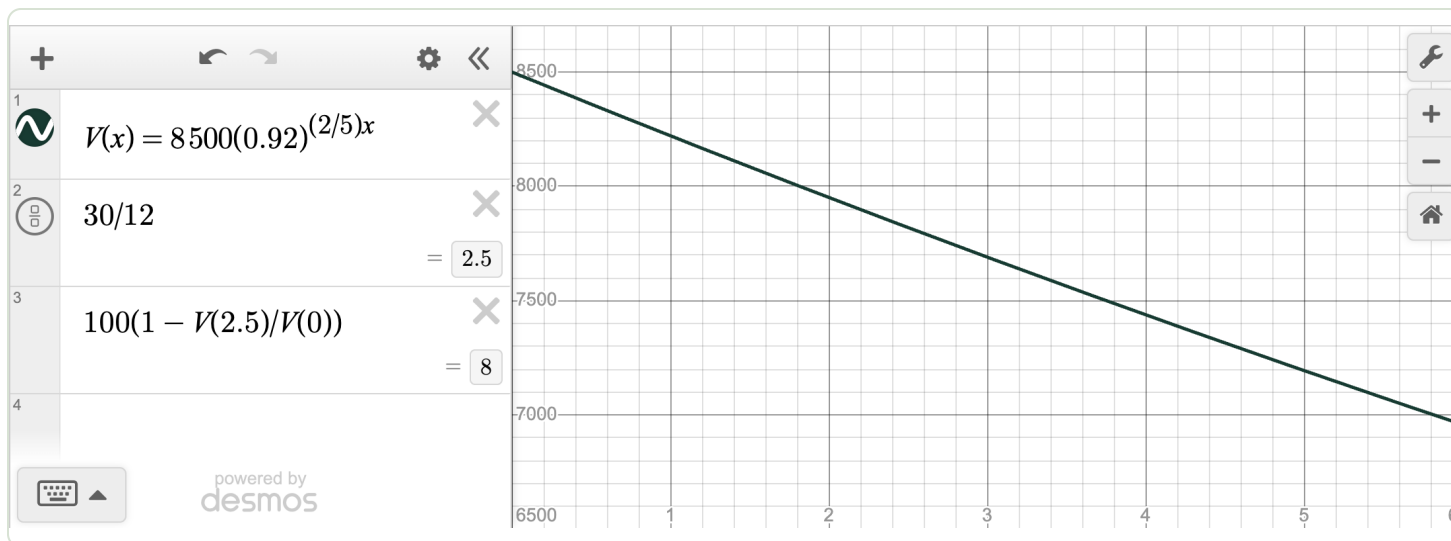
RECOGNIZE

The input is in years, but the requested decrease is over 30 months.

TOOLS TO COMBINE

Define the function → convert time → compare output ratios.

SET IT UP Convert 30 months to 2.5 years. Evaluate $100 \left(1 - \frac{V(2.5)}{V(0)} \right)$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

D • 8. Over 2.5 years, the exponent increases by $(2/5)(2.5) = 1$. The multiplier is 0.92: an 8% decrease.

Trap: 0.92 means 92% remains. It does not mean a 92% decrease.

YOUR TURN 06

Exponential growth • equivalent annual multiplier

$$f(x) = (1.44)^{\frac{x}{5}}$$

The function f is defined by the given equation. The equation can be rewritten as $f(x) = \left(1 + \frac{p}{100} \right)^x$, where p is a constant. Which of the following is closest to the value of p ?

A 12

B 20

C 22

D 44

Separate center from spread.

CONCEPT One-variable data • median • standard deviation

WORKED QUESTION 07

Pursu question bank

A set of 31 distinct numbers has a mean of 50 and a median of 50. A new set is formed by adding 10 to each number greater than the median and subtracting 10 from each number less than the median. Which statistic will NOT have the same value in both the original set and the new set?

