

Fate and Transport First Exam – 2007 (100/110)

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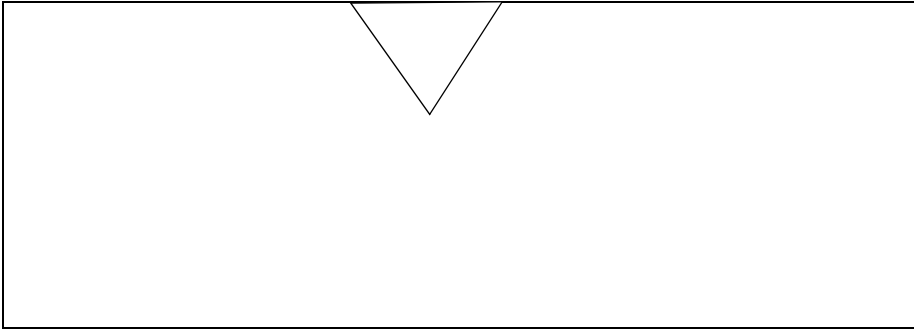
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4. (4) In unsaturated systems a gravel layer represents:
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5. (8) $C = \frac{M}{2\sqrt{\pi Dt}} \exp\left(\frac{-(x - Vt)^2}{4Dt}\right) \text{Exp}(-kt)$ define each of the variables in the equation with units.

