**Pre-calculus 10**

**Chapter 4**

**Linear Functions**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Mr. Formaran**

**4.1 Slope**

The \_\_\_\_\_\_\_\_\_\_\_ of a linear equation describes the steepness and direction of a line.



Positive Slope

Negative Slope

Zero Slope

Undefined Slope



Slope (m)



Finding Slope from Graph



Example of **Positive** Slope





C

vertical change 6 3

horizontal change 4 2

Slope of segment AB = = =



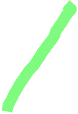
B



vertical change 9 3

horizontal change 6 2

Slope of segment AC = = =



A

vertical change 3

horizontal change 2

Slope of segment BC = =

Another Example of **Positive** Slope



vertical change

horizontal change

Slope of segment AB = = =



vertical change

horizontal change

Slope of segment AC = = =



vertical change

horizontal change

Slope of segment BC = =



My Own Example of **Positive** Slope



vertical change

horizontal change

Slope of segment AB = = =

vertical change

horizontal change

Slope of segment AC = = =

vertical change

horizontal change

Slope of segment BC = =

Example of **Negative** Slope



vertical change 3

horizontal change 4

Slope of segment AB = = -

A

vertical change 6 3

horizontal change 8 4

Slope of segment AC = = - = -



B



vertical change 3

horizontal change 4

C

Slope of segment BC = = -



Another Example of **Negative** Slope



vertical change

horizontal change

Slope of segment AB = = =



vertical change

horizontal change

Slope of segment AC = = =



vertical change

horizontal change

Slope of segment BC = =



My Own Example of **Negative** Slope



vertical change

horizontal change

Slope of segment AB = = =

vertical change

horizontal change

Slope of segment AC = = =

vertical change

horizontal change

Slope of segment BC = =

Finding Slope from Ordered Pairs

Example of **Positive** Slope



y2 – y1 - 4 – 2 - 6 3

x2 – x1 - 2 - 2 - 4 2

(4, - 5)

C

Slope of segment AB = = = =

B

(2, 2)

y2 – y1 - 4 – 5 - 9 3

x2 – x1 - 2 - 4 - 6 2

Slope of segment AC = = = =

(- 2, - 4)

A



y2 – y1 2 – 5 - 3 3

x2 – x1 2 - 4 - 2 2

Slope of segment BC = = = =

Another Example of **Positive** Slope





y2 – y1

x2 – x1

Slope of segment AB = = = =



y2 – y1

x2 – x1

Slope of segment AC = = = =



y2 – y1

x2 – x1

Slope of segment BC = = = =



My Own Example of **Positive** Slope



y2 – y1

x2 – x1

Slope of segment AB = = = =

y2 – y1

x2 – x1

Slope of segment AC = = = =

y2 – y1

x2 – x1

Slope of segment BC = = = =

Example of **Negative** Slope



y2 – y1 - 2 – 1 - 3

x2 – x1 1 – (-3) 4

Slope of segment AB = = =

A

y2 – y1 - 5 – 1 - 6 - 3

x2 – x1 5 – (-3) 8 4

(- 3, 1)

Slope of segment AC = = = =

(1, -2)

B

y2 – y1 - 5 – (-2) - 3

x2 – x1 5 – 1 4

C

Slope of segment BC = = =

(5, - 5)

Another Example of **Negative** Slope





y2 – y1

x2 – x1

Slope of segment AB = =



y2 – y1

x2 – x1

Slope of segment AC = =



y2 – y1

x2 – x1

Slope of segment BC = =



My Own Example of **Negative** Slope



y2 – y1

x2 – x1

Slope of segment AB = =

y2 – y1

x2 – x1

Slope of segment AC = =

y2 – y1

x2 – x1

Slope of segment BC = =

Lines With Zero ( 0 ) Slope and Undefined ( 0 )Slope

Example of **Zero** Slope

A

B

(4, 2)

(- 4, 2)

y2 – y1 2 – 2 0

x2 – x1 4 – (-4) 8

Slope of segment AB = = = = 0



Another Example of **Zero** Slope



y2 – y1

x2 – x1

Slope of segment AC = = = =





My Own Example of **Zero** Slope

y2 – y1

x2 – x1

Slope of segment AC = = = =

Example of **Undefined** Slope



A

(3, 4)

y2 – y1 - 4 – (4) - 8

x2 – x1 3 – 3 0

Slope of segment AB = = = = 0

(3, - 4)

B

Another Example of **Undefined** Slope



y2 – y1

x2 – x1

Slope of segment AC = = = =



My Own Example of **Undefined** Slope

y2 – y1

x2 – x1

Slope of segment AC = = = =

**4.2 Rate of Change**

The Greek letter Delta ( ) is used to represent change.



y y2 – y1

x x2 – x1

Rate of Change = = Rates of Change in Fraction Notation:



1. kilometres per hour =



2. miles per gallon =



3. dollars per hour =



Rates of Change:

1. If the city of Surrey grew by 120 000 people over a year period, it has a rate of



\_\_\_\_\_\_\_\_\_\_\_\_\_

=



\_\_\_\_\_\_

2. If a person runs the 400 metre race in 56 seconds, he is running at a rate of =



Example 1

Carly rents a car with the gas tank full. The odometer registered 86 347 km. Carly used it for three days. When the car was returned the odometer reading was 86 721 km and it needed 63 litres to fill up. The cost of renting the car was $96 plus gas which cost 90 cents per litre.



a. Determine the rate of gas consumption for the car in kilometres per litre.



b. Determine the average rate of travel per day.



c. Determine the cost of renting the car per day.



