**FUNDAMENTALS OF INDUSTRIAL HYGIENE, 6TH ED.**

**HOMEWORK #2**

**INDIVIDUAL DETERMINATION OF EXPOSURE CONCENTRATIONS**

**Name: KEY *30 pts. possible***

**EXERCISES:** Perform the calculations identified below. Show your work neatly and clearly in a manner similar to the examples provided above (i.e., write the formula, define each variable in the formula, show steps of your calculations).

**Part I: Calculating Air Volumes**

What is the total volume of air sampled if a pump moves 540 *cc* of air per minute over a time span of 6.1 hours? *(3 points)*

Calculation:

Convert this value into milliliters: ***197,640 ml***

Convert this value into liters: ***197.64* *l***

What is the total volume of air sampled if a pump moves 3.4 *l* of air per minute over a time span of 9.4 hours? *(4 points)*

Calculation:

Convert this value into cubic meters: ***1.9176* *m*3**

Convert this value into cubic centimeters: ***1,917,600 cc***

Convert this value into milliliters: ***1,917,600 ml***

**Part II: Concentrations and Conversions**

**weight-per-weight**

One of the first gasoline additives, tetraethyl lead was added to gasoline as an anti-knock agent. Use of this additive was banned in the U.S. in the early 1980s due to concerns over lead exposure. During initial site work, an abandoned underground storage tank (UST) was found. After contacting the appropriate agencies, the tank was sampled and found to contain a small amount of gasoline containing tetraethyl lead. After excavating around the tank, the tank was lifted out of the ground, whereupon staining of the soil under the tank was noticed indicating the tank had leaked. Under agency supervision, the dirt under the tank was excavated until no more staining was noticed. A total of three 10-yard dump trucks were filled with contaminated soil. A total of 15 soil samples were taken (5 from each dump truck) and sent to a lab for analysis. The total weight of the samples was 19.8 kilograms. The samples were found to contain 297 *mg* of tetraethyl lead. What is this contamination level reported in *mg/kg*? *(3 points)*

Formula:

Calculations:

Convert this value into parts-per-million: ***15 ppm***

**weight-per-volume**

While sampling a painter for exposure to acetone vapors (a chemical commonly used for both cleaning parts prior to painting and as a paint thinner), the sampling pump ran at 0.5 *l/min* for 6 hours and 15 minutes while the worker was painting. The worker spent the remainder of the 8-hour shift unexposed to solvent vapors. The lab reported a result of 34.4 *mg* of acetone for the charcoal tube. Determine the concentration so these values can be compared to the PEL-TWA or TLV-TWA. *(3 points)*

Calculation of Air Volume:

Calculation of Concentration:

Formula:

Calculations:

**fiber counts**

While sampling a basement following asbestos abatement, the sample pump was set to 4.5 *l/min* and allowed to operate for 5.8 hours to collect an adequate sample. The sample filter was sent off for analysis. Based on sampling estimates, the lab indicated a total of 846,215 fibers, of which 398,265 met the criteria for counting as asbestiform fibers. Determine the concentration so it can be compared against the PEL-TWA or TLV-TWA, both of which are 0.1 *fiber/cm*3. *(6 points)*

Calculation of Air Volume:

Calculation of Concentration:

Formula:

Calculations:

What is the conversion factor from liters to cubic centimeters? ***1 = 1000* *cc***

What is the concentration in *fibers/cc*? ***0.2543* *fibers/cc***

Would remodeling workers exposure exceed the PEL-TWA? ***Yes***

**weight-per-volume to *ppm* (solid/liquid contaminants):** Methyl ethyl ketone (MEK) is a colorless liquid that has a sharp, sweet odor reminiscent of butterscotch and acetone. MEK has a chemical formula C4H8O. It is produced industrially on a large scale and is often used as an industrial solvent since it is soluble in water. Because it readily dissolves nitrocellulose, it was once a common ingredient in gun cleaning solvents. The air in a parts cleaning workshop was sampled and found to contain 153 *ppm* of MEK, what would this be in *mg/m*3?

First, determine the molar mass of MEK. *(1 point)*

C = *4*  ** = *48*

H = *8*   *1* =  *8*

O = *1*  *16*  = *16*

Total = ***72*  *g/mol***

Next, perform the conversion calculations. *(2 points)*

Formula:

***mg/m*3**

**volume-per-volume to *ppm* (gaseous contaminants)**

Referring back to the tetraethyl lead problem above, after the visibly contaminated soil was removed, the regulatory agency charged with oversight of USTs required air monitoring of the atmosphere in the excavation before workers could enter. As the safety officer for the company performing the work, you also want the air sampled. The PEL-TWA for tetraethyl lead is 0.075 *mg/m*3, which is actually higher than the TLV-TWA (0.1 *mg/m*3). You conduct the air monitoring using an air sampler that operated for 5 minutes out of every 15 minutes throughout a 4-hour period. During operation, the pump moved 0.3 liters of air per minute. The charcoal tube from the sampler was sent in for analysis, and the results showed 0.0022 *mg* of tetraethyl lead. *(5 points)*

What was the total amount of time the air sampler operated? ***80 minutes***

What was the total amount of air sampled? ***24 liters***

What was the concentration of tetraethyl lead in milligrams per liter? ***0.000092* *mg/l***

Because the PEL/TLV is given in *mg/m*3, convert your results to these units. ***0.09* *mg/m*3**

Would a worker in this excavation be exposed above the PEL/TLV? ***Yes, for the PEL***

However, because the regulatory agency insists you report your findings in parts-per-million, convert the above value into *ppm*. (Remember, this is a volume-per-volume conversion to parts-per-million involving gaseous contaminants.) The chemical formula for tetraethyl lead is (CH3CH2)4Pb.

First, determine the molar mass of tetraethyl lead. *(1 point)*

C =  *8*   **  = *96*

H = *20*  *1* =  *20*

Pb = *1*  *207* = *207*

Total = ***323*  *g/mol***

Next, perform the conversion calculations. *(2 points)*

Formula:

**or 7 *ppb***