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 Complex numbers that the number below belongs to.

$$\frac{-11}{3} + 81i^2$$

The solution is Rational, which is option B.

A. Irrational

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

B. Rational

* This is the correct option!

C. Nonreal Complex

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

D. 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!

E. Pure Imaginary

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

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

$$5 - 14^2 + 19 \div 16 * 4 \div 9$$

The solution is -190.472, which is option A.

A. $[-190.87, -189.7]$

* -190.472, this is the correct option

B. $[-191.22, -190.73]$

-190.967, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[201.3, 201.59]$

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

D. $[200.56, 201.24]$

201.033, which corresponds to two Order of Operations errors.

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

$$\sqrt{\frac{100}{361}} + 4i^2$$

The solution is Rational, which is option E.

A. Irrational

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

B. Nonreal Complex

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

C. Pure Imaginary

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

D. 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!

E. Rational

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

$$\frac{-9 - 77i}{3 + 4i}$$

The solution is $-13.40 - 7.80i$, which is option C.

A. $a \in [-13.5, -13]$ and $b \in [-196, -194.5]$

$-13.40 - 195.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-3.5, -2.5]$ and $b \in [-20, -18]$

$-3.00 - 19.25i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-13.5, -13]$ and $b \in [-8, -7]$

* $-13.40 - 7.80i$, which is the correct option.

D. $a \in [-336, -334.5]$ and $b \in [-8, -7]$

$-335.00 - 7.80i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [11, 12.5]$ and $b \in [-11, -9.5]$

$11.24 - 10.68i$, 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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5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 + 77i}{-4 - 6i}$$

The solution is $-9.58 - 4.88i$, which is option D.

A. $a \in [-499.5, -497.5]$ and $b \in [-5, -4]$

$-498.00 - 4.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-10, -9.5]$ and $b \in [-255, -253.5]$

$-9.58 - 254.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-2.5, -1]$ and $b \in [-14, -11.5]$

$-2.25 - 12.83i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-10, -9.5]$ and $b \in [-5, -4]$

* $-9.58 - 4.88i$, which is the correct option.

E. $a \in [7.5, 9.5]$ and $b \in [-7.5, -6]$

$8.19 - 6.96i$, 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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6. Simplify the expression below and choose the interval the simplification is contained within.

$$1 - 16^2 + 4 \div 3 * 15 \div 5$$

The solution is -251.000, which is option D.

A. $[-256.7, -254.9]$

-254.982, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[257.3, 261.1]$

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

C. $[254.2, 257.8]$

257.018, which corresponds to two Order of Operations errors.

D. $[-253.8, -249.7]$

* -251.000, 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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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-6 + 9i)(-2 + 5i)$$

The solution is $-33 - 48i$, which is option B.

A. $a \in [50, 62]$ and $b \in [7, 18]$

$57 + 12i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-38, -30]$ and $b \in [-48, -45]$

* $-33 - 48i$, which is the correct option.

C. $a \in [7, 15]$ and $b \in [44, 47]$

$12 + 45i$, 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.

D. $a \in [-38, -30]$ and $b \in [46, 54]$

$-33 + 48i$, which corresponds to adding a minus sign in both terms.

E. $a \in [50, 62]$ and $b \in [-14, -11]$

$57 - 12i$, which corresponds to adding a minus sign in the first term.

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

$$\sqrt{\frac{12996}{361}}$$

The solution is Whole, which is option C.

A. Integer

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

B. Irrational

These cannot be written as a fraction of Integers.

C. Whole

* This is the correct option!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -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 114.

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

$$(7 + 3i)(-4 + 6i)$$

The solution is $-46 + 30i$, which is option A.

A. $a \in [-50, -41]$ and $b \in [29, 31]$

* $-46 + 30i$, which is the correct option.

B. $a \in [-50, -41]$ and $b \in [-33, -29]$

$-46 - 30i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-10, -6]$ and $b \in [49, 57]$

$-10 + 54i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-34, -24]$ and $b \in [15, 20]$

$-28+18i$, 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.

E. $a \in [-10, -6]$ and $b \in [-56, -50]$

$-10 - 54i$, which corresponds to adding a minus sign in the second term.

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

$$\sqrt{\frac{324}{361}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Not a Real number

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

C. Integer

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

D. Irrational

These cannot be written as a fraction of Integers.

E. Whole

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{18}{19}$.

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.
