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</table>
The number of bacteria that grow in a petri dish is approximated by the function \( G(t) = 500e^{0.216t} \), where \( t \) is time, in minutes. Use this model to approximate, to the nearest integer, the number of bacteria present after one half-hour.

\[
G(30) = 500e^{0.216(30)}
\]

\[
= 500e^{6.48}
\]

\[
= 500(451.9709463)
\]

\[
= 325985.4732
\]

\[
\approx 325985
\]

**Score 2:** The student gave a complete and correct response.
Question 28

28 The number of bacteria that grow in a petri dish is approximated by the function \( G(t) = 500e^{0.216t} \), where \( t \) is time, in minutes. Use this model to approximate, to the nearest integer, the number of bacteria present after one half-hour.

\[
G = 500 e^{0.216 \times 30}
\]

\[
G = 325986
\]

Score 1: The student made a rounding error.
28 The number of bacteria that grow in a petri dish is approximated by the function $G(t) = 500e^{0.216t}$, where $t$ is time, in minutes. Use this model to approximate, to the nearest integer, the number of bacteria present after one half-hour.

$$G = 500e^{0.216(0.5)}$$
$$= 500e^{0.108}$$
$$= 557$$

**Score 1:** The student made an error by using 0.5.
Question 28

28 The number of bacteria that grow in a petri dish is approximated by the function 
\[ G(t) = 500e^{0.216t}, \]
where \( t \) is time, in minutes. Use this model to approximate, to the nearest integer, 
the number of bacteria present after one half-hour.

\[
G(0.5) = 500e^{0.216(0.5)} \\
= 500e^{0.108} \\
= 500 \cdot 1.2533057 \\
= 626.7
\]

Score 1: The student made an error by using 60 minutes.
28 The number of bacteria that grow in a petri dish is approximated by the function \( G(t) = 500e^{0.216t} \), where \( t \) is time, in minutes. Use this model to approximate, to the nearest integer, the number of bacteria present after one half-hour.

\[
G(30) = 500e^{0.216 \times 30} \\
= 18616.5 \\
= 18617
\]

Score 1: The student correctly substituted into the function, but did not use 30 as an exponent.
Question 28

28 The number of bacteria that grow in a petri dish is approximated by the function \( G(t) = 500e^{0.216t} \), where \( t \) is time, in minutes. Use this model to approximate, to the nearest integer, the number of bacteria present after one half-hour.

\[
G(30) = 500e^{0.216(30)}
\]

\[
\frac{500 \times 859.4781}{30} = 10856.17244
\]

Score 0: The student made an error by dividing by 30 and did not round properly.
29 Determine the exact value of $\left(\frac{27}{64}\right)^{-\frac{2}{3}}$ as a fraction in simplest form.

\[
\frac{1}{\left(\frac{27}{64}\right)^{\frac{2}{3}}} = \frac{1}{\frac{9}{16}} = \frac{16}{9}
\]

**Score 2:** The student gave a complete and correct response.
29 Determine the exact value of \( \left( \frac{27}{64} \right)^{-\frac{2}{3}} \) as a fraction in simplest form.

Score 2: The student gave a complete and correct response.
29 Determine the exact value of \( \left( \frac{27}{64} \right)^{-\frac{2}{3}} \) as a fraction in simplest form.

\[
\left( \frac{27}{64} \right)^{-\frac{1}{3}} = \left( \frac{64}{27} \right)^{\frac{1}{3}} = \left( \sqrt[3]{\frac{64}{27}} \right)^2 = \left( \frac{4}{3} \right)^2 = \frac{16}{9}
\]

Score 2: The student gave a complete and correct response.
Question 29

29 Determine the exact value of \( \left( \frac{27}{64} \right)^{-\frac{2}{3}} \) as a fraction in simplest form.

Score 1: The student made an error by using the negative reciprocal of \(-\frac{2}{3}\).
Question 29

29 Determine the exact value of \( \left( \frac{27}{64} \right)^{-\frac{2}{3}} \) as a fraction in simplest form.

\[
\left( \frac{27}{64} \right)^{\frac{2}{3}} = \left( \sqrt[3]{\frac{27}{64}} \right)^2 = \frac{9}{16}
\]

Score 1: The student made a transcription error by not writing \(-\frac{2}{3}\).
29 Determine the exact value of \((\frac{27}{64})^{-\frac{2}{3}}\) as a fraction in simplest form.

\[
(\frac{27}{64})^{-\frac{2}{3}} = \left(\frac{0.421875}{1}\right)^{-\frac{2}{3}} = 1.7
\]

**Score 1:** The student did not write the answer in fraction form.
29 Determine the exact value of \( \left( \frac{27}{64} \right)^{-\frac{2}{3}} \) as a fraction in simplest form.

