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 Complex numbers that the number below belongs to.

$$\frac{0}{10\pi} + \sqrt{2}i$$

The solution is Pure Imaginary, which is option C.

A. Irrational

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

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 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. Rational

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

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

$$\frac{9 - 44i}{-3 - 5i}$$

The solution is $5.68 + 5.21i$, which is option C.

A. $a \in [-4, -2.5]$ and $b \in [7.5, 9.5]$

$-3.00 + 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [192.5, 194]$ and $b \in [4.5, 6.5]$

$193.00 + 5.21i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [4.5, 6]$ and $b \in [4.5, 6.5]$

* $5.68 + 5.21i$, which is the correct option.

D. $a \in [4.5, 6]$ and $b \in [176, 178]$

$5.68 + 177.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-8, -7]$ and $b \in [1.5, 3.5]$

$-7.26 + 2.56i$, 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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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(4 - 9i)(-7 - 3i)$$

The solution is $-55 + 51i$, which is option B.

A. $a \in [-4, 5]$ and $b \in [73, 81]$

$-1 + 75i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-57, -47]$ and $b \in [45, 52]$

* $-55 + 51i$, which is the correct option.

C. $a \in [-4, 5]$ and $b \in [-80, -67]$

$-1 - 75i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-57, -47]$ and $b \in [-53, -50]$

$-55 - 51i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-35, -26]$ and $b \in [27, 31]$

$-28 + 27i$, 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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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{72 + 33i}{-5 - 6i}$$

The solution is $-9.15 + 4.38i$, which is option C.

A. $a \in [-559, -557.5]$ and $b \in [3.5, 5]$

$-558.00 + 4.38i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-16, -13.5]$ and $b \in [-6.5, -5]$

$-14.40 - 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-10.5, -8.5]$ and $b \in [3.5, 5]$

* $-9.15 + 4.38i$, which is the correct option.

D. $a \in [-10.5, -8.5]$ and $b \in [265.5, 268]$

$-9.15 + 267.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-3.5, -1]$ and $b \in [-10, -9.5]$

$-2.66 - 9.79i$, 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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5. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{36864}{64}}$$

The solution is Integer, 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. Integer

* This is the correct option!

C. Rational

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

D. Irrational

These cannot be written as a fraction of Integers.

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 -192.

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

$$\sqrt{\frac{20736}{81}}$$

The solution is Whole, which is option B.

A. Irrational

These cannot be written as a fraction of Integers.

B. Whole

* This is the correct option!

C. Rational

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

D. Not a Real number

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

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 144.

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

$$20 - 3^2 + 2 \div 4 * 15 \div 13$$

The solution is 11.577, which is option C.

A. $[10, 11.08]$

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

B. $[29.28, 30.69]$

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

C. $[11.34, 11.71]$

* 11.577, this is the correct option

D. $[28.52, 29.53]$

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

$$\frac{\sqrt{210}}{7} + 9i^2$$

The solution is Irrational, which is option E.

A. Pure Imaginary

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

B. Rational

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

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. Nonreal Complex

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

E. Irrational

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

$$(4 + 2i)(3 + 6i)$$

The solution is $0 + 30i$, which is option E.

A. $a \in [22, 25]$ and $b \in [18, 20]$

$24 + 18i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-4, 2]$ and $b \in [-32, -29]$

$0 - 30i$, which corresponds to adding a minus sign in both terms.

C. $a \in [10, 14]$ and $b \in [10, 14]$

$12 + 12i$, 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. $a \in [22, 25]$ and $b \in [-18, -17]$

$24 - 18i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-4, 2]$ and $b \in [26, 39]$

* $0 + 30i$, 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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10. Simplify the expression below and choose the interval the simplification is contained within.

$$3 - 12^2 + 5 \div 19 * 18 \div 15$$

The solution is -140.684, which is option C.

A. $[-141.4, -140.76]$

-140.999, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[146.4, 147.28]$

147.001, which corresponds to two Order of Operations errors.

C. $[-140.88, -140.28]$

* -140.684, this is the correct option

D. $[147.01, 147.75]$

147.316, 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.
