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.

$$\frac{18 - 44i}{1 + 6i}$$

The solution is $-6.65 - 4.11i$, which is option C.

A. $a \in [-246.5, -245]$ and $b \in [-5.5, -3.5]$

$-246.00 - 4.11i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [7, 8]$ and $b \in [1, 2.5]$

$7.62 + 1.73i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-7.5, -6]$ and $b \in [-5.5, -3.5]$

* $-6.65 - 4.11i$, which is the correct option.

D. $a \in [17.5, 19]$ and $b \in [-8, -6.5]$

$18.00 - 7.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-7.5, -6]$ and $b \in [-153, -151.5]$

$-6.65 - 152.00i$, 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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2. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 1^2 + 8 \div 12 * 13 \div 11$$

The solution is 3.788, which is option A.

A. $[3.15, 4.29]$

* 3.788, this is the correct option

B. $[4.48, 5.05]$

5.005, which corresponds to two Order of Operations errors.

C. $[5.36, 7.19]$

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

D. $[2.71, 3.17]$

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

$$(-10 + 6i)(3 + 7i)$$

The solution is $-72 - 52i$, which is option E.

A. $a \in [-33, -29]$ and $b \in [40, 47]$

$-30+42i$, 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. $a \in [12, 16]$ and $b \in [87, 94]$

$12 + 88i$, which corresponds to adding a minus sign in the second term.

C. $a \in [12, 16]$ and $b \in [-89, -86]$

$12 - 88i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-74, -67]$ and $b \in [52, 53]$

$-72 + 52i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-74, -67]$ and $b \in [-52, -51]$

* $-72 - 52i$, 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.

$$\sqrt{\frac{1001}{0}} + \sqrt{105}i$$

The solution is Not a Complex Number, which is option A.

A. Not a Complex Number

* 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. Pure Imaginary

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

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

$$\sqrt{\frac{69696}{484}}$$

The solution is Whole, which is option B.

A. Integer

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

B. Whole

* This is the correct option!

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. 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 264.

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

$$\frac{45 + 77i}{6 + i}$$

The solution is $9.38 + 11.27i$, which is option A.

A. $a \in [8.5, 10]$ and $b \in [11, 12]$

* $9.38 + 11.27i$, which is the correct option.

B. $a \in [4, 6.5]$ and $b \in [13, 14.5]$

$5.22 + 13.70i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [8.5, 10]$ and $b \in [415.5, 417.5]$

$9.38 + 417.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [346, 348.5]$ and $b \in [11, 12]$

$347.00 + 11.27i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [6.5, 8]$ and $b \in [75.5, 77.5]$

$7.50 + 77.00i$, 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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7. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{14}} + \sqrt{9}i$$

The solution is Pure Imaginary, 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. Rational

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

E. Pure Imaginary

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

$$\sqrt{\frac{13}{0}}$$

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

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. Whole

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

D. Not a Real number

* This is the correct option!

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{\frac{13}{0}}$.

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 and choose the interval the simplification is contained within.

$$18 - 16 \div 20 * 2 - (14 * 9)$$

The solution is -109.600, which is option A.

A. $[-110.2, -108.8]$

* -109.600, which is the correct option.

B. $[-109.5, -107.3]$

-108.400, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[142.5, 144.2]$

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

D. $[20.2, 24]$

21.600, which corresponds to not distributing a negative correctly.

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

$$(6 + 2i)(-4 - 9i)$$

The solution is $-6 - 62i$, which is option B.

A. $a \in [-8, 3]$ and $b \in [57, 64]$

$-6 + 62i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-8, 3]$ and $b \in [-62, -57]$

* $-6 - 62i$, which is the correct option.

C. $a \in [-46, -33]$ and $b \in [-50, -45]$

$-42 - 46i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-29, -19]$ and $b \in [-19, -15]$

$-24 - 18i$, 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. $a \in [-46, -33]$ and $b \in [45, 47]$

$-42 + 46i$, 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.
