**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.

$$\sqrt{\frac{32400}{324}}$$

The solution is Whole

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. Irrational

These cannot be written as a fraction of Integers.

E. Whole

* This is the correct option!

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to 180.

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.

$$(-10 - 4i)(-3 + 8i)$$

The solution is $62 - 68i$

A. $a \in [27, 32]$ and $b \in [-39, -27]$

$30 - 32i$, 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.

B. $a \in [-5, 1]$ and $b \in [89, 96]$

$-2 + 92i$, which corresponds to adding a minus sign in the second term.

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C. $a \in [-5, 1]$ and $b \in [-97, -90]$

$-2 - 92i$, which corresponds to adding a minus sign in the first term.

D. $a \in [61, 63]$ and $b \in [64, 73]$

$62 + 68i$, which corresponds to adding a minus sign in both terms.

E. $a \in [61, 63]$ and $b \in [-74, -66]$

* $62 - 68i$, which is the correct option.

**General Comment:** General Comments: 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. Simplify the expression below and choose the interval the simplification is contained within.

$$19 - 4^2 + 17 \div 11 * 3 \div 15$$

The solution is 3.309

A. [2.89, 3.09]

3.034000, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. [35.07, 35.37]

35.309000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. [3.28, 3.57]

* 3.309000, this is the correct option

D. [34.92, 35.1]

35.034000, 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:** General Comments: 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.

$$\sqrt{\frac{0}{6}} + \sqrt{4}i$$

The solution is Pure Imaginary

A. Rational

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

B. Nonreal Complex

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

C. Pure Imaginary

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

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D. 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!

E. Irrational

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

**General Comment:** General Comments: 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.

$$\frac{-54 + 44i}{-5 - 2i}$$

The solution is $6.28 - 11.31i$

A. $a \in [12.25, 12.85]$ and $b \in [-4.5, -2]$

$12.34 - 3.86i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [181.4, 182.75]$ and $b \in [-12.5, -10.5]$

$182.00 - 11.31i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [6.2, 7.05]$ and $b \in [-330, -326]$

$6.28 - 328.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [9.45, 12.05]$ and $b \in [-23, -20.5]$

$10.80 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [6.2, 7.05]$ and $b \in [-12.5, -10.5]$

* $6.28 - 11.31i$, 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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