

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.

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

$$\frac{5}{-20} + \sqrt{-4}i$$

The solution is Rational, which is option E.

- A. 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!

- B. Nonreal Complex

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

- C. Irrational

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

- D. Pure Imaginary

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

- E. Rational

* 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.

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

$$\frac{9 + 55i}{6 - 8i}$$

The solution is $-3.86 + 4.02i$, which is option C.

- A. $a \in [0, 3]$ and $b \in [-8, -6.5]$

$1.50 - 6.88i$, which corresponds to just dividing the first term by the first term and the second by the second.

- B. $a \in [4.5, 6]$ and $b \in [2, 4]$

$4.94 + 2.58i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

- C. $a \in [-4.5, -2.5]$ and $b \in [3.5, 5.5]$

* $-3.86 + 4.02i$, which is the correct option.

D. $a \in [-386.5, -384.5]$ and $b \in [3.5, 5.5]$

$-386.00 + 4.02i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-4.5, -2.5]$ and $b \in [401.5, 403.5]$

$-3.86 + 402.00i$, 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 $2 - 3i$.

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

$$(-2 - 6i)(10 + 3i)$$

The solution is $-2 - 66i$, which is option E.

A. $a \in [-5, 0]$ and $b \in [65, 68]$

$-2 + 66i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-21, -15]$ and $b \in [-19, -14]$

$-20 - 18i$, 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. $a \in [-40, -36]$ and $b \in [53, 55]$

$-38 + 54i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-40, -36]$ and $b \in [-56, -50]$

$-38 - 54i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-5, 0]$ and $b \in [-66, -60]$

* $-2 - 66i$, 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.

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

$$\frac{36 - 88i}{1 - 6i}$$

The solution is $15.24 + 3.46i$, which is option B.

A. $a \in [35, 36.5]$ and $b \in [14.5, 15]$

$36.00 + 14.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [13.5, 15.5]$ and $b \in [2.5, 4]$

* $15.24 + 3.46i$, which is the correct option.

C. $a \in [-13.5, -12]$ and $b \in [-8.5, -8]$

$-13.30 - 8.22i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

- D. $a \in [563.5, 565]$ and $b \in [2.5, 4]$

$564.00 + 3.46i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

- E. $a \in [13.5, 15.5]$ and $b \in [127.5, 129]$

$15.24 + 128.00i$, 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 $2 - 3i$.

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

$$9 - 2 \div 15 * 19 - (13 * 12)$$

The solution is -149.533 , which is option B.

- A. $[-148.01, -144.01]$

-147.007 , which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

- B. $[-154.53, -148.53]$

* -149.533 , which is the correct option.

- C. $[-82.4, -75.4]$

-78.400 , which corresponds to not distributing a negative correctly.

- D. $[164.99, 169.99]$

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

- 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.

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

$$-\sqrt{\frac{8100}{25}}$$

The solution is Integer, which is option A.

- A. Integer

* This is the correct option!

- B. Not a Real number

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

- C. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

- D. Irrational

These cannot be written as a fraction of Integers.

E. Rational

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

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -90 .

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.

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

$$-\sqrt{\frac{625}{36}} + 36i^2$$

The solution is Rational, 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. Rational

* This is the correct option!

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. 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.

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

$$(-2 - 10i)(8 + 6i)$$

The solution is $44 - 92i$, which is option B.

A. $a \in [-82, -71]$ and $b \in [59, 75]$

$-76 + 68i$, which corresponds to adding a minus sign in the first term.

B. $a \in [36, 48]$ and $b \in [-94, -86]$

* $44 - 92i$, which is the correct option.

C. $a \in [-82, -71]$ and $b \in [-70, -61]$

$-76 - 68i$, which corresponds to adding a minus sign in the second term.

D. $a \in [36, 48]$ and $b \in [84, 98]$

$44 + 92i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-20, -15]$ and $b \in [-65, -57]$

$-16 - 60i$, 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.

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

$$-\sqrt{\frac{11664}{324}}$$

The solution is Integer, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Not a Real number

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

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. Integer

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -108 .

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.

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

$$12 - 14 \div 1 * 19 - (3 * 9)$$

The solution is -281.000 , which is option D.

A. $[33.26, 42.26]$

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

B. $[-22.74, -13.74]$

-15.737 , which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-2316, -2310]$

-2313.000, which corresponds to not distributing a negative correctly.

D. $[-283, -278]$

* -281.000, 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.
