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 Real numbers that the number below belongs to.

$$\sqrt{\frac{-1560}{12}}$$

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

A. Whole

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

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. Not a Real number

* This is the correct option!

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 $\sqrt{130}i$.

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

$$\sqrt{\frac{-1716}{12}} + \sqrt{130}$$

The solution is Nonreal Complex, which is option B.

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 the correct option!

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

$$(-5 - 7i)(9 + 3i)$$

The solution is $-24 - 78i$, which is option A.

A. $a \in [-25, -20]$ and $b \in [-82, -74]$

* $-24 - 78i$, which is the correct option.

B. $a \in [-67, -65]$ and $b \in [48, 49]$

$-66 + 48i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-49, -40]$ and $b \in [-23, -19]$

$-45 - 21i$, 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. $a \in [-25, -20]$ and $b \in [78, 80]$

$-24 + 78i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-67, -65]$ and $b \in [-52, -47]$

$-66 - 48i$, 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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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-63 + 44i}{2 + 5i}$$

The solution is $3.24 + 13.90i$, which is option D.

A. $a \in [92, 94.5]$ and $b \in [13, 14.5]$

$94.00 + 13.90i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-32.5, -29]$ and $b \in [8.5, 10]$

$-31.50 + 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [2, 5]$ and $b \in [400.5, 404]$

$3.24 + 403.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [2, 5]$ and $b \in [13, 14.5]$

* $3.24 + 13.90i$, which is the correct option.

E. $a \in [-12.5, -11.5]$ and $b \in [-8.5, -7.5]$

$-11.93 - 7.83i$, 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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5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{2431}{11}} + \sqrt{119}i$$

The solution is Nonreal Complex, which is option B.

A. Irrational

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

B. Nonreal Complex

* This is the correct option!

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. Rational

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

E. Pure Imaginary

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

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 and choose the interval the simplification is contained within.

$$9 - 7^2 + 5 \div 13 * 15 \div 3$$

The solution is -38.077, which is option A.

A. $[-39.4, -35.9]$

* -38.077, this is the correct option

B. $[58.2, 60.9]$

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

C. $[56.7, 59.1]$

58.009, which corresponds to two Order of Operations errors.

D. $[-41.6, -38.7]$

-39.991, 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.

$$\frac{45 - 33i}{-8 - 7i}$$

The solution is $-1.14 + 5.12i$, which is option C.

A. $a \in [-5.83, -5.57]$ and $b \in [4.5, 5]$

$-5.62 + 4.71i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-1.2, -0.95]$ and $b \in [578.25, 579.6]$

$-1.14 + 579.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-1.2, -0.95]$ and $b \in [4.75, 5.25]$

* $-1.14 + 5.12i$, which is the correct option.

D. $a \in [-129.11, -128.9]$ and $b \in [4.75, 5.25]$

$-129.00 + 5.12i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-5.48, -5.08]$ and $b \in [-0.9, 0.1]$

$-5.23 - 0.45i$, 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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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(10 + 6i)(9 + 4i)$$

The solution is $66 + 94i$, which is option B.

A. $a \in [109, 115]$ and $b \in [8, 22]$

$114 + 14i$, which corresponds to adding a minus sign in the second term.

B. $a \in [65, 67]$ and $b \in [93, 95]$

* $66 + 94i$, which is the correct option.

C. $a \in [88, 98]$ and $b \in [17, 25]$

$90 + 24i$, 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. $a \in [109, 115]$ and $b \in [-14, -11]$

$114 - 14i$, which corresponds to adding a minus sign in the first term.

E. $a \in [65, 67]$ and $b \in [-96, -90]$

$66 - 94i$, 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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9. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{97344}{169}}$$

The solution is Integer, which is option A.

A. Integer

* This is the correct option!

B. Rational

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

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 -312.

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

$$10 - 8^2 + 7 \div 13 * 5 \div 16$$

The solution is -53.832, which is option B.

A. $[73.94, 74.07]$

74.007, which corresponds to two Order of Operations errors.

B. $[-53.94, -53.7]$

* -53.832, this is the correct option

C. $[-54.05, -53.87]$

-53.993, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[74.12, 74.25]$

74.168, 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.
