College Algebra Word Problem Practice

Directions: For each of the following problems, 1) label the variables and 2) use the given information to write a system of equations which relate these variables. **Do not solve the system at this time.** The object here is to have you practice setting up word problems. You can practice solving the problems later.

Mixture Problems

1. A gas station owner has 30 gallons of gasoline worth $1.20 per gallon and some worth $1.40 per gallon. How many gallons of the $1.40 brand must the owner mix in to produce gasoline that costs $1.28 per gallon?

2. How many pounds of coffee worth $1.44 a pound should be mixed with 20 pounds worth $1.80 a pound to produce a mixture worth $1.56 a pound?

3. How much water must be added to 20 ounces of a 15% solution of argyrol to reduce it to a solution that is 10% argyrol?

4. How much of a 75% copper alloy should be melted into 62 kg of a 35% copper alloy to produce an alloy which is 50% copper?

Motion Problems

5. A hiker climbs a mountain path at the rate of 2 miles per hour. Following the same path down the mountain, the hiker has a rate of 4 miles per hour. If the round trip took 3 hours, how far is it from the top to the bottom of the mountain?

6. A man leaves the town of Elmsville at 8:00 am and drives to Oak City at a constant rate of 50 miles per hour. Two hours later, a woman leaves Elmsville following the same route to Oak City. The man and woman arrive in Oak City at 3:00 p.m. What was the rate of the woman? How far is Elmsville from Oak City?

7. Tim and a friend left a campsite on a trip down a river in a canoe, maintaining a constant speed of 4 miles per hour. Four hours later, Tim's father set out after them in a motorboat carrying the camping supplies. The motorboat traveled at a rate of 12 miles per hour. How long after he started did Tim's father overtake the boys?

8. It takes a passenger train 2 hours less time than it takes a freight train to make the trip from Brownsville to Greentown. If the passenger train averages 60 miles per hour on the trip while the freight train averages 40 miles per hour on the trip, how far is it from Brownsville to Greentown?
Investment Problems

9. Ms. Blackmon invested $8000, part at 4% and the rest at 5% per year. How much did she invest at each rate if her total return per year on the investments was $380?

10. A total of $9000 was invested, part at 6% and the rest at 3% per year. If the annual return from both investments was $396, how much was invested at each rate?

11. A woman had two investments, one paying a 6% dividend. The other is $680 more than half the first investment and pays a 5% dividend. If the total return is $102, find the investments.

12. A man invested a total of $1200 into two accounts, one paying a 4% dividend, the other paying a 6% dividend. The total interest earned was $57. How much was invested into each account?

Geometry Problems

13. Suppose you want to use 600 meters of fencing to surround two identical adjacent rectangular plots. Write a function for the combined area of the plots with respect to the length of one of the sides (x). What dimensions would produce the maximum combined area? What is that maximum combined area?

14. A farmer with 1000 meters of fencing wants to enclose a rectangular plot that borders along a straight river. If the farmer does not want to fence along the river, what is the largest area that can be enclosed? What dimensions produce that area?

15. You decide to build a dog run in a back corner your yard. If you only have 60 feet of fencing, what is the maximum area that you can enclose? What dimensions produce the maximum area?

16. Suppose a stream borders our land, and we want to make a right-triangular garden with the stream as the hypotenuse. If we have only 80 feet of fencing, what is the maximum area of our garden? What dimensions produce the maximum area?

Regression Problems

17. A doctor wished to determine whether a relation exists between the height of a female and her weight. She obtained the heights and weights of 10 females aged 18 to 24. Let height be the independent variable x, measured in inches, and weight be the dependent variable y, measured in pounds.

<table>
<thead>
<tr>
<th>x</th>
<th>60</th>
<th>61</th>
<th>62</th>
<th>62</th>
<th>64</th>
<th>65</th>
<th>65</th>
<th>67</th>
<th>68</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>100</td>
<td>105</td>
<td>110</td>
<td>112</td>
<td>115</td>
<td>120</td>
<td>124</td>
<td>130</td>
<td>132</td>
<td>137</td>
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</table>

a. Use a graphing utility to draw a scatter plot. Record the plot as accurately as possible on your paper.
b. Use the regression capabilities of your graphing utility to find the equation of the line that best fits the data. Include the correlation coefficient with your equation. Round to three decimal places.

c. Use your equation to predict the weight of a woman whose height is 66 inches. Show all of your work.

18. The following table gives the enrollment at NWACC for the Fall semesters from 1990 to 2000. Create a scatter plot of the data. Assuming that enrollment is growing at a constant rate, use the regression capabilities of your calculator to run a linear regression analysis on the data. Let \( x = 0 \) represent 1990. What is the linear equation which best fits the data (round to three decimal places)? What is the correlation coefficient? According to this model, what will enrollment be in the Fall of 2005? How confident are you about this projection? 1.2

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<th></th>
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</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>1232</td>
<td>1632</td>
<td>1889</td>
<td>1972</td>
<td>2037</td>
<td>2244</td>
<td>2941</td>
<td>3240</td>
<td>3542</td>
<td>3923</td>
<td>4095</td>
</tr>
</tbody>
</table>

19. The following table gives the number of motor vehicle thefts (in thousands) in the U.S. for the years 1983 - 1993. \( x = 1 \) represents 1983. Use the regression capabilities of your calculator to fit a cubic model to this data. Round to three decimal places. Use your model to predict the number of motor vehicle thefts in 1995.

