**This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.**

**If you have a suggestion to make the keys better, please fill out the short survey here.**

*Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.*

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1. Choose the interval below that $f$ composed with $g$ at $x = 1$ is in.

$$f(x) = x^3 - 1x^2 + 3x - 3 \text{ and } g(x) = -x^3 - 3x^2 - x + 3$$

The solution is $-21.0$, which is option A.

A. $(f \circ g)(1) \in [-22, -17]$

* This is the correct solution

B. $(f \circ g)(1) \in [-6, 0]$

Distractor 3: Corresponds to being slightly off from the solution.

C. $(f \circ g)(1) \in [-31, -27]$

Distractor 2: Corresponds to being slightly off from the solution.

D. $(f \circ g)(1) \in [3, 6]$

Distractor 1: Corresponds to reversing the composition.

E. It is not possible to compose the two functions.

**General Comment:** $f$ composed with $g$ at $x$ means $f(g(x))$. The order matters!

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2. Determine whether the function below is 1-1.

$$f(x) = 16x^2 + 128x + 256$$

The solution is no, which is option C.

A. Yes, the function is 1-1.

Corresponds to believing the function passes the Horizontal Line test.

B. No, because there is an $x$-value that goes to 2 different $y$-values.

Corresponds to the Vertical Line test, which checks if an expression is a function.

C. No, because there is a $y$-value that goes to 2 different $x$-values.

* This is the solution.

D. No, because the domain of the function is not $(-\infty, \infty)$.

Corresponds to believing 1-1 means the domain is all Real numbers.

E. No, because the range of the function is not $(-\infty, \infty)$.

Corresponds to believing 1-1 means the range is all Real numbers.

**General Comment:** There are only two valid options: The function is 1-1 OR No because there is a $y$-value that goes to 2 different $x$-values.

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3. Determine whether the function below is 1-1.

$$f(x) = (6x - 30)^3$$

The solution is yes, which is option A.

A. Yes, the function is 1-1.

* This is the solution.

B. No, because there is an $x$-value that goes to 2 different $y$-values.

Corresponds to the Vertical Line test, which checks if an expression is a function.

C. No, because the domain of the function is not $(-\infty, \infty)$.

Corresponds to believing 1-1 means the domain is all Real numbers.

D. No, because there is a $y$-value that goes to 2 different $x$-values.

Corresponds to the Horizontal Line test, which this function passes.

E. No, because the range of the function is not $(-\infty, \infty)$.

Corresponds to believing 1-1 means the range is all Real numbers.

**General Comment:** There are only two valid options: The function is 1-1 OR No because there is a $y$-value that goes to 2 different $x$-values.

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4. Multiply the following functions, then choose the domain of the resulting function from the list below.

$$f(x) = 9x^3 + 6x^2 + 9x + 9 \text{ and } g(x) = \sqrt{-3x - 7}$$

The solution is  The domain is all Real numbers less than or equal to$x = -2.3333333333333335.$, which is option C.

A. The domain is all Real numbers except $x = a,$ where $a \in [-4.25, -0.25]$

B. The domain is all Real numbers greater than or equal to $x = a,$ where $a \in [3.25, 4.25]$

C. The domain is all Real numbers less than or equal to $x = a,$ where $a \in [-3.33, -1.33]$

D. The domain is all Real numbers except $x = a$ and $x = b,$ where $a \in [6.2, 7.2]$ and $b \in [-12.2, -4.2]$

E. The domain is all Real numbers.

**General Comment:** The new domain is the intersection of the previous domains.

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5. Find the inverse of the function below. Then, evaluate the inverse at $x = 10$ and choose the interval that $f^{-1}(10)$ belongs to.

$$f(x) = \ln(x - 2) + 5$$

The solution is $f^{-1}(10) = 150.413$, which is option D.

A. $f^{-1}(10) \in [142.41, 147.41]$

This solution corresponds to distractor 3.

B. $f^{-1}(10) \in [3269015.37, 3269026.37]$

This solution corresponds to distractor 1.

C. $f^{-1}(10) \in [2982.96, 2989.96]$

This solution corresponds to distractor 4.

D. $f^{-1}(10) \in [149.41, 157.41]$

This is the solution.

E. $f^{-1}(10) \in [162756.79, 162766.79]$

This solution corresponds to distractor 2.

**General Comment:** Natural log and exponential functions always have an inverse. Once you switch the $x$ and $y$, use the conversion $e^y = x \leftrightarrow y = \ln(x)$.

