Example Questions involving Gas Phase Concentrations

1. The National Institute of Occupational Safety and Health's recommended short-term (15 min) exposure limit for benzene (C_6H_6) is reported as 16.3 mg/m^3, whereas it's odour threshold is given 1.5 ppm_v.
a) If a benzene odour is detected, does this necessarily mean you have exceeded the short term expousure limit?
b) Benzene has a reported vapour pressure of 95.2 torr at 25^{o}C. Calculate concentration of benzene in room air, if a large container of benzene was left open in a closed room. (Note; benzene is a known carcinogen, do not try this at home)

[*Ans* ***16.3 mg/m^3 → 5.10 ppm$_v$*** *or* ***1.5 ppm$_v$ → 4.8 mg/m^3****; P_T= 1.00 atm and T = 25^{o}C*]

[*Ans =* ***390 g/m^3 or 12.2 %****; P_T= 1.00 atm and T = 25^{o}C*]

2. A student prepares a gas standard by injecting 86 mg of chloroform ($CHCl_3$) into an empty sealed 2.00L flask, whereupon it completely evaporates. Calculate the concentration of chloroform as ppm_v.

[*Ans =* ***8790 ppm$_v$****; P_T = 1.00 atm, T = 25^{o}C*]

3. Calculate the number density of oxygen molecules in the atmosphere at an altitude of 30 km (P_T = 0.015 atm, T = -40^{o}C).

[*Ans =* ***1.0 x 10^{17} molecules/cm^3****; χ_{O2}= 0.21*]

4. The average mass/volume concentration of sulfur dioxide in Nikel Russia is 50 µg/m^3. What is the concentration of SO_2 in parts per billion at 15^{o}C and 1 atm.

[*Ans =* ***18 ppb$_v$***]

5. If the mixing ratio of ozone in polluted urban air is 50 ppbv, calculate its concentration in mg m^{-3}.

[*Ans =* ***0.10 mg/m^3****; at 1.0 atm and 15^{o}C*]