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

$$20 - 19^2 + 8 \div 11 * 6 \div 12$$

The solution is -340.636

A. $[381.08, 381.44]$

381.364000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-340.89, -340.19]$

* -340.636000, this is the correct option

C. $[-341.1, -340.76]$

-340.990000, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[380.13, 381.24]$

381.010000, 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 Comments: 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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2. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{-4}{-17} + \sqrt{-9}i$$

The solution is Rational

A. Nonreal Complex

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

B. Rational

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

C. Irrational

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

D. Pure Imaginary

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

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 Comments: 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.

$$-\sqrt{\frac{15876}{441}}$$

The solution is Integer

A. Rational

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

B. Not a Real number

These are Nonreal Complex numbers OR things that are not numbers (dividing by 0).

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. Whole

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

General Comments: First, you **NEED** to simplify the expression. This question simplifies to -126.

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.

$$\frac{9 + 22i}{3 + 5i}$$

The solution is $4.03 + 0.62i$

A. $a \in [2.6, 3.09]$ and $b \in [4.34, 4.72]$

$3.00 + 4.40i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [3.45, 5.12]$ and $b \in [20.5, 22.03]$

$4.03 + 21.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [136.76, 137.25]$ and $b \in [-0.04, 0.71]$

$137.00 + 0.62i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [3.45, 5.12]$ and $b \in [-0.04, 0.71]$

   * $4.03 + 0.62i$, which is the correct option.

E. $a \in [-2.81, -1.51]$ and $b \in [3.24, 3.4]$

   $-2.44 + 3.26i$, 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. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-8 + 5i)(-4 + 2i)$$

The solution is $22 - 36i$

A. $a \in [36, 44]$ and $b \in [3, 7]$

   $42 + 4i$, which corresponds to adding a minus sign in the first term.

B. $a \in [25, 37]$ and $b \in [5, 17]$

   $32 + 10i$, 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. $a \in [16, 28]$ and $b \in [30, 40]$

   $22 + 36i$, which corresponds to adding a minus sign in both terms.

D. $a \in [16, 28]$ and $b \in [-44, -31]$

   * $22 - 36i$, which is the correct option.

E. $a \in [36, 44]$ and $b \in [-9, 0]$

   $42 - 4i$, which corresponds to adding a minus sign in the second term.

General Comments: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.
