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.

$$\sqrt{\frac{74529}{169}}$$

The solution is Whole, 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. Integer

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

C. Whole

* This is the correct option!

D. Irrational

These cannot be written as a fraction of Integers.

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 273.

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.

$$\sqrt{\frac{1547}{13}} + \sqrt{55}i$$

The solution is Nonreal Complex, which is option D.

A. Irrational

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

B. Pure Imaginary

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

C. Rational

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

D. Nonreal Complex

* This is the correct option!

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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3. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{625}{169}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Whole

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

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

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

E. Not a Real number

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{25}{13}$.

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 and choose the interval the simplification is contained within.

$$18 - 1^2 + 20 \div 12 * 15 \div 9$$

The solution is 19.778, which is option D.

A. $[19, 19.44]$

19.012, which corresponds to two Order of Operations errors.

B. $[20.95, 22.53]$

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

C. $[16.03, 17.42]$

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

D. $[19.31, 19.82]$

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

$$\frac{10}{2} + \sqrt{-9}i$$

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. Nonreal Complex

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

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

$$\frac{-36 - 77i}{-3 + i}$$

The solution is $3.10 + 26.70i$, which is option C.

A. $a \in [2, 5]$ and $b \in [266.5, 267.5]$

$3.10 + 267.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [17.5, 19.5]$ and $b \in [19, 20]$

$18.50 + 19.50i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [2, 5]$ and $b \in [26, 27]$

* $3.10 + 26.70i$, which is the correct option.

D. $a \in [11, 13.5]$ and $b \in [-77.5, -76]$

$12.00 - 77.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [29.5, 32.5]$ and $b \in [26, 27]$

$31.00 + 26.70i$, 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 into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-10 + 4i)(2 + 7i)$$

The solution is $-48 - 62i$, which is option C.

A. $a \in [8, 12]$ and $b \in [76, 82]$

$8 + 78i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-21, -17]$ and $b \in [24, 34]$

$-20 + 28i$, 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.

C. $a \in [-49, -45]$ and $b \in [-63, -61]$

* $-48 - 62i$, which is the correct option.

D. $a \in [-49, -45]$ and $b \in [60, 69]$

$-48 + 62i$, which corresponds to adding a minus sign in both terms.

E. $a \in [8, 12]$ and $b \in [-78, -75]$

$8 - 78i$, 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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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{45 - 22i}{-3 - 6i}$$

The solution is $-0.07 + 7.47i$, which is option E.

A. $a \in [-15.5, -13]$ and $b \in [2, 4.5]$

$-15.00 + 3.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-4, -2.5]$ and $b \in [7, 8]$

$-3.00 + 7.47i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-7.5, -5]$ and $b \in [-6, -4]$

$-5.93 - 4.53i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-0.5, 0.5]$ and $b \in [335.5, 337]$

$-0.07 + 336.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-0.5, 0.5]$ and $b \in [7, 8]$

* $-0.07 + 7.47i$, 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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9. Simplify the expression below and choose the interval the simplification is contained within.

$$16 - 15^2 + 19 \div 1 * 14 \div 18$$

The solution is -194.222, which is option A.

A. $[-197.22, -193.22]$

* -194.222, this is the correct option

B. $[253.78, 259.78]$

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

C. $[238.08, 244.08]$

241.075, which corresponds to two Order of Operations errors.

D. $[-211.92, -206.92]$

-208.925, 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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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-3 + 5i)(2 - 9i)$$

The solution is $39 + 37i$, which is option A.

A. $a \in [38, 49]$ and $b \in [35, 38]$

* $39 + 37i$, which is the correct option.

B. $a \in [-51, -46]$ and $b \in [-20, -14]$

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

C. $a \in [38, 49]$ and $b \in [-40, -34]$

$39 - 37i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-51, -46]$ and $b \in [16, 20]$

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

E. $a \in [-7, -1]$ and $b \in [-49, -44]$

$-6 - 45i$, 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.
