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

$$\frac{-72 - 11i}{-4 + 3i}$$

The solution is $10.20 + 10.40i$, which is option A.

A. $a \in [9.5, 12]$ and $b \in [10, 12]$ * $10.20 + 10.40i$, which is the correct option.

B. $a \in [9.5, 12]$ and $b \in [259, 260.5]$ $10.20 + 260.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [17.5, 19]$ and $b \in [-4, -2.5]$ $18.00 - 3.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [12, 13.5]$ and $b \in [-7, -6]$ $12.84 - 6.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [254, 255.5]$ and $b \in [10, 12]$ $255.00 + 10.40i$, 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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2. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 - 9i)(10 + 3i)$$

The solution is $107 - 66i$, which is option C.

A. $a \in [77, 82]$ and $b \in [-30, -23]$ $80 - 27i$, 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.

B. $a \in [53, 56]$ and $b \in [-117, -113]$ $53 - 114i$, which corresponds to adding a minus sign in the second term.

C. $a \in [106, 118]$ and $b \in [-70, -58]$ * $107 - 66i$, which is the correct option.

D. $a \in [53, 56]$ and $b \in [106, 118]$ $53 + 114i$, which corresponds to adding a minus sign in the first term.

E. $a \in [106, 118]$ and $b \in [66, 68]$ $107 + 66i$, 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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3. Simplify the expression below and choose the interval the simplification is contained within.

$$5 - 11 \div 16 * 8 - (6 * 7)$$

The solution is -42.500, which is option A.

A. $[-43.2, -40.6]$ * -42.500, which is the correct option.

B. $[-39.8, -37]$ -37.086, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-47.3, -43.9]$ -45.500, which corresponds to not distributing a negative correctly.

D. $[46.1, 49.7]$ 46.914, which corresponds to not distributing addition and subtraction correctly.

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

$$\sqrt{\frac{630}{5}} + \sqrt{165}i$$

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

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

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

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

$$\sqrt{\frac{1190}{5}}$$

The solution is Irrational, which is option E.

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

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

C. Not a Real number These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

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

E. Irrational * This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{238}$.

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.