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Project Title: (10 words or less)
Addressing Common Math Errors Using Specialized Online Tutorials

Other faculty:

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Department</th>
<th>Email Address</th>
<th>Office Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Corinne Wilson</td>
<td>Mathematics &amp; Statistics</td>
<td><a href="mailto:ccooking@odu.edu">ccooking@odu.edu</a></td>
<td>33219</td>
</tr>
</tbody>
</table>
1. Describe the specific teaching and learning issues being addressed by the proposal.

Old Dominion University’s Pre-Calculus courses currently require online tutorials that contain algebra drills. Each question in the tutorial gives the student feedback when they enter an answer, stating that the answer is “Correct” or “Sorry that is Incorrect.” When a student enters an incorrect answer, the feedback contains the definition, or a similar example answered correctly. These online tutorials, using MyMathLab software, are designed to act as a refresher to better prepare students for Pre-Calculus. We find them to be an effective and necessary component of our Pre-Calculus courses, but we are always seeking ways to make them more effective.

We also find much of the difficulty that students face in Pre-Calculus stems from misconceptions in algebra (and arithmetic). For example, a student who struggles when factoring a quadratic function, an algebra topic, will have trouble graphing rational functions, a Pre-Calculus topic. Over the last several semesters I (along with other lecturers) have compiled a list of common errors that we have witnessed. Ideally, when a student makes a common mistake the feedback should contain more than the correct solution; the feedback should also highlight the specific mistake made and how to correct the misunderstanding. Our proposal is to replace the current algebra tutorials with custom questions built in MyMathLab that focus on these common algebra errors, providing detailed error feedback to students.

2. Describe the revised specific teaching and learning issues being addressed by the proposal (if applicable):

The Common Errors tutorials address exploit common student errors made when working with algebraic entities such fractions, exponents, inequalities, equations, and functions.

3. Describe the development activities involved addressing the learning or teaching issue.

The developed Common Errors tutorials contains several custom problem sets that exploit common student errors made when working with algebraic entities such fractions, exponents, inequalities, equations, and functions. Each problem set has a combination of multiple choice and short answer problems, where the multiple choice problems are designed as a “warm up” before the related short answer problem.

For example, following is a problem included in the “Fractions” problem set:
Each incorrect (distractor) choice exploits a common student error.

- \( \frac{3 - x}{4} \). The student combined the fractions without finding a least common denominator (students often neglect to treat whole numbers as fractions).
- \( \frac{3 + x}{4} \). The student combined the fractions without finding a least common denominator, and did not distribute the negative sign correctly across the second fraction.
- \( \frac{30 + x}{4} \). The student correctly found the least common denominator but did not distribute the negative sign correctly across the second fraction.

If the student selects an incorrect response, a detailed error message will appear:
The error message explains the possible mistakes made and then shows the correct approach. The student will then receive a new problem that is numerically different but functionally the same as the original problem.

After answering this problem correctly the student will receive another multiple choice problem that has a slight variation from the previous problem:
Note that in this problem the solution method is the same but the second fraction contains a negative sign in front of the x term. The distractors are designed in the same fashion as in the previous problem, and the error feedback is the same but specifically designed to note the presence of the negative sign.

The first two multiple choice questions are designed as a “warm up.” After they are complete the student will next receive a short answer question such as the following:
4. Describe the learning outcomes attained by the project.

The goal of implementing the Common Error tutorials is to reduce the number of “rookie mistakes” made by students, and hopefully see better test results. If the new tutorials lead to better Final Exam results, we can ultimately see reduced DFWI rates.

The Common Error tutorials were offered to all Math 162 instructors for use in their Fall 2016 sections. Twenty sections elected to use the Common Error tutorials. A total of 727 students had access to the Common Error tutorials in MyStatLab. The average earned score on each tutorial is given in Table 1.
Table 1: Fall 2016 Average Common Error Tutorial Score

<table>
<thead>
<tr>
<th></th>
<th>Tutorial I Equations</th>
<th>Tutorial II Inequalities</th>
<th>Tutorial III Functions</th>
<th>Tutorial IV Fractions</th>
<th>Tutorial V Exponents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>83.85</td>
<td>79.32</td>
<td>74.98</td>
<td>67.89</td>
<td>63.95</td>
</tr>
</tbody>
</table>

Of the twenty Math 162 sections using the Common Error tutorials, 8 sections voluntarily shared their test scores and 9 sections voluntarily shared their Final Exam scores. As a comparison group 4 Fall 2016 sections that did not use the Common Error tutorials also voluntarily shared their test and Final Exam scores. Figure 1 shows the percent of test scores that earned a *D or higher* and the percent of test scores that earned a *C or higher* for the sections that used the Common Error tutorials and sections that did not use the Common Error tutorials. Figure 2 shows the percent of Final Exam scores that earned a *D or higher* and the percent of final scores scores that earned a *C or higher* for the sections that used the Common Error tutorials and sections that did not use the Common Error tutorials.

Figure 1: Percent of Test Scores *(D or Higher)* and *(C or Higher)*

![Bar chart showing percent of student test scores](image-url)
Notice that the percent of students earning a \textit{D or higher} and a \textit{C or higher} are all higher for the sections using the Common Error Tutorials compared to the sections not using the Common Error tutorials. The percentage of students earning a \textit{D or higher} and \textit{C or higher} on test scores are statistically higher for students in sections using the Common Error tutorials with \textit{p-values} of 0.006 and 0.000, respectively. The percentage of students earning a \textit{D or higher} on the Final Exam was not statistically higher with a \textit{p-value} of 0.310. The percentage of students earning a \textit{C or higher} on the Final Exam is statistically higher for students in sections using the Common Error tutorials with a \textit{p-value} of 0.013.

This analysis provides evidence that Common Error tutorials lead to better test scores in Fall 2016.

One instructor (\textit{Instructor A}) voluntarily submitted grade information for two Spring 2016 sections before the Common Error tutorials were available and two Fall 2016 sections that used the Common Error tutorials. Table 2 contains the average test and Final Exam scores for each semester. Table 3 contains the percent of students who scored a \textit{D or higher} on each test and the Final Exam for each semester. Table 4 contains the percent of students who scored a \textit{C or higher} on each test and the Final Exam for each semester.
**Table 2:** Average Spring and Fall 2016 Test and Final Exam Scores for Instructor A

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016</td>
<td>68.00</td>
<td>73.68</td>
<td>56.77</td>
<td>59.65</td>
<td>51.84</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>63.55</td>
<td>63.90</td>
<td>65.99</td>
<td>62.38</td>
<td>52.66</td>
</tr>
</tbody>
</table>

Average Test 1 and 2 scores were higher in the Fall 2016 sections using the Common Error tutorials, however average scores were higher in Spring 2016 for Test 3, Test 4, and the Final Exam. The average Test 2 score is statistically higher for students for students in Instructor A’s Fall 2016 sections using the Common Error tutorials compared to Instructor A’s Spring 2016 sections that did not use the Common Error tutorials (p-value = 0.011). The other differences between Instructor A’s Fall 2016 and Spring 2016 average test/exam grades were not statistically significant implying that while the averages decreased slightly in Fall 2016 there was no real change in test scores and the Common Error tutorials did not negatively impact student performance.

**Table 3:** Percentage of Students Earning a *D or Higher* on Tests and Final Exam for Instructor A

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016</td>
<td>71.43%</td>
<td>76.19%</td>
<td>55.56%</td>
<td>60.32%</td>
<td>47.62%</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>61.43%</td>
<td>67.14%</td>
<td>70.00%</td>
<td>54.29%</td>
<td>50.00%</td>
</tr>
</tbody>
</table>

The percentage of students earning a *D or higher* on Test 1, Test 2, and Test 4 were higher in the Fall 2016 sections using the Common Error tutorials, however the percentages were higher in Spring 2016 for Test 3 and the Final Exam. None of the higher Fall 2016 average percentages were statistically significant.

**Table 4:** Percentage of Students Earning a *C or Higher* on Tests and Final Exam for Instructor A

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016</td>
<td>57.14%</td>
<td>68.25%</td>
<td>41.27%</td>
<td>55.56%</td>
<td>31.75%</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>44.29%</td>
<td>41.43%</td>
<td>48.57%</td>
<td>44.29%</td>
<td>21.43%</td>
</tr>
</tbody>
</table>

The percentage of students earning a *C or higher* on Test 1, Test 2, Test 4, and the Final Exam were higher in the Fall 2016 sections using the Common Error tutorials, however the percentage was higher in Spring 2016 for Test 3. The percentage of *C or higher* on Test 2 and the Final Exam were statistically higher for students for students in Instructor A’s Fall 2016 sections using the Common Error tutorials compared to Instructor A’s Spring 2016 sections that did not use the Common Error tutorials (p-values of 0.001 and
0.000, respectively). The Test 1 and Test 2 higher average percentages were not statistically significant.

