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.

$$12 - 7^2 + 9 \div 8 * 4 \div 13$$

The solution is -36.654, which is option D.

A. $[60.92, 61.3]$

61.022, which corresponds to two Order of Operations errors.

B. $[-37.11, -36.86]$

-36.978, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[61.1, 61.59]$

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

D. $[-36.73, -36.27]$

* -36.654, this 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 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.

$$(5 + 9i)(10 - 2i)$$

The solution is $68 + 80i$, which is option E.

A. $a \in [29, 34]$ and $b \in [-104, -98]$

$32 - 100i$, which corresponds to adding a minus sign in the first term.

B. $a \in [29, 34]$ and $b \in [98, 107]$

$32 + 100i$, which corresponds to adding a minus sign in the second term.

C. $a \in [66, 69]$ and $b \in [-81, -75]$

$68 - 80i$, which corresponds to adding a minus sign in both terms.

D. $a \in [46, 52]$ and $b \in [-25, -13]$

$50 - 18i$, 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.

E. $a \in [66, 69]$ and $b \in [77, 83]$

* $68 + 80i$, 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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3. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{324}{529}} + \sqrt{176}i$$

The solution is Nonreal Complex, which is option C.

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. Nonreal Complex

* This is the correct option!

D. Irrational

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

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

$$\sqrt{\frac{576}{289}}$$

The solution is Rational, which is option C.

A. Integer

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

B. Irrational

These cannot be written as a fraction of Integers.

C. Rational

* This is the correct option!

D. Whole

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

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 $\frac{24}{17}$.

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.

$$\sqrt{\frac{0}{64}} + \sqrt{2}i$$

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. Nonreal Complex

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

C. Pure Imaginary

* This is the correct option!

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

$$6 - 10^2 + 16 \div 14 * 11 \div 19$$

The solution is -93.338, which is option D.

A. $[-94.12, -93.52]$

-93.995, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[105.71, 106.28]$

106.005, which corresponds to two Order of Operations errors.

C. $[106.56, 106.71]$

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

D. $[-93.86, -93.09]$

* -93.338, this 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 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.

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

The solution is $46 - 55i$, which is option C.

A. $a \in [4, 11]$ and $b \in [65, 75]$

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

B. $a \in [27, 29]$ and $b \in [-19, -14]$

$28 - 18i$, 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.

C. $a \in [43, 48]$ and $b \in [-56, -52]$

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

D. $a \in [43, 48]$ and $b \in [53, 56]$

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

E. $a \in [4, 11]$ and $b \in [-78, -66]$

$10 - 71i$, 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.

$$-\sqrt{\frac{104976}{324}}$$

The solution is Integer, which is option D.

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. Irrational

These cannot be written as a fraction of Integers.

D. Integer

* 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 -324.

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.

$$\frac{45 - 11i}{-8 + 7i}$$

The solution is $-3.87 - 2.01i$, which is option B.

A. $a \in [-438.5, -435.5]$ and $b \in [-2.06, -1.77]$

$-437.00 - 2.01i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-5, -3.5]$ and $b \in [-2.06, -1.77]$

* $-3.87 - 2.01i$, which is the correct option.

C. $a \in [-3, -1.5]$ and $b \in [3.27, 3.7]$

$-2.50 + 3.57i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-6, -5.5]$ and $b \in [-1.78, -1.54]$

$-5.62 - 1.57i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-5, -3.5]$ and $b \in [-227.19, -226.88]$

$-3.87 - 227.00i$, 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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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{36 + 33i}{6 - 7i}$$

The solution is $-0.18 + 5.29i$, which is option B.

A. $a \in [-15.5, -14.5]$ and $b \in [4.5, 6]$

$-15.00 + 5.29i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-0.5, 1]$ and $b \in [4.5, 6]$

* $-0.18 + 5.29i$, which is the correct option.

C. $a \in [-0.5, 1]$ and $b \in [449.5, 451]$

$-0.18 + 450.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [5.5, 7]$ and $b \in [-5.5, -4]$

$6.00 - 4.71i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [4, 5.5]$ and $b \in [-2, 1]$

$5.26 - 0.64i$, 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 $2 - 3i$.