\[
\left( \frac{64}{27} \right)^{\frac{3}{2}} = 3.649
\]

**Score 0:** The student made an error by using the negative reciprocal of the exponent and expressed the answer as a decimal.
30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

\[
7 + 4i\sqrt{3}
\]

**Score 2:** The student gave a complete and correct response.
Question 30

30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

Score 2: The student gave a complete and correct response.
30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

\[
7 - \sqrt{12}\text{i} \\
7 - 2\text{i}\sqrt{3} \\
7 - 2\text{i}(2)\sqrt{3} \\
\_7 - 4\text{i}\sqrt{3}
\]

**Score 1:** The student wrote $7 - \sqrt{-48}$ in simplest $a + bi$ form, but did not state the conjugate.
30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

Score 1: The student wrote the additive inverse of $7 - \sqrt{-48}$ in simplest $a + bi$ form, not the conjugate.
30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

Score 1: The student stated the conjugate correctly, but did not express it in simplest form.
30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

\[
\frac{1}{7 - \sqrt{-48}} \cdot \frac{7 + \sqrt{-48}}{7 + \sqrt{-48}} = \frac{7 - 2\sqrt{48}}{97} = \frac{7 + 4\sqrt{3}}{97}
\]

Score 1: The student found the multiplicative inverse of $7 - \sqrt{-48}$. 
30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

\[ \underline{1 + \sqrt{48}} \]

**Score 0:** The student gave a completely incorrect response.
Question 31

31 Express \( \frac{12x^{-5}y^5}{24x^{-3}y^{-2}} \) in simplest form, using only positive exponents.

\[
\frac{12x^{-3}y^{7}}{24x^{5}} = \frac{y^{7}}{2x^{2}}
\]

Score 2: The student gave a complete and correct response.
31 Express $\frac{12x^{-5}y^5}{24x^{-3}y^{-2}}$ in simplest form, using only positive exponents.

Score 2: The student gave a complete and correct response.
Question 31

31 Express \( \frac{12x^{-5}y^5}{24x^{-3}y^{-2}} \) in simplest form, using only positive exponents.

Score 2: The student gave a complete and correct response.
Question 31

31 Express \( \frac{12x^{-5}y^5}{24x^{-3}y^{-2}} \) in simplest form, using only positive exponents.

\[
\frac{1}{2} x^{-5+3} y^{-2+2} = \frac{1}{2} x^{-2} y^7
\]

Score 1: The student did not express the answer using only positive exponents.
Question 31

31 Express \( \frac{12x^{-5}y^5}{24x^{-3}y^{-2}} \) in simplest form, using only positive exponents.

Score 1: The student did not simplify completely.
31 Express \( \frac{12x^{-5}y^5}{24x^{-3}y^{-2}} \) in simplest form, using only positive exponents.

\[
\frac{1}{2} x^{-8} y^3
\]

**Score 0:** The student added exponents and did not express the answer using only positive exponents.
Question 32

In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

\[
\begin{align*}
S_n &= \frac{n(a_1 + a_n)}{2} \\
S_n &= \frac{30(15 + 73)}{2} \\
S_n &= \frac{30(88)}{2} \\
S_n &= \boxed{1320}
\end{align*}
\]

\[
\begin{align*}
a_n &= a + d(n-1) \\
a_n &= 15 + 2(30-1) \\
a_n &= 15 + 2(29) \\
a_n &= 73
\end{align*}
\]

Score 2: The student gave a complete and correct response.
32 In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

\[
S_n = \frac{n (a_1 + (n-1)d)}{2}
\]

\[
S_{30} = \frac{30 (2(15) + 29(2))}{2} = 1320
\]

**Score 2:** The student gave a complete and correct response.
32 In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

Score 2: The student gave a complete and correct response.
In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

Score 1: The student did not list 49, but used it to find the sum, plus the 75.
In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

\[ S_n = \frac{n(a_1 + a_n)}{2} \]

\[ S_n = \frac{30(15+73)}{2} \]

\[ S_n = \frac{1350}{2} \]

\[ S_n = 675 \text{ seats} \]

**Score 1:** The student used 30 rows instead of 73 seats in row 30 when using the formula.
Question 32

32 In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

\[ a_{30} = 15 + 2(29) \]
\[ 15 + 58 \]
\[ a_{10} = 73 \]

Score 1: The student calculated the number of seats in the last row, but did not calculate the total seating capacity.
32 In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

\[ a_1 = 15 \quad a_{30} = 73 \]
\[ a_n = a_1 + (n-1)d \]
\[ a_{30} = 15 + (30-1)(2) \]
\[ a_{30} = 15 + 58 \]
\[ a_{30} = 73 \]

\[ S_n = \frac{n(a_1 + a_n)}{2} \]
\[ S_{30} = \frac{30(15 + 73)}{2} \]
\[ S_{30} = \frac{30(88)}{2} \]
\[ S_{30} = \frac{2640}{2} \]
\[ S_{30} = 1320 \]

