Questions

(4.1) Average engine-out emissions before catalytic treatment from a SI engine car operating on stoichiometric gasoline-air mixture are CO = 12 g/km, HC = 1.5 g/km and NO_x (as NO) = 1.0 g/km. The fuel consumption of car is 80 g/km. Estimate the average concentration of pollutants CO (as % volume), NO (ppm), HC (ppmc1). Take gasoline as isooctane, universal gas constant $\overline{R}$ = 8314.3 kJ/kmol.K.

(4.2) The above car meets the Euro 3 standards CO = 2.3 g/km, HC = 0.2 g/km and NO_X = 0.15 g/km. What would be the concentration of each pollutant in the exhaust gas at exit of the tail pipe.

(4.3) In the US FTP cycle (Fig 4.3) the first 505 seconds of driving schedule is repeated after 10 minutes of hot engine soak. How would the average emissions of CO, HC and NO_X differ during the initial and the last 505 seconds of the driving cycle?

(4.4) Discuss why NDIR does not measure the unburned hydrocarbons correctly even though it is calibrated with standard mixtures of n-hexane in nitrogen gas.

(4.5) A light extinction type smoke meter has smoke column length, L= 430 mm and it shows smoke density of 60% (60% light is absorbed in the smoke column). Determine absolute smoke density of the exhaust gas in terms of m-1. The full flow type of smoke meters are used by fitting them at the end the exhaust pipe. The smoke column length for the full flow smoke meter may be taken equal to the exit diameter of the exhaust pipe. Make a table for the absolute smoke density varying from 0.25 m-1 to 2.5 m-1 in steps of 0.25 m-1 correlating the smoke opacity readings observed with the sampling smoke meter having L = 430 mm and full flow smoke meter fitted to the exhaust pipe of 100 mm dia.

(4.6) Discuss the advantages and disadvantages of the full and partial flow dilution tunnels for measurement of PM emissions.

(4.7) To measure emissions under fluctuating and transient operating conditions of a vehicle during the driving cycle operation, the emission analyzers having very fast response are required so that instantaneous concentration measurement for the pollutants can be done and the concentrations are then integrated over the driving cycle to determine emissions in terms of g/km. Such emission analyzers are not yet available and there is also delay in the sampling line from the exhaust to analyzer. Discuss how a constant volume sampling (CVS) system functions and this problem is taken care of. In case, the entire exhaust gas during the driving cycle is collected in a big balloon and then the average pollutant concentration is determined, what may be the disadvantages compared to the CVS system.