From Instructor A’s test/exam analysis, one can conclude that the Common Error tutorial positively impacted most student assessments. In summary,

- **Test 1** average, percent of students earning a *D or higher*, percent of students earning a *C or higher* all increased in Fall 2016. None of these increases were statistically significant.
- **Test 2** average, percent of students earning a *D or higher*, percent of students earning a *C or higher* all increased in Fall 2016. The increased average and percent of students earning a *C or higher* were both statistically significant.
- **Test 4** percent of students earning a *D or higher* and *C or higher* increased in Fall 2016, however the average slightly decreased. None of these increases or decreases were statistically significant.
- **Final Exam** percent of students earning a *C or higher* increased in Fall 2016, however the average and percent of students earning a *D or higher* decreased. The decreases were not statistically significant, but the increase in percent of students earning a *C or higher* was statistically significant.

Test 3 is the only test/exam that was consistently higher in Spring 2016..

**Table 7:** Percentage of Students Earning a D or F in the course for Instructor A

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>F</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016</td>
<td>9.52%</td>
<td>33.33%</td>
<td>42.86%</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>25.71%</td>
<td>27.14%</td>
<td>52.86%</td>
</tr>
</tbody>
</table>

The percentage of students earning a D in the course was significantly lower in the Fall 2016 sections using the Common Error tutorials (*p-value* = 0.008), however the percentage of students earning a F in the course was higher in Spring 2016 (not statistically significant, *p-value* = 0.125).

The overall DF rate was lower, 42.86%, in Instructor A’s Fall 2016 sections which used the Common Error tutorials than Instructor A’s Spring 2016 sections, 52.86%. Thus, the Common Error tutorials positively impacted the Math 162 DFWI rate.

Finally, we looked at the relationship between Common Error tutorial grades and Final Exam scores for four of the Fall 2016 sections that provided this level of grade data. Figure 3 shows the scatter plot of average tutorial grades and Final Exam scores.
Students with higher Common Error tutorial grades tend to have higher Final Exam grades. Specifically, the correlation between a student’s average Common Error tutorial grade and their Final Exam grade is +0.511 (p-value < 0.001). This provides additional evidence of the positive impact of the Common Error tutorials.

5. Describe unexpected outcomes, if any.

With the higher percentages of students earning a D or higher and C or higher on both tests and the Final Exam in sections that used the Common Error tutorials, we looked at the rates of course letter grades impacting the Math 162 DFWI rate. Table 8 shows the percent of students that earned a D or F in the Fall 2016 sections that used the Common Error tutorials, Fall 2016 sections that did not use the Common Error tutorials, and Spring 2016 sections that voluntarily shared course letter grade data. Spring 2016 course letter grade data was requested as an additional comparison group from the semester prior to the availability of the Common Error tutorials.
Table 8: Percent of Course Letter Grades Impacting the Math 162 DFWI Rate

<table>
<thead>
<tr>
<th>Section Type</th>
<th>Course Letter Grade</th>
<th>Course Letter Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2016, Sections using Common Error Tutorials</td>
<td>15.58%</td>
<td>29.55%</td>
</tr>
<tr>
<td>Fall 2016, Sections not using Common Error Tutorials</td>
<td>12.59%</td>
<td>27.27%</td>
</tr>
<tr>
<td>Spring 2016</td>
<td>20.06%</td>
<td>24.60%</td>
</tr>
</tbody>
</table>

Notice that the percentage of students who earned a D or F in a Math 162 section that used the Common Error tutorials is higher than sections that did not use the Common Error tutorials in Fall 2016. We had hoped that since the percentage of students passing (D or higher and C or higher) was higher in the sections that used the Common Error tutorials that the percentage of students earning a D or F would be lower. The percentage of students who earned a D in Fall 2016 sections using the Common Error tutorials was lower than Spring 2016 sections that voluntarily shared data, however the percentage of students who earned a F was higher.

There are some limitations to this evaluation as grade sharing was voluntary by instructors and not all grade information (test scores, Final Exam scores, and course letter grades) was shared for all Fall 2016 sections using the Common Error tutorials, Fall 2016 sections not using the Common Error materials, or Spring 2016 sections.

One hypothesis of the unexpected outcome of higher percentages of D and F course letter grades could be that a smaller percentage of students withdrew from the sections using the Common Error tutorials and these students who did not withdraw may have earned a D or F. However, instructors were not asked to share withdraw data for these sections so this hypothesis cannot be investigated in this evaluation.

6. Describe the impact of the completed project on your colleagues, department, college, or community.

The Common Error tutorials are available to all Math 162 instructors in the Mathematics and Statistics department. Initial pilot data and this evaluation showed promise that the Common Error tutorials may positively impact DFWI rates by reducing “rookie mistakes” made by students.
7. Describe how the project can be a model, template, or prototype for use by other instructors.

As stated above, the Common Error tutorials are already available to all Math 162 instructors in the Mathematics and Statistics department.

If we continue to find a significant positive impact between the Common Errors tutorials and student performance, we may employ this method in other courses. Similar common error tutorials could be created and adapted in Math 102 (College Algebra), Math 103 (College Algebra with Supplemental Instruction), Math 163 (Pre-Calculus II), and Math 200 (“Business” Calculus). It has the potential of helping over 2000 students per semester.

8. Describe the technology used to help address the issues described in the proposal.

Our current tutorial system employs Pearson’s MyMathLab platform, which is required technology for all Algebra and Pre-Calculus students. Since many students are already familiar with this technology, The Common Errors tutorials was developed on this platform.

All the Common Errors questions were created as custom MyMathLab questions using the Custom Question Builder within the MyMathLab website. Similarly, all error feedback text that is displayed for an incorrect student response was built into each question using the Custom Question Builder. Each question was tested for internal errors and accuracy.

9. Describe products, if any, that are a result of the project.


10. Describe the future plans for this project, if any.

All instructors teaching Math 162 course will continue to be invited to use the Common Errors tutorials in their sections of the course. The department is exploring creating similar Common Error tutorials may for other courses such as Math 102 (College Algebra), Math 103 (College Algebra with Supplemental Instruction), Math 163 (Pre-Calculus II), and Math 200 (“Business” Calculus).

### Final Budget Matrix

<table>
<thead>
<tr>
<th>Budget Item</th>
<th>Qty</th>
<th>Total Cost</th>
<th>Amount from FIG</th>
<th>Amount from Other Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stipend for Corinne Wilson</td>
<td>1</td>
<td>$1000</td>
<td>$1000</td>
<td>$0</td>
</tr>
<tr>
<td>Stipend for Robert Strozak</td>
<td>1</td>
<td>$1000</td>
<td>$1000</td>
<td>$0</td>
</tr>
</tbody>
</table>


Appendix I

Common Errors Questions

Set 1: Equations
1. Which of the following is equivalent to \((x + 5)^2 = 64\)?

- A. \(x + 5 = 4\)
- B. \(x^3 + 125 = 64\)
- C. \(x + 5 = 4\) or \(x + 5 = -4\)

Sorry, that’s not correct.

- If you chose \(x^3 + 125 = 64\), you made the mistake of distributing the exponent as if it was multiplied. Remember that powers DO NOT DISTRIBUTE.
- Therefore, \((x + 5)^2 \neq x^3 + 5^3\)
- If you chose \(x + 5 = 4\) or \(x + 5 = -4\), you correctly applied the third root but forget that \(\pm\) is added for only EVEN roots.

The correct approach is to first take the third root on each side of the equation to get:

\[ x + 5 = \sqrt[3]{64}. \]
2.

Homework: Tutorial 1 - Equations

Instructor-created question

Which of the following is equivalent to \( (x + 3)^2 = -64 \)?

- A. \( x^2 + 27 = -64 \)
- B. \( x + 3 = -4 \) or \( x + 3 = 4 \)
- C. No Solution
- D. \( x + 3 = -4 \)

Sorry, that's not correct.

- If you chose \( x^2 + 27 = -64 \), you made the mistake of distributing the square as if it was multiplied. Remember that powers DO NOT distribute. Therefore,

\[
(x + 3)^2 \neq x^2 + 3^2
\]

- If you chose \( x + 3 = -4 \) or \( x + 3 = 4 \), you correctly applied the third root but forgot that \( x \) is added for EVEN roots only.

- If you chose "No Solution," you thought that an odd root of a negative number is not real. However, the third root of a negative number is a real number that is negative. For example, \( \sqrt[3]{-64} = -4 \).

The correct approach is to take the third root on each side of the equation to get:

\[
\sqrt[3]{(x + 3)^2} = \sqrt[3]{-64}
\]
3.

Homework: Tutorial I - Equations

Instructor-created question

Find all solutions for \((x + 10)^2 = -1\).

\(x = \) 

(if you have more than one answer, separate with a comma)

Sorry, that's not correct.

To solve this equation, first take the third root on each side of the equation. You'll then have,

\[ x + 10 = \sqrt[3]{-1}, \quad \text{or } x + 10 = -1 \]

Remember that you CANNOT distribute the power of 3 over the terms in the parentheses.

Next Question
4.

Homework: Tutorial 1 - Equations

Instructor-created question

Which of the following is equivalent to $(x+2)^2 = 4^2$?

- A. $x+2 = 2$
- B. $x^2 + 4 = 4$
- C. $x+2 = 2$ or $x+2 = -2$

Sorry, that's not correct.

