Math Review for CHEM 3

Chemistry uses mathematics as a language to express quantitative relationships between measurable, physical quantities. The questions below involve prerequisite mathematics that will be necessary to solving common problems encountered in chemistry. **Try your best to work through these problems WITHOUT the use of a calculator. SHOW YOUR WORK.**

Exponents:

Simplify the expressions below.

1) $10^2 \cdot 10^5 =$ $10^{2+5} = 10^7$

2) $10^{-3} \cdot 10^5 =$ $10^{-3+5} = 10^2$

3) $10^{-2} \cdot 10^{-4} =$ $10^{-2+(-4)} = 10^{-6}$

4) $(10^3)^4 =$ $10^{3 \cdot 4} = 10^{12}$

5) $(10^{-2})^4 =$ $10^{-2 \cdot 4} = 10^{-8}$

6) $\frac{10^3}{10^5} =$ $10^{3-5} = 10^{-2}$

7) $\frac{10^2}{10^{-8}} =$ $10^{2-(-8)} = \boxed{10^{10}}$

8) $\frac{(10^3)^{-3}}{10^{-6}} = \frac{10^{3 \cdot -3}}{10^{-6}} = \frac{10^{-9}}{10^{-6}} = 10^{-9-(-6)} = \boxed{10^{-3}}$

9) $100 = 10^2$

$\frac{10^9}{10^{-2} \cdot 10^5} \cdot \frac{10^{-7}}{(100^3)} = \frac{10^9}{10^{-2} \cdot 10^5} \cdot \frac{10^{-7}}{(10^2)^3} = \frac{10^9}{10^{-2+5}} \cdot \frac{10^{-7}}{10^6}$

$= \frac{10^9}{10^3} \cdot \frac{10^{-7}}{10^6} = 10^{9-3} \cdot 10^{-7-6} = 10^6 \cdot 10^{-13} = 10^{6+(-13)}$

$= \boxed{10^{-7}}$

10) $\frac{10^{-3}}{(10^4)^{-2}} \cdot \frac{10^2}{\frac{1}{10^3}} =$

$\frac{10^{-3}}{10^{4 \cdot -2}} \cdot \frac{10^2}{10^{-3}} = \frac{10^{-3}}{10^{-8}} \cdot \frac{10^2}{10^{-3}}$

$= 10^{-3-(-8)} \cdot 10^{2-(-3)} = 10^5 \cdot 10^5 = 10^{5+5} = \boxed{10^{10}}$

Scientific Notation:

1) $(5.7 \times 10^{-25}) - (1.3 \times 10^{-25}) =$

2) $(4.0 \times 10^2) + (3.00 \times 10^3) =$

3) $(2.80 \times 10^{-2}) - (1.0 \times 10^{-3}) =$

Exponent Rules

$$A^x \cdot A^y = A^{(x+y)} = A^{x+y}$$

$$\frac{A^x}{A^y} \text{ or } A^x \div A^y = A^{x-y}$$

$$(A^x)^y = A^{xy}$$

Scientific Notation

Decimal value

positive exponent value > 1

$$127936.7 = 1.279367 \times 10^5$$

$$= 1.279367 \times 100000$$

$$= 127936.7 \checkmark$$

* First digit must be between 1 & 9

First two non-zero digits

Negative exponent value < 1

$$0.00000923 = 9.23 \times 10^{-6}$$

$$9.23 \times \frac{1}{10^6}$$

$$9.23 \times \frac{1}{1000000}$$

$$9.23 \div 1000000$$

$$= 0.00000923 \checkmark$$

Scientific Notation:

As long as exponents are same, the decimals are same

1) $(5.7 \times 10^{-25}) - (1.3 \times 10^{-25}) =$

$$\begin{array}{r} 5.7 \times 10^{-25} \\ -\ 1.3 \times 10^{-25} \\ \hline 4.4 \times 10^{-25} \end{array}$$

