Math 152, Intermediate Algebra

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Practice Problems #1

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1) Evaluate each of the following expressions for the given values of the variables.

a) \(3x - 2y^2; x = 2, y = -3\)  
   b) \(2 - 2\left(x - \left[y\right]\right); x = 0, y = -6\)  
   c) \(\frac{5x}{2 + x - y}; x = 6, y = 2\)

d) \(\frac{1}{xy}; x = -3, y = -1\)  
   e) \(-\frac{3x^2 + xy}{2 - (xy)}; x = 10, y = -3\)  
   f) \(\frac{2x^3}{xy - x}; x = -2, y = 1\)

g) \((x - y + z)^2; x = 1, y = 2, z = -4\)  
   h) \(x^2 - y^2 + z^2; x = 1, y = 2, z = -4\)  
   i) \(-x^2; x = 3\)

2) Use the basic rules of algebra to simplify each of the following expressions.

a) \(-2(m + n) - 3(m - n)\)  
   b) \(2x + \frac{1}{2}(4x - 8) - x\)  
   c) \(-3p + p(p - 2) - p^2\)

d) \(a^3 + a^2 - a(a^2 + a)\)  
   e) \(12x - \left[9 - 7(5x - 6)\right]\)  
   f) \(\frac{1}{3}x(6x - 9y) - \frac{1}{2}y(4x + 10)\)

g) \(\frac{2}{3} \left(6x^2 - \frac{3}{2}x\right) - \frac{1}{3}(9x^2 - 12x)\)  
   h) \(\frac{5}{4} \left(\frac{4}{3}x^3 + \frac{4}{5}x^2\right) + 3x\left(x - \frac{1}{9}x^2\right)\)  
   i) \(\left(\frac{3}{2x}\right) \left(\frac{3}{2}\right)\)

3) Solve each of the following equations. If the equation is an identity or a contradiction, state this along with the solution.

a) \(7x - 2 = 12\)  
   b) \(x - 8 = 2x + 1\)  
   c) \(1 - 0.2b = 0.2b + 6.4\)

d) \(\frac{1}{2}(6a - 18) = \frac{1}{3}(3a + 3)\)  
   e) \(3\left(x - \frac{1}{3}\right) - x = 10\)  
   f) \(\frac{2p - 7}{3} + 1 = 2\)

g) \(4 + 7b = 7(b + 2)\)  
   h) \(2p + 6 + p = 6 + 3p\)  
   i) \(5a - 17 - 2a = 6a - 1 - a\)

j) \(3[2 - 4(r - 1)] = 3 - 4(r + 2)\)  
   k) \(\frac{1}{3}\left(b + \frac{3}{4}\right) = \frac{5}{3}(2 - b)\)  
   l) \(\frac{2}{5}\left(\frac{3}{4}m - \frac{5}{3}\right) - \frac{4}{3} = \frac{5}{3}\)

m) \(6 - (x + 3) - 3x = 5 - 2x\)  
   n) \(b = \frac{3}{4}(b + 4) = 2\)  
   o) \(7 - 3(2 - \frac{1}{6}m) = 9 + \frac{1}{2}m\)

p) \(\frac{x - 2}{4} = \frac{2}{3}x + 2\)  
   q) \(9p + 12 + 6(p - 2) = 15p\)  
   r) \(\frac{3y + 4}{2} - \frac{4y + 1}{3} = 0\)
4) Solve each of the following inequalities and then graph the solution on the number line.

a) \(2x - 1 \leq 9\) 

b) \(1 - 3x > 2x - 8\) 

c) \(3(p + 1) \geq 4p + 3 - p\) 

d) \(8m - 3(1 + m) < -3\) 

e) \(\frac{2}{3}b - \frac{b + 1}{3} \geq 6 - b\) 

f) \(4.7w - 5.48 > 11.44\) 

g) \(\frac{4y + 3}{3} - 5 \leq 0\) 

h) \(3.6y > 3(1.2y - 5)\) 

i) \(\frac{3}{4}(20h - \frac{16}{3}) \leq \frac{5}{2}(6h - 2)\) 

j) \(\frac{x - 5}{3} + 3(x - 1) \leq x\) 

k) \(-4(2m - 6) \leq -3(m - 4) + m\) 

l) \(\frac{4}{5}w - \frac{2}{5}(3w - 7) > \frac{2}{5}w - \frac{6}{5}\)

