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DEPARTMENT OF THE AIR FORCE
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AIR FORCE SPECIALTY CODE 4B051
BIOENVIRONMENTAL ENGINEERING

Basic Mathematics

QUALIFICATION TRAINING PACKAGE

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STS Line Item 3.2.2: Perform conversion of units using dimensional analysis (formula manipulation), metric conversions.

TRAINER GUIDANCE

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.
Prerequisites:	None
Training References:	N/A
Additional Supporting References:	N/A
CDC Reference:	N/A
Training Support Material:	http://www.metric-conversions.org/
Specific Techniques:	Conduct hands-on training and evaluation.
Criterion Objective:	Given a calculator, perform dimensional analysis and metric conversions successfully completing all checklist items with NO instructor assistance.
Notes: *****This QTP is limited to the task steps involved with converting units using dimensional analysis and converting metric units. The student should be able to perform these tasks at the end of this training module.	

TASK STEPS

DIMENSIONAL ANALYSIS

1. Identify quantity to be converted.[1]
2. Determine conversion calculation.[2]
3. Set up formula.[3]
4. Solve

METRIC CONVERSIONS

1. Identify quantity to be converted.[4]
2. Determine conversion calculation.
3. Solve.

LOCAL REQUIREMENTS:

NOTES:

1. Units must be the same type of measurement, i.e. measurement of length to length, weight to weight.

2. Below are examples of commonly used conversions. Pick the conversion or conversions (more than one may need to be used) to convert units.

1 inch	=	2.54 centimeters
1cubic inch	=	16.387 cubic centimeters
1 yard	=	3 feet
1 foot	=	12 inches
1 ounce	=	28 grams
1 pound	=	16 ounces
1000 milligrams	=	1 gram
1 kilogram	=	2.205 pounds
1 kilogram	=	1000 grams
1 meter	=	100 centimeters
1 centimeter	=	10 millimeters
1 gallon	=	3.785 liters
1 gallon	=	4 quarts
1 quart	=	2 pints
1 liter	=	1.057 quart
1 liter	=	1000 milliliters
1 mile	=	5,280 feet
1 pint	=	16 ounces
1 ft3	=	7.48 gallon

3. Example: converting 4 gallons into liters you would use the following formula setup. Make sure like units (Gallons/Gallons) are on opposite ends of the fraction (numerator/denominator).

$$\frac{4\ Gallons}{1} x \frac{3.785\ Liters}{1\ Gallon}$$

$$\frac{4\ Gallons}{1} x \frac{3.785\ Liters}{1\ Gallon}$$

$$\frac{4\ \cancel{Gallons}}{1} x \frac{3.785\ Liters}{1\ \cancel{Gallon}}$$

$$4\ x\ 3.785\ Liters = 15.14\ Liters$$

4. Determine starting point and ending point of conversion on the number line.

10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}	10^{0}	10^{1}	10^{2}	10^{3}	10^{6}	10^{9}
pico	nano	micro	milli	centi	deci	base	deca	hecto	kilo	Mega	Giga

Example: if converting milligrams (10^{-3}) to micrograms (10^{-6}) you would multiply by 1000. 5mg = 5000µg

TRAINEE REVIEW QUESTIONS

STS Line Item 3.2.2: Perform conversion of units using dimensional analysis (formula manipulation), metric conversions.

1. Provide the symbol for the following metric prefixes and each one's associated powers of ten.

Prefix	Symbol	Power of Ten
▫ Mega	_____	_____
▫ Kilo	_____	_____
▫ Hecto	_____	_____
▫ Deka	_____	_____
▫ deci	_____	_____
▫ centi	_____	_____
▫ milli	_____	_____
▫ micro	_____	_____

2. Convert the following metric units.

1 centimeter = _____ millimeters 0.5 centimeters = _____ millimeter

1 meter = _____ centimeters 0.3 centimeters = _____ decimeter

1 meter = _____ millimeters 1 centimeter = _____ millimeters

PERFORMANCE CHECKLIST

STS Line Item 3.2.2: Perform conversion of units using dimensional analysis (formula manipulation), metric conversions.

Proficiency Code:	3c
PC Definition:	Can do all parts of the task. Needs only a spot check of completed work. Can identify why and when the task must be done and why each step is needed.

