SECTION 1: MATH REVIEW

**The Number Line**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Horizontal Number Line** |  |  |  |  | **Vertical Number Line** |
|  |  |  |  | 5 |  |
| Numbers *left* of zero are labeled ***negative***, and |  |  |  |  | Numbers *above* zero are labeled |
| numbers *right* of zero are labeled ***positive***. |  |  |  |  | ***positive***, and |
|  |  |  |  |  | numbers *below* zero are ***negative***. |
|  |  |  |  | 0 |  |
| -4 -3 -2 -1 0 1 | 2 | 3 | 4 | -5 |  |

# Positive/Negative Convention (+ and - )

The *positive sign (+)* is used as an indicator of direction relative to a fixed *origin point* (on a number line that point is often the value zero).

The *negative sign (-)* is used to show a value which is in the complete *opposite direction* than the stated positive direction.



The blue triangle is approximately at + 2.5. The red triangle is approximately at – 3.0.

4

3

2

1

0

-1

-2

-3

-4

Example:

**Addition**

**Addition of *two positive values***

Example:

(+2) **+** (+5) **=** +7

Since both values are positive, the answer will also be positive.

On a vertical number line, if you start at two units above the origin point and move 5 more units up, you will be at a position of 7 units above the origin point.

**Addition of *two negative values***

Example:

(- 3) **+** (- 1) **=** - 4

Since both values are negative, the answer will also be negative.

On a horizontal number line, if you start at three units to the left of the origin point and move 1 more unit left, you will be at a position of 4 units left of the origin point.

**Addition of *one positive value* and *one negative value***

Example:

(- 2) **+** (+6) **=** +4

The answer will have the sign of the larger absolute value.

In this case, 6 is a larger number than 2. The difference between 6 and 2 is 4 units.

On a horizontal number line, if you start 2 units to the left of the origin point and move 6 units to the right, you will be at a position of 4 units to the right of the origin point.

# PRACTICE EXERCISES

1. (- 6) **+** (+2) **=**

4. (- 2.5) **+** (- 1.0) **=**

7. (- 4.00) **+** (+3.50) **=**

2. (+5) **+** (+3) **=**

5. (+5.0) **+** (+1.5) **=**

8. (+2.45) **+** (+6.00) **=**

3. (- 4) **+** (- 1) **=**

6. (- 3.5) **+** (-2.5) **=**

9. (- 1.25) **+** (-2.75) **=**

**Subtraction**

**Subtraction of *two positive values***

Example:

(+5) **ꟷ** (+1) **=** +4

The minus sign ( **ꟷ** ) in front of a number shows how much to move in the negative direction relative to the first

value’s starting point.

On a vertical number line, if you start at five units above the origin point and move 1 unit down, you will be at a position of 4 units above the origin point.

(+1) **ꟷ** (+5) **=** - 4

On a vertical number line, if you start at one unit above the origin point and move 5 units down, you will be at a position of 4 units below the origin point.

**Subtraction of *two negative values***

Example:

(- 2) **ꟷ** (- 7) **=** +5

On a horizontal number line, if you start at two units to the left of the origin point and move the opposite of seven units to the left (in other words seven units to the right), you will be at a position of five units right of the origin point.

(- 7) **ꟷ** (- 2) **=** - 5

On a horizontal number line, if you start at seven units to the left of the origin point and move the opposite of two units to the left (in other words two units to the right), you will be at a position of five units left of the origin point.

**Subtraction of *one positive value* and *one negative value***

Example:

(- 3) **ꟷ** (+4) **=** - 7

On a horizontal number line, if you start three units to the left of the origin point and move four units to the left (the negative direction on the number line), you will be at a position of seven units to the left of the origin point.

(- 4) **ꟷ** (+3) **=** - 7

On a horizontal number line, if you start four units to the left of the origin point and move three units to the left (the negative direction on the number line), you will be at a position of seven units to the left of the origin point.

