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.

$$\sqrt{\frac{-2640}{0}} + \sqrt{156}$$

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

A. Not a Complex Number

* This is the correct option!

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

$$\frac{36 - 22i}{3 + 8i}$$

The solution is $-0.93 - 4.85i$, which is option D.

A. $a \in [-68.5, -66.5]$ and $b \in [-5.5, -4.5]$

$-68.00 - 4.85i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [2.5, 4.5]$ and $b \in [2, 3.5]$

$3.89 + 3.04i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [11, 13]$ and $b \in [-3.5, -2]$

$12.00 - 2.75i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-1.5, -0.5]$ and $b \in [-5.5, -4.5]$

* $-0.93 - 4.85i$, which is the correct option.

E. $a \in [-1.5, -0.5]$ and $b \in [-354.5, -353]$

$-0.93 - 354.00i$, 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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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-5 + 8i)(-10 + 3i)$$

The solution is $26 - 95i$, which is option E.

A. $a \in [23, 28]$ and $b \in [95, 97]$

$26 + 95i$, which corresponds to adding a minus sign in both terms.

B. $a \in [71, 76]$ and $b \in [-70, -62]$

$74 - 65i$, which corresponds to adding a minus sign in the second term.

C. $a \in [47, 52]$ and $b \in [19, 29]$

$50 + 24i$, 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. $a \in [71, 76]$ and $b \in [64, 67]$

$74 + 65i$, which corresponds to adding a minus sign in the first term.

E. $a \in [23, 28]$ and $b \in [-96, -92]$

* $26 - 95i$, 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. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 - 44i}{-2 - 6i}$$

The solution is $6.15 + 3.55i$, which is option D.

A. $a \in [-7.5, -6]$ and $b \in [0, 1.5]$

$-7.05 + 0.85i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-5.5, -4]$ and $b \in [7, 8.5]$

$-4.50 + 7.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [244.5, 246.5]$ and $b \in [1.5, 5.5]$

$246.00 + 3.55i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [5, 7]$ and $b \in [1.5, 5.5]$

* $6.15 + 3.55i$, which is the correct option.

E. $a \in [5, 7]$ and $b \in [141, 142.5]$

$6.15 + 142.00i$, 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. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{196}{529}}$$

The solution is Rational, which is option B.

A. Whole

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

B. Rational

* This is the correct option!

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. 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 $-\frac{14}{23}$.

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

$$\sqrt{\frac{1232}{7}}$$

The solution is Irrational, 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. Rational

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

D. Whole

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

E. Irrational

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{176}$.

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

$$19 - 15^2 + 11 \div 16 * 14 \div 7$$

The solution is -204.625, which is option D.

A. $[244.3, 246.2]$

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

B. $[-206.9, -205.9]$

-205.993, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[243.2, 244.4]$

244.007, which corresponds to two Order of Operations errors.

D. $[-205.8, -203.4]$

* -204.625, 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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8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{169}{324}} + 25i^2$$

The solution is Rational, which is option C.

A. Pure Imaginary

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

B. 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!

C. Rational

* This is the correct option!

D. Irrational

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

E. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the 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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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

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

The solution is $-75 + i$, which is option B.

A. $a \in [50, 56]$ and $b \in [54.9, 57.2]$

$51 + 55i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-76, -69]$ and $b \in [-0.3, 1.8]$

* $-75 + i$, which is the correct option.

C. $a \in [-13, -11]$ and $b \in [59.7, 64.9]$

$-12 + 63i$, 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. $a \in [50, 56]$ and $b \in [-55.5, -52.9]$

$51 - 55i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-76, -69]$ and $b \in [-2.2, 0.4]$

$-75 - i$, which corresponds to adding a minus sign in both terms.

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.

$$19 - 8 \div 10 * 5 - (6 * 12)$$

The solution is -57.000, which is option C.

A. $[88.84, 91.84]$

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

B. $[-53.16, -48.16]$

-53.160, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-60, -55]$

* -57.000, which is the correct option.

D. $[105, 113]$

108.000, 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.
