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.

$$\sqrt{\frac{36}{361}} + \sqrt{70}i$$

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. Irrational

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

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

$$13 - 17 \div 8 * 12 - (10 * 6)$$

The solution is -72.500, which is option C.

A. $[71.82, 75.82]$

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

B. $[-136, -129]$

-135.000, which corresponds to not distributing a negative correctly.

C. $[-75.5, -65.5]$

* -72.500, which is the correct option.

D. $[-50.18, -46.18]$

-47.177, 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 Real numbers that the number below belongs to.

$$\sqrt{\frac{361}{529}}$$

The solution is Rational, 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. Rational

* This is the correct option!

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 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 $\frac{19}{23}$.

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

$$(8 - 7i)(-10 - 4i)$$

The solution is $-108 + 38i$, which is option E.

A. $a \in [-57, -45]$ and $b \in [-104, -100]$

$-52 - 102i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-109, -107]$ and $b \in [-40, -36]$

$-108 - 38i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-57, -45]$ and $b \in [97, 107]$

$-52 + 102i$, which corresponds to adding a minus sign in the second term.

D. $a \in [-80, -75]$ and $b \in [26, 34]$

$-80+28i$, 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. $a \in [-109, -107]$ and $b \in [33, 46]$

* $-108 + 38i$, 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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5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{110}}{18} + 8i^2$$

The solution is Irrational, which is option A.

A. Irrational

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

$$(6 + 3i)(-9 + 4i)$$

The solution is $-66 - 3i$, which is option D.

A. $a \in [-44, -34]$ and $b \in [-51, -44]$

$-42 - 51i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-57, -50]$ and $b \in [9, 14]$

$-54+12i$, 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.

C. $a \in [-44, -34]$ and $b \in [45, 56]$

$-42 + 51i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-68, -65]$ and $b \in [-4, 0]$

* $-66 - 3i$, which is the correct option.

E. $a \in [-68, -65]$ and $b \in [0, 8]$

$-66 + 3i$, 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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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{1386}{14}}$$

The solution is Irrational, which is option C.

A. Not a Real number

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

B. Rational

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

C. Irrational

* This is the correct option!

D. Whole

These are the counting numbers with 0 (0, 1, 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 $-\sqrt{99}$.

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.

$$\frac{-18 - 88i}{-4 - 5i}$$

The solution is $12.49 + 6.39i$, which is option B.

A. $a \in [4, 6]$ and $b \in [17, 18.5]$

$4.50 + 17.60i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [12, 13.5]$ and $b \in [5, 7.5]$

* $12.49 + 6.39i$, which is the correct option.

C. $a \in [510.5, 512.5]$ and $b \in [5, 7.5]$

$512.00 + 6.39i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-9.5, -8.5]$ and $b \in [10, 13]$

$-8.98 + 10.78i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [12, 13.5]$ and $b \in [261.5, 263]$

$12.49 + 262.00i$, 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.

$$6 - 13^2 + 3 \div 15 * 18 \div 5$$

The solution is -162.280, which is option A.

A. $[-162.9, -161.7]$

* -162.280, this is the correct option

B. $[173.91, 175.11]$

175.002, which corresponds to two Order of Operations errors.

C. $[-163.46, -162.96]$

-162.998, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[175.1, 176.25]$

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

$$\frac{-9 + 88i}{-7 - 6i}$$

The solution is $-5.47 - 7.88i$, which is option C.

A. $a \in [1, 2]$ and $b \in [-16, -14]$

$1.29 - 14.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-465.5, -464.5]$ and $b \in [-8.5, -7.5]$

$-465.00 - 7.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-7, -4.5]$ and $b \in [-8.5, -7.5]$

* $-5.47 - 7.88i$, which is the correct option.

D. $a \in [-7, -4.5]$ and $b \in [-670.5, -669.5]$

$-5.47 - 670.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [6, 8]$ and $b \in [-7, -6]$

$6.95 - 6.61i$, 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 $2 - 3i$.