**Score 1:** The student calculated 73, the number of seats in row, 30, but used the 30 in the formula.
In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

\[ x = 15(1 + 0.13)^{30} \]
\[ x = 15(1.13)^{30} \]
\[ x = 15(42.72970256) \]
\[ x = 640.9455383 \]
\[ x = 641 \text{ seats} \]

**Score 0:** The student gave a completely incorrect response.
33 Given \( f(x) = x^2 \) and \( g(x) = x - 3 \), express \( g(f(x + 2)) \) as a polynomial in simplest form.

\[
\begin{align*}
\text{Given } f(x) &= x^2, \\
g(x) &= x - 3 \\
\therefore g(f(x + 2)) &= x^2 - 3.
\end{align*}
\]

**Score 2:** The student gave a complete and correct response.
33 Given \( f(x) = x^2 \) and \( g(x) = x - 3 \), express \( g(f(x + 2)) \) as a polynomial in simplest form.

\[
\begin{align*}
\hat{f}(x+2) &= (x+2)^2 \\
g(x+2) &= (x+2)^2 - 3 \\
&= \frac{(x+2)(x+2) - 3}{(x+2)(x+2)} \\
&= x^2 + 4x + 4 - 3 \\
g(x+2)^2 &= x^2 + 4x + 1
\end{align*}
\]

Score 2: The student gave a complete and correct response.
33 Given \( f(x) = x^2 \) and \( g(x) = x - 3 \), express \( g(f(x + 2)) \) as a polynomial in simplest form.

\[
\begin{align*}
 g(f(x+2)) &= (x+2)^2 - 3 \\
 &= (x+2)(x+2) \\
 &= x^2 + 4x + 4 - 3 \\
 &= (x^2 + y + y) - 3 \\
\end{align*}
\]

\[ g(f(x+2)) = (x^2 + y + y) - 3 \]

Score 1: The student did not express the answer in simplest form.
33 Given \( f(x) = x^2 \) and \( g(x) = x - 3 \), express \( g(f(x + 2)) \) as a polynomial in simplest form.

\[
\begin{align*}
  f(x + 2) &= (x + 2)^2 \\
             &= x^2 + 4 \\
  g(x^2 + 4) &= x^2 + 4 - 3 \\
             &= x^2 + 1
\end{align*}
\]

**Score 1:** The student made an error when squaring \( x + 2 \).
33 Given \( f(x) = x^2 \) and \( g(x) = x - 3 \), express \( g(f(x + 2)) \) as a polynomial in simplest form.

\[
\begin{align*}
g(x + 2) &= x + 2 - 3 = x - 1 \\
f(x - 1)^2 &= x^2 - 1
\end{align*}
\]

**Score 0:** The student evaluated the expression from left to right and made an error squaring \( x - 1 \).
34 Sketch an angle of $250^\circ$ in standard position and then express $\cos 250^\circ$ as a cosine function of a positive acute angle.

Score 2: The student gave a complete and correct response.
34 Sketch an angle of $250^\circ$ in standard position and then express $\cos 250^\circ$ as a cosine function of a positive acute angle.

**Score 1:** The student sketched the angle correctly, but did not state $-\cos 70$. 
34 Sketch an angle of 250° in standard position and then express $\cos 250°$ as a cosine function of a positive acute angle.

\[ -\cos 70° \]

**Score 1:** The student did not indicate the direction of rotation.
34 Sketch an angle of $250^\circ$ in standard position and then express $\cos 250^\circ$ as a cosine function of a positive acute angle.

\[
\cos 250^\circ = \cos 70^\circ
\]

\[
\begin{array}{c}
250 \\
-180 \\
\hline
70
\end{array}
\]

\[
Q_{III} = \angle -150
\]

**Score 0:** The student did not indicate the $250^\circ$ angle and stated an incorrect sign for the function.
35 Solve the inequality $x^2 - 3x - 4 > 0$ algebraically for $x$.

\[
\begin{align*}
(x-4)(x+1) > 0 \\
\text{If } x-4 > 0 \quad \text{then } x > 4 \\
\text{If } x+1 < 0 \quad \text{then } x < -1 \\
\end{align*}
\]

\[
\begin{align*}
x > 4 \quad \text{or} \quad x < -1 \\
\end{align*}
\]

**Score 2:** The student gave a complete and correct response.
35 Solve the inequality $x^2 - 3x - 4 > 0$ algebraically for $x$.

\[ x^2 - 3x - 4 = 0 \]
\[ (x-4)(x+1) = 0 \]
\[ x = 4 \quad \text{or} \quad x = -1 \]

Score 2: The student gave a complete and correct response.
35 Solve the inequality $x^2 - 3x - 4 > 0$ algebraically for $x$.

