**Units 4 and 5 (Chapters 5 & 6)**

**5.1 Representing Relations**

**A.** Complete the following

1. A **set** is a collection of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. The words you created are a **set** of letters.
3. An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is one object in the **set**.

The letters that make up the words are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.**

1. A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ associates the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of one set with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of another set.

One way to write a set is inside **braces.** { }

For ex. Write the natural numbers from 1 to 5 as a set.

**B.** Let’s take the following relation to show **different ways to represent** **a relation.**

 FRUIT: COLOR:

Elements of second set

Elements of first set

An apple is: red, green

 A blue berry is: blue

 A cherry is: red

1) We can use **ORDERED PAIRS.**

{(apple, red), (apple, green), (blue berry, blue), (cherry, red)}

|  |  |
| --- | --- |
| **Fruit** | **Color** |
| Apple | Red |
| Apple | Green |
| Blueberry | Blue |
| Cherry | Red |

2) **TABLE**

3) **ARROW DIAGRAM (mapping)**

Apple

Blueberry

Cherry

Blue

Green

Red

4) **WORDS**

An apple may have the color green or red. A blueberry is blue. A cherry is red.

\*Notice that it is not appropriate to relate color of a fruit to the specific fruit. Not all red fruit are apples.

**5.2 Properties of Functions**

**A.** The first set of elements in a relation is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The second set of elements in a relation is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a specific type of relation where each element in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is associated with exactly one element in the range.

All functions are relations, but NOT all relations are functions.

Functions

Relations

**B.** The relation below associates a vehicle with the number of wheels it has.

1

2

3

4

Bicycle

Car

Motorcycle

Tricycle

Unicycle

Notice that all of the elements in the domain are associated with exactly one element in the range. That is, there is only one arrow from each element in the domain to the range.

1

2

3

4

Bicycle

Car

Motorcycle

Tricycle

Unicycle

**RANGE**

**DOMAIN**

This relation associates the number of wheels on certain vehicles.

Notice that this relation is **not** a function because there are two arrows from the domain number 2 to the range.

We usually write the domain and range as a set:

{1, 2, 3, 4}: Domain

{Bicycle, Car, Motorcycle, Tricycle, Unicycle} : Range

Example 1:

1. {(1,2), (1,3), (2,4)}

2. {(0,1), (1,0), (2,0)}

What is the domain and range of these sets of ordered pairs? If there are repeats in the domain and the range do not include them!

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Which set(s) of ordered pairs represents a function?

Write the ordered pairs above using an arrow diagram.

**C.** Functions can be thought of as “machines”.

Machine A for example may calculate the value in dollars of a set of quarters: 0.25 x n

Input = n (# of quarters)

Output = V (Value of quarters in $)

So V = .25n

Because the value is a *function* of the number of quarters *n* we can rewrite this statement as V(n) = .25n

This is called **function notation**. We say “V of n is 0.25 times n”

We can calculate the value of 3 quarters by entering n=3 into our machine.

V = 0.25 x 3 = 0.75.

We can also write this as V (3) = 0.25 x 3 = 0.75 We say “V of 3 equals 0.75”

Example 1:

Write the following equations in **function notation**.

C = 2πr d = 4t + 5 y = 3x + 5

C(r ) = 2πr \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

When *y* and *x* are used in a function we always **label y as the dependent variable**. The value of *y* depends on *x*.

**X is always the independent variable**. Y(x) is usually written as $f(x)$. We call this the “function according to x”

(DIXI ROYD)

**\*\*NAME 5 WAYS TO REPRESENT A RELATION:**

1. 2) 3)

4) 5)

|  |  |
| --- | --- |
| **Number of Extra Toppings (n)** | **Cost ($) (C)**DependentIndependent |
| 0 | 12.00 |
| 1 | 12.75 |
| 2 | 13.50 |
| 3 | 14.25 |
| 4 | 15.00 |
| 5 | 15.75 |

**5.6 Properties of Linear Relations**

**A.** The table of values below shows the cost of a pizza with up to 5 extra toppings.

Ex. 1

 1) Sketch a graph of this situation.



2) Write a rule that relates the cost of a pizza to the number of toppings.

3) Is this relation a function?

**In linear relations (straight lines), a constant change in the independent variable results in a constant change to the dependent variable.** As the independent variable increases by 1, the cost increases by $0.75. We can represent this as a rate of change.