5) Explain the error(s) in the work done for each problem ... then do the problem correctly.

a) Simplify the following expression. 

b) Solve the following equation. 

\[\frac{2x^2 - 9 + (x + 3)^2}{3 - x^3 + x(x^2)}\]

\[4y - 2(y - 8) = 1 - 3(y - 1)\]

\[3(x - 6) < 5(x + 9)\]

\[3x^2 - 9 + x^2 + 9\]

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

\[= 4y - 2y + 16 = 1 - 3y - 3\]

\[= 2y + 16 = -2 - 3y\]

\[= 2x \leq 9 \times 5 + 45\]

\[= 3x \leq 9 - 5x + 45\]

\[= -2x < 54\]

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

\[5y = -18\]

\[= x^2\]

\[y = -\frac{18}{5}\]

\[x < -27\]

6) The following (scientifically reliable) formula converts a temperature on the Celsius scale, \(C\), to a temperature on the Fahrenheit scale, \(F\).

\[F = \frac{9}{5}C + 32\]

a) Determine the Fahrenheit equivalent of 37°C.

b) Determine the Celsius equivalent of 70°F.

c) At what temperature does water freeze? Give answer on both scales.

d) At what temperature does water boil? Give answer on both scales.
7) “Water scarcity” is likely to be a major economic and political issue in the next few decades. As groundwater sources become depleted/compromised, more people are forced to resort to bottled water. The following (very simplistic) model predicts the average amount of bottled water consumed by people in the United States. In this model, \( W \) represents the average amount of water (measured in gallons per person per year) and \( Y \) represents the number of years after 1996.

\[
W = 13 + 1.2Y
\]

a) According to this model, how much bottled water does the average person in the United States consume now?

b) According to this model, when will the average person in the United States consume a gallon of bottled water every week? **Hint:** There are 52 weeks in a year.

8) The following (fairly simplistic) model predicts the global population, \( P \) in billions of people, \( T \) years after the year 2000.

\[
P = \frac{6 + 0.75T}{1 + 0.07T}
\]

a) According to this model what was the global population in 2000? Is this model accurate?

b) Use this model to predict the global population three years from now.

c) Use this model to predict when the global population will reach 10 billion people.

9) The following model predicts the respiratory rate, \( R \) in breaths per minute, of a sheep whose wool length is \( W \) centimeters.

\[
R = 195 - \frac{35}{2}W
\]

a) Predict the respiratory rate of a naked sheep.

b) If a sheep is dead (zero breaths per minute) what must be the length of it's wool?

c) Obviously this model has limitations … name some specific ones.

10) When a new car is purchased its value decreases rapidly at first and then slower later on. Suppose the value of a new car is estimated by the following model where \( V \) represents the value (in thousands of dollars) and \( N \) represents the number of years of ownership.

\[
V = \frac{50 + 0.2N}{2 + 1.2N}
\]

a) According to this model what was the value of the car when new?

b) According to this model what will the value of the car be after five years?

b) According to this model when will the car be worth $5,000?

d) Why estimate the value of a car? Who cares what your car is worth? Identify at least two entities that care … why do they care?
1) For each of the following functions, find the specified values (if they exist).

a) \( f(x) = 2x - 5 \); \( f(-2), \ f(0), \ f(3) \)

b) \( g(t) = 1 - t^2 \); \( g(-10), \ g(1), \ g(8) \)

c) \( h(n) = 0.1n^2 - n \); \( h(0), \ h(100), \ h(200) \)

d) \( f(x) = \frac{x + 1}{x - 3} \); \( f(0), \ f(-1), \ f(3) \)

e) \( f(t) = \sqrt{t - t^2} \); \( f(-5), \ f(1), \ f(8) \)

f) \( C(x) = 8000 - 12x \); \( C(0), \ C(10), \ C(20) \)

g) \( R(x) = \frac{1}{x^3 - 8} \); \( R(2), \ R(-2), \ R(4) \)

h) \( g(x) = \sqrt{1 - x} \); \( g(1), \ g(-8), \ g(10) \)