Score 1: The student did not state the solution as a disjunction.
35 Solve the inequality \( x^2 - 3x - 4 > 0 \) algebraically for \( x \).

\[
\begin{align*}
x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
x &= \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-4)}}{2(1)} \\
x &= \frac{3 \pm \sqrt{9+16}}{2} \\
x &= \frac{3 \pm \sqrt{25}}{2} \\
x &= \frac{3 \pm 5}{2} \\
x &= \frac{3+5}{2} = 4 \\
x &= \frac{3-5}{2} = -1
\end{align*}
\]

\((x-4)(x+1)\)

\(x-4=0\) \hspace{1cm} x+1=0

\(x=4\) \hspace{1cm} x=-1

Score 0: The student solved the equation \( x^2 - 3x - 4 = 0 \), but did nothing with the inequality.
36 The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

<table>
<thead>
<tr>
<th>Years Since 1955 (x)</th>
<th>0</th>
<th>5</th>
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</tr>
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<tbody>
<tr>
<td>Minimum Wage (y)</td>
<td>.75</td>
<td>1.00</td>
<td>1.25</td>
<td>1.45</td>
<td>2.00</td>
<td>3.10</td>
<td>3.35</td>
<td>3.80</td>
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Write the linear regression equation for this set of data, rounding all values to three decimal places.

\[ y = 0.098x + 0.402 \]

State the strength and direction indicated by the correlation coefficient.

*high positive correlation*

**Score 4:** The student gave a complete and correct response.
Question 36

The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

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Write the linear regression equation for this set of data, rounding all values to three decimal places.

\[ y = 0.098x + 0.402 \]

State the strength and direction indicated by the correlation coefficient.

The correlation coefficient was 0.988 so it is pretty strong because it is closer to the points and not zero which means that the points are graphed in a direct relationship as the years increase so does the minimum wage.

Score 4: The student gave a complete and correct response.
The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

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Write the linear regression equation for this set of data, rounding all values to three decimal places.

\[ y = 0.098x + 0.402 \]

State the strength and direction indicated by the correlation coefficient.

- The direction is positive and the strength is 0.988.

Score 3: The student did not state the strength of the correlation coefficient appropriately.
The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

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Write the linear regression equation for this set of data, rounding all values to three decimal places.

State the strength and direction indicated by the correlation coefficient.

\[ y = 0.098x + 0.402 \]

Score 3: The student did not state the strength of the correlation coefficient.
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Write the linear regression equation for this set of data, rounding all values to three decimal places.

State the strength and direction indicated by the correlation coefficient.

\[
y = ax + b
\]

\[
\text{correlation coefficient} = 0.988
\]

\[
b = 0.402
\]

Score 3: The student wrote a correct regression equation and indicated the direction when writing the correlation coefficient, but did not write the strength.
Question 36

36 The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

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Write the linear regression equation for this set of data, rounding all values to three decimal places.

State the strength and direction indicated by the correlation coefficient.

\[ y = 0.09225 + 0.0545 \times + 0.402 \]

The strength is very low and increases at a rate of 0.098 per 5 years.

Score 2: The student wrote a correct regression, but described the slope instead of the correlation coefficient.
The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

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<td>3.10</td>
<td>3.35</td>
<td>3.80</td>
<td>4.25</td>
<td>5.15</td>
<td>5.15</td>
</tr>
</tbody>
</table>

Write the linear regression equation for this set of data, rounding all values to three decimal places.

\[ y = 0.402 + 0.098x \]

State the strength and direction indicated by the correlation coefficient.

\[ r = 0.9876 \]

**Score 2:** The student wrote an expression and indicated a positive correlation.
36 The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

<table>
<thead>
<tr>
<th>Years Since 1955 (x)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Wage (y)</td>
<td>.75</td>
<td>1.00</td>
<td>1.25</td>
<td>1.45</td>
<td>2.00</td>
<td>3.10</td>
<td>3.35</td>
<td>3.80</td>
<td>4.25</td>
<td>5.15</td>
<td>5.15</td>
</tr>
</tbody>
</table>

Write the linear regression equation for this set of data, rounding all values to three decimal places.

State the strength and direction indicated by the correlation coefficient.

\[ y = ax + b \]
\[ a = 0.098 \]
\[ b = 0.402 \]

Score 2: The student wrote a correct regression equation.
Question 36

36 The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

<table>
<thead>
<tr>
<th>Years Since 1955 (x)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Wage (y)</td>
<td>.75</td>
<td>1.00</td>
<td>1.25</td>
<td>1.45</td>
<td>2.00</td>
<td>3.10</td>
<td>3.35</td>
<td>3.80</td>
<td>4.25</td>
<td>5.15</td>
<td>5.15</td>
</tr>
</tbody>
</table>

Write the linear regression equation for this set of data, rounding all values to three decimal places.

