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.

$$\frac{27 - 22i}{-6 - 8i}$$

The solution is $0.14 + 3.48i$, which is option A.

A. $a \in [-0.5, 0.5]$ and $b \in [3.35, 3.9]$

* $0.14 + 3.48i$, which is the correct option.

B. $a \in [13, 15]$ and $b \in [3.35, 3.9]$

$14.00 + 3.48i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-0.5, 0.5]$ and $b \in [347.85, 348.05]$

$0.14 + 348.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-4, -2.5]$ and $b \in [-1.6, -0.15]$

$-3.38 - 0.84i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-5.5, -3.5]$ and $b \in [2.35, 2.85]$

$-4.50 + 2.75i$, 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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2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{12996}{36}}$$

The solution is Whole, which is option E.

A. Not a Real number

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

B. Rational

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

C. Irrational

These cannot be written as a fraction of Integers.

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 114.

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

$$(-2 + 8i)(4 + 10i)$$

The solution is $-88 + 12i$, which is option B.

A. $a \in [72, 78]$ and $b \in [49, 59]$

$72 + 52i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-94, -86]$ and $b \in [11, 15]$

* $-88 + 12i$, which is the correct option.

C. $a \in [72, 78]$ and $b \in [-55, -50]$

$72 - 52i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-94, -86]$ and $b \in [-14, -10]$

$-88 - 12i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-15, -5]$ and $b \in [79, 85]$

$-8 + 80i$, 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.

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

$$\frac{-2}{-13} + 81i^2$$

The solution is Rational, which is option E.

A. Pure Imaginary

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

B. Irrational

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

C. 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!

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

$$\frac{18 + 77i}{6 - 5i}$$

The solution is $-4.54 + 9.05i$, which is option A.

A. $a \in [-5, -3.5]$ and $b \in [8.5, 9.5]$

* $-4.54 + 9.05i$, which is the correct option.

B. $a \in [-5, -3.5]$ and $b \in [551.5, 553.5]$

$-4.54 + 552.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [2, 3.5]$ and $b \in [-16.5, -13.5]$

$3.00 - 15.40i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [7.5, 9.5]$ and $b \in [5.5, 6.5]$

$8.08 + 6.10i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-278, -276]$ and $b \in [8.5, 9.5]$

$-277.00 + 9.05i$, 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.

$$17 - 19 \div 3 * 7 - (8 * 5)$$

The solution is -67.333, which is option A.

A. $[-68.33, -60.33]$

* -67.333, which is the correct option.

B. $[-177.67, -172.67]$

-176.667, which corresponds to not distributing a negative correctly.

C. $[55.1, 60.1]$

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

D. $[-24.9, -21.9]$

-23.905, 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. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-7 - 4i)(-3 + 9i)$$

The solution is $57 - 51i$, which is option E.

A. $a \in [56, 59]$ and $b \in [46, 52]$

$57 + 51i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-16, -10]$ and $b \in [-83, -70]$

$-15 - 75i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-16, -10]$ and $b \in [75, 77]$

$-15 + 75i$, which corresponds to adding a minus sign in the second term.

D. $a \in [17, 26]$ and $b \in [-36, -32]$

$21 - 36i$, 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.

E. $a \in [56, 59]$ and $b \in [-51, -45]$

* $57 - 51i$, 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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8. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-765}{9}}$$

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

A. Not a Real number

* This is the correct option!

B. Rational

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

C. Integer

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

D. Irrational

These cannot be written as a fraction of Integers.

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 $-\sqrt{85}i$.

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

$$\frac{-12}{2} + \sqrt{-49}i$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Nonreal Complex

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

C. 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!

D. Pure Imaginary

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

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

$$2 - 3^2 + 8 \div 9 * 16 \div 17$$

The solution is -6.163, which is option D.

A. $[-7.25, -6.31]$

-6.997, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[10.84, 11.05]$

11.003, which corresponds to two Order of Operations errors.

C. $[11.19, 12.39]$

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

D. $[-6.65, -5.89]$

* -6.163, 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.