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.

$$\frac{-9 - 22i}{4 + 5i}$$

The solution is $-3.56 - 1.05i$

A. $a \in [-4.97, -3.33]$ and $b \in [-1.36, -0.45]$

   * $-3.56 - 1.05i$, which is the correct option.

B. $a \in [-4.97, -3.33]$ and $b \in [-43.22, -42.93]$

   $-3.56 - 43.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-3.01, -1.54]$ and $b \in [-4.8, -4.02]$

   $-2.25 - 4.40i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-147.54, -145.94]$ and $b \in [-1.36, -0.45]$

   $-146.00 - 1.05i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [1.52, 2.38]$ and $b \in [-3.63, -2.85]$

   $1.80 - 3.24i$, 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 Complex numbers that the number below belongs to.

$$\frac{0}{-2\pi} + \sqrt{9}i$$

The solution is Pure Imaginary

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. Pure Imaginary

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

D. 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!

E. Irrational

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

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.

$$-\sqrt{\frac{935}{11}}$$

The solution is Irrational

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 (dividing by 0).

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 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 $-\sqrt{85}$.

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.

$$18 - 1 \div 4 * 16 - (12 * 9)$$

The solution is -94.0

A. $[17.4, 21.2]$

18.000, which corresponds to not distributing a negative correctly.

B. $[-90.3, -89.3]$

-90.016, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[124.8, 126.8]$

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

D. $[-95.6, -92.8]$

* -94.000, which 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 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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5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(6 - 5i)(-9 - 8i)$$

The solution is $-94 - 3i$

A. $a \in [-15, -11]$ and $b \in [92, 101]$

$-14 + 93i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-15, -11]$ and $b \in [-96, -90]$

$-14 - 93i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-99, -93]$ and $b \in [2, 7]$

$-94 + 3i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-56, -53]$ and $b \in [36, 46]$

$-54 + 40i$, 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. $a \in [-99, -93]$ and $b \in [-5, -1]$

* $-94 - 3i$, which is the correct option.

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.
