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.

$$\frac{2}{-4} + \sqrt{-25}i$$

The solution is Rational, which is option E.

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. Irrational

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

C. Pure Imaginary

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

D. Nonreal Complex

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

E. Rational

* This is the correct option!

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.

$$(-8 + 9i)(4 - 5i)$$

The solution is $13 + 76i$, which is option A.

A. $a \in [13, 17]$ and $b \in [73, 78]$

* $13 + 76i$, which is the correct option.

B. $a \in [13, 17]$ and $b \in [-79, -74]$

$13 - 76i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-39, -30]$ and $b \in [-47, -40]$

$-32 - 45i$, 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. $a \in [-83, -73]$ and $b \in [0, 6]$

$-77 + 4i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-83, -73]$ and $b \in [-6, 2]$

$-77 - 4i$, 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.

$$\frac{54 + 33i}{-4 - 5i}$$

The solution is $-9.29 + 3.37i$, which is option B.

A. $a \in [-1.5, 0]$ and $b \in [-11, -8]$

$-1.24 - 9.80i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-10, -9]$ and $b \in [3, 3.5]$

* $-9.29 + 3.37i$, which is the correct option.

C. $a \in [-10, -9]$ and $b \in [137.5, 139]$

$-9.29 + 138.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-381.5, -379.5]$ and $b \in [3, 3.5]$

$-381.00 + 3.37i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-14.5, -13]$ and $b \in [-8, -6]$

$-13.50 - 6.60i$, which corresponds to just dividing the first term by the first term and the second by the second.

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.

$$\frac{-9 + 44i}{2 - 5i}$$

The solution is $-8.21 + 1.48i$, which is option D.

A. $a \in [-239, -237]$ and $b \in [1, 2]$

$-238.00 + 1.48i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-5.5, -3.5]$ and $b \in [-9.5, -8]$

$-4.50 - 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [6, 8]$ and $b \in [3.5, 5.5]$

$6.97 + 4.59i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-9.5, -7.5]$ and $b \in [1, 2]$

* $-8.21 + 1.48i$, which is the correct option.

E. $a \in [-9.5, -7.5]$ and $b \in [42, 43.5]$

$-8.21 + 43.00i$, 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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5. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 2^2 + 5 \div 17 * 15 \div 6$$

The solution is 0.735, which is option B.

A. $[-0.33, 0.08]$

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

B. $[0.55, 1.32]$

* 0.735, this is the correct option

C. $[7.98, 8.4]$

8.003, which corresponds to two Order of Operations errors.

D. $[8.09, 9.27]$

8.735, 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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6. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{73984}{256}}$$

The solution is Integer, which is option A.

A. Integer

* This is the correct option!

B. Irrational

These cannot be written as a fraction of Integers.

C. Whole

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

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -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 -272.

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.

$$\sqrt{\frac{2916}{36}}$$

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. Rational

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

D. Integer

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

E. Whole

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 54.

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.

$$\sqrt{\frac{144}{121}} + 64i^2$$

The solution is Rational, which is option E.

A. Irrational

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

B. Pure Imaginary

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

C. Nonreal Complex

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

D. 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!

E. Rational

* This is the correct option!

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.

$$(-4 + 8i)(-9 + 5i)$$

The solution is $-4 - 92i$, which is option A.

A. $a \in [-5, 1]$ and $b \in [-92, -91]$

* $-4 - 92i$, which is the correct option.

B. $a \in [-5, 1]$ and $b \in [92, 94]$

$-4 + 92i$, which corresponds to adding a minus sign in both terms.

C. $a \in [29, 42]$ and $b \in [34, 42]$

$36 + 40i$, 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. $a \in [75, 77]$ and $b \in [51, 57]$

$76 + 52i$, which corresponds to adding a minus sign in the first term.

E. $a \in [75, 77]$ and $b \in [-56, -47]$

$76 - 52i$, 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. Simplify the expression below and choose the interval the simplification is contained within.

$$2 - 16^2 + 3 \div 5 * 9 \div 14$$

The solution is -253.614, which is option A.

A. $[-253.67, -253.48]$

* -253.614, this is the correct option

B. $[257.67, 258.35]$

258.005, which corresponds to two Order of Operations errors.

C. $[258.24, 258.57]$

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

D. $[-254.36, -253.95]$

-253.995, 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.