- A Mean B Sum of the numbers c Median D Standard deviation

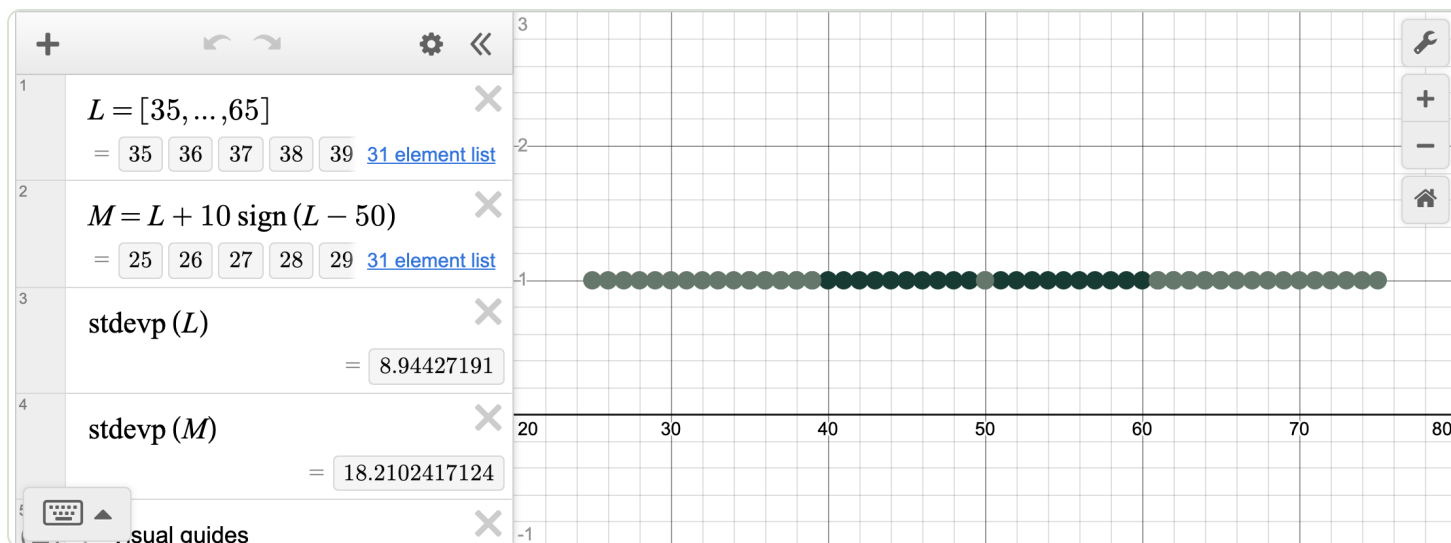
RECOGNIZE

Values move away from the median in opposite directions.

TOOLS TO COMBINE

Lists + a transformation → compare SD → justify the general rule.

SET IT UP To explore, use $L = [35, \dots, 65]$ and $M = L + 10 \text{ sign}(L - 50)$. Compare their population standard deviations.



Illustrative legal data set: 35 through 65. The bank question does not supply the 31 values.

D • Standard deviation. Fifteen values lose 10 and fifteen gain 10, so sum and mean stay fixed. The middle value stays 50. Every other distance from 50 increases, so SD increases.

Trap: The example is a check, not a proof for every set. The count-and-distance argument supplies the proof.

YOUR TURN 08

Mean • reconstructing a removed value

An engineering firm has 15 designers. The mean number of years these designers have worked with the company is 5.8 years. After one of the designers retires, the mean number of years for the remaining designers drops to 5.2 years. How many years did the retiring designer work at the company?

- A 13.6 B 14.2 C 14.7 D 15.3

Recover a model from its points.

CONCEPT Exponential functions • unknown parameters • regression

WORKED QUESTION 09

Pursu question bank

The function k is defined by $k(x) = a^x + b$, where a and b are positive constants. The graph of $y = k(x)$ in the xy -plane passes through the points $(0, 9)$ and $(-2, \frac{33}{4})$. What is the value of ab ?