Example 1b

Carly rents a car with the gas tank full. The odometer registered \_\_\_\_\_\_\_\_\_\_\_\_\_ km. Carly used it for \_\_\_\_\_ days. When the car was returned the odometer reading was \_\_\_\_\_\_\_\_\_\_\_\_ km and it needed \_\_\_\_\_\_ litres to fill up. The cost of renting the car was $\_\_\_\_\_ plus gas which cost \_\_\_\_\_\_\_\_\_\_ per litre.

a. Determine the rate of gas consumption for the car in kilometres per litre.

b. Determine the average rate of travel per day.

c. Determine the cost of renting the car per day.

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Carly rents a car with the gas tank full. The odometer registered \_\_\_\_\_\_\_\_\_\_\_\_\_ km. Carly used it for \_\_\_\_\_ days. When the car was returned the odometer reading was \_\_\_\_\_\_\_\_\_\_\_\_ km and it needed \_\_\_\_\_\_ litres to fill up. The cost of renting the car was $\_\_\_\_\_ plus gas which cost \_\_\_\_\_\_\_\_\_\_ per litre.

a. Determine the rate of gas consumption for the car in kilometres per litre.

b. Determine the average rate of travel per day.

c. Determine the cost of renting the car per day.

Example 2

Between 2000 and 2010, the cost of a TV dropped from $4600 to $1200. Graph this

result, and determine the average drop in price per year.







Example 2b



Between 20\_\_ and 20\_\_, the cost of a TV dropped from $\_\_\_\_\_\_\_\_\_ to $\_\_\_\_\_\_\_\_\_.



Graph this result, and determine the average drop in price per year.







**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Between 20\_\_ and 20\_\_, the cost of a TV dropped from $\_\_\_\_\_\_\_\_\_ to $\_\_\_\_\_\_\_\_\_.

Graph this result, and determine the average drop in price per year.



Example 3

Most cars depreciate as they age. A car costing $30 000 will have a value of $2500 at the

end of 10 years.



a. Write the formula for its value V, when it is t years old.



b. Draw a graph of this linear function.





c. Determine the car’s value after 4.5 years.



d. When is the car’s value between $12 000 and $15 000?



e. How much value does the car lose every 2.5 years?



f. What is the rate of change of the car’s value with respect to time?



Example 3b

Most cars depreciate as they age. A car costing $\_\_\_\_\_\_\_\_\_ will have a value of $\_\_\_\_\_\_

at the end of \_\_\_ years.

a. Write the formula for its value V, when it is t years old.

b. Draw a graph of this linear function.



c. Determine the car’s value after 4.5 years.

d. When is the car’s value between $12 000 and $15 000?

e. How much value does the car lose every 2.5 years?

f. What is the rate of change of the car’s value with respect to time?

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Most cars depreciate as they age. A car costing $\_\_\_\_\_\_\_\_\_ will have a value of $\_\_\_\_\_\_

at the end of \_\_\_ years.

a. Write the formula for its value V, when it is t years old.

b. Draw a graph of this linear function.



c. Determine the car’s value after 4.5 years.

d. When is the car’s value between $12 000 and $15 000?

e. How much value does the car lose every 2.5 years?

f. What is the rate of change of the car’s value with respect to time?

Example 4

Georgia sells computers. She is paid a basic salary of $1500, plus $400 for every five

computers she sells.

a. Write a formula for Georgia’s monthly wage.

b. How many computers must be sold for Georgia to make at least $3440 in one month?

c. Determine Georgia’s wage in a month when she sells 60 computers.

d. What is the rate of change of Georgia’s wage with respect to the number of computers

sold?

Example 4b

Georgia sells computers. She is paid a basic salary of $\_\_\_\_\_\_\_\_, plus $\_\_\_\_\_\_\_ for

every \_\_\_\_\_ computers she sells.

a. Write a formula for Georgia’s monthly wage.

b. How many computers must be sold for Georgia to make at least $3440 in one month?

c. Determine Georgia’s wage in a month when she sells 60 computers.

d. What is the rate of change of Georgia’s wage with respect to the number of computers

sold?

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Georgia sells computers. She is paid a basic salary of $\_\_\_\_\_\_\_\_, plus $\_\_\_\_\_\_\_ for

every \_\_\_\_\_ computers she sells.

a. Write a formula for Georgia’s monthly wage.

b. How many computers must be sold for Georgia to make at least $3440 in one month?

c. Determine Georgia’s wage in a month when she sells 60 computers.

d. What is the rate of change of Georgia’s wage with respect to the number of computers

sold?

Example 5

In the morning, Anna typed nine pages in 45 minutes. After lunch, she typed 18 pages in

1 hour, 20 minutes. If the pages typed were approximately the same length, did she type faster in the morning of after lunch?

