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.

$$\sqrt{\frac{196}{529}} + 64i^2$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Pure Imaginary

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

C. Nonreal Complex

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

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

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

The solution is $66 + 27i$, which is option A.

A. $a \in [64, 71]$ and $b \in [23, 28]$

* $66 + 27i$, which is the correct option.

B. $a \in [-20, -15]$ and $b \in [-79, -67]$

$-18 - 69i$, which corresponds to adding a minus sign in the second term.

C. $a \in [24, 30]$ and $b \in [-46, -37]$

$24 - 42i$, 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. $a \in [-20, -15]$ and $b \in [66, 73]$

$-18 + 69i$, which corresponds to adding a minus sign in the first term.

E. $a \in [64, 71]$ and $b \in [-31, -22]$

$66 - 27i$, 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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3. Simplify the expression below and choose the interval the simplification is contained within.

$$1 - 7^2 + 14 \div 9 * 12 \div 16$$

The solution is -46.833, which is option B.

A. $[48, 50.4]$

50.008, which corresponds to two Order of Operations errors.

B. $[-47.1, -43.1]$

* -46.833, this is the correct option

C. $[50.1, 51.7]$

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

D. $[-48.4, -47.8]$

-47.992, 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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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-36 - 88i}{5 - i}$$

The solution is $-3.54 - 18.31i$, which is option E.

A. $a \in [-11.5, -9]$ and $b \in [-16, -15]$

$-10.31 - 15.54i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-4.5, -2]$ and $b \in [-476.5, -475]$

$-3.54 - 476.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-8.5, -7]$ and $b \in [86.5, 89]$

$-7.20 + 88.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-93, -91]$ and $b \in [-19, -17.5]$

$-92.00 - 18.31i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-4.5, -2]$ and $b \in [-19, -17.5]$

* $-3.54 - 18.31i$, 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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5. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{625}{529}}$$

The solution is Rational, which is option C.

A. Whole

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

B. Integer

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

C. Rational

* This is the correct option!

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 $-\frac{25}{23}$.

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.

$$\frac{-54 - 33i}{2 + 7i}$$

The solution is $-6.40 + 5.89i$, which is option B.

A. $a \in [2, 2.5]$ and $b \in [-9, -8]$

$2.32 - 8.38i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-7.5, -6]$ and $b \in [5, 7]$

* $-6.40 + 5.89i$, which is the correct option.

C. $a \in [-28.5, -26]$ and $b \in [-6, -4.5]$

$-27.00 - 4.71i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-7.5, -6]$ and $b \in [311, 313]$

$-6.40 + 312.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-340, -338.5]$ and $b \in [5, 7]$

$-339.00 + 5.89i$, 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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7. Simplify the expression below and choose the interval the simplification is contained within.

$$1 - 12^2 + 6 \div 15 * 4 \div 16$$

The solution is -142.900, which is option C.

A. $[-143.02, -142.97]$

-142.994, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[145.07, 145.16]$

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

C. $[-142.92, -142.8]$

* -142.900, this is the correct option

D. $[144.96, 145.02]$

145.006, 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.

$$\frac{12}{-17} + 16i^2$$

The solution is Rational, which is option E.

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. Irrational

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

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the 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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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-6 - 3i)(2 + 10i)$$

The solution is $18 - 66i$, which is option A.

A. $a \in [13, 19]$ and $b \in [-66, -64]$

* $18 - 66i$, which is the correct option.

B. $a \in [-43, -41]$ and $b \in [50, 59]$

$-42 + 54i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-43, -41]$ and $b \in [-57, -50]$

$-42 - 54i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-18, -5]$ and $b \in [-34, -26]$

$-12 - 30i$, 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. $a \in [13, 19]$ and $b \in [66, 69]$

$18 + 66i$, 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.

$$\sqrt{\frac{-1568}{14}}$$

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. Whole

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

D. Rational

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

E. Integer

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

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

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.
