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.

$$\frac{9 + 66i}{3 - 2i}$$

The solution is $-8.08 + 16.62i$

A. $a \in [-4, 7]$ and $b \in [-37, -32]$

$3.00 - 33.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-106, -100]$ and $b \in [16, 23]$

$-105.00 + 16.62i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-9, 0]$ and $b \in [16, 23]$

* $-8.08 + 16.62i$, which is the correct option.

D. $a \in [-9, 0]$ and $b \in [214, 222]$

$-8.08 + 216.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [5, 16]$ and $b \in [9, 15]$

$12.23 + 13.85i$, 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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2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{825}{15}}$$

The solution is Irrational

A. Rational

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

B. Integer

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

C. Not a Real number

These are Nonreal Complex numbers OR things that are not numbers (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 Comments: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{55}$.

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 and choose the interval the simplification is contained within.

$$6 - 14^2 + 2 \div 18 * 9 \div 20$$

The solution is -189.95

A. $[-189.99, -189.95]$

* -189.950000, this is the correct option

B. $[202.04, 202.09]$

202.050000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[-190.01, -189.97]$

-189.999000, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[201.98, 202.01]$

202.001000, 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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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 + 3i)(7 - 10i)$$

The solution is $86 - 59i$

A. $a \in [82, 87]$ and $b \in [-66, -52]$

* $86 - 59i$, which is the correct option.

B. $a \in [24, 30]$ and $b \in [-104, -98]$

$26 - 101i$, which corresponds to adding a minus sign in the first term.

C. $a \in [82, 87]$ and $b \in [54, 61]$

$86 + 59i$, which corresponds to adding a minus sign in both terms.

D. $a \in [54, 57]$ and $b \in [-31, -29]$

$56 - 30i$, 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.

E. $a \in [24, 30]$ and $b \in [93, 103]$

$26 + 101i$, 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.

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

$$\sqrt{\frac{64}{0}} + \sqrt{240}i$$

The solution is Not a Complex Number

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. Pure Imaginary

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

C. Nonreal Complex

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

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 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.
