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 and choose the interval the simplification is contained within.

$$4 - 12^2 + 14 \div 10 * 20 \div 7$$

The solution is -136.000, which is option B.

A. $[-139.99, -137.99]$

-139.990, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-138, -133]$

* -136.000, this is the correct option

C. $[151, 154]$

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

D. $[147.01, 150.01]$

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

$$(2 + 3i)(-4 - 10i)$$

The solution is $22 - 32i$, which is option B.

A. $a \in [-10, -6]$ and $b \in [-31.9, -29.2]$

$-8 - 30i$, 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.

B. $a \in [19, 25]$ and $b \in [-33.9, -31.7]$

* $22 - 32i$, which is the correct option.

C. $a \in [19, 25]$ and $b \in [31.7, 34.7]$

$22 + 32i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-44, -36]$ and $b \in [7.1, 10]$

$-38 + 8i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-44, -36]$ and $b \in [-11.7, -6.1]$

$-38 - 8i$, 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. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{154}}{14} + 10i^2$$

The solution is Irrational, which is option B.

A. Pure Imaginary

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

B. Irrational

* This is the correct option!

C. Nonreal Complex

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

D. Rational

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

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

$$\sqrt{\frac{32400}{400}}$$

The solution is Whole, which is option E.

A. Irrational

These cannot be written as a fraction of Integers.

B. Not a Real number

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

C. Integer

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

D. Rational

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

E. Whole

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 180.

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.

$$-\sqrt{\frac{825}{5}} + 5i^2$$

The solution is Irrational, which is option D.

A. Pure Imaginary

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

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. Irrational

* This is the correct option!

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

$$20 - 13^2 + 15 \div 1 * 18 \div 10$$

The solution is -122.000, which is option C.

A. $[189.08, 196.08]$

189.083, which corresponds to two Order of Operations errors.

B. $[-151.92, -141.92]$

-148.917, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-126, -115]$

* -122.000, this is the correct option

D. $[216, 220]$

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

$$(-7 - 2i)(-9 - 4i)$$

The solution is $55 + 46i$, which is option A.

A. $a \in [52, 60]$ and $b \in [45.4, 49.8]$

* $55 + 46i$, which is the correct option.

B. $a \in [68, 74]$ and $b \in [8.5, 11.6]$

$71 + 10i$, which corresponds to adding a minus sign in the first term.

C. $a \in [61, 69]$ and $b \in [7.9, 9.8]$

$63 + 8i$, 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. $a \in [52, 60]$ and $b \in [-48.3, -45.9]$

$55 - 46i$, which corresponds to adding a minus sign in both terms.

E. $a \in [68, 74]$ and $b \in [-10.2, -7.7]$

$71 - 10i$, 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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8. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{24}{0}}$$

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

A. Integer

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

B. Rational

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

C. Whole

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

D. Not a Real number

* This is the correct option!

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{\frac{24}{0}}$.

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.

$$\frac{36 + 77i}{3 - 8i}$$

The solution is $-6.96 + 7.11i$, which is option A.

A. $a \in [-7.5, -6.5]$ and $b \in [6, 8]$

* $-6.96 + 7.11i$, which is the correct option.

B. $a \in [-7.5, -6.5]$ and $b \in [518.5, 519.5]$

$-6.96 + 519.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [11.5, 12.5]$ and $b \in [-10, -8.5]$

$12.00 - 9.62i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [9, 11.5]$ and $b \in [-2, 1]$

$9.92 - 0.78i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-508.5, -507.5]$ and $b \in [6, 8]$

$-508.00 + 7.11i$, 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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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 + 88i}{-5 + 4i}$$

The solution is $7.49 - 11.61i$, which is option D.

A. $a \in [306.5, 308.5]$ and $b \in [-12, -11]$

$307.00 - 11.61i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [6.5, 9]$ and $b \in [-477, -475]$

$7.49 - 476.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-3, -1]$ and $b \in [21.5, 22.5]$

$-1.80 + 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [6.5, 9]$ and $b \in [-12, -11]$

* $7.49 - 11.61i$, which is the correct option.

E. $a \in [-10.5, -8.5]$ and $b \in [-11, -8.5]$

$-9.68 - 9.85i$, 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 $2 - 3i$.