# PRACTICE EXERCISES

|  |  |  |
| --- | --- | --- |
| 1. (- 2) **ꟷ** (+6) **=** | 4. (- 2.5) **ꟷ** (- 1.0) **=** | 7. (- 2.00) **ꟷ** (+1.50) **=** |
| 2. (+3) **ꟷ** (+5) **=** | 5. (+5.0) **ꟷ** (+1.5) **=** | 8. (+3.45) **ꟷ** (+5.00) **=** |
| 3. (- 1) **ꟷ** (- 7) **=** | 6. (- 3.5) **ꟷ** (-2.5) **=** | 9. (- 1.25) **ꟷ** (-2.75) **=** |
| **Multiplication** |  |  |

Multiplication involves the compounding of sets. For example, think of a common package of eggs you can buy at most any grocery store. In the standard package you will typically find twelve (12) eggs. Let’s say you need twenty-four (24) eggs for a big recipe, you of course need two packages of eggs since 12 **x** 2 **=** 24.

xxxxxx xxxxxx xxxxxx xxxxxx 12 24

In this case each set is based on the number 12, and you have 2 of those sets to get the desired number of eggs. The sets of 12 increase in a set progression, always being twelve more than the previous value (12, 24, 36, 48, 60, 72…)

xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx

xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx

12 24 36 48 60 72

**Multiplication of *two positive values OR two negative values***

Example:

When multiplying numbers that have the same sign, the answer will always be *positive*.

(+5) **x** (+4) **=** +20

(- 3) **x** (- 2) **=** +6

|  |  |  |  |
| --- | --- | --- | --- |
| xxxxx | xxxxx | xxxxx | xxxxx |
| 5 | 10 | 15 | 20 |
| xxx | xxx |  |  |
| 3 | 6 |  |  |
| **Multiplication of *one positive value* and *one negative value*** | | | |
| Example:  When multiplying numbers that have opposite signs, the answer will always be *negative*.  (- 5) **x** (+4) **=** - 20  xxxxx xxxxx xxxxx xxxxx | | | |
| 5 | 10 | 15 | 20 |
|  |  |  | (+3) **x** (- 2) **=** - 6 |
| xxx | xxx |  |  |
| 3 | 6 |  |  |

# PRACTICE EXERCISES

1. (- 2) **x** (+6) **=**

4. (- 2.5) **x** (- 1.0) **=**

7. (- 6.00) **x** (+5.00) **=**

2. (+3) **x** (+5) **=**

5. (+5.0) **x** (+2.0) **=**

8. (+3.00) **x** (+8.00) **=**

3. (- 3) **x** (- 9) **=**

6. (- 3.0) **x** (-2.0) **=**

9. (- 1.50) **x** (-2.00) **=**

**Division**

Division is essentially the breaking down of a quantity into sections. Again, consider a dozen eggs.

xxxxxx xxxxxx 12

This quantity of 12 eggs can be grouped into 4 groups of 3, or 6 groups of 2.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| xxx | xxx | xxx | xxx |  |  | 12 |
| xx | xx | xx | xx | xx | xx | 12 |

**Division of *two positive values OR two negative values***

(+4) **/** (+8) **=** +1/2

***Larger Number Below Smaller Number*** – The answer will always be *less than 1.*

xxxx to break up four pieces eight times, you need to cut each of the four pieces in half.

6 eggs: split into 2 groups of 3

xxx

xxx

Example:

When dividing numbers that have the same sign, the answer will always be *positive*.

(- 6) **/** (- 2) **=** +3

***Larger Number Above Smaller Number*** – The answer will always be *greater than 1*.

**Division of *one positive value* and *one negative value***

Example:

When dividing numbers that have opposite signs, the answer will always be *negative*.

(+8) **/** (- 4) **=** - 2

# PRACTICE EXERCISES

1. (- 2) **/** (+6) **=**

4. (- 2.5) **/** (- 1.0) **=**

7. (- 20.00) **/** (+5.00) **=**

2. (+3) **/** (+15) **=**

5. (+6.0) **/** (+2.0) **=**

8. (+24.00) **/** (+8.00) **=**

3. (- 3) **/** (- 9) **=**

6. (- 3.0) **/** (-12.0) **=**

9. (- 1.50) **/** (-3.00) **=**

SECTION 2: ALGEBRA REVIEW

**Order of Operations**

# “Please, Excuse, My Dear, Aunt Sally” Pneumonic Device

Even if you do not have a dear aunt named Sally, this is still easy to remember. It is the basis for the logical order one progresses through a problem that has several mathematical operators ( +, - , x, / ).

