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 Complex numbers that the number below belongs to.

$$\frac{\sqrt{91}}{12} + 4i^2$$

The solution is Irrational, which is option C.

A. Nonreal Complex

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

B. 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!

C. Irrational

* This is the correct option!

D. Rational

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

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

$$(-8 + 9i)(10 + 2i)$$

The solution is $-98 + 74i$, which is option B.

A. $a \in [-63, -56]$ and $b \in [106, 112]$

$-62 + 106i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-101, -97]$ and $b \in [71, 75]$

* $-98 + 74i$, which is the correct option.

C. $a \in [-81, -75]$ and $b \in [16, 19]$

$-80+18i$, 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.

D. $a \in [-101, -97]$ and $b \in [-78, -68]$

$-98 - 74i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-63, -56]$ and $b \in [-109, -104]$

$-62 - 106i$, 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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3. Simplify the expression below and choose the interval the simplification is contained within.

$$19 - 11 \div 13 * 3 - (17 * 6)$$

The solution is -85.538, which is option B.

A. $[119.25, 120.99]$

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

B. $[-86.05, -84.92]$

* -85.538, which is the correct option.

C. $[-4.14, -2.99]$

-3.231, which corresponds to not distributing a negative correctly.

D. $[-84.79, -83.07]$

-83.282, 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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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-54 - 33i}{1 + 4i}$$

The solution is $-10.94 + 10.76i$, which is option A.

A. $a \in [-12.5, -10.5]$ and $b \in [10.5, 11.5]$

* $-10.94 + 10.76i$, which is the correct option.

B. $a \in [-55.5, -53]$ and $b \in [-8.5, -7.5]$

$-54.00 - 8.25i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-187, -185.5]$ and $b \in [10.5, 11.5]$

$-186.00 + 10.76i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-12.5, -10.5]$ and $b \in [181.5, 183.5]$

$-10.94 + 183.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [4, 6.5]$ and $b \in [-15.5, -14]$

$4.59 - 14.65i$, 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. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{1056}{8}}$$

The solution is Irrational, which is option E.

A. Whole

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

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -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 $\sqrt{132}$.

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

$$\frac{18 + 44i}{-7 + 6i}$$

The solution is $1.62 - 4.89i$, which is option B.

A. $a \in [-4.5, -2]$ and $b \in [6.5, 8]$

$-2.57 + 7.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [0.5, 3]$ and $b \in [-5.5, -4.5]$

* $1.62 - 4.89i$, which is the correct option.

C. $a \in [0.5, 3]$ and $b \in [-417, -415]$

$1.62 - 416.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-5.5, -4.5]$ and $b \in [-3, -1]$

$-4.59 - 2.35i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [137.5, 139]$ and $b \in [-5.5, -4.5]$

$138.00 - 4.89i$, 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 and choose the interval the simplification is contained within.

$$10 - 12^2 + 17 \div 20 * 5 \div 9$$

The solution is -133.528, which is option B.

A. $[154.38, 154.75]$

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

B. $[-133.6, -133.17]$

* -133.528, this is the correct option

C. $[153.79, 154.07]$

154.019, which corresponds to two Order of Operations errors.

D. $[-134.22, -133.93]$

-133.981, 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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8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{0}{6\pi} + \sqrt{5}i$$

The solution is Pure Imaginary, which is option C.

A. Irrational

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

B. 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!

C. Pure Imaginary

* 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. Rational

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

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

$$(8 + 10i)(-2 - 9i)$$

The solution is $74 - 92i$, which is option A.

A. $a \in [72, 80]$ and $b \in [-95.3, -90.7]$

* $74 - 92i$, which is the correct option.

B. $a \in [72, 80]$ and $b \in [90.7, 94.9]$

$74 + 92i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-107, -104]$ and $b \in [-53.1, -48.6]$

$-106 - 52i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-20, -11]$ and $b \in [-90.6, -89.3]$

$-16 - 90i$, 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. $a \in [-107, -104]$ and $b \in [49.2, 52.2]$

$-106 + 52i$, which corresponds to adding a minus sign in the second 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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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{560}{8}}$$

The solution is Irrational, which is option B.

A. Rational

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

B. Irrational

* This is the correct option!

C. Not a Real number

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

D. Whole

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

E. Integer

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{70}$.

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.
