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.

$$\frac{-54 - 44i}{-8 - 5i}$$

The solution is $7.33 + 0.92i$, which is option E.

A. $a \in [6.3, 6.8]$ and $b \in [8, 9.5]$ $6.75 + 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [7.1, 7.9]$ and $b \in [81.5, 82.5]$ $7.33 + 82.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [1.85, 2.9]$ and $b \in [6, 8]$ $2.38 + 6.99i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [651.55, 652.15]$ and $b \in [0, 2.5]$ $652.00 + 0.92i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [7.1, 7.9]$ and $b \in [0, 2.5]$* $7.33 + 0.92i$, 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 $2-3i$.

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

$$(-8 - 9i)(-7 - 6i)$$

The solution is $2 + 111i$, which is option D.

A. $a \in [55, 66]$ and $b \in [53, 58]$ $56 + 54i$, 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. $a \in [1, 3]$ and $b \in [-111, -110]$ $2 - 111i$, which corresponds to adding a minus sign in both terms.

C. $a \in [109, 116]$ and $b \in [13, 17]$ $110 + 15i$, which corresponds to adding a minus sign in the second term.

D. $a \in [1, 3]$ and $b \in [109, 113]$* $2 + 111i$, which is the correct option.

E. $a \in [109, 116]$ and $b \in [-23, -11]$ $110 - 15i$, which corresponds to adding a minus sign in the first 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.

3. **General Comment:** None

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

$$6 - 3^2 + 5 \div 19 * 13 \div 17$$

The solution is -2.799, which is option C.

A. $[15.19, 15.27]$ 15.201, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[14.92, 15.11]$ 15.001, which corresponds to two Order of Operations errors.

C. $[-2.82, -2.58]$* -2.799, this is the correct option

D. $[-3.06, -2.91]$ -2.999, 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.

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

$$\frac{\sqrt{65}}{17} + 3i^2$$

The solution is Irrational, which is option D.

A. Not a Complex NumberThis is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

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

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

D. Irrational* This is the correct option!

E. Pure ImaginaryThis 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.

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

$$\sqrt{\frac{15876}{81}}$$

The solution is Whole, which is option B.

A. Not a Real numberThese are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

B. Whole* This is the correct option!

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

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

E. IrrationalThese cannot be written as a fraction of Integers.

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