2) Climate scientists pay attention to the concentration of carbon dioxide in the atmosphere. The simple linear function \( C(T) = 387 + 3.25T \) predicts the concentration of carbon dioxide (C in parts per million) in the atmosphere \( T \) years after 2009.

a) Find \( C(6) \) ... What does this tell us?

b) Find \( C(11) - C(1) \) ... What does this tell us?

c) Solve the equation \( C(T) = 500 \) ... What does the solution to this equation tell us?

3) The linear function \( V(N) = 18500 - 1500N \) predicts the value, \( V \) in dollars, of a particular car \( N \) years after purchase.

a) Find \( V(0) \) ... What does this tell us?

b) Find \( V(20) \) ... Does this make sense? Why?

c) Determine the domain and range of this function.

4) The function \( P(T) = \frac{60 + 9T}{10 + 0.9T} \) predicts the global population, \( P \) in billions of people, \( T \) years after the year 2000.

a) Find \( P(0), P(20), P(40), P(60), P(80), \) and \( P(100) \) ... What does the pattern in these numbers suggest? What can we say about the rate at which the population is increasing?

b) If the domain for this function is \( 0 \leq T \leq 100 \), what is the range?

5) The theory behind mass production is simple: the more items you produce, the less it costs to produce each item that is, the lower the per-item cost. This theory only goes so far ... it's possible to over produce and have per-item cost start to go back up. The function \( C(N) = 0.002N^2 - 0.48N + 33 \) predicts the per-item cost if \( N \) items are produced.

a) Is \( C(50) > C(100) \) or is \( C(50) < C(100) \)? Why?

b) What would the solution to \( C(N) = 0 \) tell us? Is this possible?

c) Discuss any restrictions on the domain and range of this function. Hint: Graph this function with the help of a calculator.
6) For each of the following graphs, determine if $y$ is a function of $x$.

a) ![Graph A]

b) ![Graph B]

c) ![Graph C]

d) ![Graph D]

e) ![Graph E]

f) ![Graph F]

7) Determine the domain and range for each function shown.

a) ![Graph A with points]

b) ![Graph B with points]

c) ![Graph C with point]

d) ![Graph D with point]

e) ![Graph E with points]

f) ![Graph F with point]
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1) Plot each ordered pair and state which quadrant it is in: (3, 2), (-4, -1), (3, -3), (-2, 5).

2) For each linear relationship, complete the table, plot the points, and graph the line.
   a) \( y = 3x - 2 \)
   b) \( 2x - y = 0 \)

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   c) \( x - 1 = 2y \)
   d) \( 3x + 2y = 1 \)

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3) Create an accurate graph of each linear relationship. Label the axes accordingly and label all intercepts using ordered pair notation.
   a) \( f(x) = x + 1 \)
   b) \( 2y = 1 - 4x \)
   c) \( x + y = 5 \)
   d) \( 2y - 3 = x - 3 \)
   e) \( f(x) = \frac{2}{3}x + 2 \)
   f) \( f(x) = -\frac{1}{2}x - 3 \)
   g) \( y = x \)
   h) \( x - 2 = 3f(x) + 4 \)
   i) \( 3y - 2x = 4 \)
   j) \( f(x) = \frac{1 - 2x}{3} \)
   k) \( \frac{x}{2} - 5 = y + \frac{1}{2} \)
   l) \( x = -6 \)
   m) \( x = 3 \)
   n) \( y = 5 \)
   o) \( y = -8 \)

4) Determine the slope of the line that passes through each pair of points.
   a) \((2, 3), (4, 5)\)
   b) \((-1, 0), (3, 2)\)
   c) \((2, 2), (3, -7)\)
   d) \((3, 5), (-3, 5)\)
   e) \((-3, 0), (-3, 10)\)
   f) \((4, 5), (-1, 3)\)
   g) \((0, 0), (4, 6)\)
   h) \((4, -12), (13, 15)\)
   i) \((6, -2), (6, 5)\)
   j) \((3, 7), (-3, 7)\)

