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.

$$\sqrt{\frac{49}{169}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Not a Real number

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

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

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{7}{13}$.

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

$$-\sqrt{\frac{28224}{576}}$$

The solution is Integer, which is option B.

A. Whole

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

B. Integer

* This is the correct option!

C. Not a Real number

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

D. Rational

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

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -168.

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 and choose the interval the simplification is contained within.

$$8 - 6 \div 15 * 9 - (3 * 18)$$

The solution is -49.600, which is option B.

A. $[61.1, 65.2]$

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

B. $[-52.8, -48.7]$

* -49.600, which is the correct option.

C. $[-46.6, -45.8]$

-46.044, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[19.8, 26.9]$

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

$$\frac{6}{-17} + 64i^2$$

The solution is Rational, which is option B.

A. Nonreal Complex

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

B. Rational

* This is the correct option!

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. 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!

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.

$$\frac{9 - 88i}{-7 - 3i}$$

The solution is $3.47 + 11.09i$, which is option D.

A. $a \in [-7, -5]$ and $b \in [10, 10.5]$

$-5.64 + 10.16i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-1.5, -0.5]$ and $b \in [29, 30]$

$-1.29 + 29.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [2.5, 5]$ and $b \in [641.5, 643.5]$

$3.47 + 643.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [2.5, 5]$ and $b \in [10.5, 11.5]$

* $3.47 + 11.09i$, which is the correct option.

E. $a \in [200.5, 201.5]$ and $b \in [10.5, 11.5]$

$201.00 + 11.09i$, 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 into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-8 - 4i)(-9 + 6i)$$

The solution is $96 - 12i$, which is option D.

A. $a \in [47, 51]$ and $b \in [-87, -78]$

$48 - 84i$, which corresponds to adding a minus sign in the first term.

B. $a \in [94, 97]$ and $b \in [9, 14]$

$96 + 12i$, which corresponds to adding a minus sign in both terms.

C. $a \in [69, 77]$ and $b \in [-27, -22]$

$72 - 24i$, 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. $a \in [94, 97]$ and $b \in [-16, -10]$

* $96 - 12i$, which is the correct option.

E. $a \in [47, 51]$ and $b \in [84, 86]$

$48 + 84i$, 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.

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

$$\frac{-9 + 33i}{8 - 6i}$$

The solution is $-2.70 + 2.10i$, which is option A.

A. $a \in [-3.5, -1.5]$ and $b \in [1.4, 2.45]$

* $-2.70 + 2.10i$, which is the correct option.

B. $a \in [1, 2]$ and $b \in [2.8, 3.55]$

$1.26 + 3.18i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-3.5, -1.5]$ and $b \in [209.55, 210.2]$

$-2.70 + 210.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-270.5, -269.5]$ and $b \in [1.4, 2.45]$

$-270.00 + 2.10i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-2.5, -1]$ and $b \in [-5.9, -4.95]$

$-1.12 - 5.50i$, 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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8. Simplify the expression below and choose the interval the simplification is contained within.

$$2 - 6^2 + 10 \div 15 * 19 \div 3$$

The solution is -29.778, which is option A.

A. $[-33.78, -23.78]$

* -29.778, this is the correct option

B. $[-33.99, -32.99]$

-33.988, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[35.01, 41.01]$

38.012, which corresponds to two Order of Operations errors.

D. $[39.22, 45.22]$

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

$$\frac{19}{-11} + 64i^2$$

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. 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. Irrational

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

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

$$(-6 - 7i)(-2 + 8i)$$

The solution is $68 - 34i$, which is option C.

A. $a \in [12, 13]$ and $b \in [-57, -54]$

$12 - 56i$, 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. $a \in [-44, -38]$ and $b \in [61, 64]$

$-44 + 62i$, which corresponds to adding a minus sign in the second term.

C. $a \in [68, 69]$ and $b \in [-36, -26]$

* $68 - 34i$, which is the correct option.

D. $a \in [68, 69]$ and $b \in [33, 38]$

$68 + 34i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-44, -38]$ and $b \in [-66, -59]$

$-44 - 62i$, 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.
