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.

$$\frac{-18 - 77i}{-5 + i}$$

The solution is $0.50 + 15.50i$, which is option A.

A. $a \in [0, 1.5]$ and $b \in [14.9, 15.7]$

* $0.50 + 15.50i$, which is the correct option.

B. $a \in [2.5, 4.5]$ and $b \in [-77.55, -76.8]$

$3.60 - 77.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [0, 1.5]$ and $b \in [402.9, 403.2]$

$0.50 + 403.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [11.5, 13.5]$ and $b \in [14.9, 15.7]$

$13.00 + 15.50i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [5, 7]$ and $b \in [14, 14.55]$

$6.42 + 14.12i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

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

$$\frac{45 - 88i}{-4 + 7i}$$

The solution is $-12.25 + 0.57i$, which is option B.

A. $a \in [-11.5, -10]$ and $b \in [-13.5, -11.5]$

$-11.25 - 12.57i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-13.5, -12]$ and $b \in [-0.5, 2]$

* $-12.25 + 0.57i$, which is the correct option.

C. $a \in [-797, -795]$ and $b \in [-0.5, 2]$

$-796.00 + 0.57i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [5.5, 8]$ and $b \in [9, 11]$

$6.71 + 10.26i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-13.5, -12]$ and $b \in [36.5, 38.5]$

$-12.25 + 37.00i$, 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.

$$(4 - 6i)(3 + 7i)$$

The solution is $54 + 10i$, which is option D.

A. $a \in [-31, -28]$ and $b \in [-54, -44]$

$-30 - 46i$, which corresponds to adding a minus sign in the second term.

B. $a \in [6, 15]$ and $b \in [-44, -41]$

$12 - 42i$, 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.

C. $a \in [-31, -28]$ and $b \in [42, 48]$

$-30 + 46i$, which corresponds to adding a minus sign in the first term.

D. $a \in [48, 57]$ and $b \in [4, 13]$

* $54 + 10i$, which is the correct option.

E. $a \in [48, 57]$ and $b \in [-10, -9]$

$54 - 10i$, 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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4. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-525}{5}}$$

The solution is Not a Real number, which is option C.

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. Not a Real number

* This is the correct option!

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 $-\sqrt{105}i$.

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 and choose the interval the simplification is contained within.

$$15 - 14^2 + 5 \div 17 * 18 \div 8$$

The solution is -180.338, which is option B.

A. $[211.12, 211.99]$

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

B. $[-180.44, -180.08]$

* -180.338, this is the correct option

C. $[-181.33, -180.83]$

-180.998, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[210.75, 211.12]$

211.002, 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 and choose the interval the simplification is contained within.

$$14 - 7 \div 20 * 6 - (10 * 12)$$

The solution is -108.100, which is option C.

A. $[20.1, 24.9]$

22.800, which corresponds to not distributing a negative correctly.

B. $[133, 136.2]$

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

C. $[-109.2, -108]$

* -108.100, which is the correct option.

D. $[-107.1, -103.2]$

-106.058, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

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 Complex numbers that the number below belongs to.

$$\sqrt{\frac{-2496}{0}} + \sqrt{60}$$

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

A. Irrational

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

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 the correct option!

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

$$\frac{18}{-18} + 4i^2$$

The solution is Rational, which is option A.

A. Rational

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

$$(3 - 9i)(-10 + 5i)$$

The solution is $15 + 105i$, which is option D.

A. $a \in [-75, -73]$ and $b \in [-82, -74]$

$-75 - 75i$, which corresponds to adding a minus sign in the first term.

B. $a \in [14, 17]$ and $b \in [-109, -98]$

$15 - 105i$, which corresponds to adding a minus sign in both terms.

C. $a \in [-75, -73]$ and $b \in [73, 76]$

$-75 + 75i$, which corresponds to adding a minus sign in the second term.

D. $a \in [14, 17]$ and $b \in [104, 107]$

* $15 + 105i$, which is the correct option.

E. $a \in [-34, -27]$ and $b \in [-47, -43]$

$-30 - 45i$, 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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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{1134}{9}}$$

The solution is Irrational, which is option B.

A. Not a Real number

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

B. Irrational

* This is the correct option!

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. 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 $-\sqrt{126}$.

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.