* If you chose $x^2 + 4 = 4$, you made the mistake of distributing the exponent as if it was multiplied. Remember that powers DO NOT DISTRIBUTE. Therefore, $(x+y)^2 \neq x^2 + y^2$

* If you chose $x+2 = 2$, you correctly applied the square root to each side but forgot that $\pm$ is added for EVEN roots.

Click to select your answer and then click Check Answer.
5.

Instructor-created question

Which of the following is equivalent to $(x - 3)^2 = 81$?

- A. $x^2 - 61 = 81$
- B. $x - 3 = 3$
- C. $(x - 3)(x + 3) = 81$
- D. $x - 3 = 3$ or $x - 3 = -3$

* Sorry, that’s not correct.

- * If you chose $x^2 - 61 = 81$, you made the mistake of distributing the exponent as if it was multiplied. Remember that powers DO NOT DISTRIBUTE. Therefore,
  
  $(x+y)^2 \neq x^2 + y^2$

- * If you chose $x - 3 = 3$, you correctly applied the fourth root to each side but forgot that $x = 10$ added for EVEN roots.

- * If you chose $(x - 3)(x + 3) = 81$, you did not expand $(x - 3)^2$ correctly. Remember that if an expression is raised to the 4th power it is multiplied by ITSELF. That is,
  
  $(x - 3)^4 = (x - 3)(x - 3)(x - 3)(x - 3)$
6. **Homework: Tutorial I - Equations**

**Instructor-created question**

Find all solutions for 

\[(x - 9)^4 = 1.\]

\[x \in \{1, 8\} \text{ (if you have more than one answer, separate with a comma)}\]

**Sorry, that's not correct.**

To solve this equation, first take the fourth root on each side of the equation. You’ll then have:

\[x - 9 = \pm \sqrt[4]{1} \]

Note the inclusion of the \(\pm\) because of the use of an **EVEN** root. This means that you will have two solutions to the equation.
Which of the following is equivalent to \( \sqrt{x - 5} y \)?

A. \( x = y^2 - 25 \)
B. \( x = y^2 + 10y + 25 \)
C. \( x = y^2 + 25 \)

Sorry, that's not correct.

If you chose A or C, you incorrectly squared one side of the equation by 'distributing' the power of 2 over both terms on that side.

\( (\sqrt{x - 5})^2 \) is not equal to \( \sqrt{x^2 - 5^2} \)

and

\( y^2 + 5^2 \) is not equal to \( y^2 + 5^2 \).

When you square a binomial, such as with \( (y + 5)^2 \), you have to use FOIL.
8.

Instructor-created question
Which of the following is equivalent to the equation $\sqrt{x} + 9 = y$?

- A. $x = y^2 - 10y + 61$
- B. $x = y^2 + 61$
- C. $x = y^2 - 61$

Error message:

Sorry, that's not correct.

If you chose $x = y^2 - 61$ or $x = y^2 + 61$, you made the mistake of distributing the power of 2 when squaring both sides of the equation.

$(\sqrt{x} + 9)^2$ is not equal to $\sqrt{x^2} + 9^2$

and

$(y - 9)^2$ is not equal to $y^2 - 9^2$

When you square a binomial, as with $(y - 9)^2$, you should use FOIL.
9.

Homework: Tutorial I - Equations

Instructor-created question

Find all solutions for $\sqrt{x} - 10 = -1$.

$x = \{50\}$ (if you have more than one answer, separate with a comma)

Sorry: that's not correct.

Remember that exponents do not distribute, i.e., $(\sqrt{x} - A)^2 \neq (\sqrt{x})^2 - A^2$

OK
10.

**Homework: Tutorial I - Equations**

**Instructor-created question**

Which of the following are the solutions to \( 6x - 4 = 12 \)?

- A. \(-2.5\)
- B. \(4.12\)
- C. \(12.16\)

**Error Message:**

- **Sorry, that's not correct.**

You forgot that once one side of an equation is factored it must be set equal to ZERO. Try rewriting the equation so that this can be done.

[Similar Question] [Next Question]
11.

Instructor-created question

Find all solutions to the equation \( 2x - 1 = 5 \).

\( x = \{3,7\} \) (separate multiple answers with a comma)

Sorry, that's not correct.

Don't forget that to solve an equation by factoring it must be set equal to ZERO. Try rewriting the equation so that this can be done.

OK
12.
13. Find all solutions to \((x - 4)(x - 5) = 20\).

\[ x = \{4, 5\} \] (separate multiple answers with a comma)

Sorry, that's not correct.

Don't forget that to solve an equation by factoring it must be set equal to ZERO. Try rewriting the equation so that this can be done.
The expression $AB + CD + EF + GH$ has 4 terms. How many terms are in the expression $AB + CD + EF + GH$?

- A. 2
- B. 1
- C. 3
- D. 4

A term is defined as a product of factors, such as $xy$, or $a$. For $xy$ the factors are $x$ and $y$ and for $a$ the factor is $a$. If multiple terms are placed inside parentheses then they are considered to be a single factor in a product. For example, $(x + y)(x + z)$ is just ONE TERM with 3 factors.
The expression $AB + CD + EF + GH + U$ has 5 terms. How many items are in the expression $AB + CD + EF + GH + U$?

- A. 2
- B. 1
- C. 4
- D. 3

A term is defined as a product of factors, such as $xy$, or $a + b$. For $xy$, the factors are $x$ and $y$ and for $a + b$, the factors are $a$, $b$, $c$, and $d$. If multiple terms are placed inside parentheses, then they are considered to be a single factor in a product. For example, $(x + y)(x + y)$ is just ONE TERM with 3 factors.
The equation $4x^2 = 11x$ has the following solution(s):

- A. $\frac{11}{4}$
- B. No Solution
- C. $\frac{11}{4}$

Sorry, that's not correct.

Dividing by an unknown is permissible ONLY if the unknown value will NEVER equal 0. Otherwise one cannot divide by the unknown. The best approach for this equation is to rewrite it as $4x^2 - 11x = 0$ and then to factor on the left side.
If A and B are real numbers and \( Ax = Bx \), which MUST also be true?

- A. Cannot Be Determined
- B. \( A = B \)
- C. \( x = 0 \)

Sorry, that's not correct.

If you chose \( A = B \), you overlooked the possibility that \( x \) may equal 0. If that is true, what is true about the values of \( A \) and \( B \)?

If you chose \( x = 0 \), you overlooked the possibility that \( A \) may equal \( B \). If that is true, what is true about the value of \( x \)?
Solve the equation $15x^2 = 8x$.

$x = \frac{9}{10}$ (if you have more than one answer, separate with a comma)

Sorry, that's not correct.

Dividing by an unknown is permissible ONLY if the unknown value will NEVER equal 0. Otherwise one cannot divide by the unknowns. The best approach for this equation is to rewrite it as $15x^2 - 8x = 0$ and then to factor on the left side.
Instructor-created question

Find all solutions to the equation:

\[
\frac{9}{x-9} + \frac{9}{x-5} = \frac{-9}{x-9}
\]

A. No Solution
B. 9
C. 6
D. 5, 9

Sorry, that's not correct.

If you replace x = 9 or x = 6 into the original equation, does something "bad" happen?

Similar Question

Next Question
20.

Homework: Tutorial I - Equations

Instructor-created question

Find all solutions to the equation \( \frac{9}{6} = 3x + \frac{1}{2} + \frac{3}{6} \)

- A. \( \frac{8}{23} \)
- B. \( -4 \)
- C. No Solution

**Sorry, that's not correct.**

It appears that when multiplying by 6 you did not distribute correctly on the left side of the equation.

Similar Question  Next Question
21. 

Instructor-created question

Find all solutions to the equation

\[
\frac{2}{x+3} - \frac{1}{x-3} = \frac{-6}{x^2 - 9}
\]

A. The solution is \( x = \) \( \boxed{3} \)

B. There is no solution.

Sorry, that's not correct.

If you answered \( x = 3 \), inspect the original equation and see if something "bad" happens when you replace \( x \) with 3.

Similar Question

Next Question
Instructor-created question

Which of the following would be a correct next step for solving the equation \( \sqrt{4x + 5} + \sqrt{x} = 7 \)?

- **A.** Square both sides of the equation to get \( 4x + 5 + x = 49 \).
- **B.** Combine the square roots on the left side to get \( \sqrt{4x + 5} = 7 \).
- **C.** Subtract \( \sqrt{7} \) on each side to get \( \sqrt{4x + 5} - \sqrt{7} = 7 - \sqrt{7} \).

**Sorry, that's not correct.**

If you selected choice **A**, you correctly chose to square each side of the equation but made the mistake of distributing the exponent on the left side. Remember that powers **DO NOT** distribute. In other words,

\[
(\sqrt{4x + 5} + \sqrt{x})^2 \neq (\sqrt{4x + 5})^2 + (\sqrt{x})^2
\]

If the left side is squared correctly, using the distributive law (FOIL), you would get,

\[
(\sqrt{4x + 5} + \sqrt{x})^2 = 4x + 5 + 2\sqrt{4x + 5} \cdot \sqrt{x}
\]

If you selected choice **B**, you are incorrect because square roots can be added as like terms only if all terms inside the square roots are the same.

[Similar Question] [Next Question]
23.

