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 Real numbers that the number below belongs to.

$$\sqrt{\frac{3969}{81}}$$

The solution is Whole, which is option C.

A. Irrational

These cannot be written as a fraction of Integers.

B. Integer

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

C. Whole

* This is the correct option!

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 63.

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

$$(2 - 7i)(5 - 9i)$$

The solution is $-53 - 53i$, which is option A.

A. $a \in [-56, -48]$ and $b \in [-57, -52]$

* $-53 - 53i$, which is the correct option.

B. $a \in [4, 17]$ and $b \in [58, 66]$

$10 + 63i$, 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.

C. $a \in [69, 75]$ and $b \in [-20, -12]$

$73 - 17i$, which corresponds to adding a minus sign in the second term.

D. $a \in [-56, -48]$ and $b \in [49, 57]$

$-53 + 53i$, which corresponds to adding a minus sign in both terms.

E. $a \in [69, 75]$ and $b \in [16, 18]$

$73 + 17i$, 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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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{54 + 44i}{-7 - 5i}$$

The solution is $-8.08 - 0.51i$, which is option C.

A. $a \in [-8.2, -7.75]$ and $b \in [-38.5, -37]$

$-8.08 - 38.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-598.35, -597.5]$ and $b \in [-1.5, 0]$

$-598.00 - 0.51i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-8.2, -7.75]$ and $b \in [-1.5, 0]$

* $-8.08 - 0.51i$, which is the correct option.

D. $a \in [-2.55, -1.6]$ and $b \in [-8.5, -7]$

$-2.14 - 7.81i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-7.8, -7.65]$ and $b \in [-10, -8.5]$

$-7.71 - 8.80i$, 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. Simplify the expression below and choose the interval the simplification is contained within.

$$17 - 6^2 + 11 \div 10 * 16 \div 3$$

The solution is -13.133, which is option B.

A. $[-19.98, -17.98]$

-18.977, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-17.13, -12.13]$

* -13.133, this is the correct option

C. $[53.02, 56.02]$

53.023, which corresponds to two Order of Operations errors.

D. $[55.87, 60.87]$

58.867, 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.

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

$$\frac{5}{-9} + 36i^2$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

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. Pure Imaginary

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

D. Nonreal Complex

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

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

$$\frac{9 - 44i}{2 + 7i}$$

The solution is $-5.47 - 2.85i$, which is option A.

A. $a \in [-5.5, -4.5]$ and $b \in [-3.5, -1]$

* $-5.47 - 2.85i$, which is the correct option.

B. $a \in [-290.5, -289.5]$ and $b \in [-3.5, -1]$

$-290.00 - 2.85i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [5.5, 7]$ and $b \in [-1, 1]$

$6.15 - 0.47i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

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

$4.50 - 6.29i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-5.5, -4.5]$ and $b \in [-151.5, -149.5]$

$-5.47 - 151.00i$, 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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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{1176}{14}}$$

The solution is Irrational, 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. Whole

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

C. Rational

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

D. Integer

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

E. Irrational

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{84}$.

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

$$(-7 + 5i)(-4 + 2i)$$

The solution is $18 - 34i$, which is option A.

A. $a \in [16, 20]$ and $b \in [-37, -30]$

* $18 - 34i$, which is the correct option.

B. $a \in [37, 42]$ and $b \in [6, 8]$

$38 + 6i$, which corresponds to adding a minus sign in the first term.

C. $a \in [37, 42]$ and $b \in [-6, 1]$

$38 - 6i$, which corresponds to adding a minus sign in the second term.

D. $a \in [16, 20]$ and $b \in [29, 37]$

$18 + 34i$, which corresponds to adding a minus sign in both terms.

E. $a \in [26, 33]$ and $b \in [8, 16]$

$28 + 10i$, 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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9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1078}{0}} + \sqrt{182}i$$

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. Rational

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

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.

$$18 - 1 \div 8 * 20 - (15 * 6)$$

The solution is -74.500, which is option C.

A. $[3, 8]$

3.000, which corresponds to not distributing a negative correctly.

B. $[-72.01, -64.01]$

-72.006, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-76.5, -72.5]$

* -74.500, which is the correct option.

D. $[105.99, 111.99]$

107.994, which corresponds to not distributing addition and subtraction 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.