State the strength and direction indicated by the correlation coefficient.

\[
\begin{align*}
\text{LinReg} \\
\hat{y} &= ax + b \\
\hat{y} &= 0.0975x + 0.40722 \\
\text{Strength} &= 0.9875
\end{align*}
\]

Score 1: The student did not round correctly, and did not state the strength and the direction of the correlation coefficient.
The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

<table>
<thead>
<tr>
<th>Years Since 1955 (x)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Wage (y)</td>
<td>.75</td>
<td>1.00</td>
<td>1.25</td>
<td>1.45</td>
<td>2.00</td>
<td>3.10</td>
<td>3.35</td>
<td>3.80</td>
<td>4.25</td>
<td>5.15</td>
<td>5.15</td>
</tr>
</tbody>
</table>

Write the linear regression equation for this set of data, rounding all values to three decimal places.

\[ y = 0.9754x + 0.40227 \]

State the strength and direction indicated by the correlation coefficient.

The correlation coefficient is weak.

Score 1: The student did not round the regression equation correctly and stated the wrong strength and no direction.
Question 36

36 The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

<table>
<thead>
<tr>
<th>Years Since 1955 (x)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Wage (y)</td>
<td>.75</td>
<td>1.00</td>
<td>1.25</td>
<td>1.45</td>
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<td>3.10</td>
<td>3.35</td>
<td>3.80</td>
<td>4.25</td>
<td>5.15</td>
<td>5.15</td>
</tr>
</tbody>
</table>

Write the linear regression equation for this set of data, rounding all values to three decimal places.

State the strength and direction indicated by the correlation coefficient.

\[ y = mx + b \]
positive

Score 0: The student stated strong positive, but gave no supporting evidence.
37 Solve the system of equations algebraically for $x$ and $y$:

\[
\frac{y}{x} = \frac{x - 3}{2}
\]

\[
y + 2 = x
\]

\[
y = x - 2
\]

\[
\frac{x - 2}{x} = \frac{x - 3}{2}
\]

\[2x - 4 = x^2 - 3x\]

\[x^2 - 5x + 4 = 0\]

\[(x - 4)(x - 1) = 0\]

\[x = 4, x = 1\]

\[
y \pm 2 = 4\]

\[
y + 2 = 1\]

\[
y = -1
\]

\[
y = 2
\]

\[
solutions
\]

\[(4, 2)
\]

\[(1, -1)\]

**Score 4:** The student gave a complete and correct response.
37 Solve the system of equations algebraically for $x$ and $y$:

\[
\frac{y}{x} = \frac{x - 3}{2}
\]

\[y + 2 = x\]

\[
\begin{align*}
\frac{2y}{x} &= \frac{x^2 - 3x}{x} \\
y &= \frac{1}{2}x^2 - \frac{3x}{2}
\end{align*}
\]

\[
\begin{align*}
-\frac{2}{x} - 2 &= x - 2 \\
\frac{1}{2}x^2 - \frac{3x}{2} &= \frac{x - 2}{-x + 2} \\
2(\frac{1}{2}x^2 - \frac{5x}{2} + 2) &= 0 \\
x^2 - 5x + 4 &= 0
\end{align*}
\]

\[x = \frac{5 \pm \sqrt{25 - 4(1)(4)}}{2(1)}\]

\[x = \frac{5 \pm 3}{2}\]

\[x = \frac{5 + 3}{2} = \frac{8}{2} = 4\]

\[x = \frac{5 - 3}{2} = \frac{2}{2} = 1\]

\[y + 2 = 4\]

\[y = 2\]

\[y + 2 = 1\]

\[\frac{x - 2}{y} = 1\]

\[y = -1\]

**Score 4:** The student gave a complete and correct response. The student clearly indicated which $x$-value was used to obtain the $y$-value.
37 Solve the system of equations algebraically for $x$ and $y$:

\[ \frac{y}{x} = \frac{x - 3}{2} \]

\[ y + 2 = x \]

\[
\begin{align*}
\frac{y}{y+2} &= \frac{y+2-3}{2} \\
\frac{y}{y+2} &= \frac{y-1}{2} \\
2y &= y^2 + y - 2 \\
0 &= y^2 - y - 2 \\
(y-2)(y+1) &= 0 \\
y &= 2, \quad y = -1 \\
x &= 4, \quad x = 1
\end{align*}
\]

