CEE490/ENVH 461 Prob. 5 Name: _____

Due Oct. 14, 2008 Reduction in NMHC to Achieve Old 1-Hr Ozone NAAQS of 0.12 ppm

Given: Suppose a certain city has a measured maximum 1 hour average ozone conc. of 0.28 ppm (this is the peak hourly O_3 concentration). If no change in the 1 hr average ambient conc. of 0.16 ppm NO_X is expected (ie NO_X concentration remains constant at 0.16 ppm NO_X), use the EKMA ("Empirical Kinetic Modeling Approach" graph) to find out the % reduction in nonmethane hydrocarbons (NMHC) or Volatile Organic Compounds (VOC) needed to achieve the "old" 1996 EPA Federal NAAQS std for ozone conc in the ambient air of 0.12ppm O_3 1 hr average. The EKMA graph such as in Fig. 9.5 p. 481 WW&D use hourly averages of the NO_X, NMHC, and O_3 concentrations. Parts per million as Carbon = ppmC.

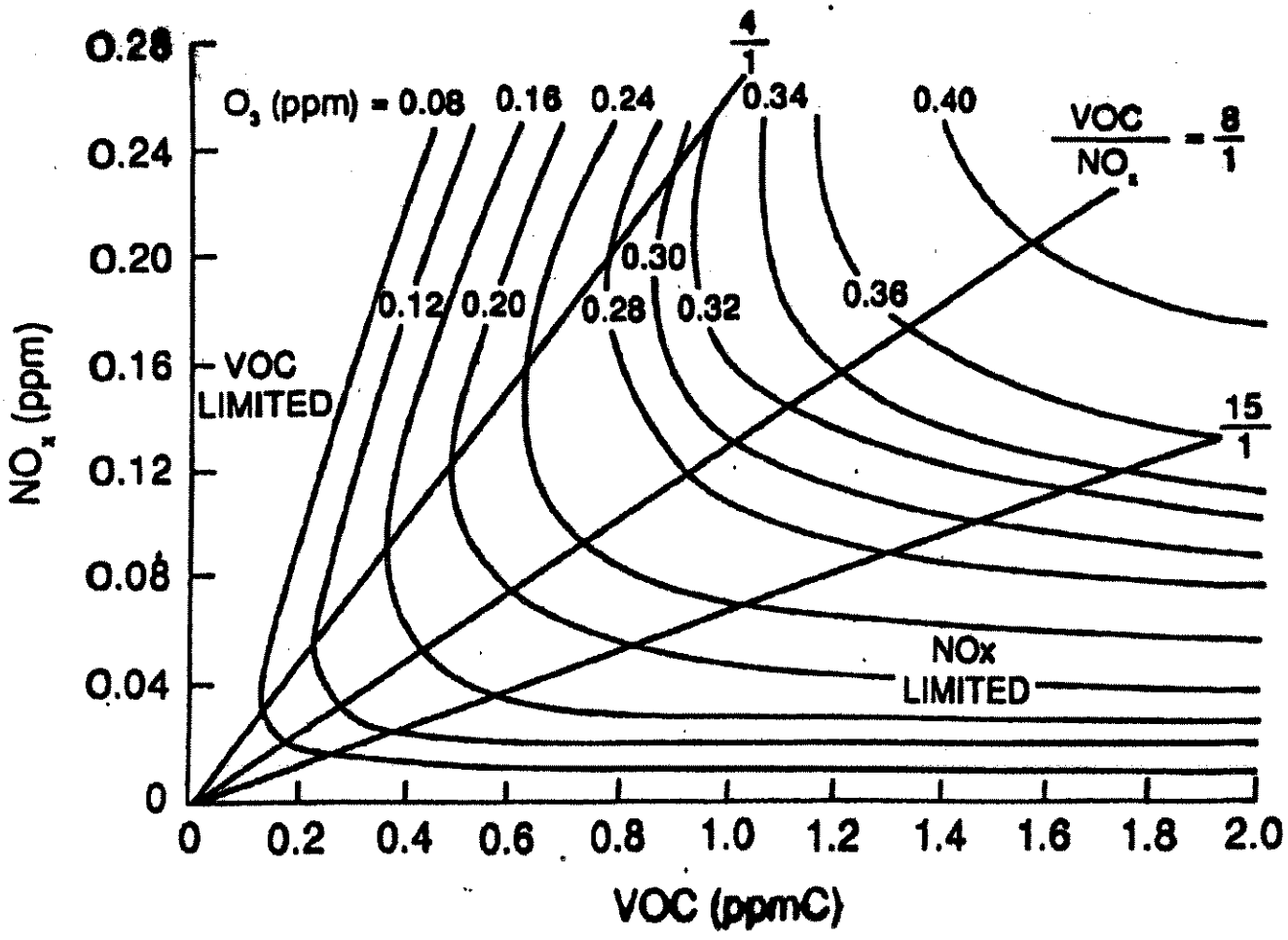
Find: Show calculations and Explain and show how you obtained NMHC concentrations From the EKMA graph (attach calculation and explanation sheets).

a. NMHC or VOC Conc. when O_3 is 0.28 ppm & NO_X is 0.16 ppm. _____ ppmC

b. NMHC or VOC Conc. when O_3 is at 1996 NAAQS of 0.12 ppm 1 hr av. and NO_X is 0.16 ppm _____ ppmC

c. % Reduction in 1-hr average Non Methane Hydrocarbon Concentration (NMHC)

$$\text{Reduction in 1-hr NMHC Conc Needed to achieve 1996 NAAQS for 1-hr Ozone} = \frac{(\text{NMHC@0.28 ppm } O_3) - (\text{NMHC@0.12p pm } O_3)}{(\text{NMHC@0.28p pm } O_3)} =$$



Empirical Kinetic Modeling Approach (EKMA).