6. (6) Draw the flow paths from the triangular infiltration experiment.



7. (12) In the figure a) circle where the dissolved oxygen is lowest, b) list three forms of dissolved inorganic carbon, c) mark an X where the exchange of carbon dioxide with the atmosphere is greatest, d) tell where (an arrow) and why the pH is lowest



(8) Show the form of the equation & derive the concentration at time = 0 and at infinite time (steady state).

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where:

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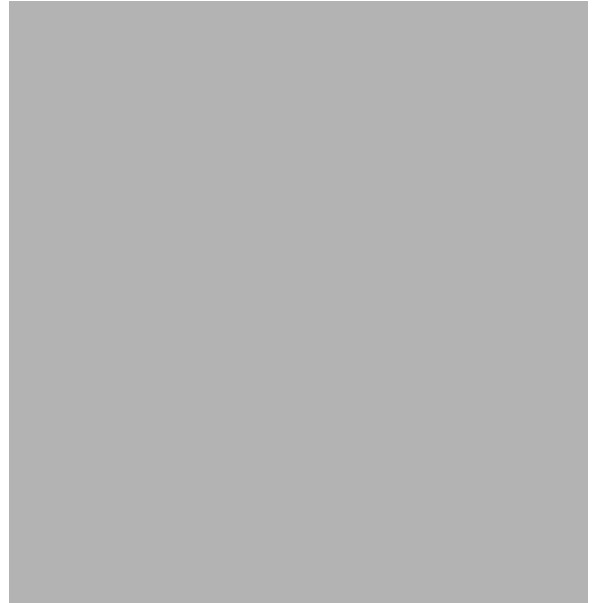
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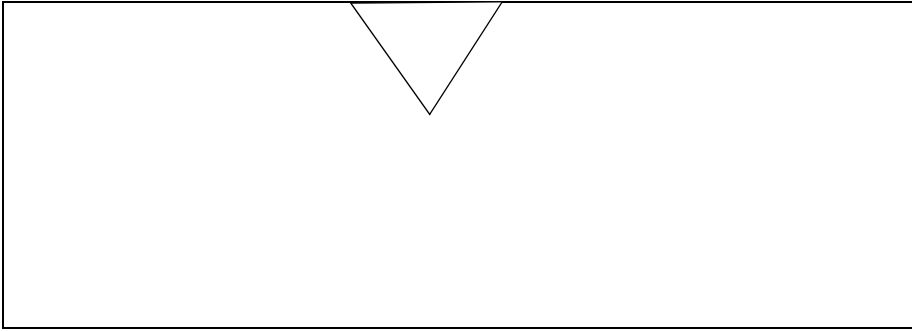
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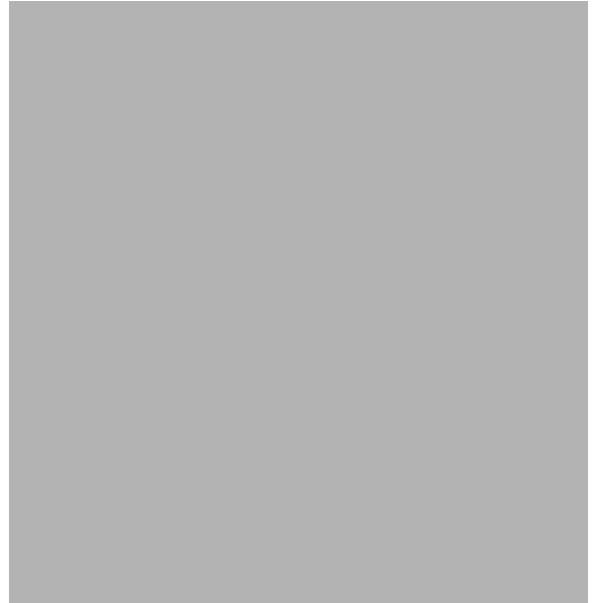
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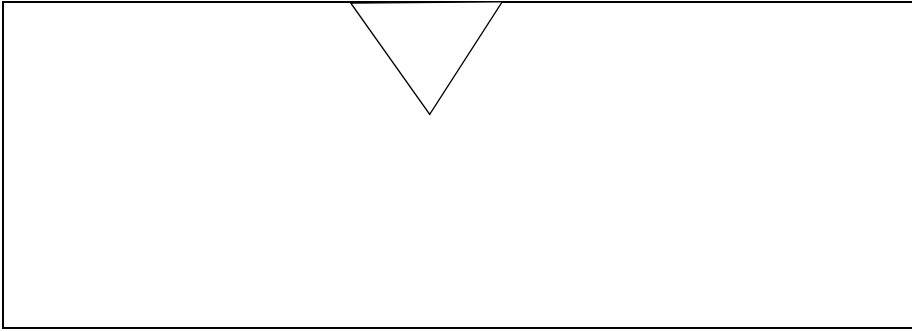
