CONCEPT: LOGARITHMIC FUNCTIONS

The logarithmic base 10 form represents the exponent that 10 must be raised in order to obtain that specific number. For example:

$$10^1 = 10 \qquad \log 10 = 1$$

$$10^4 = 10{,}000$$

$$10^{-1} = 0.10$$

$$10^0 = 1$$

EXAMPLE 1: Without using a calculator, determine the answer to the following questions.

$$\log 1.0 \times 10^{-7} \qquad \log 1000$$

EXAMPLE 2: Without using a calculator, determine the answer to the following questions.

$$\log 1.0 \times 10^{5} \qquad \log 0.0001$$

CONCEPT: INVERSE LOGARITHMIC FUNCTIONS

The inverse or anti logarithmic function can be seen as the opposite of the logarithmic function.

$$\log x = y \qquad\qquad \text{inv}\log y = 10^{y} = x$$

So applying this logic the example below would go as follows:

$$\log 100 = 2 \qquad\qquad \text{inv}\log 2 =$$

EXAMPLE: The Henderson-Hasselbalch equation is a useful equation for the determination of the pH of a buffer. With its equation, shown below, determine the ratio of conjugate base to weak acid when the pH = 4.17 and pKa = 3.83.

$$\text{pH} = \text{pKa} + \log\frac{\text{conjugate base}}{\text{weak acid}}$$

a) – 0.469

b) 0.457

c) 2.19

d) 1.0 x 10^{-8}

CONCEPT: NATURAL LOGARITHMIC FUNCTIONS

The natural logarithm, sometimes shortened to just ln, of a value is the exponent to which *e* must be raised to determine that number. For example:

$$\ln 1000 = 6.908$$

This means that *e*, the inverse of the natural logarithm, had to be said to 6.908 in order to obtain 1000.

The inverse of the natural logarithm again symbolized by the variable *e* can be seen as the opposite of the natural logarithm ln.

$$\ln x = y \qquad\qquad \text{inv}\ln y = e^{y} = x$$

So applying this logic the example below would go as follows:

$$\ln 2 = 0.693 \qquad\qquad \text{inv}\ln 0.693$$

EXAMPLE: Based on your understanding of natural logarithmic functions solve for the missing variable in the following question:

$$\ln[x] = -(2.13\times10^{-1})(12.3) + \ln[1.25]$$

CONCEPT: MATHEMATICAL RELATIONSHIPS USING LOGARITHMS

When dealing with the logarithmic form or the natural logarithmic form it is important to remember the following relationships.

MULTIPLICATION

$$\log(a \cdot b) =$$

$$\ln(a \cdot b) =$$

DIVISION

$$\log \frac{a}{b} =$$

$$\ln \frac{a}{b} =$$

RAISED TO A POWER

$$\log a^{x} =$$

$$\ln a^{x} =$$

TAKEN TO THE n^{th} ROOT

$$\log \sqrt[x]{a} =$$

$$\ln \sqrt[x]{a} =$$

EXAMPLE: Solve the following without the use of a calculator. If log 3 = 0.48 and log 2 = 0.30, what would be the value of log 12?