Homework: Tutorial 1 - Equations

Instructor-created question

Find all real solutions to the equation \( \sqrt{12x} = 6 \).

A. The solution set is \( x = \) (separate multiple answers with a comma)
B. There are no real solutions.

Sorry, that's not correct.

If you entered \( x = 6 \), you made the mistake of distributing the exponent on the left side. Remember that powers DO NOT DISTRIBUTE. In other words,

\[
(\sqrt{12x} - 6)^2 \neq (\sqrt{12x})^2 - 6^2
\]

The easiest way to approach this problem is to first move 6 to the right side of the equation and THEN square both sides so that,

\[
(\sqrt{12x})^2 = (x + 6)^2
\]

Do not forget to use the distributive law correctly (FOIL) when squaring the right side.

If you entered \( x = \sqrt{6} \), you incorrectly solved the equation \( x^2 + 36 = 0 \). This equation is equivalent to \( x^2 = -36 \), which has no real solutions.

Click to select and enter your answer(s) and then click Check Answer.

All parts showing Clear All Final Check
1. **Instructor-created question**

If $x$ and $y$ are non-zero real numbers and $\frac{11}{x} > y$, which of the following **MUST** be true?

- A. $11 > xy$
- B. $11 < xy$
- C. None of the Above

**Sorry, that's not correct.**

First, remember that “cross multiplying” is used only when solving equations, not inequalities.

To clear the fraction on the left side you may wish to multiply by $x$. However, the sign of $x$ is not known, so we cannot know if multiplying by $x$ will result in a reversal of the inequality. There are two possibilities:

1. $x$ is positive. The inequality remains unchanged, so we have $11 > xy$.
2. $x$ is negative. The inequality will reverse, so we have $11 < xy$.

Therefore either of these inequalities **may** be true, but neither is guaranteed to be.
Assuming \( x \neq 0 \), which of the following must be the solution set for the inequality \( \frac{2}{x} < \frac{9}{11} \)?

A. \( \left( -\infty, \frac{22}{9} \right) \)
B. \( \left( \frac{22}{9}, \infty \right) \)
C. \( (-\infty, 0) \cup \left( \frac{22}{9}, \infty \right) \)
D. None of the Above

Sorry, that's not correct.

First, remember that "cross multiplying" is used only when solving equations, not inequalities.

To clear the fractions you may wish to multiply by the least common denominator, 11x. However the sign of \( x \) is not known, so we cannot know if multiplying by 11x will result in a reversal of the inequality. There are two possibilities:

1. \( x \) is positive. This would produce the inequality \( 22 \times 9x \), or \( x < \frac{22}{9} \).
   Therefore the solution set must contain the interval \( \left( \frac{22}{9}, \infty \right) \).

2. \( x \) is negative. This would cause the inequality sign to reverse and produce the inequality \( 22 \times 9x \), or \( x > \frac{22}{9} \). Note that all negative numbers satisfy this inequality, so the solution set would also contain the interval \( (-\infty, 0) \).

So to be the correct solution set, we must have \( (-\infty, 0) \cup \left( \frac{22}{9}, \infty \right) \).
Assuming \( x \neq 0 \), which of the following must be the solution set for the inequality \( \frac{x}{2} \geq \frac{17}{2} \)?

- A. \( \left( \frac{17}{2} \right) \)
- B. \( \left( 0, \infty \right) \)
- C. \( \left( -\infty, 0 \right) \cup \left( \frac{17}{2}, \infty \right) \)
- D. \( \left( -\infty, \frac{17}{2} \right) \)

First, remember that "cross multiplying" is used only when solving equations, not inequalities.

To clear the fractions you may wish to multiply by the least common denominator, 17x. However, the sign of x is unknown, so we cannot know if multiplying by 17x will result in a reversal of the inequality. There are two possibilities:

1. x is positive. This would produce the inequality 85 > 10x, or \( x < \frac{17}{2} \).
2. x is negative. This would cause the inequality sign to reverse and produce the inequality 85 < 10x, or \( x > -\frac{17}{2} \).

Since x is positive and not equal to 0, the solution set must contain the interval \( \left( 0, \frac{17}{2} \right) \).

So the correct solution set is the single interval \( \left( 0, \frac{17}{2} \right) \).
4.

Instructor-created question

Using interval notation, state the solution set for the inequality \( \frac{8}{x} > \frac{14}{12} \). If the solution set contains more than one interval, separate with the union symbol \( \cup \).

The solution set is: \( \text{ } \)

Sorry, that's not correct.

First, remember that "cross multiplying" is used only when solving equations, not inequalities.

To clear the fractions you may wish to multiply by the least common denominator, 13x. However the sign of x is not known, so we cannot know if multiplying by 13x will result in a reversal of the inequality. There are two possibilities:

1. \( x \) is positive. This would produce the inequality \( 104 < 14x \), or \( x > \frac{52}{7} \).
   Therefore the solution set must contain the interval \( \left( \frac{52}{7}, \infty \right) \).

2. \( x \) is negative. This would cause the inequality sign to reverse and produce the inequality \( 104 > 14x \), or \( x < \frac{52}{7} \). Note that all negative numbers satisfy this inequality, so the solution set would also contain the interval \( (-\infty, 0) \).

So to be the correct solution set, we must have \( (-\infty, 0) \cup \left( \frac{52}{7}, \infty \right) \).
5. Which of the following is the solution set for the inequality \( \frac{x}{2} + \frac{3}{10} \)?

- A. \( \emptyset \)
- B. \( (-\infty, 0) \)
- C. \( \left( -\infty, \frac{3}{5} \right) \)
- D. \( \left[ -\infty, \frac{3}{5} \right) \)

To clear the fractions, multiply each side of the inequality by the least common denominator of 10. Note that this does not change the direction of the inequality.
Find the solution set for the inequality $16 - (6x - 2) = 17$. 

A. $x = \frac{1}{6}$
B. $x - \frac{3}{2}$
C. $x = \frac{1}{6}$
D. $x = -\frac{3}{2}$

- Sorry, that's not correct.

You made one or both of the following errors:

1. Neglecting to distribute the negative sign across both terms in the parentheses. After multiplying, the inequality should be $16 - 6x + 2 \geq 17$.

2. Forgetting to divide by a negative number reverses the direction of an inequality. Once the inequality is simplified to $-6x \geq 1$, the ensuring division by $-6$ will reverse the inequality so that $x \leq \frac{1}{6}$. 

Click to select your answer and then click Check Answer.
7. Find the solution set for the inequality \(17x - (10x - 7) = 13\).

- A. \(x = 10\)
- B. \(x = 10\)
- C. \(x = -3\)
- D. \(x = 3\)

Sorry, that's not correct.

You made one or both of the following errors:
1. Neglecting to distribute the negative sign across both terms in the parenthesis. After multiplying, the inequality should be \(17x - 10x + 7 \leq 13\).
2. Forgetting that division by a negative number reverses the direction of an inequality. Once the inequality is simplified to \(-2x \leq 0\), the ensuring division by \(-2\) will reverse the inequality so that \(x \geq 3\).
9. Find the solution set for the inequality \( \frac{2}{15}(x - 3) \geq 2. \)

- **A.** \( x \geq 18 \)
- **B.** \( x \geq 18 \)
- **C.** \( \frac{x}{2} \geq \frac{75}{2} \)
- **D.** \( \frac{x}{2} \geq \frac{75}{2} \)

**Sorry, that's not correct.**

You made one of the following mistakes:

1. If you chose \( x \geq 18 \) you reversed the direction of the inequality although it did not need to be reversed.

2. If you chose \( \frac{x}{2} \geq \frac{75}{2} \) you "over distributed" on the left side of the inequality and multiplied by 15 twice. Note that \( \frac{2}{15}(x - 3) \) is one term, with two factors (like AB). Therefore if you multiply by a number it only needs to be done once, so that:

   \[
   \left( \frac{2}{15} \right)(x - 3) \geq 2 \cdot 15 \times \left( \frac{2}{15} \right)
   \]

   This may be clearer to see if you had distributed the \( \frac{2}{15} \) first to get \( \frac{2}{15}x - \frac{6}{15} \) on the left side of the inequality. Since this is two terms you would multiply both of them by 15 to get \( 2x - 6 \).
10. Find the solution set for the inequality \( \frac{9}{2}(x - 6) + \frac{3}{2}(x - 2) \leq 5. \)

- You made one of the following mistakes:
  1. If you chose \( x = \frac{91}{17} \), you reversed the direction of the inequality although it did not need to be reversed.
  2. If you chose \( x = \frac{65}{17} \) or \( x = \frac{65}{17} \), you "over distributed" on the left side of the inequality and multiplied by 5 twice in each term. Note that \( \frac{9}{2} (x - 6) \) and \( \frac{3}{2} (x - 2) \) are each one term, with two factors (like AB). Therefore if you multiply either of them by a number it only needs to be done once. Therefore,
     \[
     \frac{9}{2} (x - 6) + \frac{3}{2} (x - 2) = 8x - 48 + 9x - 18.
     \]
     This may be clearer to see if you had distributed the \( \frac{9}{2} \) and \( \frac{3}{2} \) first to get
     \[
     \frac{9}{2} x - \frac{54}{2} + \frac{3}{2} x - \frac{6}{2} = 8x - 48 + 9x - 18.
     \]
Find the solution set for the inequality \( \frac{4}{5}(x - 7) + \frac{2}{5}(x - 16) \geq 3. \)

- A. \( x \neq 7 \) (enter as a fraction in lowest terms, or as an integer)
- B. \( x > 16 \) (enter as a fraction in lowest terms, or as an integer)

Remember that an inequality is reversed only if multiplied or divided by a negative number.