EKMA = Empirical Kinetic Modeling Approach

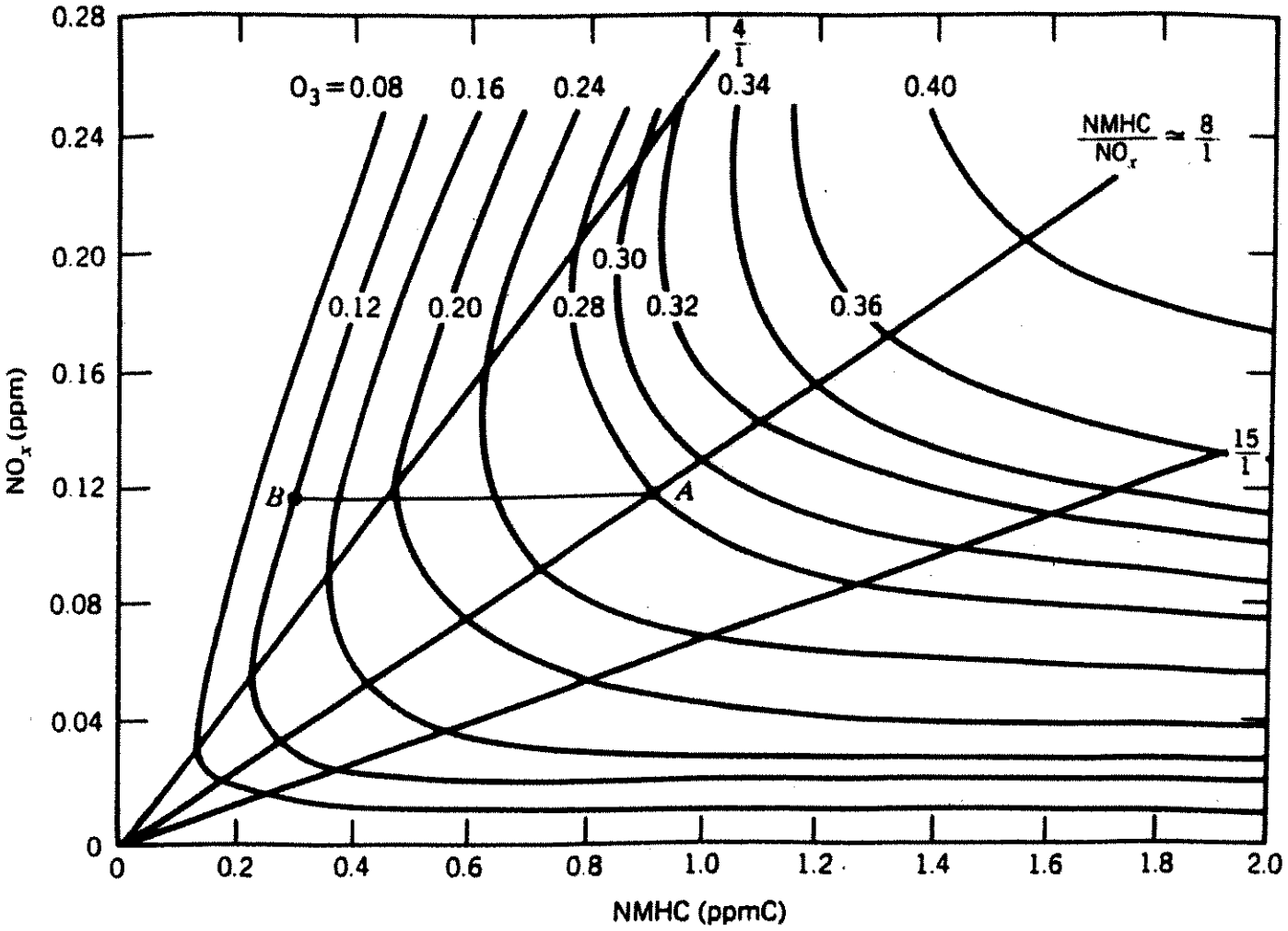


FIGURE 10.5. Ozone isopleths used in EKMA approach (from Dodge, 1977a).

Figure 10.5 can be used to predict the changes in NMHC and NO_x needed to produce a given change in the peak O_3 concentration. For example, suppose a particular city is characterized by a NMHC/NO_x ratio of 8:1, and a *design value*[2] of O_3 of 0.28 ppm (i.e., point *A* on Fig. 10.5). If no change in ambient NO_x is anticipated, and one wants to reduce the peak O_3 from 0.28 to the federal air quality standard of 0.12 ppm, one must reduce NMHC to point *B* in Fig. 10.5 or by approximately 67%.

The term *empirical* in the title EKMA comes from the use of *observed* O_3 peaks to examine various control strategy options. The *kinetics modeling* portion of the title reflects the use of a chemical submodel validated against smog chamber data to generate the isopleths of Fig. 10.5.