Score 4: The student gave a complete and correct response.
Question 37

37 Solve the system of equations algebraically for $x$ and $y$:

\[
\begin{align*}
\frac{-1}{x} &= \frac{1 - 3}{2} \\
y + 2 &= x \\
\frac{y}{y + 2} &= \frac{(y + 2)(y - 1)}{2}
\end{align*}
\]

\[x = 0, \quad y = 1\]

\[2y = (y + 2)(y - 1)\]

\[0 = y^2 - y - 2\]

\[(y - 2)(y + 1) = 0\]

\[y = 2, \quad y = -1\]

\[y + 1 = 0, \quad y - 1 = 0\]

\[y = 1\]

Score 3: The student found both $y$-values, but only one $x$-value.
Question 37

37 Solve the system of equations algebraically for $x$ and $y$:

\[
\frac{y}{x} = \frac{x - 3}{2}
\]

\[y + 2 = x\]

\[
\frac{y}{y+2} = \frac{(y+2)-(3)}{2}
\]

\[2y = (y+2)(y+2) - 5\]

\[2y = y^2 + 4y + 4 - 3\]

\[-2y\]

\[y^2 + 2y + 1 = 0\]

\[
\left( y + 1 \right) \left( y + 1 \right) = 0
\]

\[y = -1\]  \[y = -1\]

\[-1 + 2 = 1\]

\[
\begin{cases} 
  y = -1 \\
  x = 3 
\end{cases}
\]

Score 2: The student made a conceptual error performing the cross product.
37 Solve the system of equations algebraically for $x$ and $y$:

\[
\frac{y}{x} = \frac{x - 3}{2}
\]

\[
y + 2 = x
\]

\[
y = x - 2
\]

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

\[
2(x - 2) = x^2 - 3x
\]

\[
x^2 - 4 = x^2 - 3x
\]

\[
x^2 + 5x + 4 = 0
\]

\[
(x + 5)(x - 1) = 0
\]

\[
x = -5 \quad x = 1
\]

Score 2: The student did not factor correctly and only found one pair of solutions.
37 Solve the system of equations algebraically for $x$ and $y$:

\[
\frac{y}{x} = \frac{x - 3}{2}
\]

\[y + 2 = x\]

\[\frac{y(x + 2 - 3)}{x + 2} = \frac{y}{x}\]

\[y(x + 2) = 3\]

\[y = \frac{3}{x + 2}\]

\[\frac{y(x - 1)(y - 3)}{y - 1} = \frac{y}{y - 1}\]

\[y = \frac{y(x - 1)(y - 3)}{y - 1}\]

\[y = 1 \quad y = 3\]

\[y = 2 \quad y = -2\]

\[y = 2 \quad y = -6\]

**Score 1:** The student wrote a correct equation in one variable, but then made numerous errors.
37 Solve the system of equations algebraically for \( x \) and \( y \):

\[
\frac{y}{x} = \frac{x - 3}{2}
\]

\[y + 2 = x\]

Score 0: The student obtained one correct solution by an obviously incorrect procedure.
A rocket is shot vertically into the air. Its height, \( h \), at any time, \( t \), in seconds, can be modeled by the equation \( h = -16t^2 + 184t \). Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
\begin{align*}
\text{let } & \quad X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
& \quad X = \frac{184 \pm \sqrt{184^2 - 4(-16)(-529)}}{2(-16)} \\
& \quad X = \frac{184 \pm \sqrt{33856 - 33856}}{-32} \\
& \quad X = \frac{184 \pm 0}{-32} \\
& \quad X = \frac{184}{-32} \\
& \quad X = -5.75
\end{align*}
\]

Score 4: The student gave a complete and correct response.
38 A rocket is shot vertically into the air. Its height, \( h \), at any time, \( t \), in seconds, can be modeled by the equation \( h = -16t^2 + 184t \). Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
\begin{align*}
15(529) &= 184 \\
-8646 &= 184 \\
26 &= 4 \\
2116 &= 1058 \\
529 &= 123 \\
\end{align*}
\]

\[
\begin{align*}
\text{\( h = -16t^2 + 184t \)} \\
-16t^2 + 184t - 529 &= 0 \\
-4t(4t - 23) + 23(4t - 23) &= 0 \\
(4t + 23)(4t - 23) &= 0 \\
\end{align*}
\]

\[
\begin{align*}
4t &= 23 \\
t &= \frac{23}{4}
\end{align*}
\]

\[
\begin{align*}
t &= \frac{23}{4} \\
\text{or 5.75 seconds}
\end{align*}
\]

