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.

$$-\sqrt{\frac{196}{289}}$$

The solution is Rational, which is option A.

A. Rational

* 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. Not a Real number

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

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 $-\frac{14}{17}$.

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 Real numbers that the number below belongs to.

$$\sqrt{\frac{35721}{441}}$$

The solution is Whole, which is option A.

A. Whole

* 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. Irrational

These cannot be written as a fraction of Integers.

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 189.

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

$$(-9 - 2i)(7 - 10i)$$

The solution is $-83 + 76i$, which is option A.

A. $a \in [-83, -81]$ and $b \in [75, 82]$

* $-83 + 76i$, which is the correct option.

B. $a \in [-51, -40]$ and $b \in [-107, -103]$

$-43 - 104i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-66, -59]$ and $b \in [18, 25]$

$-63 + 20i$, 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. $a \in [-83, -81]$ and $b \in [-80, -69]$

$-83 - 76i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-51, -40]$ and $b \in [100, 105]$

$-43 + 104i$, which corresponds to adding a minus sign in the first 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.

$$\frac{18 + 55i}{4 + 6i}$$

The solution is $7.73 + 2.15i$, which is option E.

A. $a \in [400.5, 402.5]$ and $b \in [1.5, 3.5]$

$402.00 + 2.15i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [6.5, 8]$ and $b \in [111.5, 113]$

$7.73 + 112.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-6, -4]$ and $b \in [6, 7]$

$-4.96 + 6.31i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [3, 6]$ and $b \in [8.5, 10]$

$4.50 + 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [6.5, 8]$ and $b \in [1.5, 3.5]$

* $7.73 + 2.15i$, 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 Complex numbers that the number below belongs to.

$$\frac{-5}{2} + \sqrt{-16}i$$

The solution is Rational, 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. Irrational

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

C. Rational

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

$$19 - 6^2 + 20 \div 9 * 8 \div 5$$

The solution is -13.444, which is option D.

A. $[56.6, 61.3]$

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

B. $[-19.2, -13.5]$

-16.944, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[54.7, 57.5]$

55.056, which corresponds to two Order of Operations errors.

D. $[-15, -12.5]$

* -13.444, this is the correct option

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 and choose the interval the simplification is contained within.

$$6 - 11 \div 2 * 7 - (1 * 12)$$

The solution is -44.500, which is option A.

A. $[-51.5, -40.5]$

* -44.500, which is the correct option.

B. $[17.21, 24.21]$

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

C. $[-402, -401]$

-402.000, which corresponds to not distributing a negative correctly.

D. $[-10.79, -1.79]$

-6.786, 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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8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{-20}{5} + \sqrt{-64}i$$

The solution is Rational, which is option C.

A. Nonreal Complex

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

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. Rational

* This is the correct option!

D. Irrational

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

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

$$(9 - 3i)(8 + 4i)$$

The solution is $84 + 12i$, which is option E.

A. $a \in [84, 85]$ and $b \in [-18, -7]$

$84 - 12i$, which corresponds to adding a minus sign in both terms.

B. $a \in [58, 65]$ and $b \in [-61, -56]$

$60 - 60i$, which corresponds to adding a minus sign in the second term.

C. $a \in [69, 73]$ and $b \in [-18, -7]$

$72 - 12i$, 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.

D. $a \in [58, 65]$ and $b \in [55, 64]$

$60 + 60i$, which corresponds to adding a minus sign in the first term.

E. $a \in [84, 85]$ and $b \in [10, 17]$

* $84 + 12i$, 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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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{63 - 66i}{2 - 4i}$$

The solution is $19.50 + 6.00i$, which is option A.

A. $a \in [19, 20]$ and $b \in [5, 7]$

* $19.50 + 6.00i$, which is the correct option.

B. $a \in [19, 20]$ and $b \in [118.5, 120.5]$

$19.50 + 120.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [30.5, 33]$ and $b \in [16, 17]$

$31.50 + 16.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-8, -6.5]$ and $b \in [-19.5, -18.5]$

$-6.90 - 19.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [389.5, 390.5]$ and $b \in [5, 7]$

$390.00 + 6.00i$, 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 $2 - 3i$.
