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.

$$-\sqrt{\frac{529}{81}} + 9i^2$$

The solution is Rational, 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. Irrational

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

C. Rational

* This is the correct option!

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 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.

$$(4 - 7i)(-2 - 10i)$$

The solution is $-78 - 26i$, which is option C.

A. $a \in [62, 65]$ and $b \in [-54, -50]$

$62 - 54i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-11, -3]$ and $b \in [66, 74]$

$-8 + 70i$, 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. $a \in [-78, -76]$ and $b \in [-29, -24]$

* $-78 - 26i$, which is the correct option.

D. $a \in [-78, -76]$ and $b \in [25, 31]$

$-78 + 26i$, which corresponds to adding a minus sign in both terms.

E. $a \in [62, 65]$ and $b \in [51, 61]$

$62 + 54i$, 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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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{36 + 77i}{-6 - 8i}$$

The solution is $-8.32 - 1.74i$, which is option D.

A. $a \in [3, 6]$ and $b \in [-8, -7]$

$4.00 - 7.50i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-833.5, -831]$ and $b \in [-2.5, -1]$

$-832.00 - 1.74i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-7, -5.5]$ and $b \in [-11, -9]$

$-6.00 - 9.62i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-10, -7.5]$ and $b \in [-2.5, -1]$

* $-8.32 - 1.74i$, which is the correct option.

E. $a \in [-10, -7.5]$ and $b \in [-175.5, -173]$

$-8.32 - 174.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

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

$$\frac{-27 + 44i}{2 - 8i}$$

The solution is $-5.97 - 1.88i$, which is option B.

A. $a \in [-6.5, -4]$ and $b \in [-128.5, -127.5]$

$-5.97 - 128.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-6.5, -4]$ and $b \in [-2.5, -1.5]$

* $-5.97 - 1.88i$, which is the correct option.

C. $a \in [-15, -12.5]$ and $b \in [-6, -5]$

$-13.50 - 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-408, -405.5]$ and $b \in [-2.5, -1.5]$

$-406.00 - 1.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [4, 4.5]$ and $b \in [4, 5.5]$

$4.38 + 4.47i$, 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 and choose the interval the simplification is contained within.

$$15 - 10 \div 17 * 5 - (9 * 11)$$

The solution is -86.941, which is option B.

A. $[111.3, 115.6]$

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

B. $[-87.9, -84.7]$

* -86.941, which is the correct option.

C. $[-84.7, -82.5]$

-84.118, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[31.8, 35.2]$

33.647, which corresponds to not distributing a negative 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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6. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-2652}{12}}$$

The solution is Not a Real number, which is option C.

A. Whole

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

B. Irrational

These cannot be written as a fraction of Integers.

C. Not a Real number

* This is the correct option!

D. Integer

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

E. Rational

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{221}i$.

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

$$-\sqrt{\frac{81}{169}}$$

The solution is Rational, which is option E.

A. Integer

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

B. Not a Real number

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

C. Irrational

These cannot be written as a fraction of Integers.

D. Whole

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

E. Rational

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{9}{13}$.

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

$$-\sqrt{\frac{1690}{13}} + 4i^2$$

The solution is Irrational, which is option A.

A. Irrational

* This is the correct option!

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. 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. Nonreal Complex

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

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.

$$(10 + 3i)(-4 + 8i)$$

The solution is $-64 + 68i$, which is option C.

A. $a \in [-67, -63]$ and $b \in [-69, -65]$

$-64 - 68i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-18, -15]$ and $b \in [90, 98]$

$-16 + 92i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-67, -63]$ and $b \in [67, 75]$

* $-64 + 68i$, which is the correct option.

D. $a \in [-18, -15]$ and $b \in [-97, -91]$

$-16 - 92i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-45, -34]$ and $b \in [19, 27]$

$-40+24i$, 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.

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

$$14 - 1 \div 3 * 16 - (2 * 15)$$

The solution is -21.333, which is option B.

A. $[-18.7, -12.3]$

-16.021, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-22.9, -17.7]$

* -21.333, which is the correct option.

C. $[43.8, 44.5]$

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

D. $[98.9, 101.4]$

100.000, which corresponds to not distributing a negative 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.
