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.

$$\frac{-27 - 22i}{7 - 8i}$$

The solution is $-0.12 - 3.27i$, which is option D.

A. $a \in [-13.5, -12.95]$ and $b \in [-5, -3]$

$-13.00 - 3.27i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-0.4, -0.05]$ and $b \in [-372, -369.5]$

$-0.12 - 370.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-3.65, -2.55]$ and $b \in [0, 2]$

$-3.23 + 0.55i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-0.4, -0.05]$ and $b \in [-5, -3]$

* $-0.12 - 3.27i$, which is the correct option.

E. $a \in [-4.15, -3.3]$ and $b \in [2.5, 3.5]$

$-3.86 + 2.75i$, 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.

$$\sqrt{\frac{324}{121}}$$

The solution is Rational, which is option B.

A. Integer

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

B. Rational

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

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 $\frac{18}{11}$.

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.

$$(-8 + 9i)(-2 + 5i)$$

The solution is $-29 - 58i$, which is option E.

A. $a \in [14, 24]$ and $b \in [45, 48]$

$16 + 45i$, 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.

B. $a \in [59, 69]$ and $b \in [-22, -19]$

$61 - 22i$, which corresponds to adding a minus sign in the first term.

C. $a \in [59, 69]$ and $b \in [21, 28]$

$61 + 22i$, which corresponds to adding a minus sign in the second term.

D. $a \in [-32, -22]$ and $b \in [56, 61]$

$-29 + 58i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-32, -22]$ and $b \in [-58, -52]$

* $-29 - 58i$, 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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4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{12}{-20} + \sqrt{-100}i$$

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. Nonreal Complex

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

C. Irrational

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

D. Pure Imaginary

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

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.

$$\frac{72 + 33i}{1 + 7i}$$

The solution is $6.06 - 9.42i$, which is option A.

A. $a \in [5, 7.5]$ and $b \in [-10, -7.5]$

* $6.06 - 9.42i$, which is the correct option.

B. $a \in [70, 72.5]$ and $b \in [3, 5]$

$72.00 + 4.71i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-4, -1.5]$ and $b \in [10, 11.5]$

$-3.18 + 10.74i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [5, 7.5]$ and $b \in [-472.5, -470]$

$6.06 - 471.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [302.5, 303.5]$ and $b \in [-10, -7.5]$

$303.00 - 9.42i$, 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.

$$3 - 20 \div 18 * 14 - (4 * 10)$$

The solution is -52.556, which is option D.

A. $[37.92, 46.92]$

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

B. $[-166.56, -161.56]$

-165.556, which corresponds to not distributing a negative correctly.

C. $[-42.08, -35.08]$

-37.079, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-54.56, -49.56]$

* -52.556, which 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.

$$(5 - 10i)(9 - 6i)$$

The solution is $-15 - 120i$, which is option D.

A. $a \in [104, 109]$ and $b \in [54, 68]$

$105 + 60i$, which corresponds to adding a minus sign in the first term.

B. $a \in [104, 109]$ and $b \in [-67, -58]$

$105 - 60i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-18, -12]$ and $b \in [119, 126]$

$-15 + 120i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-18, -12]$ and $b \in [-120, -119]$

* $-15 - 120i$, which is the correct option.

E. $a \in [40, 48]$ and $b \in [54, 68]$

$45 + 60i$, 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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8. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{1210}{11}}$$

The solution is Irrational, which is option C.

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. Irrational

* 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 $\sqrt{110}$.

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.

$$\sqrt{\frac{-2178}{11}} + \sqrt{0}i$$

The solution is Pure Imaginary, which is option A.

A. Pure Imaginary

* 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. Rational

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

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.

$$12 - 4^2 + 19 \div 1 * 8 \div 13$$

The solution is 7.692, which is option A.

A. $[0.69, 14.69]$

* 7.692, this is the correct option

B. $[-5.82, -2.82]$

-3.817, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[26.18, 31.18]$

28.183, which corresponds to two Order of Operations errors.

D. $[37.69, 40.69]$

39.692, 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.
