DOMAIN

Advanced Math

Quadratics, exponentials, absolute value, radicals and rational expressions. The other third of the Math section, and home to most of the hardest Module 2 questions.

- **Nonlinear functions**
- **Nonlinear equations and systems**
- **Equivalent expressions**

Practice every problem in this section online.
Get your free account at **desmos.prepdrills.com**: live Desmos, instant feedback and the full walk-through for each one.

Problem 24

ADVANCED MATH · NONLINEAR FUNCTIONS

TRY IT FIRST

$$g(x) = \frac{x^2 - 5x + 6}{x - 2}$$

For the function g defined above, what is $g(-1)$?

A) -5

B) -4

C) -2

D) 2

MULTIPLE CHOICE

Problem 24

ADVANCED MATH · NONLINEAR FUNCTIONS

STEP BY STEP IN DESMOS

ALGEBRA FIRST, DESMOS TO CHECK *The algebra is short; Desmos confirms it.*

1 **TYPE**

1 $g(x) = \dfrac{x^2 - 5x + 6}{x - 2}$

YOU SEE Press / to build the fraction. It looks like the line $y = x - 3$; Desmos doesn't mark that $x = 2$ is left out.

2 **TYPE**

2 $g(-1)$

YOU SEE Desmos shows $= -4$.

WHY IT WORKS

Naming the function lets Desmos evaluate it at any input. Only $x = 2$ is off limits (try $g(2)$: Desmos says *undefined*), and -1 is allowed.

TRAP

Choice D, 2, factors the top as $(x - 2)(x + 3)$ and simplifies to $x + 3$: $-1 + 3 = 2$. The top is $(x - 2)(x - 3)$, so $g(x) = x - 3$ for $x \neq 2$.

BY HAND

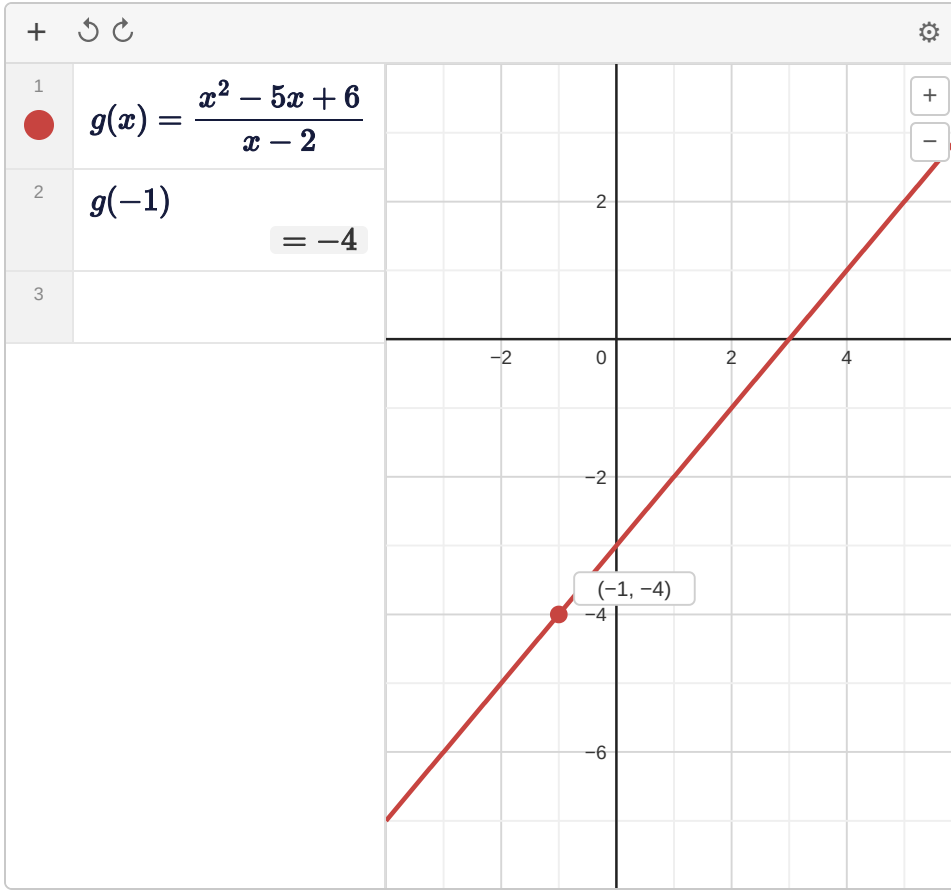
Numerator: $(-1)^2 - 5(-1) + 6 = 1 + 5 + 6 = 12$. Denominator: $-1 - 2 = -3$. So $g(-1) = \dfrac{12}{-3} = -4$.