5) Determine the slope number for each linear relationship.
   a) \( y - 3 = 2x \)
   b) \( 2x + y = 6 \)
   c) \( 2f(x) + x = 0 \)
   d) \( x - 6 = -f(x) \)
   e) \( 14x - 28y = 1 \)
   f) \( 3(x - 2) = y - 4 \)
   g) \( f(x) = x \)
   h) \( x = 5 \)
   i) \( x - y = 1 \)
   j) \( 2x - 1 = \frac{y}{3} \)
   k) \( \frac{3x - 5}{2} = 2y - \frac{1}{3} \)
   l) \( y = -2 \)
   m) \( 3x = 6 \)
   n) \( y - 2 = 2 \)
   o) \( 2y - x = 10 - x \)
6) Suppose Alex (who’s 25 years old) takes a job with a starting salary of $28,000 and each year he gets a $3,100 raise. His income, I, is modeled by the linear function $I(N) = 28000 + 3100N$ where N represents the number of years he has spent at the job.

   a) Think about domain and range issues for this model.
   b) Graph this function (keep the domain and range in mind).
   c) When will his salary be $100,000?
   d) When will his salary be $250,000? Is this reasonable?

7) In the United States, the per-capita consumption of beef has been decreasing since 1970. This decrease is modeled by the function $C(N) = 79 - 0.68N$ where N represents the number of years after 1970 and C represents the per-capita consumption in pounds per year.

   a) Think about domain and range issues for this model.
   b) Graph this function (keep the domain and range in mind).
   c) Find and interpret both intercepts.
   d) What is the slope number for this line? Why is it negative?

8) The number of acres in the National Park System is decreasing. This decrease can be modeled by $A(t) = 76.4 - 0.375t$ where t represents the number of years after 1990 and A represents the number of acres in millions.

   a) Think about domain and range issues for this model.
   b) Graph this function (keep the domain and range in mind).
   c) Find the t-intercept for this line ... think about what information this point provides ... is this situation possible?
   d) Put into words (using the appropriate units) the meaning of the slope number for this linear model.

9) According to data from World Resources Institute (www.wri.org), the global carbon dioxide emissions have increased from 14 billion tons in 1970 to 24 billion tons in 1995. The linear model that fits this data is $E(T) = 14 + 0.4T$ where T represents the number of years after 1970 and E is the emissions in billions of tons.

   a) Do you think there is an upper bound on T for this model? Why?
   b) Graph this function for the years 1970 to 2020. Label your graph carefully.
   c) Put into words (using the appropriate units) the meaning of the slope number for this linear model.
   d) According to this model, when will emissions be triple what they were in 1970?

10) Suppose Dave takes out a loan to pay for a car and pays it off by making equal monthly payments. The balance, B, owed on the loan is given the linear function $B(N) = 13200 - 275N$ where N represents the number of monthly payments that have been made.

    a) Find and interpret the B-intercept for this function.
    b) Find and interpret the N-intercept for this function.
    c) The slope number for this function is -275 ... in plain words, explain what this number means. Why is the slope number negative?
1) Determine the slope number for each line shown.

(a) \[y = \frac{1}{2}x + 3\]

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

(c) \[y = \frac{2}{3}x - 4\]

(d) \[y = \frac{3}{4}x - 2\]

(e) \[y = 4x - 5\]

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

2) Determine the slope number for each linear relationship. Write a sentence that explains what the slope number tells us. Be sure to include the appropriate units.

