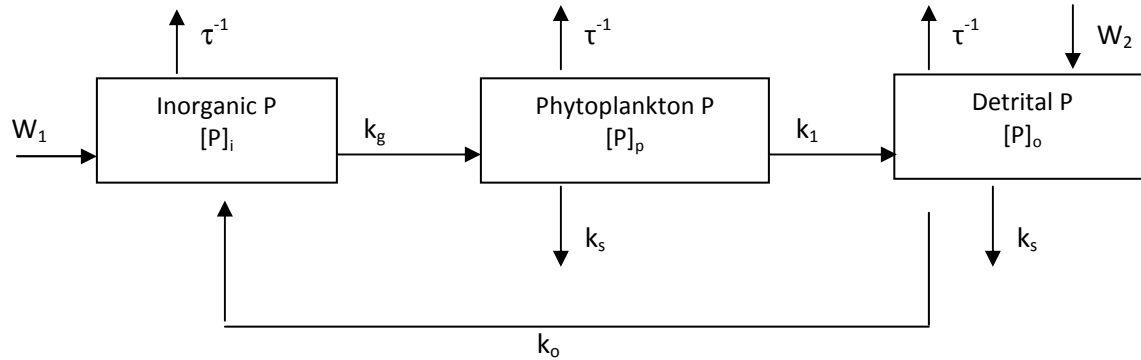


For both problems show all work to receive full credit.

Problem 1. Assume the phytoplankton summer-time kinetics shown below for the epilimnion of Lake Ontario. Calculate the *steady state* epilimnion concentration of inorganic phosphorus, phytoplankton phosphorus, and organic phosphorus. Briefly, *but not too briefly*, discuss the assumptions of the model and improvements that could be made.



$$\tau = 534 \text{ days}$$

$$k_1 = 0.20 \text{ day}^{-1}$$

$$k_g = 0.04 \text{ L}/(\mu\text{g}\cdot\text{days}); \text{ assume constant } K_g \text{ and autocatalytic kinetics such that } dP/dt = K_g \cdot N_i \cdot P$$

$$k_s = \text{sinking velocity}/\text{epilimnion depth} = (0.4 \text{ m/day})/(17 \text{ m}) = 0.024 \text{ day}^{-1}$$

$$k_o = 0.14 \text{ day}^{-1}$$

$$W_1\tau/V = 14.3 \mu\text{g/L}$$

$$W_2\tau/V = 45.7 \mu\text{g/L}$$

Problem 2. Atrazine, a neutral triazine herbicide (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) manufactured by Ciba-Geigy Corp., undergoes biological and chemical decomposition to form hydroxy-atrazine: (a) Draw the chemical structures of both compounds; (b) Assuming a pseudo-first-order decay constant of $k_A = 0.03 \text{ day}^{-1}$ for atrazine, and $k_H = 0.02 \text{ day}^{-1}$ for hydroxy-atrazine, solve for the steady-state concentration of both compounds (A and H) in a rural lake assumed to be completely mixed; (c) solve for the dynamic loss of both compounds over time from the lake assuming that the inflow concentration goes to zero after the steady-state in part (b) is reached (show graphically to 5% of the SS value) Solve part c analytically and numerically.

$$V_{\text{Lake}} = 10,000 \text{ m}^3$$

$$\text{inflow} = \text{outflow} = 400 \text{ m}^3 / \text{day}$$

$C_{\text{in}} = 10 \mu\text{M}$ (this is the inflow concentration of atrazine; you may assume that hydroxy-atrazine's input concentration is zero.)