Score 4: The student gave a complete and correct response.
A rocket is shot vertically into the air. Its height, $h$, at any time, $t$, in seconds, can be modeled by the equation $h = -16t^2 + 184t$. Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
529 = -16t^2 + 184t
\]

\[
-16t^2 + 184t - 529 = 0
\]

\[
\begin{align*}
\text{x} &= \frac{-(184) \pm \sqrt{(184)^2 - 4(-16)(-529)}}{2(-16)} \\
&= \frac{-184 \pm \sqrt{90576 - 33856}}{-32} \\
&= \frac{-184 \pm \sqrt{56720}}{-32} \\
&= \frac{-184 \pm 238.5}{-32}
\end{align*}
\]

\[
\begin{align*}
\text{x} &= 8.75, \quad \text{or} \quad \text{x} = 6.25
\end{align*}
\]

**Score 3:** The student made one error when converting the fraction to a decimal.
38 A rocket is shot vertically into the air. Its height, \( h \), at any time, \( t \), in seconds, can be modeled by the equation \( h = -16t^2 + 184t \). Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
529 = -16t^2 + 184t + 16t^2 - 184t + 529 = 0
\]

\[
+184 \pm \sqrt{184^2 - 4(16)(529)} \quad \text{(rearranged)}
\]

\[
2(16)
\]

\[
\frac{184 \pm \sqrt{0}}{32}
\]

\[
\frac{46 \pm \sqrt{0}}{4}
\]

\[
\frac{23 \pm 0}{2}
\]

**Score 3:** The student made an error when reducing the fraction \( \frac{184 \pm \sqrt{0}}{32} \).
A rocket is shot vertically into the air. Its height, $h$, at any time, $t$, in seconds, can be modeled by the equation $h = -16t^2 + 184t$. Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

Score 2: The student wrote $-184$ instead of $184$ in the quadratic formula. The final answer did not make sense in the context of the problem.
38 A rocket is shot vertically into the air. Its height, \( h \), at any time, \( t \), in seconds, can be modeled by the equation \( h = -16t^2 + 184t \). Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
\begin{align*}
529 &= -16t^2 + 184t \\
-184 &= -16t^2 + 184t \\
529 &= 16t^2 \\
\sqrt{529} &= \sqrt{16t^2} \\
\frac{184}{4} &= \frac{16t}{4} \\
9.13543905 &\approx t
\end{align*}
\]

**Score 1:** The student made a transcription error when writing the equation and made a conceptual error by subtracting 184 instead of 184\( t \).
Question 38

38 A rocket is shot vertically into the air. Its height, $h$, at any time, $t$, in seconds, can be modeled by the equation $h = -16t^2 + 184t$. Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
\begin{align*}
529 &= -16t^2 + 184t \\
529 &= -32t + 184t \\
529 &= 152t \\
\frac{529}{152} &= t \\
3.4 \text{ Seconds}
\end{align*}
\]

Score 0: The student made a conceptual error when going from line 1 to line 2, creating a simpler linear equation for which no credit was earned, and made a rounding error.
Question 38

A rocket is shot vertically into the air. Its height, $h$, at any time, $t$, in seconds, can be modeled by the equation $h = -16t^2 + 184t$. Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

\[
\frac{529}{-16} = -16t^2
\]

\[
-16t^2 = 33.625
\]

\[
t^2 = 2.15625
\]

\[
t = 5.75 \text{ seconds}
\]

Score 0: The student obtained a correct answer by an obviously incorrect procedure
A rocket is shot vertically into the air. Its height, $h$, at any time, $t$, in seconds, can be modeled by the equation $h = -16t^2 + 184t$. Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

Score 0: The student did not show enough work to receive any credit.
Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

Find, to the nearest degree, the angle between the smaller force and the resultant force.

Score 6: The student gave a complete and correct response.
39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[ x^2 = 22^2 + 43^2 - 2(22)(43)\cos 128 \]
\[ x^2 = 484 + 1849 - 1849.8 \]
\[ x = 59 \]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[ 43^2 = 22^2 + 59^2 - 2(22)(59)\cos y \]
\[ 1849 = 484 + 3481 - 2(22)(59)\cos y \]
\[ 2\cos y = 815 \]
\[ \cos y = \frac{815}{2} \]
\[ y = 35° \]

Score 6: The student gave a complete and correct response.
39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[
\begin{align*}
\alpha^2 &= b^2 + c^2 - 2bc \cos \alpha \\
\alpha^2 &= 43^2 + 22^2 - 2(43)(22) \cos 52° \\
\alpha &= \sqrt{\alpha^2} \\
\alpha &= 59.14246792 \\
\end{align*}
\]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[
\begin{align*}
\frac{a}{\sin A} &= \frac{b}{\sin B} \\
\frac{59.14246}{\sin 128°} &= \frac{43}{\sin B} \\
33.88446241 &= \frac{59.14246 \sin B}{59.14246} \\
\sin B &= 0.57292954 \\
\text{ref } \theta &= 34.9547° \\
\theta &\approx 35°
\end{align*}
\]