<table>
<thead>
<tr>
<th>Year (x)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thefts (y)</td>
<td>1008</td>
<td>1032</td>
<td>1103</td>
<td>1224</td>
<td>1289</td>
<td>1433</td>
<td>1565</td>
<td>1636</td>
<td>1662</td>
<td>1611</td>
<td>1561</td>
</tr>
</tbody>
</table>

20. The table below shows the per capita consumption of beef in the United States in recent years. What is the equation of the regression line which best fits this data? What is the correlation coefficient for this regression line? How close a fit is the regression line? Use the regression line to predict the per capita consumption of beef in 2001.

<table>
<thead>
<tr>
<th>Year</th>
<th>x</th>
<th>Per capita consumption of beef, in lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>0</td>
<td>64.0</td>
</tr>
<tr>
<td>1991</td>
<td>1</td>
<td>63.1</td>
</tr>
<tr>
<td>1992</td>
<td>2</td>
<td>62.8</td>
</tr>
<tr>
<td>1993</td>
<td>3</td>
<td>61.5</td>
</tr>
</tbody>
</table>
21. The table below shows the total annual amount of advertising expenses (in billions of dollars) in the United States in recent years. What is the equation of the regression line which best fits this data? What is the correlation coefficient for this regression line? How close a fit is the regression line? Use the regression line to predict the annual amount of advertising expenses in 2003. \( x = 1 \) corresponds to 1991. Round all numbers to three decimal places.

<table>
<thead>
<tr>
<th>Year (x)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenses (y)</td>
<td>$126.4</td>
<td>$131.3</td>
<td>$138.1</td>
<td>$150.0</td>
<td>$160.9</td>
<td>$173.2</td>
</tr>
</tbody>
</table>

Miscellaneous Problems

Directions: Solve the following problems. Show all of your support work.

22. In 1990, around 115 billion dollars was invested globally in telecommunications infrastructure. In 1994, around 145 billion was spent. Assuming that global investment in telecom infrastructure is growing at a constant rate, write a linear model which gives investment (I) in billions of dollars as a function of \( t \), the number of years since 1990. Use your model to predict global telecom investment in 2003.

23. Zeno’s Cabs purchased a taxi for $24,600 in 1994. After 8 years, the cab must be replaced. It’s salvage value is $2,200. Write a linear equation (in slope-intercept form) giving the value of the cab during its 8 years of use. What was the value of the cab 3 years after it was purchased? Show all of your support work.

24. Congratulations! You have just won a jet ski worth $8000. The depreciated value of the jet ski \( (V) \) after \( t \) years is given by \( V = 8000 - 725t \), \( 0 \leq t \leq 11 \).
   a. Use a graphing utility to graph the equation. Include a t-chart with at least 5 key points with your accurate labeled graph.
   b. After how many years will the jet ski be worth $5100? Show all of your work or explain how you came up with your answer.
   c. What will be the value of the jet ski after 9 years? Show all of your work or explain how you came up with your answer.

25. The cost of installing insulation in a particular two-bedroom house is $1080. Present monthly heating bills average $60, but the insulation is expected to reduce the heating cost by 10%. How many months will it take to recover the cost of the insulation? Show all of your work or explain how you came up with your solution.

26. To get a B in American Government, you must have an average of at least 80% on four exams. The first three exams are 100 points each, and the final is 200 points. If you have scored 75, 87, and 83 on the first three exams, what must you score on the final to earn a B in the course? Solve the problem algebraically and show all of your support work.
Quadratic Applications. Solve the following problems algebraically. Do not use a graphing calculator.

27. A textile manufacturer has daily production costs of $C = 0.55x^2 - 110x + 10,000$ where $C$ is the total cost (in dollars) and $x$ is the number of units produced. Determine how many units should be produced each day to yield a minimum cost. What is that minimum cost? Show all of your work.

28. The *Guinness Book of World Records* reports that German shepherds can make vertical leaps over 10 feet when scaling walls. If the distance $d$ (in feet) off the ground after $t$ seconds is given by the equation $d = -16t^2 + 24t + 1$, for how many seconds is the dog more than 9 feet off the ground? Show all of your work or explain how you came up with your solution.

29. To determine the appropriate landing speed of an airplane, the formula $D = 0.1x^2 - 3x + 22$ is used, where $x$ is the initial landing speed in feet per second and $D$ is the distance needed in feet. If the landing speed is too fast, the pilot may run out of runway; if the speed is too slow, the plane may stall. What is the appropriate landing speed if the runway is 800 feet long? Show all of your work or explain how you came up with your solution.

30. The national catch of Atlantic Cod has been declining in the past few decades. We can model this decline with the equation $y = -0.003x^2 + 0.120x + 1.909$ where $x$ is the number of years since 1950 and $y$ is the catch in millions of metric tons. In which year did the catch reach its maximum? In which year will the catch reach 0? For what years was the catch increasing? Decreasing? When was the catch greater than 2.5 million metric tons? Show all of your work or explain how you came up with your solutions.