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.

$$-\sqrt{\frac{81}{625}}$$

The solution is Rational, which is option D.

A. Whole

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

B. Integer

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

C. Irrational

These cannot be written as a fraction of Integers.

D. Rational

* This is the correct option!

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 $-\frac{9}{25}$.

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.

$$(3 - 8i)(6 + 4i)$$

The solution is $50 - 36i$, which is option E.

A. $a \in [-14, -9]$ and $b \in [57, 62]$

$-14 + 60i$, which corresponds to adding a minus sign in the first term.

B. $a \in [16, 20]$ and $b \in [-34, -29]$

$18 - 32i$, 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. $a \in [-14, -9]$ and $b \in [-64, -53]$

$-14 - 60i$, which corresponds to adding a minus sign in the second term.

D. $a \in [48, 58]$ and $b \in [28, 37]$

$50 + 36i$, which corresponds to adding a minus sign in both terms.

E. $a \in [48, 58]$ and $b \in [-40, -33]$

* $50 - 36i$, 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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3. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1190}{10}} + \sqrt{143}i$$

The solution is Nonreal Complex, which is option A.

A. Nonreal Complex

* This is the correct option!

B. Irrational

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

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. Pure Imaginary

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

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

$$\frac{9 - 44i}{-2 + 3i}$$

The solution is $-11.54 + 4.69i$, which is option E.

A. $a \in [-151, -148]$ and $b \in [3.5, 5]$

$-150.00 + 4.69i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [8, 9.5]$ and $b \in [8, 10.5]$

$8.77 + 8.85i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-12.5, -10]$ and $b \in [60.5, 61.5]$

$-11.54 + 61.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-5.5, -4]$ and $b \in [-15.5, -13.5]$

$-4.50 - 14.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-12.5, -10]$ and $b \in [3.5, 5]$

* $-11.54 + 4.69i$, which is the correct option.

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

$$6 - 12^2 + 8 \div 20 * 7 \div 18$$

The solution is -137.844, which is option C.

A. $[-138.19, -137.89]$

-137.997, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[150.06, 150.37]$

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

C. $[-137.85, -137.52]$

* -137.844, this is the correct option

D. $[149.71, 150.09]$

150.003, which corresponds to two Order of Operations errors.

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

$$(-2 + 8i)(-5 + 6i)$$

The solution is $-38 - 52i$, which is option C.

A. $a \in [57, 61]$ and $b \in [-31, -22]$

$58 - 28i$, which corresponds to adding a minus sign in the second term.

B. $a \in [9, 12]$ and $b \in [45, 51]$

$10 + 48i$, 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. $a \in [-41, -37]$ and $b \in [-56, -46]$

* $-38 - 52i$, which is the correct option.

D. $a \in [57, 61]$ and $b \in [27, 29]$

$58 + 28i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-41, -37]$ and $b \in [50, 53]$

$-38 + 52i$, 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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7. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{143}}{8} + 4i^2$$

The solution is Irrational, which is option A.

A. Irrational

* 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. 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. Pure Imaginary

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

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.

$$\sqrt{\frac{1040}{13}}$$

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. Rational

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

C. Not a Real number

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

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 $\sqrt{80}$.

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.

$$17 - 7^2 + 8 \div 2 * 3 \div 13$$

The solution is -31.077, which is option A.

A. $[-31.36, -30.93]$

* -31.077, this is the correct option

B. $[-32.85, -31.71]$

-31.897, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[65.48, 66.41]$

66.103, which corresponds to two Order of Operations errors.

D. $[66.81, 67.15]$

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

$$\frac{-45 + 66i}{3 + 2i}$$

The solution is $-0.23 + 22.15i$, which is option B.

A. $a \in [-3.5, -2.5]$ and $b \in [20.5, 23.5]$

$-3.00 + 22.15i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-1, 0.5]$ and $b \in [20.5, 23.5]$

   * $-0.23 + 22.15i$, which is the correct option.

C. $a \in [-16, -14.5]$ and $b \in [32.5, 33.5]$

   $-15.00 + 33.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-21.5, -19.5]$ and $b \in [7.5, 9.5]$

   $-20.54 + 8.31i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-1, 0.5]$ and $b \in [287.5, 289]$

   $-0.23 + 288.00i$, 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 $2 - 3i$.
