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 $a + bi$.

$$\frac{27 + 88i}{5 - 4i}$$

The solution is $-5.29 + 13.37i$.

Plausible alternative answers include: $-5.29 + 548.00i$, which corresponds to forgetting to multiply the conjugate by the numerator. $5.40 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second. * $-5.29 + 13.37i$, which is the correct option. $11.88 + 8.10i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly. $-217.00 + 13.37i$, 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 $a + bi$.

$$\frac{-27 + 55i}{-4 + 2i}$$

The solution is $10.90 - 8.30i$.

Plausible alternative answers include: $-0.10 - 13.70i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly. $6.75 + 27.50i$, which corresponds to just dividing the first term by the first term and the second by the second. $10.90 - 166.00i$, which corresponds to forgetting to multiply the conjugate by the numerator. * $10.90 - 8.30i$, which is the correct option. $218.00 - 8.30i$, 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. What is the **smallest** set of Complex numbers that the number below belongs to?

$$\sqrt{\frac{715}{11}} + 6i^2$$

The solution is Irrational.

Plausible alternative answers include: This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number! These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5) * This is the correct option! This is a Complex number $(a + bi)$ that is not Real (has i as part of the number). 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.

---

4. Simplify the expression below into the form $a + bi$.

$$(7 + 6i)(5 + 4i)$$

The solution is $11 + 58i$.

> **Plausible alternative answers include:** $11 - 58i$, which corresponds to adding a minus sign in both terms. $35 + 24i$, 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. $59 - 2i$, which corresponds to adding a minus sign in the first term. * $11 + 58i$, which is the correct option. $59 + 2i$, 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.

---

5. What is the **smallest** set of Real numbers that the number below belongs to?

$$\sqrt{\frac{1872}{8}}$$

The solution is Irrational.

> **Plausible alternative answers include:**These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...) * This is the correct option! These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0). These are numbers that can be written as fraction of Integers (e.g., -2/3) These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{234}$.

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. What is the **smallest** set of Complex numbers that the number below belongs to?

$$\sqrt{\frac{0}{6}} + \sqrt{6}i$$

The solution is Pure Imaginary.

> **Plausible alternative answers include:**This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number! These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5) These cannot be written as a fraction of Integers. Remember: π is not an Integer! * This is the correct option! 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.

---

7. Simplify the expression below into the form $a + bi$.

$$(-7 - 10i)(2 + 9i)$$

The solution is $76 - 83i$.

Plausible alternative answers include:* $76 - 83i$, which is the correct option. $-104 - 43i$, which corresponds to adding a minus sign in the first term. $76 + 83i$, which corresponds to adding a minus sign in both terms. $-104 + 43i$, which corresponds to adding a minus sign in the second term. $-14 - 90i$, 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.

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.

---

8. Simplify the expression below.

$$20 - 1 \div 19 * 13 - (2 * 3)$$

The solution is 13.316.

Plausible alternative answers include: 51.947, which corresponds to not distributing a negative correctly. 13.996, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division. * 13.316, which is the correct option. 25.996, which corresponds to not distributing addition and subtraction correctly. 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.

---

9. Simplify the expression below.

$$2 - 7^2 + 9 \div 16 * 13 \div 4$$

The solution is -45.172.

Plausible alternative answers include: 51.011, which corresponds to two Order of Operations errors. 52.828, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$ * -45.172, this is the correct option -46.989, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division. 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. What is the **smallest** set of Real numbers that the number below belongs to?

$$-\sqrt{\frac{19}{0}}$$

The solution is Not a Real number.

Plausible alternative answers include: These are the counting numbers with 0 (0, 1, 2, 3, ...) * This is the correct option! These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...) These are numbers that can be written as fraction of Integers (e.g., -2/3) These cannot be written as a fraction of Integers.

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{\frac{19}{0}}$.

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.