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.

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

The solution is $12 + 88i$, which is option C.

A. $a \in [-74, -69]$ and $b \in [-58, -48]$

$-72 - 52i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-74, -69]$ and $b \in [51, 53]$

$-72 + 52i$, which corresponds to adding a minus sign in the second term.

C. $a \in [9, 18]$ and $b \in [80, 92]$

* $12 + 88i$, which is the correct option.

D. $a \in [-31, -24]$ and $b \in [-46, -39]$

$-30 - 42i$, 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.

E. $a \in [9, 18]$ and $b \in [-90, -84]$

$12 - 88i$, 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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2. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{208}}{17} + 8i^2$$

The solution is Irrational, which is option A.

A. Irrational

* This is the correct option!

B. Pure Imaginary

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

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

$$\frac{-9 - 22i}{-4 + 8i}$$

The solution is $-1.75 + 2.00i$, which is option E.

A. $a \in [1.89, 2.48]$ and $b \in [-3.5, -2]$

$2.25 - 2.75i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-1.86, -1.46]$ and $b \in [159.5, 160.5]$

$-1.75 + 160.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-140.08, -139.66]$ and $b \in [1.5, 3]$

$-140.00 + 2.00i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [2.6, 2.89]$ and $b \in [0, 1]$

$2.65 + 0.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-1.86, -1.46]$ and $b \in [1.5, 3]$

* $-1.75 + 2.00i$, 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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4. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{576}{25}}$$

The solution is Rational, which is option B.

A. Integer

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

B. Rational

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Whole

These are the counting numbers with 0 (0, 1, 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 $\frac{24}{5}$.

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

$$\frac{-72 - 66i}{-1 + 3i}$$

The solution is $-12.60 + 28.20i$, which is option E.

A. $a \in [-13.5, -11]$ and $b \in [281, 283.5]$

$-12.60 + 282.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [25.5, 28.5]$ and $b \in [-16, -14.5]$

$27.00 - 15.00i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-128, -125.5]$ and $b \in [27.5, 29]$

$-126.00 + 28.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [71, 72.5]$ and $b \in [-23.5, -21.5]$

$72.00 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-13.5, -11]$ and $b \in [27.5, 29]$

* $-12.60 + 28.20i$, 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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6. Simplify the expression below and choose the interval the simplification is contained within.

$$9 - 15 \div 19 * 20 - (12 * 5)$$

The solution is -66.789, which is option D.

A. $[-93.95, -90.95]$

-93.947, which corresponds to not distributing a negative correctly.

B. $[66.96, 70.96]$

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

C. $[-52.04, -46.04]$

-51.039, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-68.79, -63.79]$

* -66.789, which 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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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{22500}{36}}$$

The solution is Whole, which is option C.

A. Not a Real number

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

B. Rational

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

C. Whole

* This is the correct option!

D. Irrational

These cannot be written as a fraction of Integers.

E. Integer

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 150.

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 and choose the interval the simplification is contained within.

$$17 - 9^2 + 19 \div 12 * 10 \div 2$$

The solution is -56.083, which is option B.

A. $[104.92, 111.92]$

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

B. $[-58.08, -55.08]$

* -56.083, this is the correct option

C. $[-64.92, -62.92]$

-63.921, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[95.08, 103.08]$

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

$$-\sqrt{\frac{49}{121}} + 25i^2$$

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. Irrational

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

C. Rational

* This is the correct option!

D. Nonreal Complex

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

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

$$(8 + 7i)(3 + 5i)$$

The solution is $-11 + 61i$, which is option D.

A. $a \in [24, 29]$ and $b \in [34, 37]$

$24 + 35i$, 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. $a \in [54, 62]$ and $b \in [17, 22]$

$59 + 19i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-16, -9]$ and $b \in [-62, -54]$

$-11 - 61i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-16, -9]$ and $b \in [60, 62]$

* $-11 + 61i$, which is the correct option.

E. $a \in [54, 62]$ and $b \in [-22, -12]$

$59 - 19i$, 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.