Answer: B, -4

Problem 24

ADVANCED MATH · NONLINEAR FUNCTIONS

WHAT YOUR SCREEN LOOKS LIKE



$g(-1) = -4$. The graph looks like the line $y = x - 3$.

Try this one live with the real calculator: **desmos.prepdrills.com**

Problem 25

ADVANCED MATH · NONLINEAR FUNCTIONS

TRY IT FIRST

$$m(t) = 250(0.5)^{\frac{t}{12}}$$

A lab uses the function m to model the mass, in grams, of a radioactive sample t days after it was first measured. According to the model, what was the mass, in grams, of the sample when it was first measured?

A) 0.5

B) 12

C) 125

D) 250

MULTIPLE CHOICE

Problem 25

ADVANCED MATH · NONLINEAR FUNCTIONS

STEP BY STEP IN DESMOS

DO THIS ONE BY HAND *Mental math is faster. Desmos is only a safety net.*

1 **TYPE**

1 $m(t) = 250(0.5)^{\frac{t}{12}}$

YOU SEE A decaying curve, falling from left to right.

2 **TYPE**

2 $m(0)$

YOU SEE Desmos shows $= 250$.

WHY IT WORKS

When it was first measured means $t = 0$, and any number to the power 0 is 1. The starting value of $a(b)^{\text{something}}$ is a.

TRAP

Choice C, 125, is the mass after one half-life (12 days). The question asks about the start.

BY HAND

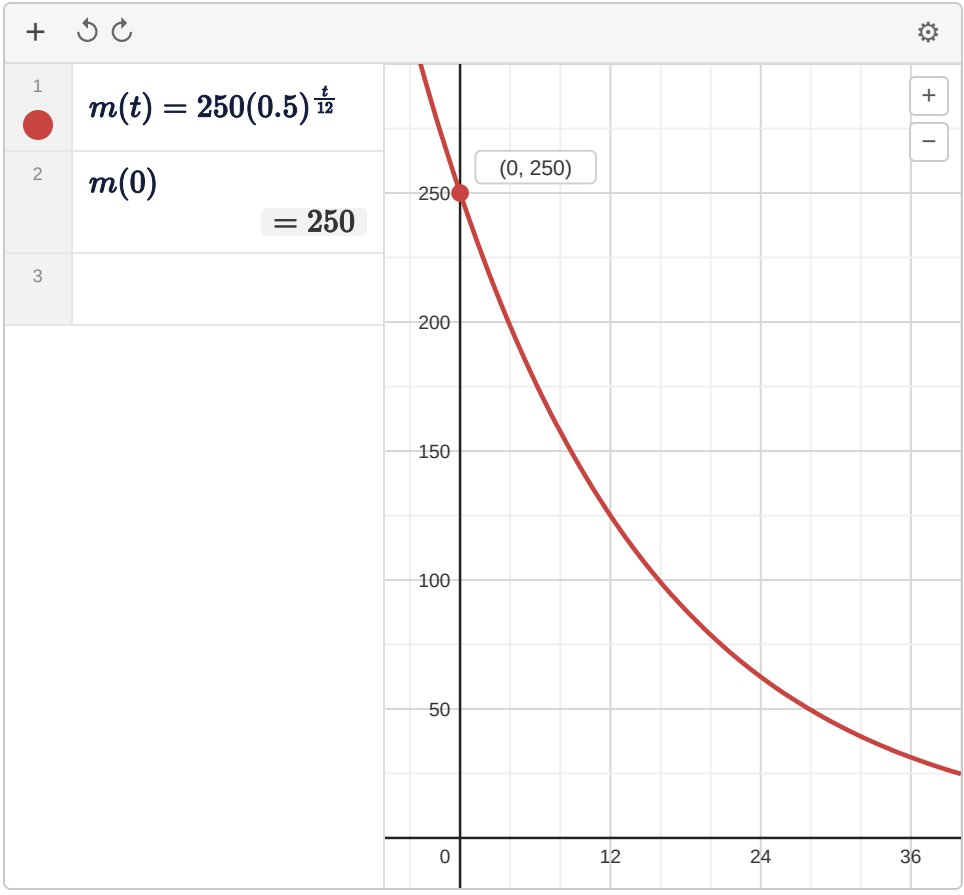
$m(0) = 250(0.5)^0 = 250(1) = 250$.

Answer: D, 250

Problem 25

ADVANCED MATH · NONLINEAR FUNCTIONS

WHAT YOUR SCREEN LOOKS LIKE



At $t = 0$ the model gives the starting mass, 250 grams.

Try this one live with the real calculator: **desmos.prepdrills.com**

Problem 26

ADVANCED MATH · NONLINEAR FUNCTIONS

TRY IT FIRST

$$f(x) = 4(2)^x$$

The function f is defined above. If $g(x) = f(x + 3)$, which equation defines g?

