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.

$$-\sqrt{\frac{1764}{14}} + 3i^2$$

The solution is Irrational, 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. Rational

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

C. Irrational

* This is the correct option!

D. Pure Imaginary

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

E. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the 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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2. Simplify the expression below and choose the interval the simplification is contained within.

$$19 - 3^2 + 11 \div 1 * 6 \div 13$$

The solution is 15.077, which is option A.

A. $[13.2, 17.4]$

* 15.077, this is the correct option

B. $[27.3, 28.8]$

28.141, which corresponds to two Order of Operations errors.

C. $[30.9, 36]$

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

D. $[9.3, 11]$

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

$$\frac{\sqrt{60}}{11} + \sqrt{-5}i$$

The solution is Irrational, which is option E.

A. Nonreal Complex

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

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

$$\frac{-9 - 44i}{-5 + 7i}$$

The solution is $-3.55 + 3.82i$, which is option A.

A. $a \in [-4.5, -2.5]$ and $b \in [3.5, 4]$

* $-3.55 + 3.82i$, which is the correct option.

B. $a \in [-4.5, -2.5]$ and $b \in [282, 284.5]$

$-3.55 + 283.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [4, 5.5]$ and $b \in [2, 3]$

$4.77 + 2.12i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [1.5, 2.5]$ and $b \in [-8, -6]$

$1.80 - 6.29i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-264, -262.5]$ and $b \in [3.5, 4]$

$-263.00 + 3.82i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

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.

$$\frac{-63 - 55i}{-2 - 8i}$$

The solution is $8.32 - 5.79i$, which is option E.

A. $a \in [564.5, 567.5]$ and $b \in [-7, -3.5]$

$566.00 - 5.79i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [30, 32]$ and $b \in [6, 7.5]$

$31.50 + 6.88i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-5.5, -4]$ and $b \in [8, 9.5]$

$-4.62 + 9.03i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [7.5, 9]$ and $b \in [-396, -393]$

$8.32 - 394.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [7.5, 9]$ and $b \in [-7, -3.5]$

* $8.32 - 5.79i$, 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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6. Simplify the expression below and choose the interval the simplification is contained within.

$$11 - 19^2 + 3 \div 7 * 13 \div 12$$

The solution is -349.536, which is option A.

A. $[-349.54, -349.31]$

* -349.536, this is the correct option

B. $[372.21, 372.49]$

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

C. $[371.92, 372.46]$

372.003, which corresponds to two Order of Operations errors.

D. $[-350.27, -349.92]$

-349.997, 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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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 + 5i)(-7 - 10i)$$

The solution is $-6 - 115i$, which is option E.

A. $a \in [-57, -55]$ and $b \in [-51.6, -49.6]$

$-56 - 50i$, 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.

B. $a \in [-106, -104]$ and $b \in [44, 47.6]$

$-106 + 45i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-106, -104]$ and $b \in [-47.6, -42.1]$

$-106 - 45i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-8, -1]$ and $b \in [114.8, 116.5]$

$-6 + 115i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-8, -1]$ and $b \in [-116.5, -114.7]$

* $-6 - 115i$, 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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8. Choose the **smallest** set of Real numbers that the number below belongs to.

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

The solution is Irrational, which is option D.

A. Integer

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

B. Rational

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

C. Whole

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

D. Irrational

* This is the correct option!

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 $-\sqrt{65}$.

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.

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

$$(6 + 9i)(10 - 8i)$$

The solution is $132 + 42i$, which is option B.

A. $a \in [-16, -10]$ and $b \in [-140, -136]$

$-12 - 138i$, which corresponds to adding a minus sign in the first term.

B. $a \in [129, 135]$ and $b \in [36, 43]$

* $132 + 42i$, which is the correct option.

C. $a \in [-16, -10]$ and $b \in [137, 145]$

$-12 + 138i$, which corresponds to adding a minus sign in the second term.

D. $a \in [57, 65]$ and $b \in [-72, -69]$

$60 - 72i$, 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. $a \in [129, 135]$ and $b \in [-45, -40]$

$132 - 42i$, 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.

$$-\sqrt{\frac{144}{169}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Whole

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

C. Integer

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

D. Not a Real number

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

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{12}{13}$.

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.