$\frac{Change in dependent variable}{Change in an independent variable}$ = $\frac{0.75}{1}$ = $0.75

Rate of Change

Initial cost

Therefore for every extra topping it costs $0.75.

C = 0.75n + 12

We can write this relationship as an equation:

Dependent Variable

Independent Variable

**Unit 5 Chapter 6 Linear Functions**

**6.1 Slope of a Line**

Recall that a linear relation has a rate of change. The rate of change is how much the dependent variable increases over the independent variable. That is:

$\frac{Change in Dependent Variable }{Change in Independent Variable}$ = Rate of Change

 When working with a coordinate plane we use *x* as the independent variable and

*y* as the dependent variable.



**When talking about coordinate geometry (where points fall on a coordinate plane) we call the rate of change “slope”. THEY ARE THE SAME THING!**

Because this formula regulates rate of change it also regulates slope.

$$\frac{Change in Dependent Variable }{Change in Independent Variable}= \frac{Difference between Y points}{Difference between X points}=\frac{Y2-Y1}{X2-X1}=\frac{Rise}{Run}=SLOPE$$

 Example 1:

 **Find the slope of the line shown.**

1. Pick 2 points on the line (must be readable)
2. Label the points (X1,Y1) and (X2,Y2)
3. Calculate the slope.
4. Leave the slope **as a fraction** in lowest terms.

Example 2:

a)

b)

A line that increases (goes up) and to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ has a **positive** slope.

$$\frac{Y2-Y1}{X2-X1}=\frac{Rise}{Run}= \frac{+}{+}=+$$

A line that decreases (goes down) and to the right has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ slope.

$$\frac{Y2-Y1}{X2-X1}=\frac{Rise}{Run}= \frac{-}{+}=-$$

A vertical line has no run.

$$\frac{Y2-Y1}{X2-X1}=\frac{Rise}{Run}= \frac{+}{0}=Undefined$$

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ line has no rise.

$$\frac{Y2-Y1}{X2-X1}=\frac{Rise}{Run}= \frac{0}{+}=0$$

Example 3:

Draw a line segment with a slope of $\frac{7}{5}$ that goes through (-3, -5)

Draw a line segment with a slope of - $\frac{7}{5}$ that goes through (-3, -5)

Draw a line segment with a slope of 0 that goes through (-3, -5)

Draw a line segment with an undefined slope that

goes through (-3, -5)

**6.2 Slopes of parallel and perpendicular lines**

Activity:

Calculate the slopes of the side lengths that create the rectangle. 

**Parallel lines have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

**Perpendicular lines (lines that intersect each other at 90⁰ angles) have**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**



1) Draw a line that runs through (-1,4) and through (2,6).

2) Calculate the slope of that line.

3) Draw a line that runs through (0, -3) and (6,1).

4) Calculate the slope of that line.

5) In the space below note any similarities between the lines.

**6.4 Slope Intercept Form for the Equation of a Linear Function**



**6.4 Slope y-intercept form**

A line can be described by its slope and y-intercept.

**Slope-Intercept Form** of the equation of a linear function is

$$y=mx+b$$

y-intercept

slope

Example 1: The graph of a linear function has a *slope* of -3 and a *y-intercept* of 1. What is the equation of the linear function? *y = \_\_\_\_\_\_x + \_\_\_\_\_\_*

Example 2: Graph the linear function that has a *slope of -3* and

a *y-intercept of 1.*

Example 3: Given a graph, give its equation.

There are a number of situations that can be graphed using a linear function. The x and y intercepts along with the slope (rate of change) can be valuable in solving questions.

Example 4: A student council sponsored dance cost $5 per ticket. The cost for the DJ was $300.

1. Write an equation for the profit, P, and the ticket sales, t.
2. Suppose 123 went to the dance what is the profit?
3. Suppose the profit was $350, how many bought tickets.
4. Could the profit be exactly $146?

e) Draw a graph for this function

**6.5 Slope-point form of a linear function**

Given the slope of a line and any point along that line, we are able to determine its equation.

So. Cool.

Example: A line has the slope of -3 and passes through (-2,5).