The concept is you first perform the operation in Parenthesis, then once that is complete you perform the Exponent operations (i.e. 10x , ex , x2 , √ , etc.…), followed by Multiplication and Division, then Addition and Subtraction.

Technically it does not matter whether you do the Multiplication or Division first (likewise with Addition and Subtraction).

Also, we generally work left to right when there are multiples of the same operator in one problem.

# Parenthesis (Please)

Example:

(10 **+** 2) **/** 2 **=** 6

With the 10 + 2 in the parenthesis () then it was appropriate to perform the addition of ten and two first.

Without parenthesis written in this problem then it would be correct to perform the division prior to the addition.

10 **+** 2 **/** 2 **=** 11

**Exponents (Excuse)**

Example:

5 **+** 32 **=** 14

The three must first be squared (raised to the second power) before the addition can be performed. So, with 32 = 9 it works out that 5 + 9 = 14.

**Multiplication and Division (My Dear)**

Example:

8 **+** 6 **x** 4 **/** 2 **=** 20

Here you see an addition, multiplication, and a division all in one problem.

The proper order will be first the Multiplication, then the Division, then finally the Addition. So it works out 6 x 4 = 24, then 24 / 2 = 12, and finally 8 + 12 = 20.

**Addition and Subtraction (Aunt Sally)**

Example:

(9 **–** 4 **+** 3) **/** 2 **=** 4

Obviously, the Parenthesis must be taken care of first. (9 – 4 + 3) must be done before the division. It works out that 9 – 4 = 5, and that 5 + 3 = 8.

So ultimately, we end up with 8 / 2 = 4.

**PRACTICE EXERCISES**

1. (12 **–** 2 **+** 6) **/** 2 **=** 4. 20 **/** 4 **+** 6 **x** 2 **=**

2. (3 **–** 2) **+** 42 **=** 5. 10 **+** 2 **/** 2 **=**

3. (9 **+** 5) **/** 7 **=** 6. 5 **+** 3 **x** (6 **+** 2) **=**

**Isolate a Variable**

# “Finding x”

The concept of solving for an unknown in an algebraic expression revolves around the idea of “isolating” the unknown (variable) by itself to one side of the equals sign ( = ). The logical way to do this is to Reverse the Operators and the Order of Operations seen in the problem.

# Addition and Subtraction

Example:

5 **+** ◊ **=** 7

The unknown in this problem is the ◊. Five is being added to the ◊, so the idea is you take 5 away from each side of

the equals sign ( = ). Since 5 – 5 = 0, there is nothing left on the side of the ◊, the variable has been isolated.

(5 + ◊) – 5 = 7 – 5

◊ = 2

* **–** 24 **=** 10

The unknown in this problem is the ○. Twenty-four is being subtracted from the ○, so the idea is you add 24 to each

side of the equals sign ( = ). Since 24 – 24 = 0, there is nothing left on the side of the ○, the variable has been isolated. (○ – 24) + 24 = 10 + 24

○ = 34

**Multiplication and Division**

Example:

5 **x** ◊ **=** 30

The unknown in this problem is the ◊. Five is being multiplied to the ◊, so the idea is you divide each side of the equals sign ( = ) by 5. Since 5 / 5 = 1, and multiplying by one does not change a numbers value, there is nothing left on the side of the ◊, the variable has been isolated.

(5 x ◊) / 5 = 30 – 5

◊ = 6

* **/** 24 **=** 3

The unknown in this problem is the ○. In this problem ○ is being divided by twenty-four, so the idea is you multiply 24 to each side of the equals sign ( = ). Since 24 / 24 = 1, there is nothing left on the side of the ○, the variable has been isolated.