Example 5b

In the morning, Anna typed nine pages in \_\_\_\_ minutes. After lunch, she typed \_\_\_ pages

in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If the pages typed were approximately the same length, did she type faster in the morning of after lunch?

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

In the morning, Anna typed nine pages in \_\_\_\_ minutes. After lunch, she typed \_\_\_ pages

in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If the pages typed were approximately the same length, did she type faster in the morning of after lunch?

**4.3 Graphing Linear Functions**

Example 1 Graph a line with slope 2, going through the point (1 , - 4)







Example 1b Graph a line with slope \_\_\_, going through the point (\_\_\_\_\_\_\_\_)







**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Graph a line with slope \_\_\_, going through the point (\_\_\_\_\_\_\_\_)



Example 2 Find a point in quadrant IV on the line with slope - going through the point



1

3

(- 5 , 2)





\_\_

Example 2b Find a point in quadrant IV on the line with slope - going through the point

(\_\_\_\_\_\_)







**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

\_\_

Find a point in quadrant IV on the line with slope - --- going through the point

(\_\_\_\_\_\_)



Intercepts

The point at which a graph crosses the y-axis is called y-intercept and the point at which a graph crosses the x-axis is called x-intercept.

The x-intercept of a line is the point (a , 0)

The y-intercept of a line is the point (0 , b)

2

3

Example 3 Determine the x-intercept of the linear equation with slope , going through

 (- 4 , - 2)

\_\_

Example 3 Determine the x-intercept of the linear equation with slope , going through

 (\_\_\_\_\_)

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

\_\_

Determine the x-intercept of the linear equation with slope , going through

 (\_\_\_\_\_\_)

Example 4 Determine the slope of a line with x-intercept (- 3, 0) and y-intercept of (0 , - 4)

Example 4b Determine the slope of a line with x-intercept (\_\_\_\_\_) and y-intercept of (\_\_\_\_\_)

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Determine the slope of a line with x-intercept (\_\_\_\_\_) and y-intercept of (\_\_\_\_\_)

**4.4 Parallel and Perpendicular Lines**

Parallel Lines - lines in a coordinate system that never intersect.



* have identical slopes because they rise or fall at the same rate







m1 =



m2 =



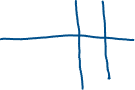
Perpendicular Lines - lines that form right angles when they intersect



a

b

- if the slope of one line is , the slope of the line that is



b

a

perpendicular to it has slope - .



- The product of the slopes of perpendicular lines is - 1





m1 =



(m1) (m2) =



m2 =



Example 1

Determine if the line through the first pair of points is parallel to, perpendicular to, or

neither parallel nor perpendicular to the line through the second pair of points.



a. (- 4, 1) and (3 , 5); (1 , - 3) and (15 , - 11) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



b. (- 4, 1) and (3 , 5); (1 , - 11) and (15 , 3) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



c. (- 4, 1) and (3 , 5); (- 13 , 10) and (- 9 , 3) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



Another example



d. (- 1 , 0) and (5 , 3); (0 , 0) and (- 2 , - 4) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

e. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Example 2

Determine if the line through the first pair of points is parallel to, perpendicular to, or

neither parallel nor perpendicular to the line through the second pair of points.

a. (x, 3) and (3 , x); (7 , x) and (x , 7) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



b. (- x, - 2) and (2 , x); (x , 8) and (8 , x) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



c. (m , a) and (a , m); (t , h) and (h , t) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**4.5 Applications of Linear Relations**



Example 1 A TV repair company charges a fixed amount, plus an hourly rate for a



service call. A two hour service call is $80, and a four hour call is $140.



a. Write the equation that shows how the total cost, T, depends on the number of



hours, h, and the fixed cost, C, Use R for hourly rate.



b. Find the hourly rate.



c. Find the fixed amount cost.



d. Find the domain and range

Domain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Range: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



Example 1b A TV repair company charges a fixed amount, plus an hourly rate for a

service call. A \_\_\_ hour service call is $\_\_\_, and a \_\_\_ hour call is $\_\_\_\_.



a. Write the equation that shows how the total cost, T, depends on the number of

hours, h, and the fixed cost, C, Use R for hourly rate.



b. Find the hourly rate.



c. Find the fixed amount cost.



d. Find the domain and range

Domain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Range: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



Example 2 An antique dresser increases in value $50 per year. The dresser is worth



$600 now.



a. Write the equation that shows how the current worth of the dresser, C, depends on

the number of years, t.



b. What price was paid for the dresser if it was bought three years ago?



c. What will the value of the dresser be in five years?



d. Determine the domain and range.

Domain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Range: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



Example 2b An antique dresser increases in value $\_\_\_ per year. The dresser is worth

$\_\_\_\_\_\_ now.

a. Write the equation that shows how the current worth of the dresser, C, depends on

the number of years, t.

b. What price was paid for the dresser if it was bought \_\_\_\_ years ago?

c. What will the value of the dresser be in \_\_\_\_ years?

d. Determine the domain and range.

Domain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Range: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**My Own Word Problem Answered by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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