We can use any point (x,y) to find the equation of the line:

Using the slope formula, we see that:

$$\frac{Y2-5}{X2-(-2)}=\frac{Rise}{Run}=-3$$

$$y-5=-3 (x+2)$$

**Slope-Point Form of the Equation of a Linear Function:**

The equation of a line that passes through P(x1 , y1) and has the slope *m* is:

$$y-y\_{1}=m(x-x\_{1})$$

**A. Given the point-slope form of a line** we have enough information to **draw the linear function** by:

1. **Plotting the point…careful with the signs**
2. **Using the slope to find more points…rise, run (watch for positive/negative)**

Example 1: Graph the following linear equation

 y – 2 = $\frac{1}{3}$(x + 4)

Point (-4,2) …notice the “change in signs”

Slope $\frac{1}{3}$ …easy to find, right?

**B. Given the graph of a line** we have enough information **to come up with the equation** that gives us that graph by:

1. **Finding the coordinates of two points.**
2. **Using the points, determine the slope.**
3. **Plug in one of the points and the slope into the equation. Don’t forget about the “sign change”.**
4. **Write in slope y-intercept form, if necessary.**

Example 2: Write the equation of this graph in:

1. Point Slope form
2. Slope y intercept form

 Using (-1, -2) and (3,1), we find that m = 3/4

Using (3, 1) $\left(y-1\right)=\frac{3}{4}\left(x-3\right)$

$$\left(y-1\right)=\frac{3}{4}x-\frac{9}{4}$$

$y=\frac{3}{4}x-\frac{9}{4}+1$ $y=\frac{3}{4}x-\frac{5}{4}$

Try it using (-1, -2)

**C. Given 2 points on a line** we have enough information to write the equation.

Example 3: P(-3,-2) and Q(4,6) are on the same line.

1. Write the line in point-slope form
2. Write the line in slope y-intercept form

Steps are like Part B, but without a graph. Use the slope formula to find the slope.

Try this one on your own.

m = $\frac{8}{7}$ use (4, 6)

You should get $\left(y-6\right)=\frac{8}{7}(x-4)$ and $y=\frac{8}{7}x+\frac{10}{7}$

**D. Given a point and the equation of another line** it is possible to find the equation of a line that is perpendicular or parallel to the first.

Example 4: Find the equation of a perpendicular line to the equation y = $\frac{2}{3}$x -5 and that passes through the point (1, -1). Leave your answer in point slope form.

Steps are easier than you might think:

1. Find slope, using what you know about parallel and perpendicular slopes.
2. Use the given point and follow steps given in Part B.

Try this one on your own.

Perpendicular to $\frac{2}{3}$ is $\frac{-3}{2}$ and using the point (1, -1).

**6.6 General Form of the Equation of a line**

The line y = $\frac{2}{3}x+4$ is written in slope- y intercept form. We can rearrange this equation to get rid of the fraction in the slope.

This is called the general form.

**General Form of the Equation of a Linear Relation:**

***Ax + By + C = 0***, where A is a whole number and B and C are integers.

Example 1: Determine the x and y intercepts of the line whose equation is 3x + 2y = 18 and graph the line

We can use our graphing calculator to explore linear relations as well.

In y= we can enter any equation in slope y-intercept form. By pressing graph we can see the graph. By pressing 2nd Graph we can see the table of values. If we want to calculate the x or y intercepts we can try the table of values or we can use the 2nd Trace Zero.

Examples:

Find the x and y intercepts and the graph of

1. y = 4x + 5

“Verify”

1. 2y = 50x + 100
2. 3y + 9x -18 = 0
3. Y = 200x + 400

**Ch. 6 – Linear Functions**

**Review**

1. The point where a line intercepts the y-axis is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The co-ordinates of a the point at which the x and y axis cross are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. The y-intercept of the equation –y = 3x – 12 is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. An equation for a vertical line through (3, 0) is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Calculate the slope of the following
	1. A (-2, 8) and B (2, -5)
	2. A (, -4) and B(2, )

**1**

**3**

**2**

* 1. Line 1-

Line 2-

Line 3-

1. Match the equation with the appropriate graph.



a. y = 

**Line 1**

b. 

**Line 2**

c. 

**Line 3**

d. 

**Line 4**

1. Find the slope, x-intercept and y-intercept for the following
	1. 3x – 7y + 30 = 0
	2. y = 3x + 2
	3. 2x + 3y + 12 = 0
	4. 4x – 5y -1 = 0
	5. x = 3y +4
	6. x = 5
2. Graph the following lines. Label your lines.