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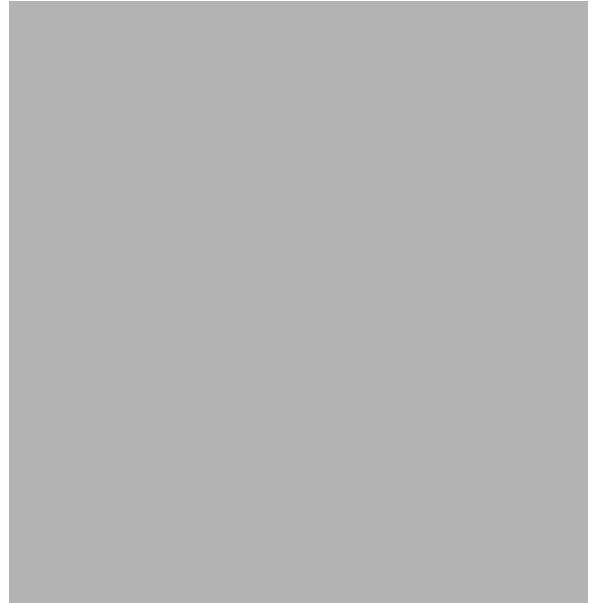
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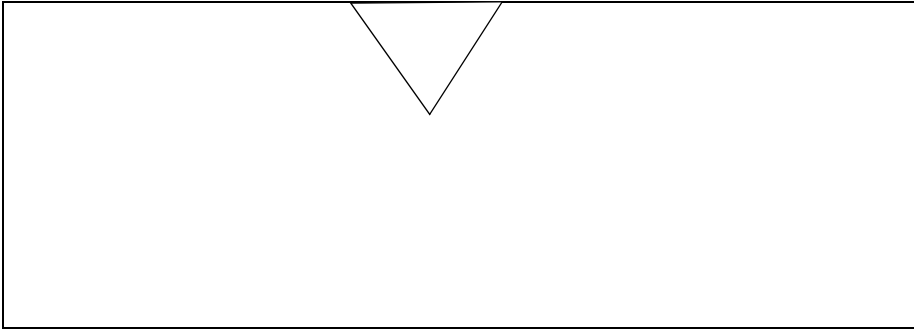
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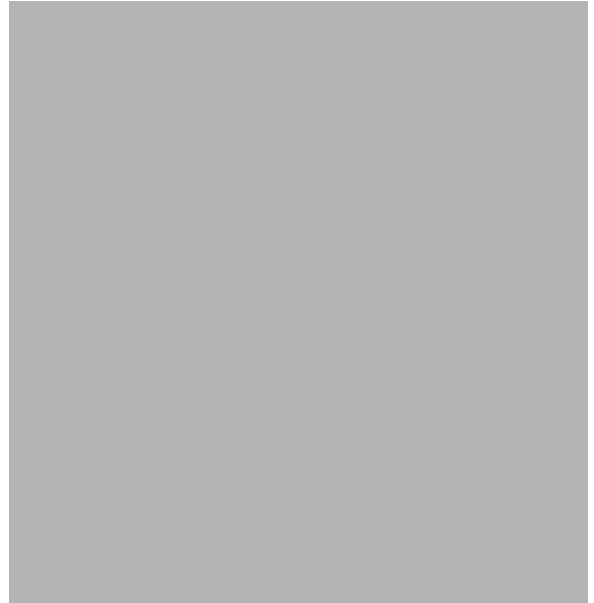
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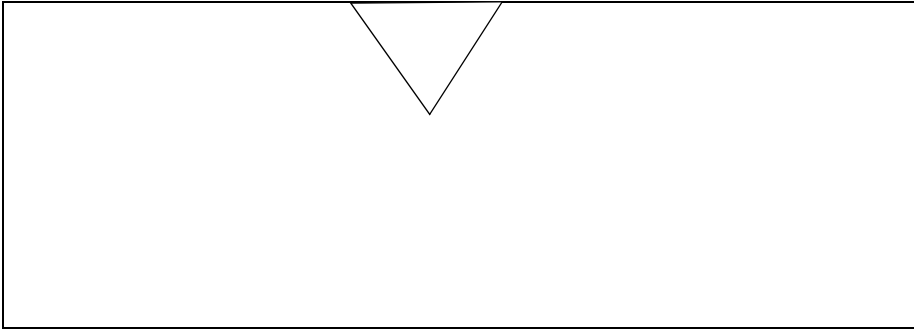
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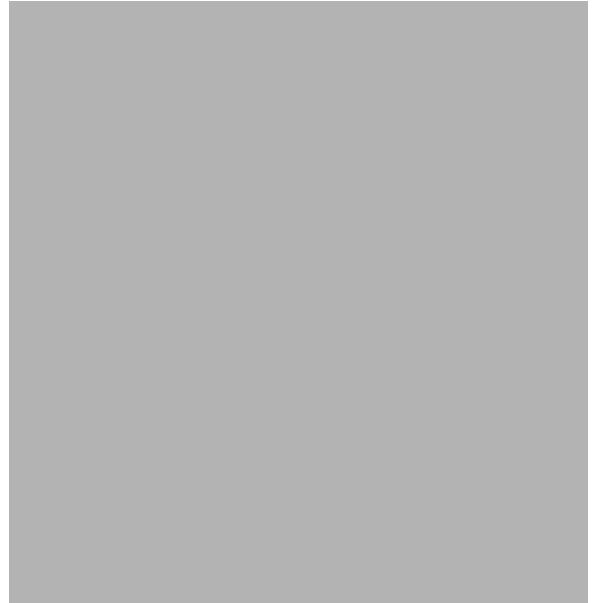