- A 14 B 15 C 16 D 18

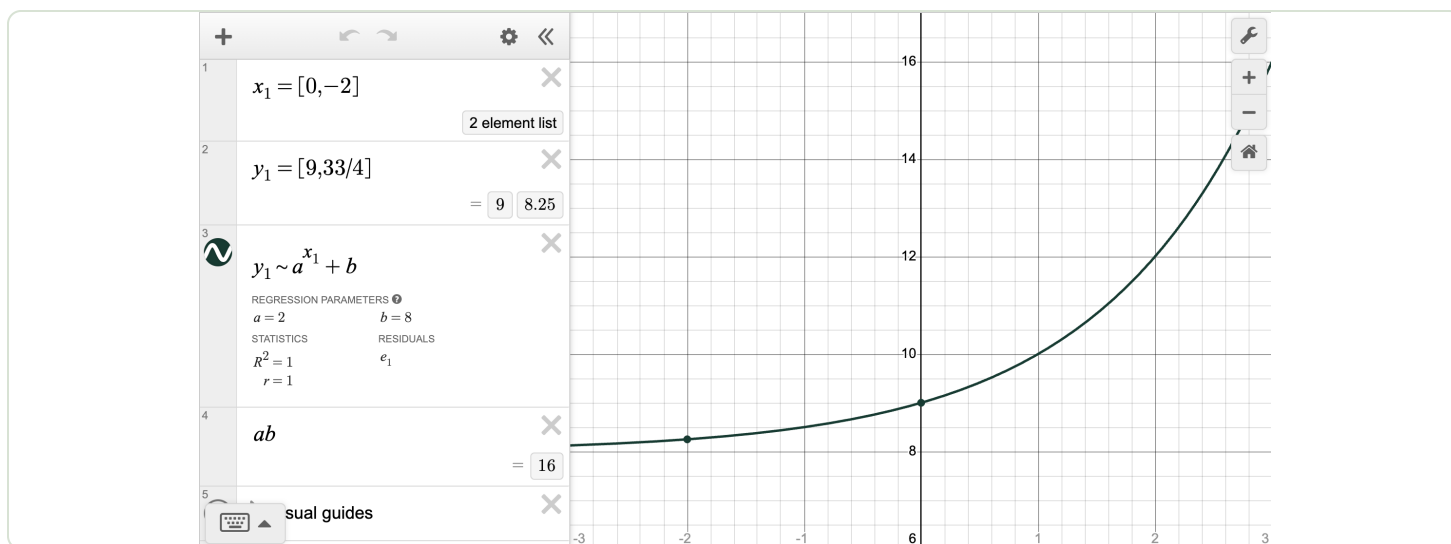
RECOGNIZE

A function form is supplied, with enough points to determine its constants.

TOOLS TO COMBINE

Paired lists → custom regression → evaluate the requested combination.

SET IT UP Enter the two points as x_1 and y_1 . Fit $y_1 \sim a^{x_1} + b$, then check $a > 0$ and $b > 0$. Evaluate ab .



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

C • 16. The fit gives $a = 2$, $b = 8$. Exactly: $1 + b = 9$, then $a^{-2} + 8 = 33/4$, so $a = 2$.

Trap: Use the stated model and constraints. A different curve can also pass through two points.

YOUR TURN 10

Exponential parameters • intercept conditions

The function f is defined by $f(x) = a^x + b$, where a and b are constants. In the xy -plane, the graph of $y = f(x)$ has an x -intercept at $(3, 0)$ and a y -intercept at $(0, -26)$. What is the value of a ?

- A 3 B 4 C 5 D 6

A tangent starts with the radius.

CONCEPT Circles • perpendicular slopes • checking answer choices

WORKED QUESTION 11

Pursu question bank

A circle in the xy -plane has center at $(2, -3)$. Line t is tangent to this circle at the point $(-4, 1)$. Which of the following points also lies on line t ?

