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 **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{4096}{64}}$$

The solution is Whole, which is option C.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Whole

* This is the correct option!

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 64.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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2. Simplify the expression below and choose the interval the simplification is contained within.

$$12 - 10 \div 17 * 15 - (6 * 18)$$

The solution is -104.824, which is option C.

A. $[-53.82, -46.82]$

-50.824, which corresponds to not distributing a negative correctly.

B. $[115.96, 121.96]$

119.961, which corresponds to not distributing addition and subtraction correctly.

C. $[-110.82, -103.82]$

* -104.824, which is the correct option.

D. $[-104.04, -92.04]$

-96.039, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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3. Simplify the expression below and choose the interval the simplification is contained within.

$$12 - 7^2 + 19 \div 14 * 17 \div 10$$

The solution is -34.693, which is option D.

A. $[63.08, 64.09]$

63.307, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-38.16, -36.7]$

-36.992, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[60.5, 61.5]$

61.008, which corresponds to two Order of Operations errors.

D. $[-34.8, -34.29]$

* -34.693, this is the correct option

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{165}}{16} + 3i^2$$

The solution is Irrational, which is option E.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

E. Irrational

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 + 7i)(9 + 10i)$$

The solution is $2 + 143i$, which is option D.

A. $a \in [140, 147]$ and $b \in [-17, -15]$

$142 - 17i$, which corresponds to adding a minus sign in the second term.

B. $a \in [1, 7]$ and $b \in [-152, -141]$

$2 - 143i$, which corresponds to adding a minus sign in both terms.

C. $a \in [140, 147]$ and $b \in [14, 18]$

$142 + 17i$, which corresponds to adding a minus sign in the first term.

D. $a \in [1, 7]$ and $b \in [142, 146]$

* $2 + 143i$, which is the correct option.

E. $a \in [70, 77]$ and $b \in [64, 79]$

$72 + 70i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-45 + 77i}{2 - 3i}$$

The solution is $-24.69 + 1.46i$, which is option C.

A. $a \in [-23, -22]$ and $b \in [-26.5, -25]$

$-22.50 - 25.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-25, -24.5]$ and $b \in [18, 20]$

$-24.69 + 19.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-25, -24.5]$ and $b \in [0.5, 2]$

* $-24.69 + 1.46i$, which is the correct option.

D. $a \in [-321.5, -319.5]$ and $b \in [0.5, 2]$

$-321.00 + 1.46i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [10, 11.5]$ and $b \in [21.5, 23]$

$10.85 + 22.23i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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7. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{361}{256}} + \sqrt{198}i$$

The solution is Nonreal Complex, which is option C.

A. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

B. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

C. Nonreal Complex

* This is the correct option!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(4 - 8i)(6 + 7i)$$

The solution is $80 - 20i$, which is option E.

A. $a \in [-36, -28]$ and $b \in [70, 79]$

$-32 + 76i$, which corresponds to adding a minus sign in the first term.

B. $a \in [23, 28]$ and $b \in [-59, -52]$

$24 - 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-36, -28]$ and $b \in [-83, -70]$

$-32 - 76i$, which corresponds to adding a minus sign in the second term.

D. $a \in [75, 87]$ and $b \in [17, 21]$

$80 + 20i$, which corresponds to adding a minus sign in both terms.

E. $a \in [75, 87]$ and $b \in [-24, -18]$

* $80 - 20i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-45 - 44i}{2 + 7i}$$

The solution is $-7.51 + 4.28i$, which is option E.

A. $a \in [-9, -6.5]$ and $b \in [226, 228.5]$

$-7.51 + 227.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-399, -397]$ and $b \in [4, 5]$

$-398.00 + 4.28i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [3, 5]$ and $b \in [-9, -7]$

$4.11 - 7.60i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-23, -21.5]$ and $b \in [-7, -6]$

$-22.50 - 6.29i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-9, -6.5]$ and $b \in [4, 5]$

* $-7.51 + 4.28i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{1680}{15}}$$

The solution is Irrational, which is option C.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

C. Irrational

* This is the correct option!

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{112}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.