* 1. 3x – 4y +12 = 0
	2. x + 3 = 0
	3. m = - and passing through the point

(-5, 3)

1. If one point on a line with slope is (-3, -2), find another point on this line.
2. What is the equation for the following lines
	1. A **vertical** line passing through the point (2, –5).
	2. A **horizontal** line passing through the point (–7, –4).
3. Determine the equations of the following lines in any form

**1**

**3**

**2**

Line 1-

Line 2-

Line 3-

1. Find the equation for the line in slope point form, slope intercept form and general form for the following
	1. A line that passes through the point (3, -1) and has a slope of - 
	2. A line that passes through the points (3, -4) and (1, 2)
	3. A line that has an x-intercept of – 4 and is perpendicular to the line defined by the equation y = x + 4



1. Triangle ABC is determined by A (-6, 3), B (0, 5) and C (2, -1). Show and state whether the triangle is right or not.
2. Determine k so that the three points A (6, -3), B (2, 7) and C (-6, k) are collinear
3. You earned $358 when you worked 23 hours and $523 when you worked 35 hours.
	1. How much did you get paid per hour for the hours between 23 and 35?
	2. How many hours did you work if you were paid $743?
4. Determine whether the following lines are parallel, perpendicular or neither
	1. y = x + 3 b. y – 3x + 10 = 0

6x – 8y + 13 = 0 y + 3x – 11 =0

1. Find the value of ‘k’ when the slope is 4. A ( 2, 6) and B (3, k)
2. A line passes through the points (-2, 1) and (5, 7)
	1. Sketch the line
	2. Find the slope of the line
	3. Find an equation for the line in general form, slope point form and y-int form
3. Which of the lines below passes through (-2, -5) and has a slope of -
	1. y = - x – 8
	2. y = -2x – 5
	3. y = -x – 5
	4. y = -3x – 8
4. Find k so that (3, –5) is on the line 2x + ky – 19 = 0.
5. . Which of the following points are on the line 2x + y – 17 = 0?

 a. (5, 7) b. (8, –1) c. (–8. –1) d. (10, –3) e. (–3, 23)

1. Determine P so that the point (P, –5) is on the line 3x + 2y – 11 = 0
2. The relationship between air temperature and how fast a make cricket chirps is linear. A group of biology students conducted the following experiment. The students counted the number of chirps per minute by a cricket at various locations within the school. In a room where the air temperature was 14°C, the cricket chirped 70 times per minute. In the cafeteria, the air temperature was 21°C and the cricket chirped 119 times per minute.
	1. Write a linear equation relating the number of cricket chirps per minute, n, to the air temperature, T, in degrees Celsius. Express the equation in slope-intercept form.
	2. Sketch a graph of the linear equation
	3. In the boiler room, the cricket chirped 168 chirps per minute. What is the temperature in the boiler room.

**Review Answers**

1. y-intercept 2. Origin 3. (0, 12) 4. x = 3 5.a.  b. 

 c. Line 1=  Line 2=  Line 3 y = 6 6. A=Line 1, B = Line 2, C = Line 3, D = Line 4

 7. a. (-10, 0), (0, ) and m=  b. (, 0), (0, 2) and m= 3 c. (-6, 0), (0, -4) and m= 

 d. (, 0) , (0, ) and m=  e. (4, 0) , (0, ) and m=  f. (5, 0), no y-int and m is undefined

8. 9.several answers possible- (2, 5) 10.a. x = 2 b. y = –4

11. Line 1- y = 4x – 3 Line 2-  Line 3- x = -5

12. a. , , 3x +5y – 4 = 0

b. y + 4 = -3(x – 3) or y – 2 = -3 (x – 1) , y = -3x + 5 , 3x + y – 5 = 0

c. y = - 5/2 (x + 4) , , 5x + 2y + 20 = 0

d. y = -8/3 (x) , 8x + 3y = 0

13. mAB = 1/3 and mBC = -3 therefore, yes it’s a right triangle

14. k = 27 15. a. $13.74 b. 54 hrs 16. a. perpendicular b. neither 17. k = 10

18. b. m=6/7 c. y – 1 = 6/7 ( x+ 2) or y – 7 = 6/7 (x – 5), y = 6/7x + 19/7 , 6x - 7y + 19 = 0

19. a 20. k = -13/5 21. a,d,e 22.p = 7 23. a. n = 7T – 28 c. 28˚C