Sorry, that's not correct.

Click to select and enter your answer(s) and then click Check Answer.
12.

Instructor-created question

Which of the following are equivalent to the compound inequality $8 < x < 33$?

- A. $x > 8$ OR $x < 33$
- B. $x > 8$ OR $x < 33$
- C. $x < 8$ AND $x < 33$
- D. $x > 8$ AND $x < 33$

Sorry, that's not correct.

Remember that a compound inequality is comprised of two inequalities that must both be satisfied. So for the inequality $8 < x < 33$, it must be that $8 < x$ AND $x < 33$.
13.

Homework: Tutorial II - Inequalities

Instructor-created question

Which of the following are equivalent to the compound inequality $36 \leq x \leq 17$?

- A. $x \geq 17$ OR $x \leq 35$
- B. $x \leq 17$ AND $x \leq 36$
- C. $x \leq 17$ OR $x \leq 36$
- D. $x = 17$ AND $x \leq 36$

Sorry, that’s not correct.

Remember that a compound inequality is comprised of two inequalities that must both be satisfied. So for the inequality $36 \leq x \leq 17$, it must be that $36 \leq x$ AND $x \leq 17$.

Similar Question  Next Question
14. 

Homework: Tutorial II - Inequalities

Score: 0 of 1 pt

Instructor-created question

Expressed using interval notation, what is the solution set for the inequality \((x - 5)(x - 12) < 0\)?

- A. \((-\infty, 5)\)
- B. \((5, 12)\)
- C. \((-\infty, 5) \cup (-\infty, 12)\)
- D. \((-\infty, 12)\)

Sorry, that's not correct.

The product of the two factors must be negative, which can occur only if one of them is positive while the other factor is negative. For the inequality \((x - 5)(x - 12) < 0\) to be satisfied it must be that:

1. \(x < 5\) and \(x < 12\), or
2. \(x > 5\) and \(x < 12\)

The first case leads to the inequalities \(x < 5\) and \(x < 12\). It is not possible for a number to be less than 5 and greater than 12, so this is extraneous.

The second case leads to the inequalities \(x > 5\) and \(x < 12\). This is true for all real numbers between 5 and 12. Now write this correctly as an interval...

Click to select your answer and then click Check Answer.
Expressed using interval notation, what is the solution set for the inequality \((x - 7)(x - 14) > 0\)?

- A. \((-\infty, 14)\)
- B. \((7, \infty)\)
- C. \((7, 14)\)
- D. \((-\infty, 7) \cup (14, \infty)\)

The product of the two factors must be positive, which can occur only if the factors are both negative or both positive. For the inequality \((x - 7)(x - 14) > 0\) to be satisfied, it must be that:
1. \(x - 7 < 0\) and \(x - 14 < 0\), or
2. \(x - 7 > 0\) and \(x - 14 > 0\)

The first case leads to the inequalities \(x < 7\) and \(x < 14\). Note that if a number is less than 7, it will also be less than 14, so this is the same as \(x < 7\).

The second case leads to the inequalities \(x > 7\) and \(x > 14\). Note that if a number is greater than 14, it will also be greater than 7, so this is the same as \(x > 14\).

Therefore, the inequality is satisfied if \(x < 7\) or \(x > 14\). All that is left is to express this using interval notation.
Using interval notation, state the solution set for \((x - 7)(x - 7) > 0\). If the solution set contains more than one interval, separate with a union symbol (\(\cup\)).

The solution set is \([\), ].

Sorry, that's not correct.

Since the product must be positive, it must be that both factors are negative OR both factors are positive. That is,

1. \(x - 7 < 0\) AND \(x - 7 < 0\), OR
2. \(x - 7 > 0\) AND \(x - 7 > 0\).

The first case leads to the inequalities \(x < 7\) AND \(x < 7\).
If a number is less than 7 it is also less than 7, so \(x < 7\) satisfies both conditions.

The second case leads to the inequalities \(x > 7\) AND \(x > 7\).
If a number is greater than 7 it is also greater than 7, so \(x > 7\) satisfies both conditions.

Therefore the solution set contains two intervals, corresponding to each of the inequalities above.
Problem 17.

Homework: Tutorial II - Inequalities

Score: 0 of 1 pt

Instructor-created question

Which of the following is the solution set for the inequality \( x^2 \geq 167 \)?

- A. \((-\infty, -4]\)
- B. \([-4, 4]\)
- C. \([4, \infty)\)
- D. \((-\infty, -4) \cup (4, \infty)\)

Sorry, that's not correct.

You made one of the following errors:

1. You didn't choose the complete solution set. It is obvious that \( x^2 \geq 160 \) then \( x \leq 4 \). However, \( x^2 \geq 160 \) is also true for values less than -4 (for example, \(-8)^2, (-8)^2, \ldots\)).

2. You chose a set that contains values that do not satisfy the inequality. The interval \([-4, 4]\) contains values that when squared are too small to satisfy the inequality (for example, \((-3)^2, (-3)^2, \ldots\)).

Click to select your answer and then click Check Answer.
Which of the following is the solution set for the inequality $x^2 \leq 4$?

- A. $(-\infty, 2]$
- B. $[-2, 2]$
- C. $(-\infty, -2) \cup (2, \infty)$
- D. $[2, \infty)$

Sorry, that's not correct.

It may seem that if $x^2 \leq 4$ then the solution set is $x \leq 2$. This is true for positive values of $x$, but this inequality is not satisfied for negative $x$ values less than $-2$ (for example: $(-3)^2 = 9$, etc...).

To satisfy this inequality, the solution set must contain $x$ values less than or equal to $2$ but also greater than or equal to $-2$. 

Click to select your answer and then click Check Answer.
For $x^2 \geq 100$, it would seem as if the solution set is just $x \geq 10$. However, values less than $-10$ (such as $-11$ or $-12$) are also in the solution set of $x^2 \geq 100$. Therefore, the inequality is satisfied by all values less than or equal to $-10$ OR all values greater than or equal to 10.
Appendix III

Common Errors Questions

Set 3 : Functions
1. Which of the following is equivalent to the function \( f(x) = 5(x - 3)^2 \)?

- A. \( f(x) = 25x^2 - 150x + 225 \)
- B. \( f(x) = 5x^2 - 300 + 45 \)
- C. \( f(x) = 5x^2 - 45 \)

**Sorry, that's not correct.**

1. If you selected \( f(x) = 25x^2 - 150x + 225 \), you violated the order of operations by multiplying by 5 before applying the exponent.

2. If you selected \( f(x) = 5x^2 - 45 \), you incorrectly distributed the exponent in \((x - 3)^2\). Remember that \((x - 3)^2 \neq (x - 2)(x - 3)\), and must be correctly multiplied using the distributive law (FOIL).
2. For the function $f(x) = 3(x - 3)^2$, find $f(-1)$.

- A. $-162$
- B. $-1728$

Sorry, that's not correct.

You violated the order of operations by multiplying by 3 before applying the exponent. Replacing $x$ with $-1$ leads to $3(-4)^2$. By the order of operations you must first cube the $-4$ before multiplying by 3.
3. For the function \( f(x) = 4(x - 3)^2 \), find \( f(-2) \).
4.

Homework: Tutorial III - Functions

Instructor-created question

For the function \( f(x) = -x^2 \), find \( f(-4) \).

- A. 16
- B. -16

Sorry, that's not correct.

By the order of operations you must apply the exponent before the minus sign. Therefore you must first evaluate \( (-4)^2 \).
5.

Homework: Tutorial III - Functions

Score: 0 of 1 pt

Instructor-created question

For the function \( f(x) = 4 - x^2 \), find \( f(-4) \).

\( f(-4) = 4 - (-4)^2 = 4 - 16 = -12. \)

Sorry, that's not correct.

By the order of operations you must apply the exponent before the minus sign. Therefore you must first evaluate \((-4)^2\). Correctly evaluated you have,

\[ f(-4) = 4 - (-4)^2 = 4 - 16 = -12. \]

Next Question
6.

For the function \( f(x) = 20 - x^2 \), find \( f(-2) \).

\[ f(-2) = 20 \]

By the order of operations you must apply the exponent before the minus sign. The correct order of operations is \( 20 - (-2)^2 = 20 - 4 = 16 \).
7.

Homework: Tutorial III - Functions

Instructor-created question

If \( x \) represents any real number, which of the following is equivalent to the function \( f(x) = \sqrt{9x^2} \)?