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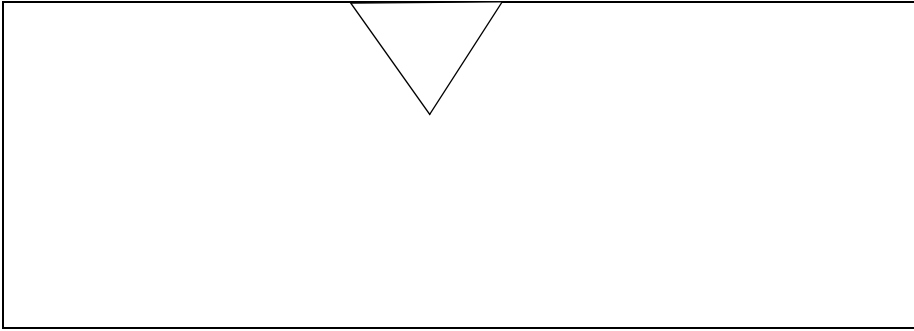
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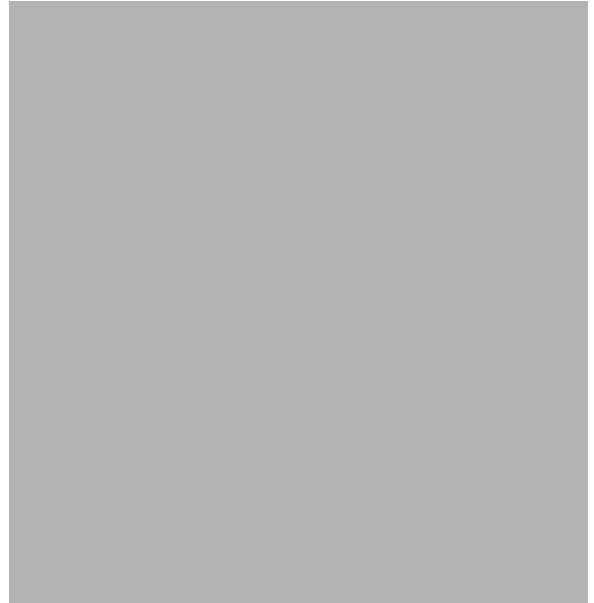
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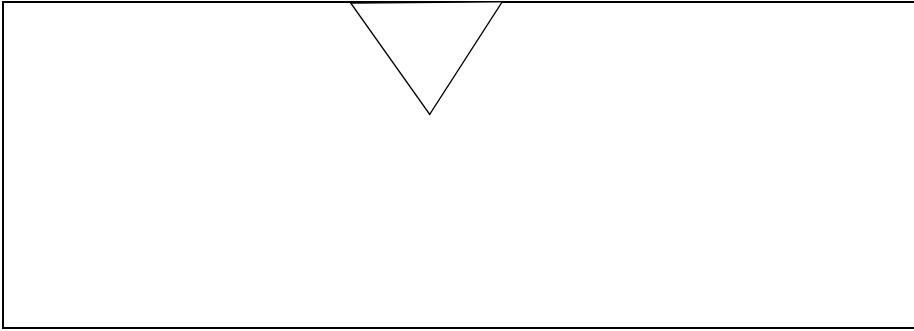
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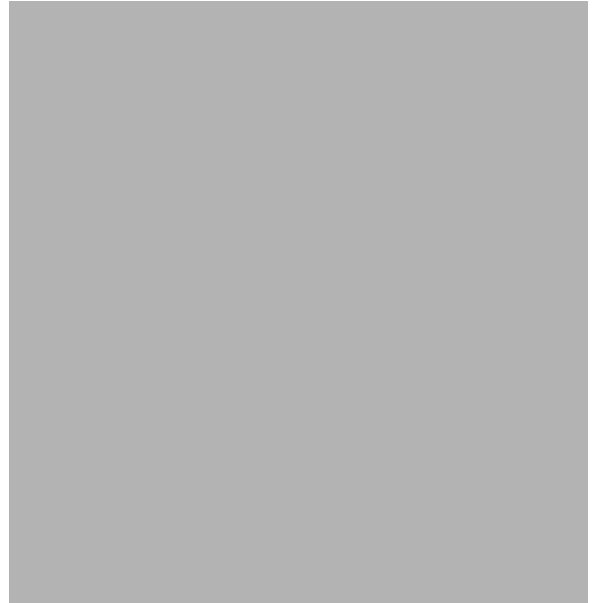
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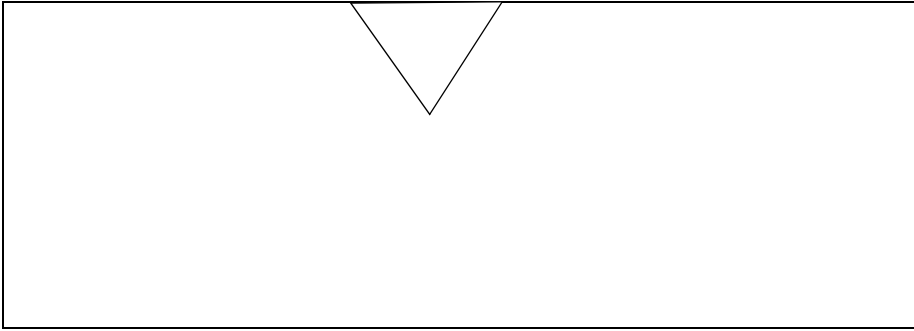