A) $g(x) = 12(2)^x$

B) $g(x) = 32(2)^x$

C) $g(x) = 4(8)^x$

D) $g(x) = 64(2)^x$

MULTIPLE CHOICE

Problem 26

ADVANCED MATH · NONLINEAR FUNCTIONS — STEP BY STEP IN DESMOS

DESMOS IS FASTER *Desmos beats the algebra here.*

1 **TYPE**

1 $f(x) = 4(2)^x$

YOU SEE A rising exponential curve.

2 **TYPE**

2 $g(x) = f(x + 3)$

YOU SEE A second curve, the first one shifted 3 units left.

3 **TYPE**

3 $y = 32(2)^x$

YOU SEE Choice B. It lands exactly on g. Try the others: each one is a different curve.

WHY IT WORKS

Two equations define the same function exactly when their graphs match everywhere. Desmos lets you check each choice against g without any exponent rules.

TRAP

Choice A multiplies 4 by 3. The $+3$ is in the exponent: $2^{x+3} = 2^x \cdot 2^3 = 8 \cdot 2^x$.

BY HAND

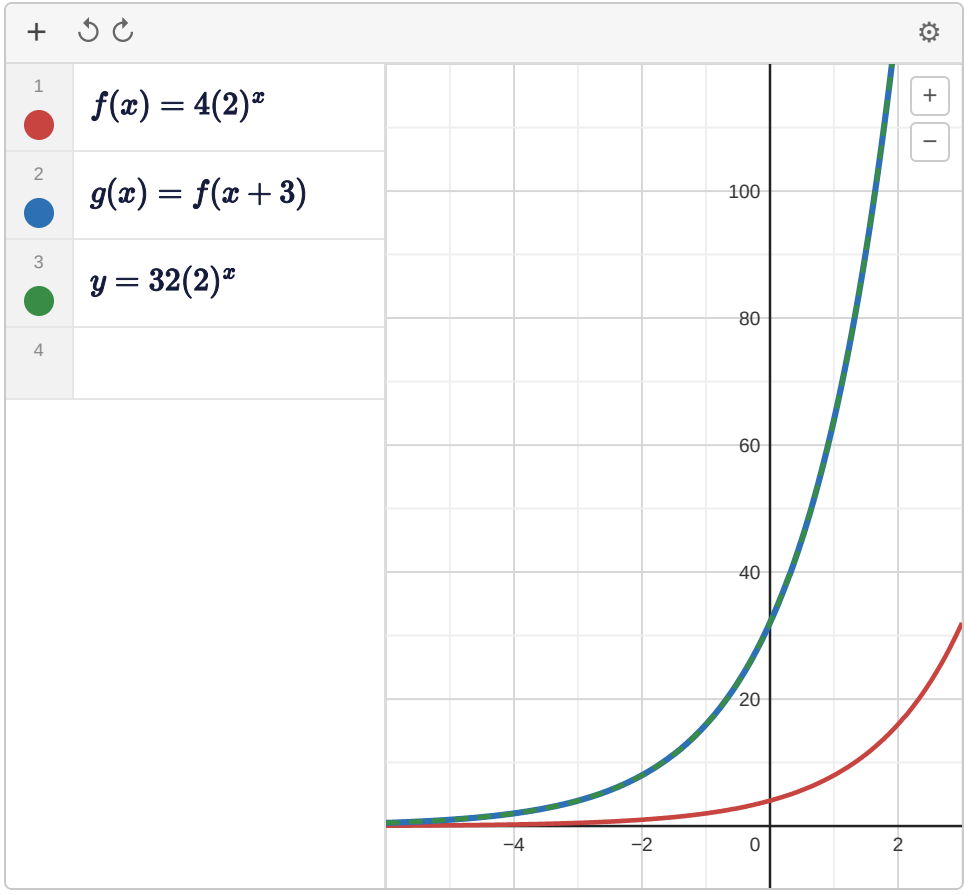
$g(x) = 4(2)^{x+3} = 4 \cdot 2^3 \cdot 2^x = 4 \cdot 8 \cdot 2^x = 32(2)^x$.

Answer: B, $g(x) = 32(2)^x$

Problem 26

ADVANCED MATH · NONLINEAR FUNCTIONS

WHAT YOUR SCREEN LOOKS LIKE



Choice B (green, dashed) lies right on g (blue).

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Problem 27

ADVANCED MATH · NONLINEAR FUNCTIONS

TRY IT FIRST

$$f(x) = x^2 - 6x + 5$$

The function f is defined above. The function g is defined by $g(x) = f(x - 2) + 3$. What is the minimum value of $g(x)$?