(○ / 24) x 24 = 3 x 24

○ = 72

**PRACTICE EXERCISES**

|  |  |  |  |
| --- | --- | --- | --- |
| 1. *x* **/** 12 **=** 4 | *x* **=** | 5. *x* **+** 2.5 **=** 7.0 | *x* **=** |
| 2. 5 **–** *x* **=** 16 | *x* **=** | 6. 1.5 **–** *x* **=** 8.9 | *x* **=** |
| 3. 14 **+** *x* **=** 20 | *x* **=** | 7. 2.0 **x** *x* **=** 4.6 | *x* **=** |
| 4. 5 **x** *x* **=** 40 | *x* **=** | 8. *x* **/** 8.4 **=** 2.2 | *x* **=** |

SECTION 3: CALCULATOR REVIEW

**Layout**

**Scientific and Graphing Calculators**

You can easily perform computations on a calculator, once you get familiar with your calculator’s keys and features. All basic calculators are capable of four functions ( +, - , x , / ) and most calculators will have the ± , sin, cos, tan, sin-1, cos-1, tan-1, x^2, 10^x, log, and many other buttons and features.

Since most calculators have more or less the same capabilities, using one is simply a matter of knowing how to access the needed operation, and typing the keys in the correct order.

Graphing and Scientific calculators are both capable of performing all normal operations one would typically need. The main difference between the two types is the screen, and sometimes how the keys are laid out on the device.

Need: Illustration of Scientific Calculator

(simple drawing with each function key clearly visible)

Need: Illustration of Graphing Calculator

(simple drawing with each function key clearly visible)

**Basic Functions**

# + , - , x , / , ± , =, ( ), .

**=**

The

**Enter**

button is used instead of the Equals Sign

on some calculators.

Some calculators have a

sign for switching a number to a negative value, other calculators use the

**–**

button.

**±**

**=**

**+**

**.**

Example:

1.4 **+** 2 **=**

Type into the calculator:

**1 4 2**

The answer **3.4** will appear on the screen.

(- 7 **+** 2) **x** 3 **=**

Type into the calculator:

**( 7 2 ) 3**

The answer **-15** will appear on the screen.

# PRACTICE EXERCISES

**=**

**x**

**+**

**±**

1. (- 12 **x** 2) **+** 26 **=** 4. (- 7.2 **+** 4.5) **x** 2.8 **=**

2. 8 + 79 **=** 5. 10 **/** 2 **+** 2.7 **=**

3. – 4 x 19 **=** 6. 5.2 **x** - 3 **/** 8.5 **=**

**Advanced Functions**

# sin, cos, tan, sin-1, cos-1, tan-1, x2, log, ^, 10x, √

The Advanced Function keys may have to be accessed as button features or within menus on Graphing calculators.

**2nd**

These are various mathematical operations that can be performed on numbers. Most often the answer on the calculator screen will be a lengthy decimal number (i.e. 0. 075825621) that you should round when stating your answer.

Occasionally an ***“ERROR”*** message of some sort will appear after you hit or **Enter** . Some mathematical operations

**=**

cannot be performed on all values, and this is the calculator’s way to indicate this action cannot be performed.

**( 70 )**

**8.37**

√ (70) =

**4 8 10 5**

**480000**

4.8 x 105 =

**log ( 0 019 )**

**-1.72**

log (0.019) =

**( 0 5 )**

**60**

cos-1 (0.5) =

**sin ( 45 )**

**0.707**

sin (45) =

Example:

Note – Rounding will be discussed in further detail at a different point. For the time being, state answer to a maximum of 3 digits (i.e. 34.279329837495 just needs to be written as 34.3)

**Enter**

**√**

**Enter**

**^**

**x**

**.**

**Enter**

**.**

**Enter**

**.**

**2nd cos**

**Enter**

# PRACTICE EXERCISES

|  |  |  |  |
| --- | --- | --- | --- |
| 1. sin-1 (0.75) = |  | 5. log (0.082) = |  |
| 2. tan (40) = |  | 6. cos-1 (0.20) = |  |
| 3. 5.9 x 104 = |  | 7. 4.32 = |  |
| 4. √ (50) = |  | 8. sin (79) = |  |

**Problems Involving Angles**

The functions sine, cosine, and tangent are used when dealing with angles.