Score 6: The student gave a complete and correct response.
39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[
\sin x = \frac{\sin y}{y}
\]

\[
\sin 128^\circ = \frac{\sin x}{22}
\]

\[
x = 17.08
\]

Score 5: The student did not solve for the correct angle. Since the student only gave one legible response to find 59, it can be scored, even though it is crossed out.
Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[ a^2 = b^2 + c^2 - 2bc \cos A \]
\[ a^2 = 22^2 + 43^2 - 2(43)(22) \cos 52° \]
\[ a^2 = 2333 + 1164.831511 \]
\[ a = \sqrt{3498.831511} \]
\[ a = 59.14246792 \]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[ \frac{59.14246792}{22} = \frac{22}{\sin x} \]
\[ 1.3362368 = \frac{22}{\sin x} \]
\[ \sin x = 0.2931267032 \]
\[ x = 17°.2' \]
\[ x = 17° \]

**Score 4:** The student did not round the magnitude to 59 and solved for the wrong angle.
Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[
x^2 = y^2 + z^2 - 2yz\cos X
\]
\[
x^2 = 22^2 + 43^2 - 2(22)(43)\cos 128°
\]
\[
x^2 = 4883 - 1892\cos 128°
\]
\[
\sqrt{x^2} = \sqrt{3497.831511}
\]
\[
x = 59
\]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

**Score 4:** The student only determined the magnitude.
Question 39

Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[
\begin{align*}
    c^2 &= a^2 + b^2 - 2ab \cos C \\
    c^2 &= 22^2 + 43^2 - 2(22)(43) \cos 52° \\
    c^2 &= 484 + 1849 - 1892 \cos 52° \\
    c^2 &= 2333 - 1164.83151 \\
    c &= \sqrt{1168.168489} \\
    c &= 34.17847991 \\
\end{align*}
\]

Resultant force = 34 pounds

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[
\frac{\sin A}{43} = \frac{\sin 52°}{34} \\
43 \sin 52° = 34 \sin A \\
\sin A = 0.996018354 \\
A = 85.27520585° \\
\]

\[m\angle = 85°\]

Score 4: The student made a conceptual error by using 52° instead of 128° when solving for both the magnitude and the angle.
39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[ a^2 = b^2 + c^2 - 2bc \cos A \]
\[ a^2 = (43)^2 + (22)^2 - 2 \cdot 43 \cdot 22 \cdot \cos 128° \]
\[ a^2 = 1849 + 484 - 1184.83151 \]
\[ a^2 = 1968.16484 \]
\[ a = 34.17841 \text{ lb} \]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[ \frac{22^2 - 43^2 + 484 - 2(43)(48)}{3} \]
\[ 184 = 1849 - 2(43)(48) \cos A \]
\[ 3065 = 3065 \]
\[ -2521 = -2924 \cos A \]
\[ -2924 \]
\[ \cos A = 0.862175126 \]
\[ A = 30.93831245° \]
\[ A = 30° \]

**Score 4:** The student made an error in sign when computing the magnitude and found the wrong angle.
Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

Find, to the nearest degree, the angle between the smaller force and the resultant force.

Score 3: The student did not round the magnitude correctly and did not find the correct angle.
Question 39

39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[ a^2 = 22^2 + 43^2 - 2 \times 22 \times 43 \times \cos 52° \]
\[ a = \sqrt{1849 + 1892 - 1892 \cos 52°} \]
\[ a = 31.96937761 \]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[ a^2 = 2383 - 1892 \cos 128° \]
\[ a^2 = 2333 + 1310.958895 \]
\[ a = 1022.041105 \]
\[ a = 31.96937761 \]

Score 2: The student only made a correct substitution into the Law of Cosines.
39. Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

Find, to the nearest degree, the angle between the smaller force and the resultant force.

Score 1: The student only drew a correct diagram.
39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[
\begin{align*}
C &= \sqrt{(22)^2 + (43)^2 - 2(22)(43) \cos 52°} \\
\sqrt{C^2} &= \sqrt{2641} \\
C &= 51.39
\end{align*}
\]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

Score 0: The student used 52° instead of 128° and made both a computational and a rounding error.
39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the nearest pound, the magnitude of the resultant force.

\[ \sqrt{22^2 + 43^2 - 2(22)(43)\cos 52} \]

Find, to the nearest degree, the angle between the smaller force and the resultant force.

\[ \frac{65}{\sin 52°} = \frac{51.4}{\sin \theta} \]

\[ \sin \theta = \frac{51.4 \sin 52°}{65} \]

\[ \theta = 51° \]

**Score 0:** The student used 52° instead of 128°, calculated in radians and did not round correctly. The student also added the forces and made a computational error.