DID THE TRAINEE…		YES	NO
DIMENSIONAL ANALYSIS			
1. Identify quantity to be converted?			
2. Determine conversion calculation?			
3. Set up formula?			
4. Solve?			
METRIC CONVERSIONS			
1. Identify quantity to be converted?			
2. Determine conversion calculation?			
3. Solve?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. Provide the symbol for the following metric prefixes and each one's associated powers of ten.

A:

Prefix	Symbol	Power of Ten
▫ Mega	___M_____	____10^{6}_____
▫ Kilo	___K_____	____10^{3}_____
▫ Hecto	___h_____	____10^{2}_____
▫ Deka	____da_____	___10^{1}_____
▫ deci	___d_____	____10^{-1}_____
▫ centi	___c_____	_____10^{-2}_____
▫ milli	___m_____	____10^{-3}_____
▫ micro	___µ_____	___10^{-6}_____

(Source: N/A)

2. Convert the following metric units.

A: 1 centimeter = __10___ millimeters 0.5 centimeters = __5___ millimeter

1 meter = __100___ centimeters 0.3 centimeters = __0.03___ decimeter

1 meter = __1000___ millimeters 1 centimeter = __10___ millimeters

(Source: N/A)

STS Line Item 3.2.6: Use basic statistics.

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step by step procedures for doing the task.
Prerequisites:	None
Training References:	N/A
Additional Supporting References:	N/A
CDC Reference:	N/A
Training Support Material:	N/A
Specific Techniques:	Conduct hands-on training and evaluation.
Criterion Objective:	Given a calculator, perform basic statistical analysis with minimal instructor assistance.
Notes: *****This QTP is limited to the task steps involved with calculating the mean, median, and mode of a given set of numbers.	

TASK STEPS

1. Determine the mean.[1]
2. Determine the median.[2]
3. Determine the mode.[3]

LOCAL REQUIREMENTS:

NOTES:

1. The mean is usually symbolized as $\bar{x}$ and called " x bar."

The equation for calculating the mean can be given as:

$$\bar{x} = \frac{\sum x}{n}$$

Where: $\bar{x}$ = the mean value
Σx = sum of all values for x
n = total number of data points

Example: Find the mean of the set of values: 5, 2, 3, 6.

First add all the numbers in the set (x_1 to x_i).

5 + 2 + 3 + 6 = 16

Secondly, count the total number of values (find n)

n = 4

Finally, divide the sum of the values (x_1 to x_i) by the number of values in the set (n).

$$\text{mean} = \bar{x} = \frac{16}{4} = 4$$

2. Consider the following sample data:

50 35 20 65 90 120 100 45 35 90 40

The average, or mean:

$$\bar{x} = \frac{\sum x}{n} = \frac{690}{11} = 62.73$$

The median would be determined by aligning the data with the smallest number at one end and the highest at the other:

20 35 35 40 45 **50** 65 90 90 100 120

In this case the median will be at 50. Note the difference between mean and median.

3. The value that occurs <u>most frequently</u> is called the mode. There may not be a mode (if no value repeats), or there may be more than one mode (if more than one value is repeated.

Using the same set of numbers:

20 **35** **35** 40 45 50 65 **90** **90** 100 120

There are two modes, 35 and 90.

TRAINEE REVIEW QUESTIONS

STS Line Item 3.2.6: Use basic statistics.

1. Determine the mean and mode of the following set of numbers:

   11, 25, 23, 26, 18, 22, 26, 14, 32, 21, 15

2. Determine the mean and mode of the following test scores:
   96, 81, 87, 70, 93, 77, 84

PERFORMANCE CHECKLIST

STS Line Item 3.2.6: Use basic statistics.

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.

DID THE TRAINEE…		YES	NO
Determine the mean?			
Determine the median?			
Determine the mode?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT)

TRAINER NAME (PRINT)

ANSWERS

1. Determine the mean and mode of the following set of numbers:

   11, 25, 23, 26, 18, 22, 26, 14, 32, 21, 15

Mean:
$\bar{x} = \frac{\sum x}{n} = \frac{233}{11} = 21.18$
Mode: 26

(Source: Steps 1 and 3 of this QTP)

2. Determine the mean and mode of the following test scores:

   96, 81, 87, 70, 93, 77, 84

A:
Mean:
$\bar{x} = \frac{\sum x}{n} = \frac{588}{7} = 84$

Mode : None

(Source: Steps 1 and 3 of this QTP)