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.

$$\frac{-18 - 44i}{-3 + 8i}$$

The solution is $-4.08 + 3.78i$, which is option B.

A. $a \in [5.9, 6.8]$ and $b \in [-6, -4]$

$6.00 - 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-4.2, -4]$ and $b \in [2.5, 4.5]$

* $-4.08 + 3.78i$, which is the correct option.

C. $a \in [-4.2, -4]$ and $b \in [275.5, 277]$

$-4.08 + 276.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-298.35, -297.9]$ and $b \in [2.5, 4.5]$

$-298.00 + 3.78i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [5, 5.7]$ and $b \in [-1, 0.5]$

$5.56 - 0.16i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

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.

$$\frac{18 + 11i}{7 - 8i}$$

The solution is $0.34 + 1.96i$, which is option B.

A. $a \in [1.45, 2.15]$ and $b \in [-0.65, -0.2]$

$1.89 - 0.59i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [0.2, 0.45]$ and $b \in [1.9, 2.15]$

* $0.34 + 1.96i$, which is the correct option.

C. $a \in [0.2, 0.45]$ and $b \in [220.8, 221.2]$

$0.34 + 221.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [2.4, 3.1]$ and $b \in [-1.55, -0.95]$

$2.57 - 1.38i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [37.35, 38.35]$ and $b \in [1.9, 2.15]$

$38.00 + 1.96i$, 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.

$$(7 - 4i)(-5 - 10i)$$

The solution is $-75 - 50i$, which is option B.

A. $a \in [0, 13]$ and $b \in [85, 94]$

$5 + 90i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-83, -74]$ and $b \in [-55, -49]$

* $-75 - 50i$, which is the correct option.

C. $a \in [-40, -29]$ and $b \in [38, 43]$

$-35 + 40i$, 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.

D. $a \in [-83, -74]$ and $b \in [50, 57]$

$-75 + 50i$, which corresponds to adding a minus sign in both terms.

E. $a \in [0, 13]$ and $b \in [-93, -88]$

$5 - 90i$, 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.

---

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

$$\sqrt{\frac{39204}{324}}$$

The solution is Whole, which is option D.

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. Whole

* This is the correct option!

E. Irrational

These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 198.

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.

$$9 - 7^2 + 12 \div 17 * 8 \div 13$$

The solution is -39.566, which is option D.

A. $[58.41, 58.54]$

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

B. $[-40.59, -39.77]$

-39.993, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[57.88, 58.26]$

58.007, which corresponds to two Order of Operations errors.

D. $[-39.73, -39.06]$

* -39.566, this 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.

---

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

$$12 - 1^2 + 18 \div 3 * 5 \div 14$$

The solution is 13.143, which is option B.

A. $[15.06, 15.19]$

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

B. $[13.11, 13.2]$

* 13.143, this is the correct option

C. $[13, 13.14]$

13.086, which corresponds to two Order of Operations errors.

D. $[11.03, 11.11]$

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

$$\sqrt{\frac{36}{0}} + \sqrt{182}i$$

The solution is Not a Complex Number, which is option A.

A. Not a Complex Number

* 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. Irrational

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

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.

---

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

$$\frac{-18}{10} + 36i^2$$

The solution is Rational, which is option B.

A. Irrational

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

B. Rational

* This is the correct option!

C. Pure Imaginary

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

D. Nonreal Complex

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

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.

$$(3 + 6i)(-4 - 7i)$$

The solution is $30 - 45i$, which is option E.

A. $a \in [26, 31]$ and $b \in [44.7, 45.2]$

$30 + 45i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-60, -47]$ and $b \in [0.2, 3.5]$

$-54 + 3i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-16, -3]$ and $b \in [-42.6, -39.8]$

$-12 - 42i$, 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.

D. $a \in [-60, -47]$ and $b \in [-4, -1.7]$

$-54 - 3i$, which corresponds to adding a minus sign in the second term.

E. $a \in [26, 31]$ and $b \in [-47.3, -44.9]$

* $30 - 45i$, 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. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{-605}{11}}$$

The solution is Not a Real number, which is option E.

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. Whole

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

D. Irrational

These cannot be written as a fraction of Integers.

E. Not a Real number

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{55}i$.

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.