- A $(-3, 5)$ B $(-1, 2)$ C $(-2, 4)$ D $(0, 3)$

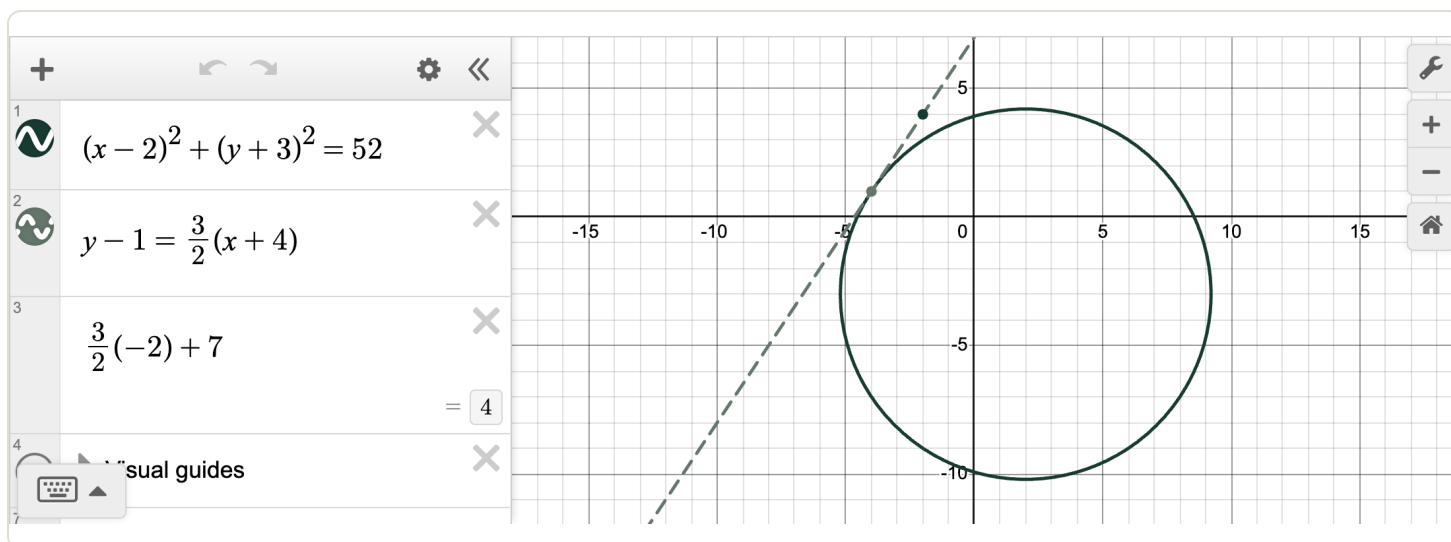
RECOGNIZE

The center and point of tangency define a radius perpendicular to the tangent.

TOOLS TO COMBINE

Slope calculation → graph the tangent → test candidate points.

SET IT UP Radius slope: $\frac{1 - (-3)}{-4 - 2} = -2/3$. Tangent slope: $3/2$. Enter $y - 1 = \frac{3}{2}(x + 4)$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

C • $(-2, 4)$. Substitute $x = -2$ into $y = \frac{3}{2}x + 7$; the output is 4. The circle is drawn as a visual check.

Trap: Using the radius slope would give a line through the center, not the tangent.

YOUR TURN 12

Circle equations • completing the square

The equation $x^2 - 6x + y^2 + 10y = -9$ describes a circle in the x - y plane. What are the coordinates of the center of the circle?

- A $(-20, -16)$ B $(-10, -8)$ C $(3, -5)$ D $(16, 20)$

Ignore the scale. Match the angle.

CONCEPT Similar triangles • tangent-to-sine conversion

WORKED QUESTION 13

Pursu question bank

Triangle PQR is similar to triangle LMN, where angle P corresponds to angle L and angles R and N are right angles. The length of PQ is 1.8 times the length of LM. If $\tan(P) = \frac{8}{15}$, what is the value of $\sin(L)$?