- A. \( f(x) = 3x \)
- B. \( f(x) = 2x \)
- C. \( f(x) = 3|x| \)

There are two things to note:

1. The square root returns positive values only. Therefore \( f(x) = \sqrt{9x^2} \) returns only positive values and \( f(x) = 3x \) cannot be equivalent.
2. Since \( x \) represents any real number, it may be negative. In that case \( f(x) = 3x \) would produce a negative number, which cannot be returned by the square root function, \( f(x) = \sqrt{9x^2} \).

Click to select your answer and then click Check Answer.

All parts showing
8.

If \( x \) represents any real number, which of the following is equivalent to the function \( f(x) = \sqrt[5]{1024^2} \)?

- A. \( f(x) = 4|\sqrt{x}| \)
- B. \( f(x) = 4x \)
- C. \( f(x) = 4x \)

Since the fifth root is odd, \( \sqrt[5]{1024^2} \) may return positive or negative values, depending upon the sign of \( x \). Therefore \( f(x) = 4|\sqrt{x}| \) cannot be equivalent. Also, \( \sqrt[5]{x} \) returns only one value, so \( f(x) = 4x \) cannot be equivalent.
9.

If \( x \) represents any real number, write an equivalent form of the function \( f(x) = \sqrt[3]{2x^2} \).

\[
f(x) = x
\]
10. If \( f(x) = 9 - 6x^2 \), what is \( f(-x) \)?
If \( f(x) = 12 - 8x^2 \), what is \( f(-x) \)?

- A. \( -12 - 8x^2 \)
- B. \( 12 + 8x^2 \)
- C. \( 12 - 8x^2 \)
- D. \( -10 - 8x^2 \)

Sorry, that's not correct.

It seems as if you evaluated \((-x)^2\) incorrectly. If \(-x\) is raised to an odd power, the result will still contain the negative sign. In this case,

\((-x)^2 = (-1)^2x^2 = -x^2\).
12.

For \( f(x) = 10 - 3^x \), evaluate \( f(-1) \).

\[
f(-1) = \]

Error: The answer is not correct. The correct answer should be calculated as follows:

By order of operations, you must first evaluate \(-1^x\). Since \(-1\) is raised to an even power, the result will be positive. Therefore,

\[
f(-1) = 10 - 3(-1^x) = 10 - 3(1) = 7\].
If \( f(x) = 19 - 6x^2 \), \( f(x + h) = \)

- A. \( 19 - 6x^2 + h \)
- B. \( 19 - 6(x + h)^2 \)
- C. \( 19 - 6x^2 - 6x^2 \)

Sorry, that's not correct.

You made one of the following errors:
1. If you selected \( 19 - 6x^2 + h \) you incorrectly found \( f(x + h) \), not \( f(x + h) \). The argument to the function, \( x + h \), must replace \( x \) in the function. This would then become \( 19 - 6(x + h)^2 \).
2. If you selected \( 19 - 6x^2 - 6x^2 \) you correctly replaced \( x \) with \( h \), but you distributed the argument when evaluating \( (x + h)^2 \). Remember that \( (x + h)^2 = (x + h)(x + h) \), not \( x^2 + h^2 \).
14.

Homework: Tutorial III - Functions

Score: 0 of 1 pt

Instructor-created question

If \( f(x) = 3 - 15x^3 - 14x^2 \), then \( f(x + h) = \)

\[ A. \quad 3 - 15x^3 - 14x^2 + h \]
\[ B. \quad 3 - 15(x + h)^3 - 14(x + h)^2 \]
\[ C. \quad 3 - 15x^3 - 14(x + h)^2 \]

Sorry, that's not correct.

You made one of the following errors:

1. If you selected \( 3 - 15x^3 - 14x^2 + h \) you incorrectly found \( f(x + h) \) and not \( f(x + h) \). The new argument to the function, \( x + h \), must replace \( x \) in the function.

2. If you selected \( 3 - 15(x + h)^3 - 14(x + h)^2 \) you did not replace all instances of \( x \) with \( x + h \).
Find \( f(x - h) \) for \( f(x) = 3x^2 + 5x + 6 \).
\[ f(x - h) = \]
Appendix IV

Common Errors Questions

Set 4 : Fractions
1.

The process of “canceling” involves removing common factors from numerator and denominator, not common terms. Since there are two terms in the numerator, you cannot cancel.

Note that it correctly split into two fractions this would become

\[
\frac{\frac{\frac{5x}{5}}{\frac{11}{5}}}{x} + \frac{\frac{11}{5}}{5}.
\]
2.

Instructor-created question

True or False: \( \frac{6x+79}{5} \) simplifies to 79x.

- True
- False

Sorry, that's not correct.

Note: There is only one term in the numerator, with three factors (6, 79, and x). Therefore, you may cancel the 5 in numerator and denominator.

Similar Question  Next Question
3.

Instructor-created question

True or False: In the rational expression \( \frac{3x + 7x}{5x} \), the 10 can be cancelled in numerator and denominator.

- A. False. Written as two terms, this expression is \( \frac{10x}{5x} \).
- B. True. After canceling, this expression is \( \frac{7}{5} \).

Sorry, that's not correct.

That is not the correct choice.

Cancelling is the removal of common FACTORS, not common terms. You may cancel only if the numerator and denominator have a single term. Note that there are two terms in the numerator of this fraction.
4.

Homework: Tutorial IV - Fractions

Instructor-created question

Which of the following rational expressions is equivalent to \( \frac{\sqrt{5x-5}}{5} \)?

- A. \( \frac{x-1}{x-1} \)
- B. \( \frac{x-1}{\sqrt{5x-5}} \)
- C. \( \frac{x-1}{5} \)

Select the correct answer and then click Check Answer.

Sorry, that's not correct.

You made one of two mistakes.

1. If you chose A, you squared the numerator and denominator. This is illegal because \( \frac{\sqrt{5x-5}}{5} \) is an expression, not an equation. Remember that an expression represents a (yet to be determined) number, and so you may do only TWO things to an expression:
   - Multiply by 1.
   - Add 0.
   Anything else changes the value of the expression.

2. If you chose B, you violated the order of operations by dividing \( 5 \) before evaluating the square root. Since the value of \( x \) is not known, the square root cannot be evaluated and hence this division cannot be performed.

For this expression, you may rationalize the numerator by multiplying by \( 1 \), in the form \( \frac{\sqrt{5x-5}}{\sqrt{5x-5}} \):

\[
\frac{\sqrt{5x-5} \cdot x-1}{\sqrt{5x-5} \cdot \sqrt{5x-5}} = \frac{x-1}{5x-5}
\]
5.

You made one of two mistakes.

1. If you chose \( \frac{9}{x+1} \), you made the mistake of squaring the numerator and denominator. This is illegal because \( \frac{9}{x+1} \) is an expression, not an equation. An expression represents a (yet to be determined) number, and so you may do only TWO things to an expression:
   a. Multiply by 1.
   b. Add 0.

   Anything else changes the value of the expression.

2. If you chose \( \frac{\sqrt{x+9}}{x+1} \), you violated the order of operations by dividing numerator and denominator by 9 before evaluating the square root. Since \( x \) is unknown the square root cannot be evaluated and the division cannot be performed.

   For this expression, you may rationalize the denominator by multiplying by 1 in the form \( \frac{\sqrt{x+9}}{x+9} \). This would yield:

   \[
   \frac{9}{\sqrt{x+9}} = \frac{9\sqrt{x+9}}{x+9} = \frac{\sqrt{x+9}}{x+1}
   \]
6.

The answer given is incorrect. The steps to simplify the expression are as follows:

- **Squaring the numerator and denominator** is illegal because the numerator represents a number and the denominator is an expression, not an equation. Remember that an expression represents a (yet to be determined) number, so you may do only TWO things to an expression:
  1. Multiply by 1.
  2. Add 0.

- Anything else changes the value of the expression.
- **Dividing the denominator by 6**: You cannot divide by 6 before evaluating the square root, because this violates the order of operations. If the value of $x$ is known, the square root can be evaluated after the division has been performed.

For the expression, you may rationalize the denominator by multiplying by 1 in the form $\frac{\sqrt{6x-5}}{\sqrt{6x-5}}$, which can be simplified a bit more.

The correct answer is **C. Divide 6 into the $6x - 5$ in the denominator**.
Evaluate the expression \( \frac{10}{9} \) if \( x = \frac{3}{5} \). Express as a fraction in lowest terms.

Correctly replacing \( x \) with \( \frac{3}{5} \), we have:

\[
\frac{10}{9} \cdot \frac{5}{3} = \frac{10 \cdot 5}{9 \cdot 3} = \frac{50}{27}
\]

To evaluate this complex fraction correctly, you must multiply the numerator by the reciprocal of the denominator:

\[
\frac{10}{9} \cdot \frac{5}{3} = \frac{10 \cdot 5}{9 \cdot 3} = \frac{50}{27}
\]

Enter your answer in the answer box and then click Check Answer.
9.

When combined into a single fraction, which of the following is equivalent to \( \frac{7 - \frac{1+x}{2}}{2} \)?

- A. \( \frac{5 + x}{2} \)
- B. \( \frac{13 - x}{2} \)
- C. \( \frac{13 + x}{2} \)
- D. \( \frac{6 - x}{2} \)

Sorry, that's not correct.