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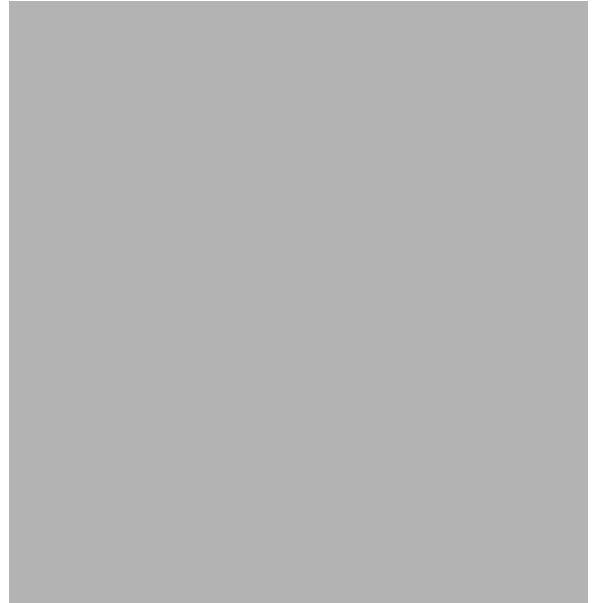
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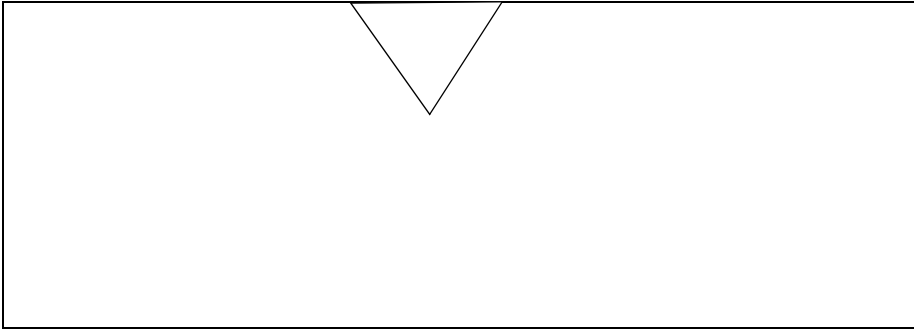
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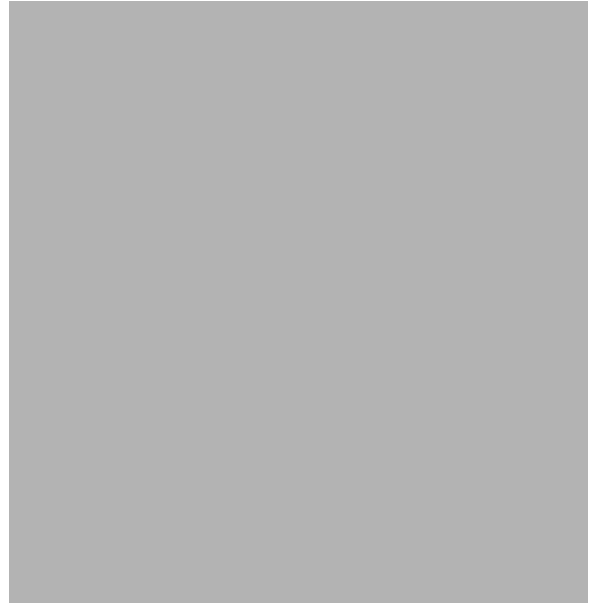
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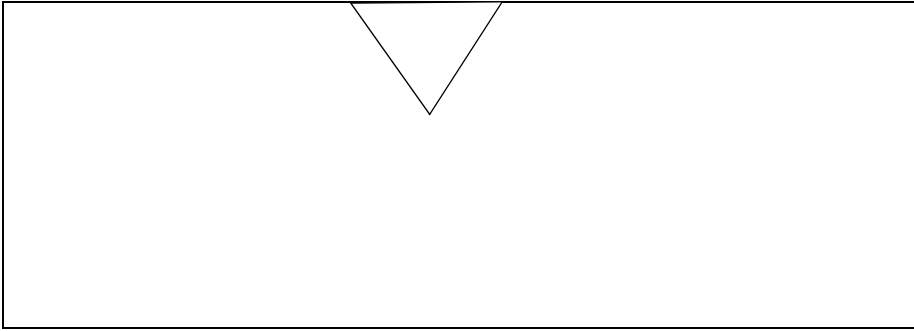
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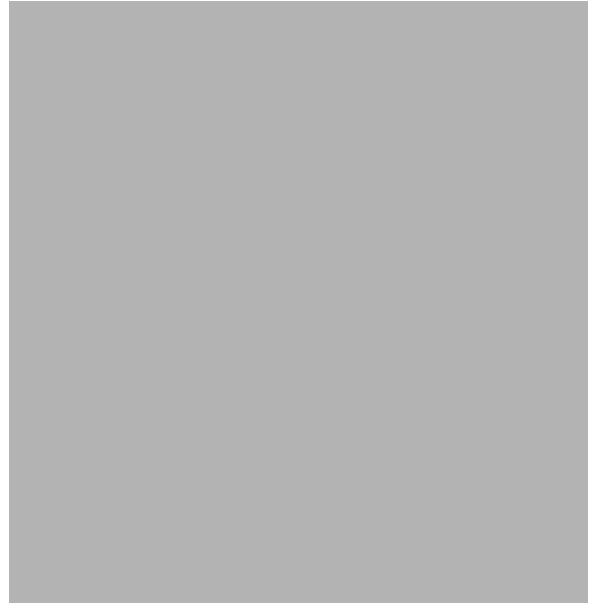