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6. Choose the interval below that $f$ composed with $g$ at $x = -1$ is in.

$$f(x) = -2x^3 - 4x^2 - 4x \text{ and } g(x) = x^3 + 2x^2 - x - 2$$

The solution is 0.0, which is option C.

A. $(f \circ g)(-1) \in [12, 15]$

Distractor 1: Corresponds to reversing the composition.

B. $(f \circ g)(-1) \in [17, 22]$

Distractor 3: Corresponds to being slightly off from the solution.

C. $(f \circ g)(-1) \in [-2, 2]$

* This is the correct solution

D. $(f \circ g)(-1) \in [-9, -5]$

Distractor 2: Corresponds to being slightly off from the solution.

E. It is not possible to compose the two functions.

**General Comment:** $f$ composed with $g$ at $x$ means $f(g(x))$. The order matters!

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7. Find the inverse of the function below. Then, evaluate the inverse at $x = 8$ and choose the interval that $f^{-1}(8)$ belongs to.

$$f(x) = \ln(x - 4) - 2$$

The solution is $f^{-1}(8) = 22030.466$, which is option C.

A. $f^{-1}(8) \in [162752.79, 162759.79]$

This solution corresponds to distractor 2.

B. $f^{-1}(8) \in [400.43, 410.43]$

This solution corresponds to distractor 1.

C. $f^{-1}(8) \in [22026.47, 22035.47]$

This is the solution.

D. $f^{-1}(8) \in [51.6, 54.6]$

This solution corresponds to distractor 4.

E. $f^{-1}(8) \in [22021.47, 22023.47]$

This solution corresponds to distractor 3.

**General Comment:** Natural log and exponential functions always have an inverse. Once you switch the $x$ and $y$, use the conversion $e^y = x \leftrightarrow y = \ln(x)$.

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8. Find the inverse of the function below (if it exists). Then, evaluate the inverse at $x = 15$ and choose the interval that $f^{-1}(15)$ belongs to.

$$f(x) = 3x^2 - 2$$

The solution is  The function is not invertible for all Real numbers. , which is option E.

A. $f^{-1}(15) \in [1.72, 2.16]$

Distractor 2: This corresponds to finding the (nonexistent) inverse and not subtracting by the vertical shift.

B. $f^{-1}(15) \in [7.7, 8.51]$

Distractor 4: This corresponds to both distractors 2 and 3.

C. $f^{-1}(15) \in [2.3, 2.85]$

Distractor 1: This corresponds to trying to find the inverse even though the function is not 1-1.

D. $f^{-1}(15) \in [4.85, 5.63]$

Distractor 3: This corresponds to finding the (nonexistent) inverse and dividing by a negative.

E.  The function is not invertible for all Real numbers.

* This is the correct option.

**General Comment:** Be sure you check that the function is 1-1 before trying to find the inverse!

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9. Find the inverse of the function below (if it exists). Then, evaluate the inverse at $x = 12$ and choose the interval the $f^{-1}(12)$ belongs to.

$$f(x) = \sqrt[3]{4x - 3}$$

The solution is 432.75, which is option D.

A. $f^{-1}(12) \in [-433.14, -431.76]$

This solution corresponds to distractor 2.

B. $f^{-1}(12) \in [430.43, 432.1]$

Distractor 1: This corresponds to

C. $f^{-1}(12) \in [-431.68, -430.43]$

This solution corresponds to distractor 3.

D. $f^{-1}(12) \in [432.29, 434.48]$

* This is the correct solution.

E.  The function is not invertible for all Real numbers.

This solution corresponds to distractor 4.

**General Comment:** Be sure you check that the function is 1-1 before trying to find the inverse!

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10. Add the following functions, then choose the domain of the resulting function from the list below.

$$f(x) = \frac{4}{4x + 21} \text{ and } g(x) = \frac{1}{3x - 19}$$

The solution is  The domain is all Real numbers except $x = -5.25$ and $x = 6.333333333333333$, which is option D.

A. The domain is all Real numbers greater than or equal to $x = a$, where $a \in [-10.4, -4.4]$

B. The domain is all Real numbers except $x = a$, where $a \in [-9.25, -0.25]$

C. The domain is all Real numbers less than or equal to $x = a$, where $a \in [3.75, 7.75]$

D. The domain is all Real numbers except $x = a$ and $x = b$, where $a \in [-9.25, -3.25]$ and $b \in [4.33, 15.33]$

E. The domain is all Real numbers.

**General Comment:** The new domain is the intersection of the previous domains.

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