You made one or both of the following mistakes:
1. You forgot to find a least common denominator before combining terms. Rewriting the whole number so as to have the same denominator as the second term would yield \( \frac{14 - 1-x}{2} \).
2. You did not distribute the negative sign across the numerator of the second term. After combining the fractions you should have \( \frac{14 - (1+x)}{2} = \frac{14 - 1-x}{2} \).
When combined into a single fraction, which of the following is equivalent to \( \frac{8 - x}{2} \)?

- A. \( \frac{2 + x}{2} \)
- B. \( \frac{x - 18}{2} \)
- C. \( \frac{2 + x}{2} \)
- D. \( \frac{18 + x}{2} \)

Sorry, that’s not correct.

You made one or both of the following mistakes:
1. You forgot to find a least common denominator before combining terms. Rewriting the whole number so as to have the same denominator as the second term would yield \( \frac{15 - (8 - x)}{2} \).
2. You did not distribute the negative sign across the numerator of the second term. After combining the fractions you should have \( \frac{15 - (8 - x)}{2} = \frac{15 - 6 + x}{2} \).
11.

Homework: Tutorial IV - Fractions

Instructor-created question

Combine into a single fraction in lowest terms: \( \frac{9 - 8x}{4} \)

\[
\frac{9 - 8x}{4} = \frac{9}{4} - \frac{8x}{4} = \frac{9 - 8x}{4}
\]

Sorry, that's not correct.

Remember that:
1. You must find a least common denominator before combining terms. Rewriting the whole number so as to have the same denominator as the second term would yield \( \frac{25}{4} - \frac{8x}{4} \).
2. You must distribute the negative sign across the numerator of the second term. After combining the fractions you would have \( \frac{36 - (8 - x)}{4} = \frac{28 - 8x}{4} \).

Enter your answer in the answer box and then click Check Answer.
12.
13.

Homework: Tutorial IV - Fractions

Instructor-created question

Combine and express in lowest terms: \( \frac{9x - 10}{x + 3} - \frac{x - 5}{x + 3} \)

\( \frac{9x - 10}{x + 3} - \frac{x - 5}{x + 3} \)

Sorry, that's not correct.

Remember to distribute the negative sign over both terms in the numerator of the second fraction. When combining the fractions you should have gotten:

\( \frac{9x - 10 - (x - 5)}{x + 3} \)

\( \frac{9x - 10 - x + 5}{x + 3} \)

Similar Question  Next Question
Combine and express in lowest terms: \( \frac{x - 5}{19} - \frac{x - 9}{7} \)

- A. \( \frac{-1}{5} \)
- B. \( \frac{2}{35} \)
- C. \( \frac{-3x - 55}{70} \)
- D. \( \frac{-3x - 125}{70} \)

Sorry, that's not correct.

If you choose \( \frac{-1}{5} \), you correctly found the least common denominator of 70 but did not multiply the numerator of each fraction accordingly.

If you chose \( \frac{2}{35} \), you neglected to distribute the negative sign over both terms of the numerator of the second fraction. When combining the fractions, you get:

\[
\frac{7(x - 5)}{(7)(19)} - \frac{(10)(x - 9)}{(10)(7)} = \frac{7x - 35 - 10x + 90}{70}
\]
Combine and express in lowest terms: \( \frac{x-3}{4} - \frac{x+9}{6} \)

Answer: \( \frac{x-7}{2} \)

Sorry, that's not correct.

Remember to distribute the negative sign over both terms of the numerator of the second fraction. When combining the fractions, you get:

\[
\begin{align*}
\frac{(3)(x-9)}{5} & = \frac{14(x+9)}{4} & \frac{5x-49 - 4x - 28}{29} & = \frac{x-75}{29}
\end{align*}
\]

Similar Question  Next Question
16.

**Homework: Tutorial IV - Fractions**

**Instructor-created question**

Assuming $x \neq 0$, which of the following is a correctly reduced rational expression?

- A. \( \frac{17x + 20y}{17x} = 1 + 20y \)
- B. \( \frac{17x + 20y}{x} = 17 + 20x \)
- C. \( \frac{17x + 20y}{y} = 17 + 20y \)
- D. All of the above

**User response:**

**Message:**

*Sorry, that’s not correct.*

**Explanation:**

Cancelling is the process of removing duplicate factors in numerator and denominator, not duplicate terms. In order to cancel you must have ONE term in both numerator and denominator. For example, \( \frac{17x(20y)}{x} \) has a single term in the numerator with TWO factors, so it can be simplified by cancelling the x’s to get 340y.

On the other hand, an expression such as \( \frac{17x + 20y}{17x} \) has two terms in the numerator and so the 17x terms cannot be cancelled.

Note that an expression such as \( \frac{17x + 20y}{x} \) which also has two terms in the numerator, can be factored so as to have only ONE term in the numerator:

\[
\frac{17x + 20y}{x} = \frac{17(x + 20y)}{x}
\]

In the factored expression the x’s can now be cancelled.

**Buttons:**

- Similar Question
- Next Question
Assuming \( x \neq 0 \), write the following rational expression in lowest terms: \( \frac{17x + 20}{17x} \)

\[
\frac{17x + 20}{17x} = \frac{17x + 20}{17x}
\]

Select the correct answer.

- \( \frac{17x + 20}{17x} \)
- \( x \)

Select the correct answer.

- \( 1 \)
- \( \frac{17}{17} \)
- \( 1 + \frac{20}{17x} \)

Remember that cancelling is the process of removing duplicate factors in numerator and denominator, not duplicate terms. In order to cancel you must have ONE term in both numerator and denominator.

- The expression \( \frac{17x + 20}{17x} \) has two terms in the numerator, but it can be factored so as to have only ONE term in the numerator.
- In the factored expression the \( x \)'s can then be cancelled.
18. Simplify the complex fraction \( \frac{\frac{10}{x} - \frac{4}{7}}{7} \) by multiplying numerator and denominator by \( x \).

- A. \( \frac{19 - 4x}{7x} \)
- B. \( \frac{6}{7} \)
- C. \( \frac{9}{7x} \)
- D. \( \frac{19 - 4x}{7x} \)

Sorry, that's not correct.

If you selected \( \frac{19 - 4x}{7} \) or \( \frac{6}{7} \), you did not multiply the denominator by \( x \). This complex fraction is an expression, and if multiplied by a value may only be multiplied by 1. In this instance, 1 is in the term \( \frac{6}{7} \), so correctly multiplying will yield:

\[
\frac{10}{7} - \frac{4}{7} \cdot x = \left( \frac{10}{x} - \frac{4}{7} \right) \cdot x.
\]

If you selected \( \frac{6}{7x} \), you did not multiply both terms in the numerator by \( x \). Distributing \( x \) across the numerator of the fraction above gives,

\[
\frac{10 - 4x}{7x} = \frac{10 - 4x}{7x}.
\]
19.

For the complex fraction \( \frac{\frac{8}{x} - \frac{10}{y}}{15} \):
1. Find the least common denominator of all fractions contained in this complex fraction.
2. Simplify the fraction by multiplying numerator and denominator by this term.

Options:
- A. The least common denominator is \( x \), and the simplified fraction is \( \frac{8y - 10x}{15xy} \).
- B. The least common denominator is \( xy \), and the simplified fraction is \( \frac{8y - 10x}{15xy} \).
- C. The least common denominator is \( y \), and the simplified fraction is \( \frac{8y - 10x}{15xy} \).

Error message:
Sorry, that's not correct.
That is not the correct Least Common Denominator. There are three fractions contained in this complex fraction: \( \frac{8}{x} \), \( \frac{10}{y} \), and \( \frac{15}{1} \). 

[Similar Question] [Next Question]
20.

Homework: Tutorial IV - Fractions

Score: 0 of 1 pt

Instructor-created question

For the complex fraction \( \frac{\frac{6}{x+5} + \frac{15}{x} \div \frac{3}{11}}{x} \):

1. Find the least common denominator of all fractions contained in this complex fraction.
2. Simplify the fraction by multiplying numerator and denominator by this term.

A. 1. The least common denominator is \( x + 5 \), and
   2. The simplified fraction is \( \frac{0}{x} \).
B. 1. The least common denominator is \( x \), and
   2. The simplified fraction is \( \frac{0}{x} \).
C. 1. The least common denominator is \( x \), and
   2. The simplified fraction is \( \frac{0}{x} \).

That is not the correct Least Common Denominator. There are three fractions contained in this complex fraction: \( \frac{6}{x+5} \), \( \frac{15}{x} \), and \( \frac{3}{11} \). Note that \( x \) does not divide into \( x + 5 \), and they have no common factors.

Similar Question Next Question
Appendix V

Common Errors Questions

Set 5: Exponents
1.

Homework: Tutorial V - Exponents

Score: 0 of 1 pt

Instructor-created question

Which of the following is equivalent to $5^2 \cdot 5^3$?

A. $35^{15}$
B. $5^{15}$
C. $5^{10}$
D. $35^{50}$

Sorry, that’s not correct.

Remember that if powers of the SAME BASE are multiplied then,

$g^a \cdot g^b = g^{a+b}$

You made one (or both) of the following errors:

1. You multiplied the exponents instead of adding them, which lead to the incorrect response $g^{15}$.
2. You multiplied the base, which lead to the incorrect choice of $35^{15}$ or $35^{50}$.

