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.

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

The solution is $-48 - 26i$, which is option D.

A. $a \in [-8, -3]$ and $b \in [-57, -53]$

$-8 - 54i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-50, -41]$ and $b \in [21, 31]$

$-48 + 26i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-32, -24]$ and $b \in [20, 21]$

$-28 + 20i$, 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. $a \in [-50, -41]$ and $b \in [-26, -25]$

* $-48 - 26i$, which is the correct option.

E. $a \in [-8, -3]$ and $b \in [47, 55]$

$-8 + 54i$, 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. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{18}{-20} + \sqrt{-49}i$$

The solution is Rational, which is option D.

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

D. Rational

* This is the correct option!

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

$$\frac{54 - 22i}{-3 + 5i}$$

The solution is $-8.00 - 6.00i$, which is option C.

A. $a \in [-272.5, -271.5]$ and $b \in [-6.5, -5.5]$

$-272.00 - 6.00i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-9, -7.5]$ and $b \in [-204.5, -203.5]$

$-8.00 - 204.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-9, -7.5]$ and $b \in [-6.5, -5.5]$

* $-8.00 - 6.00i$, which is the correct option.

D. $a \in [-2.5, -1]$ and $b \in [8.5, 10.5]$

$-1.53 + 9.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-19, -16]$ and $b \in [-4.5, -2.5]$

$-18.00 - 4.40i$, 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. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{2145}{13}}$$

The solution is Irrational, which is option C.

A. Rational

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

B. Integer

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

C. Irrational

* This is the correct option!

D. Not a Real number

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

E. Whole

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{165}$.

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

$$\frac{-27 + 44i}{6 + i}$$

The solution is $-3.19 + 7.86i$, which is option D.

A. $a \in [-5.2, -4.05]$ and $b \in [42.5, 44.5]$

$-4.50 + 44.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-6, -5.25]$ and $b \in [6, 6.5]$

$-5.57 + 6.41i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-3.75, -2.85]$ and $b \in [290.5, 292.5]$

$-3.19 + 291.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-3.75, -2.85]$ and $b \in [6.5, 8.5]$

* $-3.19 + 7.86i$, which is the correct option.

E. $a \in [-118.15, -117.85]$ and $b \in [6.5, 8.5]$

$-118.00 + 7.86i$, 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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6. Simplify the expression below and choose the interval the simplification is contained within.

$$10 - 19 \div 12 * 16 - (4 * 11)$$

The solution is -59.333, which is option B.

A. $[52.9, 56.9]$

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

B. $[-61.33, -57.33]$

* -59.333, which is the correct option.

C. $[-214.67, -207.67]$

-212.667, which corresponds to not distributing a negative correctly.

D. $[-42.1, -27.1]$

-34.099, 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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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{24336}{144}}$$

The solution is Whole, 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. 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 156.

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

$$6 - 16^2 + 5 \div 18 * 2 \div 8$$

The solution is -249.931, which is option D.

A. $[-250, -249.97]$

-249.983, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[262.06, 262.09]$

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

C. $[261.98, 262.04]$

262.017, which corresponds to two Order of Operations errors.

D. $[-249.95, -249.91]$

* -249.931, 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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9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{484}{441}} + \sqrt{208}i$$

The solution is Nonreal Complex, 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. Rational

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

E. Nonreal Complex

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

$$(-8 - 9i)(3 + 4i)$$

The solution is $12 - 59i$, which is option D.

A. $a \in [-30, -19]$ and $b \in [-36, -35]$

$-24 - 36i$, 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. $a \in [12, 14]$ and $b \in [59, 69]$

$12 + 59i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-64, -57]$ and $b \in [3, 6]$

$-60 + 5i$, which corresponds to adding a minus sign in the second term.

D. $a \in [12, 14]$ and $b \in [-62, -56]$

* $12 - 59i$, which is the correct option.

E. $a \in [-64, -57]$ and $b \in [-6, -3]$

$-60 - 5i$, 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.