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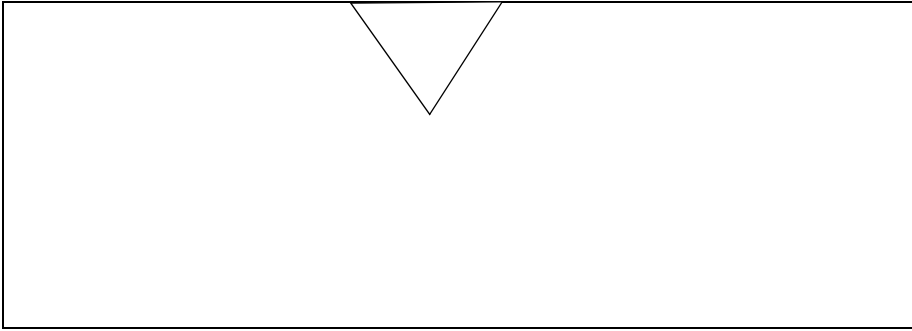
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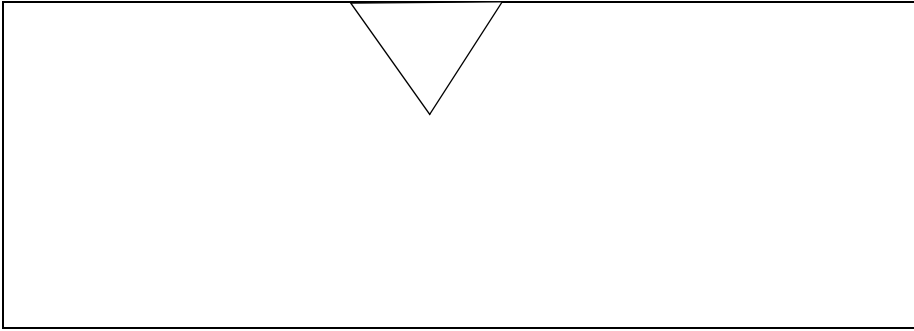
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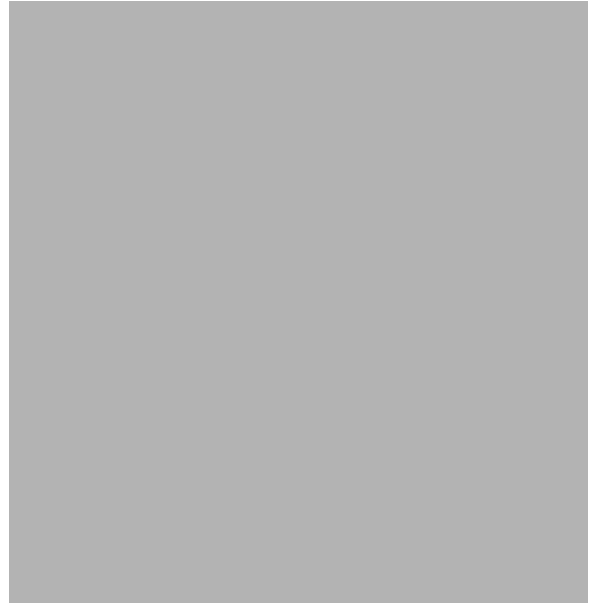
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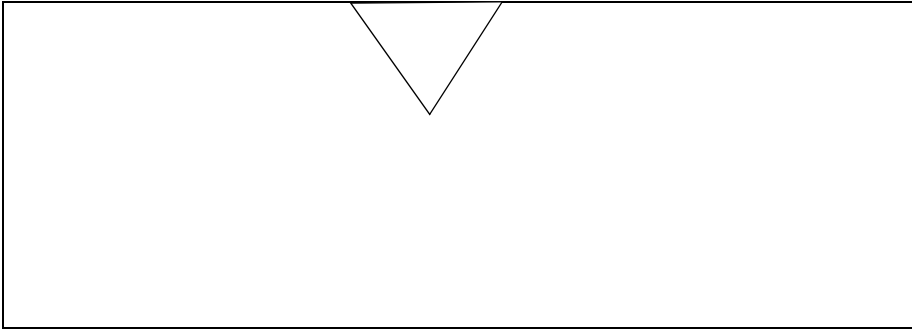
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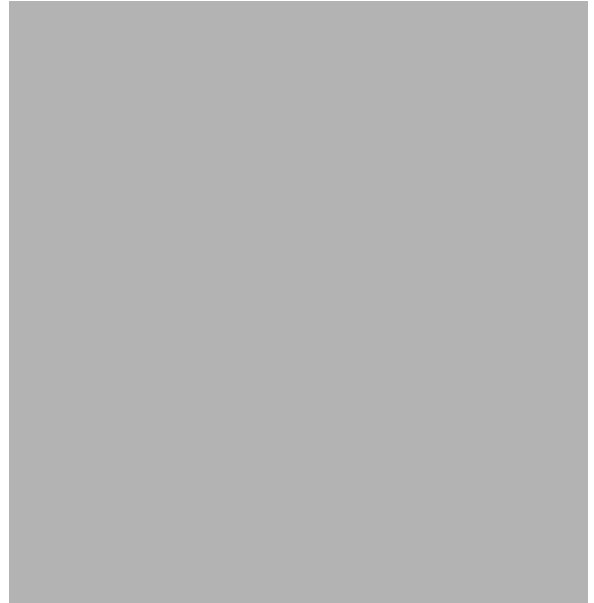