A $\frac{8}{17}$

B $\frac{9}{17}$

C $\frac{10}{17}$

D $\frac{11}{17}$

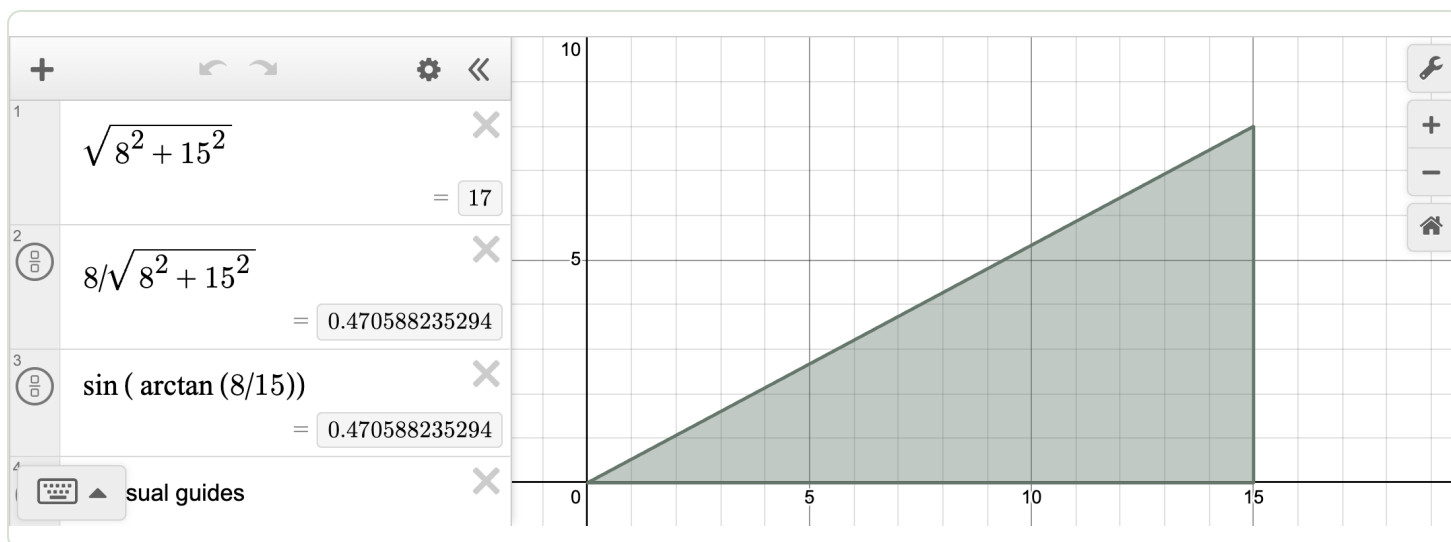
RECOGNIZE

Corresponding angles are equal; the given tangent supplies two side ratios.

TOOLS TO COMBINE

Right-triangle model → square root → ratio or inverse trig.

SET IT UP Use opposite 8 and adjacent 15. Compute $\sqrt{8^2 + 15^2} = 17$, then $8/17$. The third row checks with $\sin(\arctan(8/15))$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

A • $8/17$. Angle L equals angle P , so their sines are equal. The 1.8 length scale does not change a trig ratio.

Trap: Match the named angle first. The other acute angle has a different tangent.

YOUR TURN 14

Complementary angles • reciprocal tangent

Triangle XYZ is similar to triangle PQR, where angle X corresponds to angle P and angle Z corresponds to angle R. Angles Z and R are right angles. If $\tan(X) = \frac{3}{4}$, what is the value of $\tan(Q)$?

A $\frac{3}{4}$

B $\frac{4}{3}$

C $\frac{12}{5}$

D $\frac{5}{12}$

Area ratios are not volume ratios.

CONCEPT Similar solids • square and cube scale factors

WORKED QUESTION 15

Pursu question bank

Right rectangular prism A is similar to right rectangular prism B ; the surface area of prism A is 72cm^2 , the surface area of prism B is $1,800\text{cm}^2$, and the volume of prism B is $2,500\text{cm}^3$; what is the sum of the volumes, in cm^3 , of prisms A and B ?