A) -4

B) -1

C) 3

D) 5

MULTIPLE CHOICE

Problem 27

ADVANCED MATH · NONLINEAR FUNCTIONS — STEP BY STEP IN DESMOS

DESMOS IS FASTER *Desmos beats the algebra here.*

1 **TYPE**

1 $f(x) = x^2 - 6x + 5$

YOU SEE A parabola with its lowest point at $(3, -4)$.

2 **TYPE**

2 $g(x) = f(x - 2) + 3$

YOU SEE A copy moved 2 right and 3 up.

3 **TAP**

Tap the lowest point of g.

YOU SEE Desmos labels $(5, -1)$. The minimum value is the y-coordinate, -1.

WHY IT WORKS

$f(x - 2)$ moves a graph 2 units right, and $+3$ moves it 3 up. Desmos does the moving; you just read the new vertex.

TRAP

Choice D, 5, is where the minimum happens ($x = 5$), not the minimum value. Choice A is f's minimum, before the shift.

BY HAND

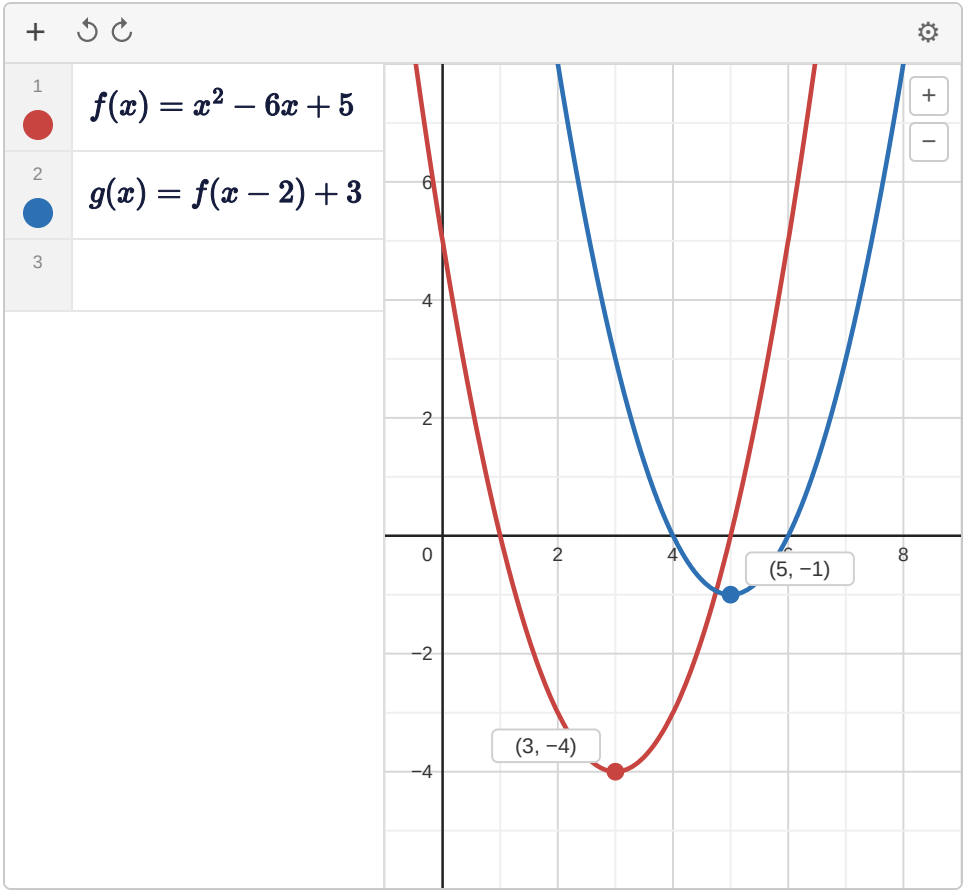
$f(x) = (x - 3)^2 - 4$, minimum -4 at $x = 3$. Shifting 2 right and 3 up moves the vertex to $(5, -1)$. Minimum value: -1.

Answer: B, -1

Problem 27

ADVANCED MATH · NONLINEAR FUNCTIONS

WHAT YOUR SCREEN LOOKS LIKE



g (blue) is f (red) moved right 2 and up 3; its lowest point is $(5, -1)$.

Try this one live with the real calculator: **desmos.prepdrills.com**

Problem 28

ADVANCED MATH · NONLINEAR FUNCTIONS

TRY IT FIRST

$$p(x) = 2x^3 - 5x^2 + rx - 4$$

In the polynomial above, r is a constant. When $p(x)$ is divided by $x - 3$, the remainder is 20. What is the value of r?

GRID-IN