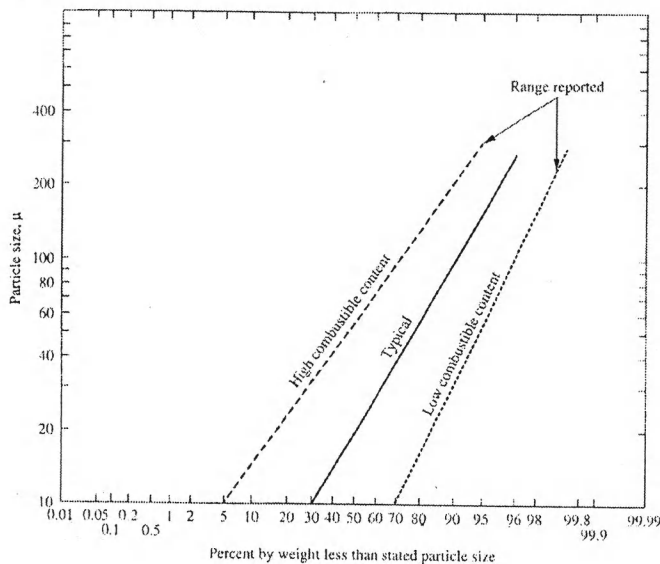


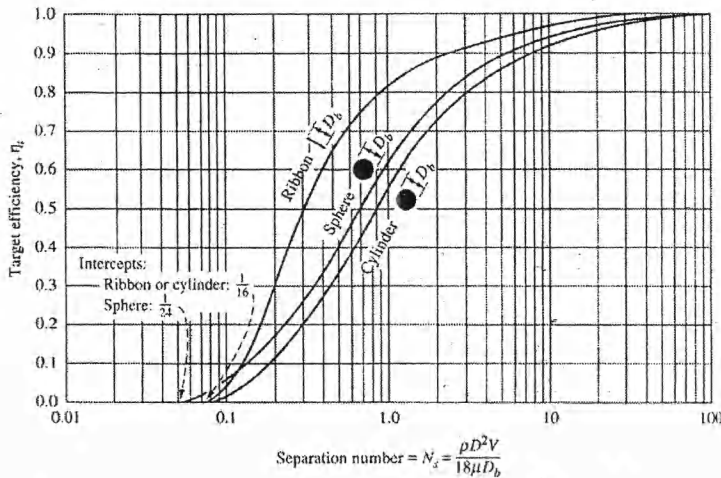
SECTION "B"

Answer *ALL* the questions. The data or information not given in the questions should be assumed properly.

1. (a) How does the law of diminishing returns apply to air pollution control? Explain with an example. [3]
 (b) Explain cost-benefit philosophy in air pollution control using a schematic representation of the relation between damage, control, and total costs, for one pollutant at one location. [4]
2. (a) In a source testing, the stack was divided into five sectors, each of which had the same cross-sectional area. The velocities were measured as 14, 18, 17, 12, 13 m/s and pollutant concentrations were measured as 333, 450, 390, 655, 475 mg/m³ respectively. What is the average concentration in the gas flowing in this stack? [4]
 (b) Describe the sampling train for measuring the SO₂ concentration in a stack. [4]
3. (a) We pass a gas stream through a fiber filter that collects 88 percent of the particles present. If we were to use three such filters in series and if we assume that each of them has an 88 percent efficiency, what would the expected overall collection efficiency be? [4]
 (b) Give an example of a predictive intermittent control scheme for air pollution control. [3]
4. (a) A spherical particle with diameter 1.2 μ and specific gravity 4.5 is settling in still air. What is the terminal settling velocity of this particle, taking the Cunningham correction factor into account? [3]
 (b) For the "Typical" log-normal distribution shown in the given figure, what are the values of D_{mean} and σ ? [3]



5. (a) Describe and discuss two types of fabric filter used in air pollution control. [2+2]
 (b) Using the given figure, estimate the percent target efficiency for a 12- μ particle in air moving at 30 m/s against a 1-cm diameter cylinder. Take viscosity as 1.8×10^{-5} kg/m \cdot s. [4]



6. In gasoline bulk-loading terminals, the displacement loss from the returning tank trucks must not exceed 35 mg of VOCs per liter of gasoline filled. One common solution to this problem is two-stage condenser-separator for recovering VOC from the displacement vapors of a gasoline tank truck. The first stage takes out much of the gasoline and most of the water, and the second, at a lower temperature, takes out most of the remaining gasoline. Assuming that the vapor leaving the truck is at $20^\circ\text{C} = 68^\circ\text{F}$, in equilibrium with the remaining gasoline in the truck, and that that vapor is 1 mol % water vapor, how cold must the second chiller cool the displaced vapor before discharging it to the atmosphere? Assume that the discharged vapor is in equilibrium with liquid gasoline at that temperature, that the gasoline vapor in the air has a molecular weight of 60, and that its vapor pressure is given approximately by $\ln P$ (psia) = $11.724 - (5236.5^\circ\text{R})/T$. [7]
7. Explain a method to remove sulfur dioxide from rich waste gases. [6]
8. Show the application of staged combustion in controlling nitrogen oxides with the help of temperature-time plot. [6]