Cannot be added when exponents different

2) $(4.0 \times 10^{2}) + (3.00 \times 10^{3}) =$

$$\begin{array}{rl} 4.0 \times 10^{2} = & 400. \\ 3.00 \times 10^{3} = + & 3000. \\ \hline 3400. = & 3.40 \times 10^{3} \end{array}$$

3) $(2.80 \times 10^{-2}) - (1.0 \times 10^{-3}) =$

$$\begin{array}{r} 0.0280 \\ -\ 0.0001 \\ \hline 0.0270 \end{array} = \boxed{2.70 \times 10^{-2}}$$

$1023 + 3.72 =$

$$\begin{array}{r} 1023. \\ +\ \ 3.72 \\ \hline 1026.72 \end{array}$$

Key is alignment of decimal

$(2.80 \times 10^{-2}) - (1.0 \times 10^{-3}) =$

$$\begin{array}{r} 28.0 \times 10^{-3} \\ -\ \ 1.0 \times 10^{-3} \\ \hline 27.0 \times 10^{-3} \end{array}$$

$$\boxed{2.70 \times 10^{-2}}$$

$$\begin{array}{r} 2.80 \times 10^{-2} \\ -0.10 \times 10^{-2} \\ \hline 2.70 \times 10^{-2} \end{array}$$

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Algebra:

Solve for x.

Hint: Sometimes it may be helpful to express quantities in scientific notation and then simplify.

1) $50x = 5000$ $\quad x = \frac{5000}{50}$ $\quad \boxed{x = 100}$

2) $3x + 25 = 55$ $\quad 3x = 55 - 25$ $\quad \frac{3x}{3} = \frac{30}{3}$ $\quad \boxed{x = 10}$

3) $3 \times (2x) = 30$ $\quad 2x = 10$ $\quad \boxed{x = 5}$

4) $4 \times (2x - 100) = 800$ $\quad 2x - 100 = 200$ $\quad 2x = 300$ $\quad \boxed{x = 150}$

5) $\frac{x}{5} = \frac{2500}{25}$ $\quad 5 \times \frac{x}{5} = 100 \times 5$ $\quad \boxed{x = 500}$

6) $\times\ 200 = \frac{10}{x} \times x$ $\quad 200x = 10$ $\quad \boxed{x = \frac{1}{20} \text{ or } x = 0.05}$

Same

7) $\frac{400}{20} = \frac{80}{x}$ $\quad \times 20 = \frac{80}{x} \times x$ $\quad 20x = 80$ $\quad \boxed{x = 4}$

8) $(x+10)\,10 = \frac{200}{(x+10)}(x+10)$ $\quad 10(x+10) = 200$ $\quad x + 10 = 20$ $\quad \boxed{x = 10}$

9) $\sqrt{400} = \sqrt{x^2}$ $\quad x = 20 \text{ or } x = -20$ $\quad = \boxed{x = \pm 20}$

10) $1003 = x^3 + 3$ $\quad \sqrt[3]{1000} = \sqrt[3]{x^3}$ $\quad = (1000)^{\frac{1}{3}} = (x^3)^{\frac{1}{3}}$ $\quad = \boxed{x = 10}$

11) $\frac{(x+3)}{5} = \frac{30}{0.15}$ $\quad \frac{x+3}{5} = 200 \times 5$ $\quad x + 3 = 1000$ $\quad \boxed{x = 997}$

12) $\frac{600}{(2x+16)} = \frac{200}{10}$ $\quad \frac{300}{(2x+16)} = 20$ $\quad 2(x+8)$ $\quad 300 = 20(x+8)$

$$\frac{300}{20} = \frac{20(x+8)}{20}$$

$$15 = x + 8$$

$$-8 \qquad -8$$

$$\boxed{7 = x}$$

$\sqrt{100} = \pm 10$

$10 \times 10 = 100$

$-10 \times -10 = 100$

$\sqrt[3]{1000} = 10$

$10 \times 10 \times 10 = 1000$

$-10 \times -10 \times -10 = -1000$