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.

$$(-8 - 9i)(-4 - 7i)$$

The solution is $-31 + 92i$, which is option A.

A. $a \in [-31, -25]$ and $b \in [89, 98]$

* $-31 + 92i$, which is the correct option.

B. $a \in [92, 97]$ and $b \in [-26, -19]$

$95 - 20i$, which corresponds to adding a minus sign in the second term.

C. $a \in [31, 33]$ and $b \in [62, 66]$

$32 + 63i$, 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. $a \in [-31, -25]$ and $b \in [-99, -91]$

$-31 - 92i$, which corresponds to adding a minus sign in both terms.

E. $a \in [92, 97]$ and $b \in [13, 23]$

$95 + 20i$, 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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2. Simplify the expression below and choose the interval the simplification is contained within.

$$10 - 18^2 + 14 \div 19 * 11 \div 9$$

The solution is -313.099, which is option C.

A. $[-314.74, -313.67]$

-313.993, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[333.63, 334.21]$

334.007, which corresponds to two Order of Operations errors.

C. $[-313.97, -311.99]$

* -313.099, this is the correct option

D. $[334.86, 335.48]$

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

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

$$11 - 12^2 + 20 \div 17 * 6 \div 10$$

The solution is -132.294, which is option C.

A. $[155.64, 156.28]$

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

B. $[154.41, 155.04]$

155.020, which corresponds to two Order of Operations errors.

C. $[-132.54, -131.39]$

* -132.294, this is the correct option

D. $[-134.12, -132.81]$

-132.980, 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. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{27225}{121}}$$

The solution is Whole, which is option D.

A. Irrational

These cannot be written as a fraction of Integers.

B. Integer

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

C. Rational

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

D. Whole

* This is the correct option!

E. Not a Real number

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 165.

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

$$\frac{-12}{-9} + \sqrt{-36}i$$

The solution is Rational, which is option C.

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. Rational

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

$$\frac{-45 + 88i}{3 + 4i}$$

The solution is $8.68 + 17.76i$, which is option A.

A. $a \in [8, 9]$ and $b \in [17.5, 19]$

* $8.68 + 17.76i$, which is the correct option.

B. $a \in [-16, -14.5]$ and $b \in [21, 22.5]$

$-15.00 + 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-21, -18.5]$ and $b \in [2.5, 4]$

$-19.48 + 3.36i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [216, 217.5]$ and $b \in [17.5, 19]$

$217.00 + 17.76i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [8, 9]$ and $b \in [443, 444.5]$

$8.68 + 444.00i$, 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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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-54 + 55i}{8 + 7i}$$

The solution is $-0.42 + 7.24i$, which is option E.

A. $a \in [-47.65, -46.45]$ and $b \in [6.85, 7.6]$

$-47.00 + 7.24i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-7.3, -7.05]$ and $b \in [0.5, 1.25]$

$-7.23 + 0.55i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-7.05, -6.7]$ and $b \in [7.25, 8.3]$

$-6.75 + 7.86i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-0.8, -0.15]$ and $b \in [817.55, 818.3]$

$-0.42 + 818.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-0.8, -0.15]$ and $b \in [6.85, 7.6]$

* $-0.42 + 7.24i$, which is the correct option.

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

$$-\sqrt{\frac{-2002}{14}}$$

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

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

* This is the correct option!

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 Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{143}i$.

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

$$(6 + 7i)(9 + 2i)$$

The solution is $40 + 75i$, which is option E.

A. $a \in [67, 77]$ and $b \in [-54, -46]$

$68 - 51i$, which corresponds to adding a minus sign in the first term.

B. $a \in [48, 56]$ and $b \in [12, 16]$

$54 + 14i$, 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. $a \in [67, 77]$ and $b \in [51, 53]$

$68 + 51i$, which corresponds to adding a minus sign in the second term.

D. $a \in [40, 47]$ and $b \in [-78, -74]$

$40 - 75i$, which corresponds to adding a minus sign in both terms.

E. $a \in [40, 47]$ and $b \in [74, 79]$

* $40 + 75i$, which is the correct option.

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 Complex numbers that the number below belongs to.

$$\sqrt{\frac{1890}{15}} + \sqrt{143}i$$

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. Pure Imaginary

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

D. Rational

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

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.