(a) Population in millions vs. Time in years

(b) Value in dollars vs. Time in years

(c) Profit in dollars vs. Items produced

(d) Salary in dollars vs. Years on the job

(e) Cost (x $1000) vs. Time in years

(f) Acres (in millions) vs. Time in years
3) Find the equation of each line shown. Present your equation in the *Slope-Intercept* form.

a) 

b) 

c) 

d) 

e) 

f) 

4) Find the equation for each linear relationship shown. Present your equation in the *Slope-Intercept* form. Be sure to use the correct variables/notation.

a)  

b)  

c)  

d)  

5) In each of the following figures, a scatter plot is shown for the data set. Estimate the line of best fit for each scatter plot. Present your equation in Slope-Intercept form.

a) ![Image a]

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d) ![Image d]

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6) For each situation, assume that the relationship between the two variables is linear and find the equation of the requested function.

a) Jay takes a job with a starting salary of $42,000 per year and each year he gets a $5200 raise. Find S(N) where S is his salary and N is the number of years on the job.

b) The per-capita consumption of chicken in the U.S. has been increasing since 1970. In 1970 it was 26 pounds per year and in 1993 it was 47 pounds per year. Find C(t) where C is the per-capita consumption in pounds per year and t is the number of years after 1970.

c) The amount of "garbage" produced in California is increasing. In 1997, we produced 52 million tons and in 2006 we produced 91 million tons. Find G(T) where G is the amount of garbage in millions of tons and T is the number of years after 1997.

d) The life expectancy of the average female in the U.S. is increasing. In 1980 it was 77.4 years and in 1987 it was 78.3 years. Find E(n) where E the life expectancy and n is the number of years after 1980.

e) The number of deaths in the U.S. due to motor vehicle accidents is decreasing (why?). In 1980 there were 46.7 deaths per 100,000 people and in 1990 there were 37.0 deaths per 100,000 people. Find D(T) where D is the number of deaths per 100,000 people and T is the number of years after 1980.

f) The number of acres in the National Park System is decreasing. In 1990 there were 76.4 million acres and in 1994 there were 74.9 million acres. Find A(N) where A is the number of acres in millions and N is the number of years after 1990.

g) Coming soon…

h) Coming soon…

i) Coming soon…

j) Coming soon…

7) Consider the line shown in the following figure.

\[ \begin{align*}
\text{(2, 2)} & \quad \text{and is parallel to the line shown.} \\
\text{(-2, 1)} & \quad \text{Find the equation of the line that passes through (2, 2) and is parallel to the line shown.} \\
\text{(-3, 0)} & \quad \text{Find the equation of the line that passes through (-2, 1) and is perpendicular to the line shown.} \\
\text{(6, -3)} & \quad \text{Find the equation of the line that passes through (1, -6) and is parallel to the line shown.}
\end{align*} \]

8) Consider the line shown in the following figure.

\[ \begin{align*}
\text{(4, 5)} & \quad \text{Find the equation of the line that passes through the origin and is parallel to the line shown.} \\
\text{(-3, 0)} & \quad \text{Find the equation of the line that passes through (1, 1) and is perpendicular to the line shown.} \\
\text{(6, -3)} & \quad \text{Find the equation of the line that passes through (0, 5) and is perpendicular to the line shown.}
\end{align*} \]
9) Consider the line shown in the following figure.

a) Find the equation of the line that passes through (5, 100) and is parallel to the line shown.

b) Find the equation of the line that passes through (0, 0) and is perpendicular to the line shown.

10) Consider the line shown in the following figure.

a) Find the equation of the line that passes through (3, -6) and is parallel to the line shown.

b) Find the equation of the line that passes through (-1, 1) and is perpendicular to the line shown.

11) Find the equation of the line that...

a) Passes through (-2, 3) and is parallel to \( y = 3x - 1 \).

b) Passes through (0, -2) and is parallel to \( 2x - y = -6 \).

c) Passes through the origin and is perpendicular to \( 3y = 4x \).

d) Passes through (6,10) and is perpendicular to \( y = 2 \).

e) Passes through (6, 4) and is parallel to the line containing (-3, 4) and (6, 2).

f) Passes through (-14, 0) and is perpendicular to the line containing the origin and the point (6, 0).

g) Passes through (-1, 5) and is perpendicular to the line that passes through (5, 4) and (0, -8).

h) Passes through (3, 14) and is parallel to the identity line.
1) Write each of the following using interval notation.

