Name: _____ Date: _____

BLM MS–3

Working with Very Large and Very Small Numbers

- Very large and very small numbers can be expressed in scientific notation. In general, a number is expressed in scientific notation as: $a \times 10^n$, where $1 \leq |a| \leq 9$ and n is a positive or negative integer. To enter a number into your calculator in scientific notation, use the exponent key. What does the exponent key look like on your calculator? Is it [EE] or [EXP]?
- Do not use the 10^x key for scientific notation. It is used in calculations involving exponential and logarithmic equations.

$|a|$ means all positive values of a. For any value of a, take its absolute value. Example: $|-6| = 6$

Example 1

The planet Pluto is approximately 5 913 000 000 km from the Sun. Express this number in scientific notation. How would you enter this number into your calculator?

Solution

Express a as a decimal number that is greater than or equal to 1 and less than 10.
Therefore, $a = 5.913$.
The number of decimal places from the decimal point to the end of the original number is 9.
Therefore, $n = 9$.
In scientific notation, the distance between Pluto and the sun is 5.913×10^9.
The key sequence is 5.913 [EE] 9 or 5.913 [EXP] 9.

Example 2

Round 0.000 981 7 to five decimal places. Write this new number in scientific notation. How would you enter this number into a calculator?

Solution

Round to five decimal places: 0.000 981 7 = 0.000 98.
Use scientific notation: 9.8×10^{-4}. Note that the exponent is a negative value. This is because the original number is less than 1.
The key sequence is 9.8 [EE] –4 or 9.8 [EXP] –4.

Questions

1. Round each number to the number of digits indicated. Then, express each new number in scientific notation.

a) 45 600 (to 1 decimal place)
b) 0.5512 (to 3 decimal places)
c) 0.000 047 81 (to 6 decimal places)
d) 0.007 1185 (to 6 decimal places)
e) 184 927 155 (to 5 decimal places)
f) –571 204 000 (do not round)

2. Express each number in scientific notation as a decimal number.

a) 6.04×10^{-12}
b) 3.87×10^4
c) 1.87×10^{10}
d) -9.045×10^{-7}
e) -6.591×10^{-1}
f) 2.419×10^2

3. A calculator displays each of the following numbers after you perform a calculation. How should you copy each number into your notebook as a decimal number?

a) 294.256^{11}
b) -3.648^{-08}
c) -6.27^{05}
d) 9.501^{-10}

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- Using the calculator's exponent key allows you to easily perform arithmetic operations with very large and very small numbers.

Example

A computer is being designed to process 2 100 000 bits of data in 0.000 005 50 s. At what rate can this computer process data?

Solution

Express the rate of processing data as a ratio of bits of data to seconds of processing time. Therefore,

$$\frac{2\ 100\ 000}{0.000\ 005\ 50} = \frac{2.1\times10^{6}}{5.5\times10^{-6}}$$
$$= \left(\frac{2.1}{5.5}\right)\times10^{[6-(-6)]}$$
$$= 0.38\overline{18}\times10^{12}$$
$$= 3.8\overline{18}\times10^{11}$$

With a calculator, solve in one step, using the exponent key.
The key sequence is
2.1 [EE] 6 [÷] 5.5 [EE] –6 or 2.1 [EXP] 6 [÷] 5.5 [EXP] –6.
The answer generated by the calculator is 3.818181818^{11}, or $3.8\overline{18}\times10^{11}$.
Therefore, the computer can process data at a rate of $3.8\overline{18}\times10^{11}$.

Note that your calculator may require you to use brackets around the operations in the numerator and in the denominator.

Questions

4. Calculate. Express your answers in scientific notation.

a) $(2 \times 10^{-6})(9 \times 10^{-10})$

b) $(4.6 \times 10^{-12})(7.2 \times 10^{8})$

c) $\dfrac{\left(1.7\times10^{5}\right)}{\left(5.1\times10^{11}\right)}$

d) $\dfrac{\left(8.4\times10^{25}\right)}{\left(3.2\times10^{8}\right)}$

e) $\dfrac{\left(3\times10^{-5}\right)\left(8\times10^{-3}\right)}{\left(4\times10^{-9}\right)\left(1.2\times10^{8}\right)}$

Note that if you use a calculator for part e), you will need to use brackets in the denominator.

f) $(1.2 \times 10^{7})^{3}$

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