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 Real numbers that the number below belongs to.

$$-\sqrt{\frac{1404}{12}}$$

The solution is Irrational, which is option A.

A. Irrational

* 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. Rational

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

D. Integer

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

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 $-\sqrt{117}$.

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.

---

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

$$-\sqrt{\frac{81}{196}}$$

The solution is Rational, which is option E.

A. Not a Real number

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

B. Irrational

These cannot be written as a fraction of Integers.

C. Integer

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

D. Whole

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

E. Rational

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\frac{9}{14}$.

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.

---

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

$$(-7 + 9i)(-5 - 10i)$$

The solution is $125 + 25i$, which is option B.

A. $a \in [-57, -54]$ and $b \in [-119, -114]$

$-55 - 115i$, which corresponds to adding a minus sign in the second term.

B. $a \in [122, 129]$ and $b \in [24, 27]$

* $125 + 25i$, which is the correct option.

C. $a \in [-57, -54]$ and $b \in [111, 121]$

$-55 + 115i$, which corresponds to adding a minus sign in the first term.

D. $a \in [33, 36]$ and $b \in [-90, -86]$

$35 - 90i$, 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.

E. $a \in [122, 129]$ and $b \in [-25, -19]$

$125 - 25i$, 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.

---

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

$$\frac{-9 + 66i}{2 + 8i}$$

The solution is $7.50 + 3.00i$, which is option A.

A. $a \in [7, 8]$ and $b \in [1.5, 5]$

* $7.50 + 3.00i$, which is the correct option.

B. $a \in [-9, -7]$ and $b \in [0.5, 1.5]$

$-8.03 + 0.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [509, 510.5]$ and $b \in [1.5, 5]$

$510.00 + 3.00i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-6, -3.5]$ and $b \in [6.5, 9.5]$

$-4.50 + 8.25i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [7, 8]$ and $b \in [203, 204.5]$

$7.50 + 204.00i$, 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. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{-12}{-11} + \sqrt{-25}i$$

The solution is Rational, which is option B.

A. Nonreal Complex

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

B. Rational

* This is the correct option!

C. Irrational

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

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. Pure Imaginary

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

$$12 - 3 \div 10 * 15 - (9 * 2)$$

The solution is -10.500, which is option C.

A. $[27.9, 33.7]$

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

B. $[-5.4, -1]$

-3.000, which corresponds to not distributing a negative correctly.

C. $[-11.7, -8]$

* -10.500, which is the correct option.

D. $[-8.6, -5.5]$

-6.020, 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.

---

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

$$17 - 2 \div 1 * 9 - (16 * 13)$$

The solution is -209.000, which is option B.

A. $[223.78, 225.78]$

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

B. $[-210, -204]$

* -209.000, which is the correct option.

C. $[-194.22, -185.22]$

-191.222, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-224, -218]$

-221.000, which corresponds to not distributing a negative 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.

---

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

$$\frac{15}{-17} + 4i^2$$

The solution is Rational, which is option C.

A. Nonreal Complex

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

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. Irrational

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

E. 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!

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.

---

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

$$(10 - 4i)(-6 + 7i)$$

The solution is $-32 + 94i$, which is option E.

A. $a \in [-63, -58]$ and $b \in [-34, -25]$

$-60 - 28i$, 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. $a \in [-91, -85]$ and $b \in [-49, -40]$

$-88 - 46i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-91, -85]$ and $b \in [46, 54]$

$-88 + 46i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-38, -29]$ and $b \in [-96, -91]$

$-32 - 94i$, which corresponds to adding a minus sign in both terms.

E. $a \in [-38, -29]$ and $b \in [92, 95]$

* $-32 + 94i$, 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.

---

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

$$\frac{27 - 55i}{-7 + 6i}$$

The solution is $-6.11 + 2.62i$, which is option B.

A. $a \in [-7, -5]$ and $b \in [222, 224]$

$-6.11 + 223.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-7, -5]$ and $b \in [2.5, 3]$

* $-6.11 + 2.62i$, which is the correct option.

C. $a \in [0.5, 2]$ and $b \in [5, 7]$

$1.66 + 6.44i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-520, -518]$ and $b \in [2.5, 3]$

$-519.00 + 2.62i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-4, -3]$ and $b \in [-10.5, -8.5]$

$-3.86 - 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

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 $2 - 3i$.
