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.

$$\frac{13}{-7} + 9i^2$$

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. Nonreal Complex

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

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. Irrational

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

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

$$9 - 15^2 + 11 \div 4 * 14 \div 17$$

The solution is -213.735, which is option C.

A. $[-216.12, -215.29]$

-215.988, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[235.09, 236.38]$

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

C. $[-214.19, -213.5]$

* -213.735, this is the correct option

D. $[231.73, 234.55]$

234.012, 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 Real numbers that the number below belongs to.

$$\sqrt{\frac{130321}{361}}$$

The solution is Whole, which is option C.

A. Irrational

These cannot be written as a fraction of Integers.

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. 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 361.

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

$$(-5 - 6i)(-10 - 2i)$$

The solution is $38 + 70i$, which is option D.

A. $a \in [33, 39]$ and $b \in [-76, -67]$

$38 - 70i$, which corresponds to adding a minus sign in both terms.

B. $a \in [54, 63]$ and $b \in [47, 54]$

$62 + 50i$, which corresponds to adding a minus sign in the second term.

C. $a \in [54, 63]$ and $b \in [-54, -47]$

$62 - 50i$, which corresponds to adding a minus sign in the first term.

D. $a \in [33, 39]$ and $b \in [70, 74]$

* $38 + 70i$, which is the correct option.

E. $a \in [47, 53]$ and $b \in [8, 17]$

$50 + 12i$, 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.

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

$$\sqrt{\frac{0}{625}} + \sqrt{2}i$$

The solution is Pure Imaginary, which is option D.

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. Nonreal Complex

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

C. Irrational

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

D. Pure Imaginary

* This is the correct option!

E. Rational

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

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

$$(6 + 7i)(-3 + 5i)$$

The solution is $-53 + 9i$, which is option B.

A. $a \in [-21, -16]$ and $b \in [33, 38]$

$-18+35i$, 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. $a \in [-53, -51]$ and $b \in [4, 14]$

* $-53 + 9i$, which is the correct option.

C. $a \in [13, 18]$ and $b \in [51, 53]$

$17 + 51i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-53, -51]$ and $b \in [-13, -6]$

$-53 - 9i$, which corresponds to adding a minus sign in both terms.

E. $a \in [13, 18]$ and $b \in [-53, -50]$

$17 - 51i$, 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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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{81}{196}}$$

The solution is Rational, which is option B.

A. Integer

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

B. Rational

* This is the correct option!

C. Not a Real number

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

D. Whole

These are the counting numbers with 0 (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 $-\frac{9}{14}$.

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

$$\frac{72 - 66i}{4 - 3i}$$

The solution is $19.44 - 1.92i$, which is option D.

A. $a \in [485.5, 486.5]$ and $b \in [-4, -0.5]$

$486.00 - 1.92i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [17.5, 19]$ and $b \in [21.5, 22.5]$

$18.00 + 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [2, 4]$ and $b \in [-19.5, -19]$

$3.60 - 19.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [18.5, 20]$ and $b \in [-4, -0.5]$

* $19.44 - 1.92i$, which is the correct option.

E. $a \in [18.5, 20]$ and $b \in [-48.5, -47]$

$19.44 - 48.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

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

$$7 - 9 \div 5 * 18 - (1 * 2)$$

The solution is -27.400, which is option A.

A. $[-30.4, -24.4]$

* -27.400, which is the correct option.

B. $[-57.8, -45.8]$

-52.800, which corresponds to not distributing a negative correctly.

C. $[2.9, 6.9]$

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

D. $[6.9, 13.9]$

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

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

$$\frac{-27 + 22i}{-5 - 8i}$$

The solution is $-0.46 - 3.66i$, which is option D.

A. $a \in [-1.5, 1]$ and $b \in [-326.5, -325.5]$

$-0.46 - 326.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-42, -40.5]$ and $b \in [-4.5, -3]$

$-41.00 - 3.66i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [4.5, 7]$ and $b \in [-3.5, -2.5]$

$5.40 - 2.75i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-1.5, 1]$ and $b \in [-4.5, -3]$

* $-0.46 - 3.66i$, which is the correct option.

E. $a \in [3, 5]$ and $b \in [0.5, 2]$

$3.49 + 1.19i$, 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 $2 - 3i$.