If you are given an angle measurement such as 32° (32 degrees), then you will use **sin** , **cos** , or on the calculator.

**tan**

If you are asked to find the angle of something such as a decimal number less than one, then you will use the **sin-1** , buttons on the calculator.

**cos-1** , or

**tan-1**

Example:

The sine of 30 degrees

In this case the angle measurement is given (degrees), so the following is typed into the calculator:

**sin ( 30 )**

And the value **0.5** appears on the screen.

tan a = 0.248 What is angle a?

In this case the angle (a) is unknown and a decimal value less than one is given. So, the following is typed into the calculator:

**( 0 248 )**

And the value **13.9** appears on the screen. Therefore, the angle a equals 13.9 degrees.

**Enter**

**.**

**2nd tan**

**Enter**

# PRACTICE EXERCISES

1. Determine the following: (3-digit max) cos 45 =
2. What is angle a? (3-digit max)

cos a = 0.492 a =

tan 30 = tan a = 0.0148 a =

sin 80 = sin a = 0.823 a =

SECTION 4: SIGNIFICANCE AND PRECISION

**Significant Digits**

# Rules for Counting Significant Digits

When you have 3 books, you have *exactly* three books. When you have a rounded value, or a value that can conceivably be measured to more decimal places (i.e. a ruler measurement of 3.56 cm, could be measured to more decimal places with a caliper) you have what is called an *approximate* value.

***Significant Digits*** – These are the digits that are considered “accurate” according to the ability of the measuring equipment.

When you take a measurement with a metric ruler, you will often come out with a value such as 3.56 cm. This value has THREE Significant Digits. Here is why:

* + All non-zero digits are significant (3.56)
  + Zeros to the right of a decimal point are significant (115.00, 4.0, 2.7500)
  + Zeros between digits are significant (409, 26.0058)
  + Zeros to the right of a digit without a decimal point are NOT significant (118000, 90)
  + Zeros to the left of a digit are NOT significant (0.0059, 0.023)

Example:

State the number of Significant Digits:

|  |  |
| --- | --- |
| 115.00 | **5** |
| 4.0 | **2** |
| 2.7500 | **5** |
| 409 | **3** |
| 26.0058 | **6** |
| 118000 | **3** |
| 90 | **1** |
| 0.0059 | **2** |
| 0.023 | **2** |

# Precision

This describes the measuring equipment’s ultimate ability to provide information.

A metric ruler is broken down into units of 10. If the full length of a meter stick is 100 cm, there are 10 major divisions of 10 cm, then ten more divisions of 1 cm, and within that you will typically find ten more minor divisions marking 1- millimeter increments.

This means a metric ruler can measure a value such as 59.2 centimeters. In other words, such a ruler can provide a measurement that is *precise* to one-tenth of a centimeter or one-millimeter.

**Rounding**

# Rules for Rounding

Often values will need to be *rounded*, since the extra values you cut off are rather insignificant compared to other measured values.

The only digit that matters when it comes to rounding is the first digit beyond the decimal place you intend on having your final answer stated to.

If that digit is:

* + 0,1,2,3,4 then you DROP that digit and everything to the right of it
  + 5,6,7,8,9 then you INCREASE the digit to the left of it by ONE, and drop all other digit

**4.58 m**

4.58276 m to the hundredths place

**7.5 cm**

7.492 cm to the tenths place

**13 mm**

Example:

Round the following values to the stated decimal places: 12.793 mm to the ones place

# PRACTICE EXERCISES

1. State the number of Significant Digits 2. Round to the stated decimal place

|  |  |  |  |
| --- | --- | --- | --- |
| 0.00298 |  | 8.056 m to the tenths place |  |
| 29700 |  | 38.890 cm to the ones place |  |
| 120.0048 |  | 0.3527 mm to the hundredths place |  |
| 9.050 |  |  |  |