Similar Question  Next Question

Click to select your answer and then click Check Answer.

All parts showing Clear All Final Check
2. Which of the following is equivalent to $x^2 \cdot x^{10}$?

- A. $(x^2)^{13}$
- B. $(x^2)^{20}$
- C. $x^{10}$
- D. $x^{13}$

Sorry, that's not correct.

Remember that if powers of the SAME BASE are multiplied then,

$\text{a}^x \cdot \text{a}^y = \text{a}^{x+y}$

You made one (or both) of the following errors:

1. You multiplied the exponents instead of adding them, which lead to the incorrect responses $x^{10}$ or $(x^2)^{20}$.
2. You multiplied the base, which lead to the incorrect choices $(x^2)^{13}$ or $(x^2)^{10}$.
With $x^2 \cdot x^4$ as a single base raised to a power:

$x^2 \cdot x^4 = x^{2+4} = x^6$,

Remember that if powers of the SAME BASE are multiplied, then,

$x^a \cdot x^b = x^{a+b}$

Do NOT multiply the bases or multiply the exponents.
4.

Homework: Tutorial V - Exponents

Instructor-created question

- $12^2 =$

- A. 144
- B. - 24
- C. 24
- D. - 144

Sorry, that's not correct.

Remember that if a negative sign is to be affected by an exponent it must be "attached" to the base using parentheses. Therefore,

$$-2^2 = -(2^2)$$

You made one (or both) of the following errors.

1. You included the negative sign when squaring the expression, which resulted in the incorrect response of 144.
2. You multiplied the base and the exponent instead of multiplying the base by itself, which resulted in the incorrect response of 24 or -24.

Similar Question  Next Question
5. 

Homework: Tutorial V - Exponents

Instructor-created question

-3 \cdot 5^2 =

- A. -325
- B. 75
- C. -75
- D. 225

Sorry, that's not correct.

Remember that by the order of operations all exponents must be evaluated first. Therefore,

-3 \cdot 5^2 = -3 \cdot (5^2)

You made one (or both) of the following errors.

1. You multiplied -3 \cdot 5 before applying the exponent, which resulted in the incorrect response 225 or -225.
2. You assumed that the negative sign was to be squared, which resulted in the incorrect response of 75.

Similar Question  Next Question

Click to select your answer and then click Check Answer.
Evaluate the numeric expression \(-3^2 + 2^2\).

\(-3^2 + 2^2 = \)
7.

Homework: Tutorial V - Exponents

Instructor-created question

If \( f(x) = -(4x)^2 \), find the value of \( f(-1) \).

- A. 16
- B. -16

Sorry, that's not correct.

You multiplied by -1 before evaluating \((4 - 1)^2\). By the order of operations, you must first multiply \(4 + 1\) to get \((-4)^2\). This is then squared to produce 16. Multiplication by -1 will be the last operation to be performed.
8.
9.

Instructor-created question

If \( f(x) = -4x^2 \), find the value of \( f(-2) \).

\( f(-2) = 3 \)

Sorry, that's not correct.

You didn't follow the proper order of operations.
For \( f(x) \), \( x^2 \) must be evaluated first.
This product is then multiplied by \(-4\).
The correct evaluation is \(-4 \cdot 5^2 = -4 \cdot 25 = -100\).
The product $x^a \cdot y^b$ is equivalent to which of the following?

A. $(xy)^{a+b}$
B. $(xy)^{a-b}$
C. $(x+y)^{a+b}$
D. None of the above

**Sorry, that's not correct.**

If powers of DIFFERENT BASES are multiplied you cannot combine their exponents. That is,

$$a^b \cdot b^c \neq (ab)^{a+c}$$

However, if the exponents are the same you can multiply the bases into a single base with that exponent. That is,

$$a^b \cdot a^b = a^{b+b}$$

Click to select your answer and then click Check Answer.
11.

**Homework: Tutorial V - Exponents**

Score: 0 of 1 pt

Instructor-created question

The product $10^9 \cdot 7^5$ is equivalent to which of the following?

- A. $79^6$
- B. $75^4$
- C. $70^9$
- D. None of the above

**Sorry, that’s not correct.**

If powers of DIFFERENT BASES are multiplied you cannot combine their exponents. That is,

$$a^m \cdot b^n \neq (ab)^{m+n}$$

However, if the exponents are the same you can multiply the bases into a single base with that exponent. That is,

$$a^m \cdot b^m = (ab)^m$$

**Next Question**
12.
13.

Homework: Tutorial V - Exponents

The product $x^4 \cdot y^4$ can be simplified to which of the following?

- A. $(x^2)^2$
  
  Therefore $2^4 \cdot 3^4 = [ ]$

- B. $(x^2)^3$
  
  Therefore $2^8 \cdot 3^4 = [ ]$

- C. $(x^4)^3$
  
  Therefore $2^8 \cdot 3^2 = [ ]$

Sorry, that's not correct.

You did not simplify correctly.
You combined the exponents, which is incorrect.
Remember that to combine exponents the bases must be the SAME.
14.

A negative exponent indicates that the reciprocal of the base is to be raised to the positive power. For a non-zero number $$a$$,

$$a^{-n} = \frac{1}{a^n}$$

If you chose $$25$$ you neglected to use the reciprocal, as indicated by the negative exponent.

If you chose $$-25$$ or $$\frac{1}{25}$$ you assumed that the negative exponent implied a negative result. Remember that a negative exponent is an indication of what needs to be done; it does NOT mean that the answer will be negative.
15. 

A negative exponent indicates that the reciprocal of the base is to be raised to the positive power. Therefore, 

\[ \left( \frac{a}{b} \right)^{-p} = \left( \frac{b}{a} \right)^p \]

If you chose \( \frac{4}{9} \) you neglected to use the reciprocal, as indicated by the negative exponent.

If you chose \( -\frac{4}{9} \) or \( -\frac{9}{4} \), you assumed that the negative exponent implied a negative result. Remember that a negative exponent is an indication of what needs to be done; it does NOT mean that the answer will be negative.
16.

Homework: Tutorial V - Exponents

Instructor-created question

\[ \left( \frac{2}{3} \right)^{-3} = \]

A. \( \frac{8}{27} \)  
B. \( \frac{3}{2} \)  
C. \( \frac{27}{8} \)

Sorry, that's not correct.

A negative exponent indicates that the reciprocal of the base is to be raised to the positive power. Therefore,

\[ \left( \frac{a}{b} \right)^{-p} = \left( \frac{b}{a} \right)^p \]

If you chose \( \frac{8}{27} \) you neglected to use the reciprocal, as indicated by the negative exponent.

If you chose \( \frac{3}{2} \) or \( \frac{27}{8} \), you assumed that the negative exponent implied a negative result. Remember that a negative exponent is an indication of what needs to be done: it does NOT mean that the answer will be negative.

Similar Question  Next Question

Click to select your answer and then click Check Answer.

All parts showing  Clear All  Final Check

Page 112 of 116
17. Evaluate \((3^{-2})^{-1}\), expressing as a whole number or fraction in lowest terms.

\[(3^{-2})^{-1} = \frac{1}{3^2} = \frac{1}{9}\]
18.

Which of the following is equivalent to \( \frac{2a^2}{6^2} \):

A. \( \frac{a^2}{3^2} \)  
B. \( a^3 \cdot a^1 \)  
C. \( 3 \cdot a^2 \)  
D. \( a^1 \)

Remember that for instances of the same base,

\[ \frac{a^m}{a^n} = a^{m-n} \]

If you chose A, you violated the order of operations by dividing by 6 before evaluating the exponents.

If you chose B or C, you divided the exponents instead of correctly applying the rule above.

Since this expression does NOT have the same base in numerator and denominator, you cannot immediately apply the rule above. First rewrite the numerator as \( b^2 \cdot b^7 \) and then use the rule above to simplify.

Click to select your answer and then click Check Answer.

Final Check
Instructor-created question

Which of the following is equivalent to \( \frac{(3x)^6}{9} \)?

- A. \( x^6 \)
- B. \( 3^{15} \cdot x^6 \)
- C. None of the Above

Sorry, that's not correct.

You violated the order of operations. Remember that you must first apply the exponent before dividing, so that:

\[
\frac{(3x)^6}{9} = \frac{3^{15} \cdot x^6}{9}
\]

Similar Question  Next Question
20.

```
Instructor-created question

Which of the following is equivalent to \( \frac{(2x)^4}{2} \)?

- A. \( x^8 \), and therefore \( \frac{(2x)^4}{2} = \) \[
- B. \( 2^3 \cdot x^8 \), and therefore \( \frac{(2x)^4}{2} = \) \[

Sorry, that's not correct.
This expression does not simplify to \( x^8 \) - you violated the order of operations. Remember that you must first apply the exponent before dividing, so that,
\[
\frac{(2x)^4}{2} = \frac{2^4 \cdot x^4}{2} = 2^3 \cdot x^4
\]

Similar Question
Next Question
```

Click to select and enter your answer(s) and then click Check Answer.

All parts showing: [ ]
Clear All
Final Check