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

$$\frac{-54 + 77i}{5 - i}$$

The solution is $-13.35 + 12.73i$, which is option A.

A. $a \in [-14, -12.5]$ and $b \in [11.5, 13]$

* $-13.35 + 12.73i$, which is the correct option.

B. $a \in [-12, -10.5]$ and $b \in [-77.5, -76.5]$

$-10.80 - 77.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-14, -12.5]$ and $b \in [330.5, 331.5]$

$-13.35 + 331.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-8, -6.5]$ and $b \in [15.5, 18.5]$

$-7.42 + 16.88i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-348, -346.5]$ and $b \in [11.5, 13]$

$-347.00 + 12.73i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

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.

$$\frac{63 - 55i}{-8 + i}$$

The solution is $-8.60 + 5.80i$, which is option B.

A. $a \in [-9.2, -8.2]$ and $b \in [376, 377.5]$

$-8.60 + 377.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-9.2, -8.2]$ and $b \in [5, 6]$

* $-8.60 + 5.80i$, which is the correct option.

C. $a \in [-8.2, -7.35]$ and $b \in [-56, -54.5]$

$-7.88 - 55.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-7.5, -6.55]$ and $b \in [7.5, 8]$

$-6.91 + 7.74i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-559.1, -558.35]$ and $b \in [5, 6]$

$-559.00 + 5.80i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

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.

$$(-7 + 8i)(3 + 10i)$$

The solution is $-101 - 46i$, which is option B.

A. $a \in [59, 63]$ and $b \in [-96, -90]$

$59 - 94i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-109, -100]$ and $b \in [-49, -44]$

* $-101 - 46i$, which is the correct option.

C. $a \in [-109, -100]$ and $b \in [46, 48]$

$-101 + 46i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-31, -19]$ and $b \in [76, 86]$

$-21 + 80i$, 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. $a \in [59, 63]$ and $b \in [94, 98]$

$59 + 94i$, which corresponds to adding a minus sign in the second 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.

---

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

$$\sqrt{\frac{1716}{11}}$$

The solution is Irrational, which is option B.

A. Whole

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

B. Irrational

* 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 $\sqrt{156}$.

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.

---

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

$$17 - 20^2 + 16 \div 12 * 5 \div 13$$

The solution is -382.487, which is option A.

A. $[-382.5, -382.32]$

* -382.487, this is the correct option

B. $[-383.45, -382.66]$

-382.979, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[416.92, 417.21]$

417.021, which corresponds to two Order of Operations errors.

D. $[417.51, 417.62]$

417.513, 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.

---

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

$$15 - 9^2 + 20 \div 6 * 10 \div 4$$

The solution is -57.667, which is option C.

A. $[95.08, 101.08]$

96.083, which corresponds to two Order of Operations errors.

B. $[-65.92, -64.92]$

-65.917, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-58.67, -55.67]$

* -57.667, this is the correct option

D. $[97.33, 111.33]$

104.333, 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.

---

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

$$\sqrt{\frac{-1980}{12}} + \sqrt{0}i$$

The solution is Pure Imaginary, which is option E.

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. 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 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.

---

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

$$\frac{\sqrt{154}}{13} + \sqrt{-7}i$$

The solution is Irrational, which is option A.

A. Irrational

* This is the correct option!

B. Rational

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

C. Nonreal Complex

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

D. Pure Imaginary

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

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.

$$(6 + 7i)(-9 - 5i)$$

The solution is $-19 - 93i$, which is option D.

A. $a \in [-25, -18]$ and $b \in [90.8, 93.8]$

$-19 + 93i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-89, -84]$ and $b \in [31, 36.1]$

$-89 + 33i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-89, -84]$ and $b \in [-34.1, -31.3]$

$-89 - 33i$, which corresponds to adding a minus sign in the second term.

D. $a \in [-25, -18]$ and $b \in [-95.7, -90.9]$

* $-19 - 93i$, which is the correct option.

E. $a \in [-60, -49]$ and $b \in [-38.1, -34]$

$-54 - 35i$, 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.

---

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

$$-\sqrt{\frac{256}{289}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Integer

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

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

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

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 $-\frac{16}{17}$.

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.