- A 2000
- B 2200
- C 2500
- D 2520

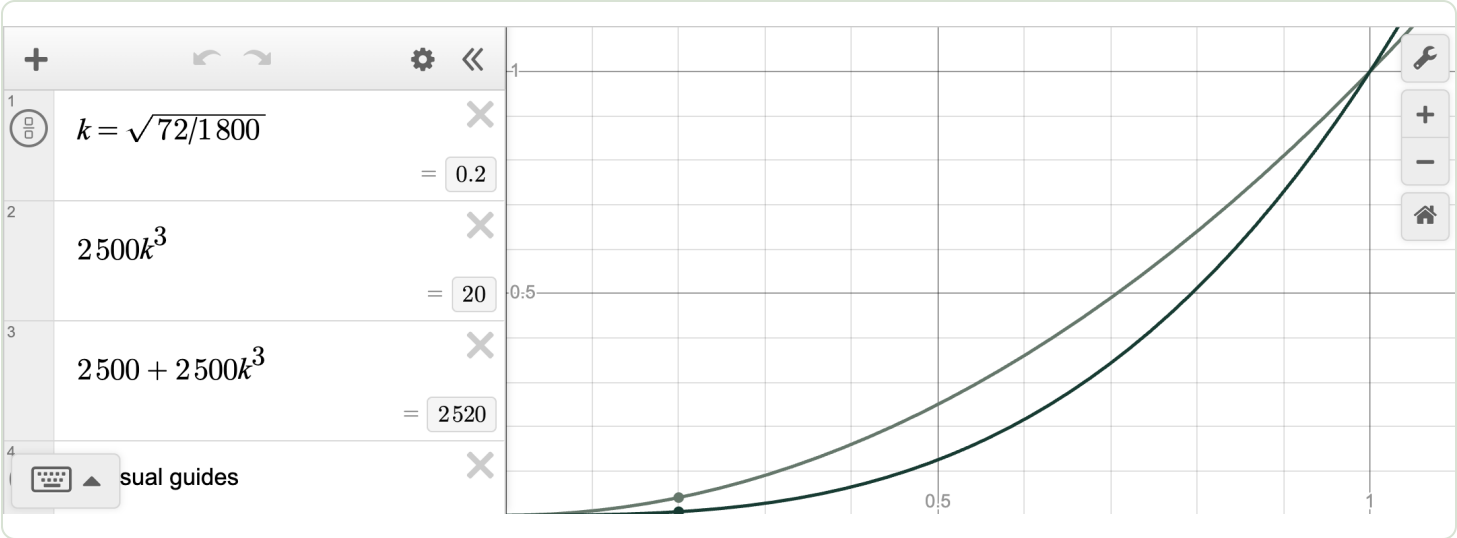
RECOGNIZE

Surface areas are given, but the requested quantity is a volume sum.

TOOLS TO COMBINE

Square root of the area ratio $\rightarrow$ cube the length ratio $\rightarrow$ combine volumes.

SET IT UP Small-to-large length scale: $k = \sqrt{72/1800} = 1/5$. Small volume: $2500k^3$. Add the large volume.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

D • 2520. Prism A has volume 20; prism B has volume 2500. The curves compare k^2 and k^3 for the same linear scale.

Trap: Multiplying 2500 by 72/1800 applies an area ratio to a volume.

YOUR TURN 16

Composite prisms • hidden faces • equation model

Two identical right rectangular prisms each have a height of 30 centimeters. The base of each prism is a square, and the surface area of each prism is $S\text{ cm}^2$. If the prisms are glued together along a square base, the resulting prism has a surface area of $\frac{7}{4}S\text{ cm}^2$. What is the side length, in centimeters, of each square base?

- A 10
- B 12
- C 15
- D 20

Translate “one solution” into tangency.

CONCEPT Linear-quadratic systems • discriminant • parameter values

WORKED QUESTION 17

Pursu question bank

$$y + m = x + 14$$

$$y - m = x^2 - 8x$$

In the given system of equations, m is a constant. The system has exactly one distinct real solution. What is the value of m ?