a) [-3, 12]  
b) [-1, -8]  
c) [15, 120]  
d) (-\infty, 12]  
e) (1, 15)  
f) (-\infty, 15]  

2) For each of the following intervals, produce a number line graph.

a) (2, 4]  
b) (-3, 5)  
c) [0, 5]  
d) (-\infty, 8)  
e) [1, \infty)  
f) [128, 129)  

3) Solve each of the following inequalities and present the solution algebraically, graphically, and using interval notation.

a) \(2(x - 3) > -6\)  
b) \(-\frac{3}{4}x - 1 \geq 5\)  
c) \(3(x - 2) < 5(x - 1)\)  
d) \(\frac{1}{2}x + 7 \leq \frac{3}{4}x - 5\)  
e) \(-3 < \frac{3x + 1}{2} \leq 5\)  
f) \(3 \leq 5(x - 3) \leq 8\)  
g) \(2 \leq 4 - \frac{1}{2}(x - 8) < 10\)  
h) \(-0.68 < 1.02x + 0.34 < 3.4\)  

4) The following graph shows the revenue and cost lines for a small manufacturing company. The company has start-up costs of $640 and each item costs $8.45 to make. They then sell each item for $22.75 (this is the revenue).

a) If no items are produced and sold, profit (profit = revenue - cost) is -$640. What does this mean? Why is the profit negative?

b) What is the profit if 30 items are produced and sold? What if 60 items are produced and sold?

c) How many items would have to be produced and sold to break even (profit = 0, in other words, revenue = cost)?

5) Suppose Eddie is planning a 3-day road trip and wants to rent a car. He has the choice of two plans for the same car. Plan A charges $14.95 per day plus 20¢ per mile and Plan B charges $49.95 per day and has no charge for mileage. Explain under what circumstances Plan B would be a better choice. Be specific about the mileage.
6) The following graph shows how beef and chicken consumption have changed in the United States since 1970. Consumption is measured in pounds per person per year. For example, in 1970 the average person consumed 79 pounds of beef and 26 pounds of chicken. The equation for each line is given ... N represents the number of years after 1970. According to these models...

a) When will chicken consumption be two pounds a week?

b) When will beef consumption be a pound a month?

c) When did chicken consumption exceed beef consumption?

d) Will beef consumption ever be zero? If yes, when? If no, why not?

![Graph showing beef and chicken consumption change over years]

Beef: \[ B = 79 - 0.68N \]

Chicken: \[ C = 26 + 0.91N \]

7) A few months ago I was approached by a real estate agent saying that he had a client interested in buying my house. He told me that my house could sell for $875,000 … I was skeptical and thought that it would sell for less. The real estate agent wanted a 4% commission … and I suspected that he knew the house would sell for $800,000 and he would walk away with $32,000 … I decided that this was not in my best interest. I decided that it was only worth my while if the house could sell for a minimum of $825,000. I proposed an alternative to his 4% commission: $25,000 plus 35% of any amount over my minimum of $825,000. He did not like the offer …

a) Suppose the house sold for $825,000 … by my plan he would get $25,000 in commission … what would his 4% plan get him?

b) Suppose the house sold for $875,000 … what would his 4% plan get him in commission? What would my plan get him in commission?

c) Clearly my plan earns him a higher commission if the selling price is "high enough". "High enough" is the critical issue here … what selling price makes my plan beneficial?

d) Why did this agent not like my offer? *Hint: He is the buyer’s agent, not mine as the seller.*

8) Graph each of the following inequalities in the plane. Be sure the boundary line is accurate.

a) \[ y \geq x + 4 \]

b) \[ x + y < 4 \]

c) \[ 3x + 4y \geq 12 \]

d) \[ 2x - 2y > 8 + 2y \]

e) \[ 8x + 5y > 20 \]

f) \[ x < -3 \]

g) \[ y \geq -1 \]

h) \[ y < x \]

i) \[ -3x + 2y > 2 \]

j) \[ \frac{1}{2}y - 3x \leq 4 \]

k) \[ \frac{4 - x}{3} - \frac{5y - 3}{2} > x - 2 \]

l) \[ 2y \leq 7x - 2 \]