OPERATIONS WITH DECIMALS

TO ADD OR SUBTRACT DECIMALS:

1) Line up the decimal points vertically. Fill in any 0's where necessary.

2) Add or subtract the numbers as if they were whole numbers.

3) Place the decimal point in the sum or difference so that it lines up vertically with the numbers being added or subtracted.

EXAMPLE 1: Add 0.56 + 9 + 6.287

To add decimals, line up the decimal points vertically and fill in 0's as shown:

```
  0.560
  9.000
+ 6.287
```

15.847 ← Place the decimal point in the sum so that it lines up vertically.

EXAMPLE 2: Subtract 6 − 1.859

To subtract decimals, line up the decimal points vertically and add 0's where shown. Remember to borrow when necessary.

```
  5  9  9  10
  6̸ . 0̸ 0̸ 0̸
− 1 . 8 5 9   ⎫
───────────    ⎬  Add to check!
  4 . 1 4 1   ⎭
```

EXAMPLE 3: Subtract 3.742 − 10.638

If the decimals have opposite signs, place the larger decimal on top, line up the decimal points, subtract the numbers, and carry down the sign, as shown:

```
−10.638
  3.742
───────
− 6.896
```

DIVIDING DECIMALS BY POWERS OF TEN:

1) If the power of ten is a whole number, such as 100 or 1000, move the decimal point as many places to the **left** as there are 0's in the power of 10.

2) If the power of ten is a decimal, move the decimal point as many places to the **right** as there are decimal places in the power of 10.

EXAMPLE 10: Divide a) $237.36 \div 10{,}000$; and b) $237.36 \div 0.0001$

a) The power of 10 has 4 zeros. To divide 237.3651 by 10,000, move the decimal point four places to the left, filling in a 0 as shown:

$$237.36 \div 10{,}000 = 0.0237.36 = 0.023736$$

b) The decimal power of 10 has 3 decimal places. To divide 237.36 by 0.001, move the decimal point 3 places to the right, filling in a 0 as shown:

$$237.36 \div 0.001 = 237.360. = 237{,}360$$

To MULTIPLY DECIMALS:

1) Multiply the decimals as if the decimals were whole numbers.

2) To place the decimal point, count the number of decimal places in each factor.

3) The number of decimal places in the product is the sum of the number of decimal places in each factor.

EXAMPLE 4: Multiply 3.48 x 12.7

Multiply the decimals as if they were whole numbers. Then count the number of decimal places in each factor. Since the total number of decimal places in each factor is 3, the product must have 3 decimal places. (Note: the decimal points are not lined up when we multiply decimals.)

$$
\begin{array}{r}
3.48 \quad \leftarrow \textbf{2 decimal places} \\
\times\ 12.7 \quad \leftarrow \textbf{1 decimal place} \\
\hline
2436 \\
696\ \\
348\ \ \\
\hline
44.196. \quad \leftarrow \textbf{3 decimal places}
\end{array}
$$

$3.48 \times 12.7 = 44.196$

MULTIPLYING DECIMALS BY POWERS OF TEN:

1) If the power of ten is a whole number, such as 100 or 1000, move the decimal point as many places to the **right** as there are 0's in the power of 10.

2) If the power of ten is a decimal, such as 0.1 or 0.01, move the decimal point as many places to the **left** as there are decimal places in the power of 10.

EXAMPLE 5: Multiply: a) 734.582 x 1000; and b) 734.582 x 0.01

a) The power of 10 contains 3 zeros. To multiply 734.582 by 1000, move the decimal point 3 places to the right, as shown:

$$734.852 \ \times \ 1000 = 734.\,582. = 734{,}582$$

b) The decimal power of 10 has two places. To multiply 734.582 by 0.01, move the decimal point two places to the left, as shown:

$$734.582 \ \times \ 0.01 = 7.34.582 = 7.34582$$

To DIVIDE DECIMALS:

1) **When the divisor is a whole number**, place the decimal point in the quotient directly over the decimal point in the dividend. Then divide the numbers as if they were whole numbers.

EXAMPLE 6: Divide $0.54 \div 12$

Because the divisor is a whole number, the decimal point in the dividend does not move. Place the decimal point in the quotient directly above the decimal point in the dividend. Then carry out the division until it terminates, adding any 0's to the dividend where necessary:

Place the decimal point ⌐   Quotient

$$
\begin{array}{r}
0.045 \\
12\overline{)0.540} \\
-48 \\
\hline
60 \\
-60 \\
\hline
0
\end{array}
$$

Divisor → 12 Dividend

2) **When the divisor is a decimal**, move the decimal point in the divisor as many places as necessary to make it a whole number. Move the decimal point in the dividend the same number of places to the right. Place the decimal point in the quotient directly over the decimal point in the dividend. Then divide the numbers as if they were whole numbers.

EXAMPLE 7: Divide $2.176 \div 0.34$

Move the decimal point in the divisor 2 places to get a whole number. Then move the decimal point in the dividend the same number of places to the right. Place the decimal point in the quotient directly over the moved decimal point in the dividend, as shown.

$$
\begin{array}{r}
6.4 \\
0.34.\overline{)\,2.17.6} \\
-204 \\
\hline
136 \\
-136 \\
\hline
0
\end{array}
$$

Note: Moving the decimal point the same number of places in the divisor and the dividend does not change the quotient. We use this same process when we write equivalent fractions by multiplying the numerator and denominator of the fraction by the same number:

$$
0.34\overline{)2.176} = \frac{2.176}{0.34} \cdot \frac{100}{100} = \frac{217.6}{34} = 34\overline{)217.6}
$$

EXAMPLE 8: Divide $63 \div 2.8$

Move the decimal point in the divisor 1 place to get a whole number. Add a decimal point and a zero to the dividend. Then move the decimal point in the dividend 1 place and carry out the division.

$$2.8\overline{)63} = 2{,}8{,}\overline{)63{,}0{,}} = 28\overline{)630.0}$$

$$\begin{array}{r} 22.5 \\ 28\overline{)630.0} \\ \underline{-56} \\ 70 \\ \underline{-56} \\ 140 \\ \underline{-140} \\ 0 \end{array}$$

ROUNDING A QUOTIENT TO A GIVEN PLACE VALUE:

To round a quotient to a given place value, carry out the division one place beyond the given place value and use the rule for rounding rule for rounding decimals to round the quotient.

EXAMPLE 9: Divide $6.25 \div 3.5$ and round the quotient to the nearest thousandth.

To carry out the division move the decimal point in the divisor and the dividend 1 place. Because we are rounding the quotient to the nearest thousandth, add 3 0's to the dividend to carry out the division to the ten thousandths place – one place beyond thousandths.

$$\begin{array}{r} 1.7857 \\ 3{,}5{,}\overline{)6{,}2{,}5000} \\ \underline{-35} \\ 275 \\ \underline{-245} \\ 300 \\ \underline{-280} \\ 200 \\ \underline{-175} \\ 250 \end{array}$$

Since the digit in the ten thousandths place is greater than 5, add 1 to the digit in the thousandths place, and drop the 7 in the ten thousandths place:

$$6.25 \div 3.5 \approx 1.7857 \approx 1.786$$