A $\frac{113}{8}$

B $\frac{123}{8}$

C $\frac{137}{8}$

D $\frac{35}{2}$

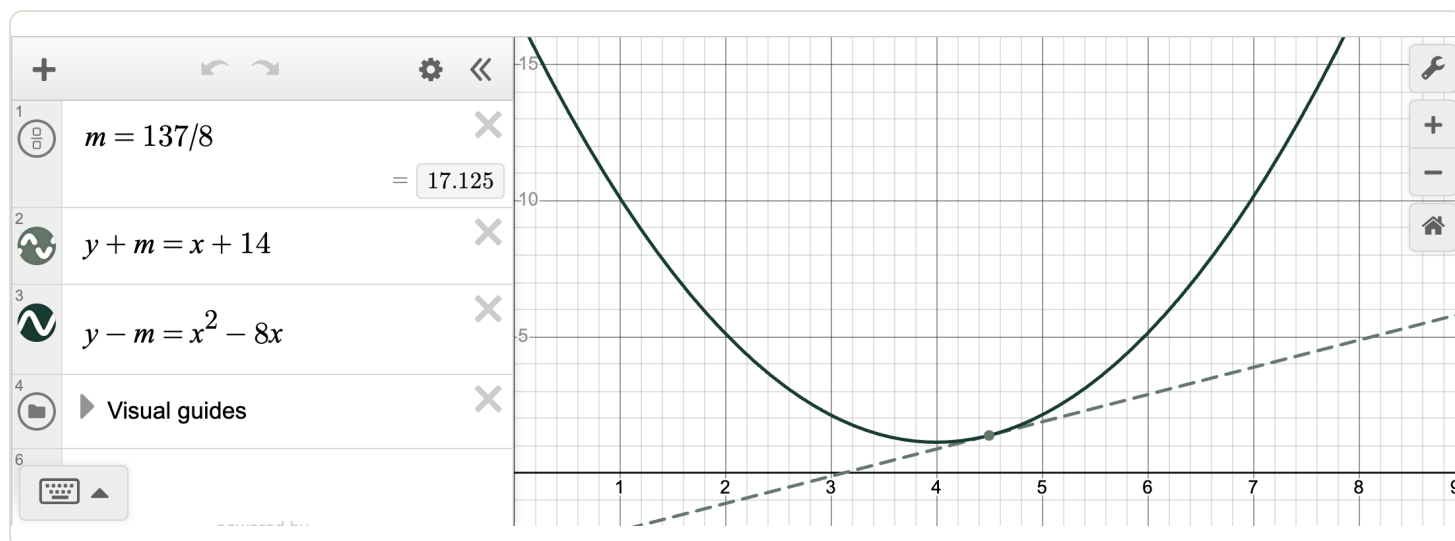
RECOGNIZE

“Exactly one distinct real solution” means the graphs meet once.

TOOLS TO COMBINE

Parameter slider → intersection check → zero discriminant.

SET IT UP Enter both original equations with a slider for m . Eliminate y : $x^2 - 9x + 2m - 14 = 0$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

C • $137/8$. The discriminant is $137 - 8m$. Set it to zero. At $m = 137/8$, the graphs touch at $(9/2, 11/8)$.

Trap: A near-tangent picture is not an exact value. Use the zero-discriminant condition to finish.

YOUR TURN 18

Quadratic discriminant • strict inequality • integer bound

$$x(mx - 42) = -24$$

In the given equation, m is an integer constant. If the equation has no real solution, what is the least possible value of m ?

A 16

B 19

C 22

D 25

The hardest case: parameter + domain.

CONCEPT Radical equations • domain restriction • minimum parameter

WORKED QUESTION 19

Pursu question bank

$$\sqrt{p - y} = 34 - y$$

In the given equation, p is a constant. The equation has exactly one real solution. What is the minimum possible value of $3p$?

