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.

$$\sqrt{\frac{-1683}{9}}i + \sqrt{156}i$$

The solution is Nonreal Complex, which is option C.

A. 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!

B. Pure Imaginary

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

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

$$(8 - 2i)(3 - 6i)$$

The solution is $12 - 54i$, which is option B.

A. $a \in [11, 14]$ and $b \in [52, 55]$

$12 + 54i$, which corresponds to adding a minus sign in both terms.

B. $a \in [11, 14]$ and $b \in [-58, -52]$

* $12 - 54i$, which is the correct option.

C. $a \in [32, 37]$ and $b \in [-48, -39]$

$36 - 42i$, which corresponds to adding a minus sign in the first term.

D. $a \in [24, 29]$ and $b \in [10, 14]$

$24 + 12i$, 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. $a \in [32, 37]$ and $b \in [40, 43]$

$36 + 42i$, 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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3. Simplify the expression below and choose the interval the simplification is contained within.

$$3 - 19^2 + 5 \div 8 * 7 \div 15$$

The solution is -357.708, which is option C.

A. $[363.88, 364.06]$

364.006, which corresponds to two Order of Operations errors.

B. $[-358.14, -357.93]$

-357.994, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-357.85, -357.68]$

* -357.708, this is the correct option

D. $[364.15, 364.3]$

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

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

$$\frac{-45 + 77i}{-6 + 2i}$$

The solution is $10.60 - 9.30i$, which is option C.

A. $a \in [9.5, 11.5]$ and $b \in [-373, -371.5]$

$10.60 - 372.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [1.5, 3.5]$ and $b \in [-14.5, -13.5]$

$2.90 - 13.80i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [9.5, 11.5]$ and $b \in [-10, -8.5]$

* $10.60 - 9.30i$, which is the correct option.

D. $a \in [423, 424.5]$ and $b \in [-10, -8.5]$

$424.00 - 9.30i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [6.5, 8.5]$ and $b \in [37, 40.5]$

$7.50 + 38.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

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

$$\sqrt{\frac{-1170}{5}}$$

The solution is Not a Real number, which is option A.

A. Not a Real number

* This is the correct option!

B. Irrational

These cannot be written as a fraction of Integers.

C. Integer

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

D. Rational

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

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 $\sqrt{234}i$.

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

$$\frac{-72 + 22i}{7 + i}$$

The solution is $-9.64 + 4.52i$, which is option C.

A. $a \in [-10.4, -9.96]$ and $b \in [21.5, 22.5]$

$-10.29 + 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-482.12, -481.89]$ and $b \in [4, 6]$

$-482.00 + 4.52i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-9.87, -9.61]$ and $b \in [4, 6]$

* $-9.64 + 4.52i$, which is the correct option.

D. $a \in [-9.87, -9.61]$ and $b \in [224, 228]$

$-9.64 + 226.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-10.64, -10.39]$ and $b \in [1, 2.5]$

$-10.52 + 1.64i$, 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. Simplify the expression below and choose the interval the simplification is contained within.

$$7 - 13^2 + 9 \div 18 * 8 \div 10$$

The solution is -161.600, which is option C.

A. $[176.02, 176.86]$

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

B. $[-162.44, -161.93]$

-161.994, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-161.97, -161.41]$

* -161.600, this is the correct option

D. $[175.86, 176.03]$

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

$$\sqrt{\frac{1056}{6}} + \sqrt{70}i$$

The solution is Nonreal Complex, which is option A.

A. Nonreal Complex

* This is the correct option!

B. Rational

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

C. Pure Imaginary

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

D. Irrational

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

E. 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!

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

$$(-3 - 6i)(-8 - 7i)$$

The solution is $-18 + 69i$, which is option B.

A. $a \in [66, 73]$ and $b \in [24, 32]$

$66 + 27i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-24, -16]$ and $b \in [67, 72]$

* $-18 + 69i$, which is the correct option.

C. $a \in [20, 25]$ and $b \in [42, 43]$

$24 + 42i$, 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. $a \in [66, 73]$ and $b \in [-27, -23]$

$66 - 27i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-24, -16]$ and $b \in [-74, -65]$

$-18 - 69i$, which corresponds to adding a minus sign in both terms.

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.

$$-\sqrt{\frac{455}{7}}$$

The solution is Irrational, which is option A.

A. Irrational

* 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. Whole

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

E. Rational

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{65}$.

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.
