# Midterm review

# Basics of chemistry + water quality

**Q:** Benzene can be completely mineralized to carbon dioxide and water by aerobic bacteria. Write up the chemical reaction for benzene mineralization. What is the theoretical oxygen demand (ThOD) of a benzene solution with a concentration of 50 mg/L?

If the half-life of benzene in the solution is 2 days, what is the first-order reaction constant? How long will it take for benzene concentration to become 1/4 of the initial value?

# Basics of chemistry

**Q:** A water initially contains 40 mg/L of $Mg^{2+}$. The pH of the water is increased until pH=11. What is the concentration of $Mg^{2+}$ in this water? Give your answer in mg/L. Assume the T=25°C and the ionic strength is negligible. (atomic weight of Mg: 24.3, $pK_s$ of $Mg(OH)_2$: 11.25)

# Material balances & reactors

**Q:** A 90-m$^3$ basement in a residence is found to be contaminated with radon coming from the ground through the floor drains. The concentration of radon in the room is 1.5 Bq/L under steady-state conditions. The room behaves as a CMFR, and the decay of radon is a first-order reaction with a decay rate constant of 2.9 x 10$^{-6}$ s$^{-1}$. If the source of radon is closed off and the room is vented with radon-free air at a rate of 0.14 m$^3$/s, how long will it take to lower the radon concentration to an acceptable level of 0.15 Bq/L?

# Risk assessment

**Q:** 2,4-D is a pesticide having carcinogenicity. Calculate the chronic daily intakes for ingestion of a soil contaminated with 10 mg/kg of 2,4-D by a person being exposed to the contaminated soil for the age of 6 to 75 (70 years). Assume that the person has an exposure of 1 day per week for 20 weeks a year and that the averaging time equals the exposure duration (70 years). Use Table 6-7 of the textbook for intake parameters.

# Hydrology

**Q:** A 70.8-ha lake receives an inflow of 1.5 m³/s for the month of April. The dam regulated the outflow from the lake to be 1.25 m³/s. If the precipitation recorded for the month was 7.62 cm and the storage volume increased by 650000 m³, what is the estimated evaporation in m³ and cm? Assume there are no other processes affecting water budget.

# Water quality

**Q:** If the ultimate BOD values of two wastes having *k* values of 0.38 day$^{-1}$ and 0.22 day$^{-1}$ are 280 mg/L, what would be the 5-day BOD for each?