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.

$$\frac{72 - 44i}{2 + 3i}$$

The solution is $0.92 - 23.38i$, which is option C.

A. $a \in [34.5, 37]$ and $b \in [-16, -14]$

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

B. $a \in [0, 1.5]$ and $b \in [-304.5, -303]$

$0.92 - 304.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [0, 1.5]$ and $b \in [-24, -23]$

* $0.92 - 23.38i$, which is the correct option.

D. $a \in [11.5, 12.5]$ and $b \in [-24, -23]$

$12.00 - 23.38i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [21, 22]$ and $b \in [9.5, 10.5]$

$21.23 + 9.85i$, 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 and choose the interval the simplification is contained within.

$$17 - 10 \div 19 * 5 - (2 * 16)$$

The solution is -17.632, which is option C.

A. $[47.5, 49.7]$

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

B. $[196, 200.9]$

197.895, which corresponds to not distributing a negative correctly.

C. $[-17.9, -17.4]$

* -17.632, which is the correct option.

D. $[-16.4, -12.7]$

-15.105, 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.

---

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

$$(-3 - 2i)(7 - 10i)$$

The solution is $-41 + 16i$, which is option C.

A. $a \in [-48, -40]$ and $b \in [-19, -9]$

$-41 - 16i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-3, 1]$ and $b \in [-45, -43]$

$-1 - 44i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-48, -40]$ and $b \in [16, 18]$

* $-41 + 16i$, which is the correct option.

D. $a \in [-3, 1]$ and $b \in [40, 49]$

$-1 + 44i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-24, -18]$ and $b \in [18, 21]$

$-21 + 20i$, 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.

---

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

$$\frac{\sqrt{187}}{6} + \sqrt{-9}i$$

The solution is Irrational, 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. Irrational

* This is the correct option!

C. Rational

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

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.

---

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

$$-\sqrt{\frac{115600}{400}}$$

The solution is Integer, which is option B.

A. Irrational

These cannot be written as a fraction of Integers.

B. Integer

* This is the correct option!

C. Not a Real number

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

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -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 -340.

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.

---

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

$$\frac{9 - 22i}{4 - 8i}$$

The solution is $2.65 - 0.20i$, which is option B.

A. $a \in [1.4, 2.3]$ and $b \in [2, 3]$

$2.25 + 2.75i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [2.5, 3.05]$ and $b \in [-1, 1]$

* $2.65 - 0.20i$, which is the correct option.

C. $a \in [-1.9, -1.2]$ and $b \in [-2.5, -0.5]$

$-1.75 - 2.00i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [211.9, 212.1]$ and $b \in [-1, 1]$

$212.00 - 0.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [2.5, 3.05]$ and $b \in [-17, -15.5]$

$2.65 - 16.00i$, 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 $2 - 3i$.

---

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

$$\sqrt{\frac{0}{15}} + \sqrt{3}i$$

The solution is Pure Imaginary, which is option B.

A. Irrational

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

B. Pure Imaginary

* This is the correct option!

C. Nonreal Complex

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

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. Rational

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

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 Real numbers that the number below belongs to.

$$\sqrt{\frac{2210}{10}}$$

The solution is Irrational, which is option D.

A. Not a Real number

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

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

* This is the correct option!

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 $\sqrt{221}$.

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.

---

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

$$6 - 2^2 + 3 \div 7 * 16 \div 1$$

The solution is 8.857, which is option C.

A. $[16.67, 18.75]$

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

B. $[0.61, 2.57]$

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

C. $[7.88, 9.48]$

* 8.857, this is the correct option

D. $[9.08, 11.1]$

10.027, which corresponds to two Order of Operations errors.

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.

---

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

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

The solution is $-2 - 114i$, which is option E.

A. $a \in [-2, -1]$ and $b \in [111, 116]$

$-2 + 114i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-111, -108]$ and $b \in [29, 31]$

$-110 + 30i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-57, -54]$ and $b \in [-56, -51]$

$-56 - 54i$, 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.

D. $a \in [-111, -108]$ and $b \in [-32, -26]$

$-110 - 30i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-2, -1]$ and $b \in [-119, -111]$

* $-2 - 114i$, 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.