A 99.75

B 101.25

C 105.65

D 110.15

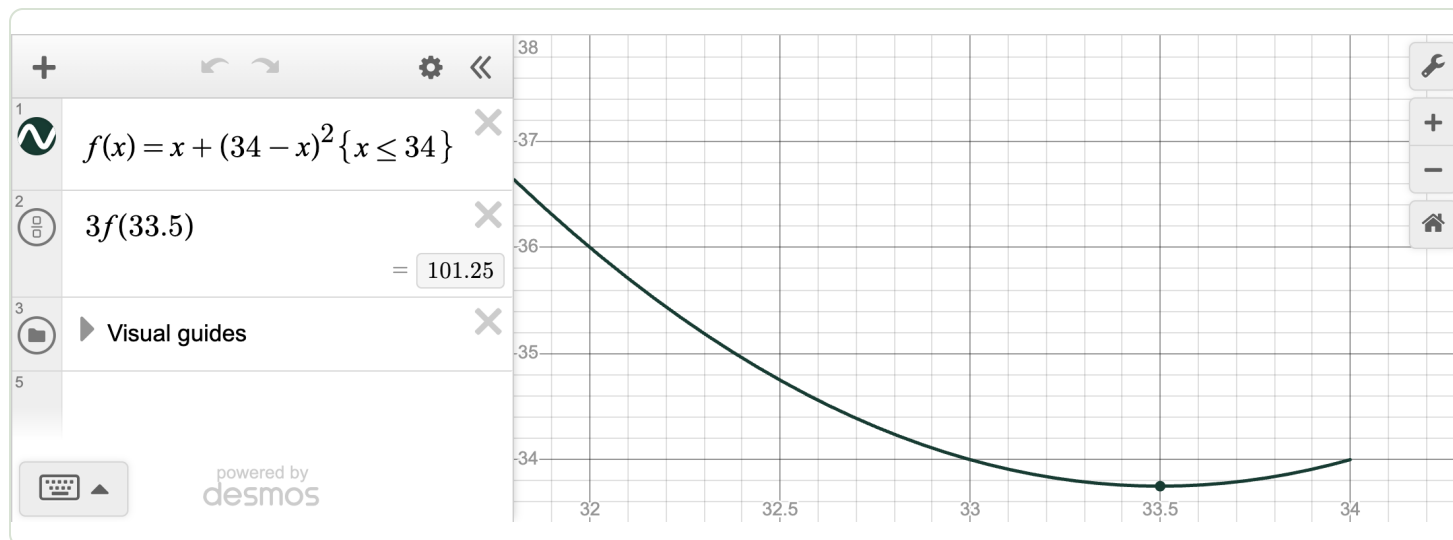
RECOGNIZE

“Exactly one real solution” and “minimum possible” require both counting and a boundary.

TOOLS TO COMBINE

Rearrange to a parameter function → restrict the domain → read the vertex.

SET IT UP The right side forces $y \leq 34$. Squaring gives $p = y + (34 - y)^2$. Plot this as $f(x) = x + (34 - x)^2 \{x \leq 34\}$.



Actual Desmos screen for this bank question. Visual guides are optional plotting aids.

B • 101.25. The restricted parabola has minimum $p = 33.75$ at $y = 33.5$. At that value there is one root, and $3p = 101.25$.

Trap: Verify the original: $\sqrt{33.75 - 33.5} = 34 - 33.5 = 0.5$. The graph-x represents the original y ; graph-y represents p .

YOUR TURN 20

Rational equations • excluded denominators

Solve for y :

$$\frac{y^2}{y^2 - 16} - \frac{2y}{y + 4} = \frac{2}{y - 4}$$

A 2

B 4

C 6

D 8

The last step is verification.

These answers correspond to the ten “Your turn” bank questions.

02 Linear systems • sum of coordinates

C • 6. The intersection is $(15/7, 27/7)$; add the coordinates to get $42/7 = 6$.

04 Quadratic symmetry • equal heights

C • 10 seconds. The axis is $t = 5$. The other time at the starting height is 5 seconds to the right, at $t = 10$.

06 Exponential growth • equivalent annual multiplier

B • 20. $(1.44)^{x/2} = (\sqrt{1.44})^x = 1.2^x$. Thus $1 + p/100 = 1.2$.

08 Mean • reconstructing a removed value

B • 14.2 years. Total years before retirement: $15(5.8) = 87$. After: $14(5.2) = 72.8$. Difference: 14.2.

10 Exponential parameters • intercept conditions

A • 3. The y-intercept gives $1 + b = -26$, so $b = -27$. The x-intercept gives $a^3 = 27$.

12 Circle equations • completing the square

C • $(3, -5)$. Complete squares to obtain $(x - 3)^2 + (y + 5)^2 = 25$. Read the center with the signs reversed.

14 Complementary angles • reciprocal tangent

B • $4/3$. Angles P and X correspond. Angle Q is complementary to P , so its tangent is the reciprocal.

16 Composite prisms • hidden faces • equation model

D • 20. For base side $s > 0$, one prism has $S = 2s^2 + 120s$. Joined: $2s^2 + 240s = \frac{7}{4}S$. Hence $s = 20$.

18 Quadratic discriminant • strict inequality • integer bound

B • 19. Rewrite as $mx^2 - 42x + 24 = 0$. No real roots require $1764 - 96m < 0$, so $m > 18.375$.

20 Rational equations • excluded denominators

A • 2. Exclude $y = \pm 4$. Clearing denominators gives $(y - 2)(y - 4) = 0$; discard 4 and retain 2.

Keep the concept. Reuse the method.

A changed story or different numbers do not necessarily require a new tool. Identify what stays the same: an intersection, an extremum, a rate, a ratio, or a domain condition.

Question source: Pursu's internal SAT math bank. Question wording and answer choices retained, with mathematical typesetting normalized. Selected answers independently checked.