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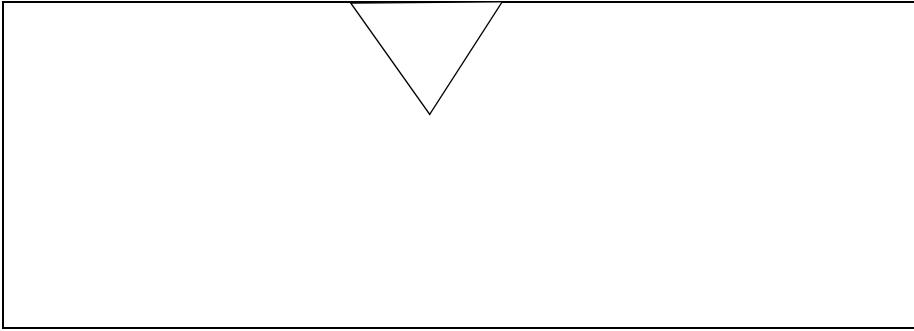
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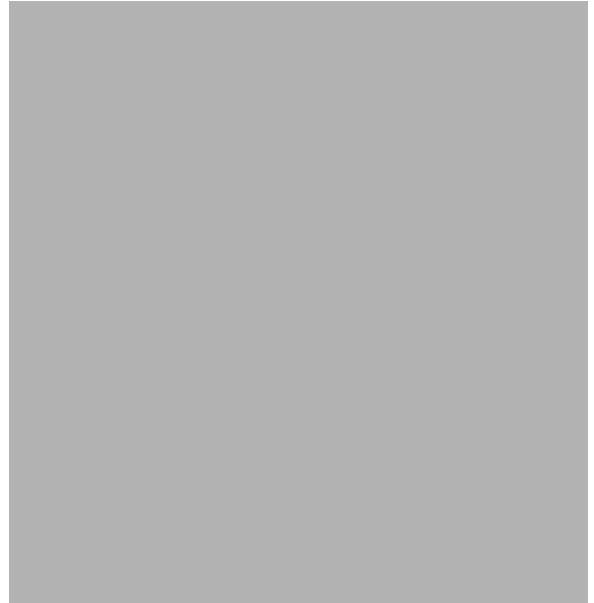
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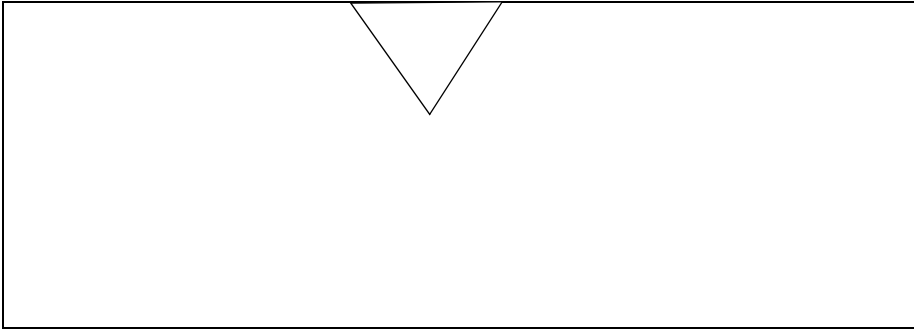
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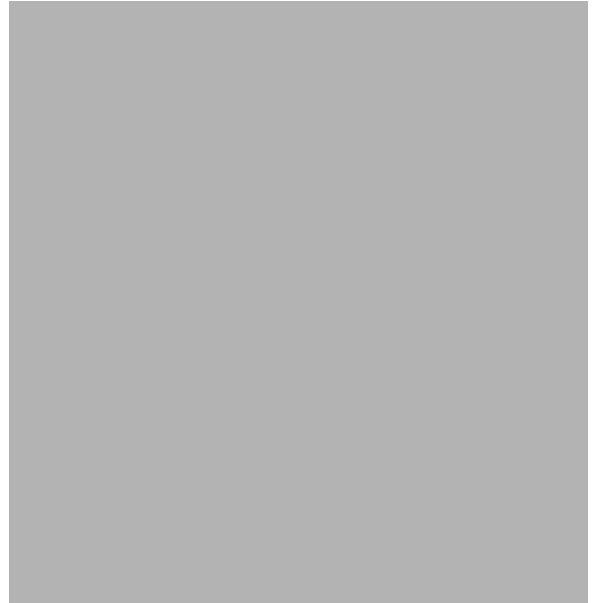
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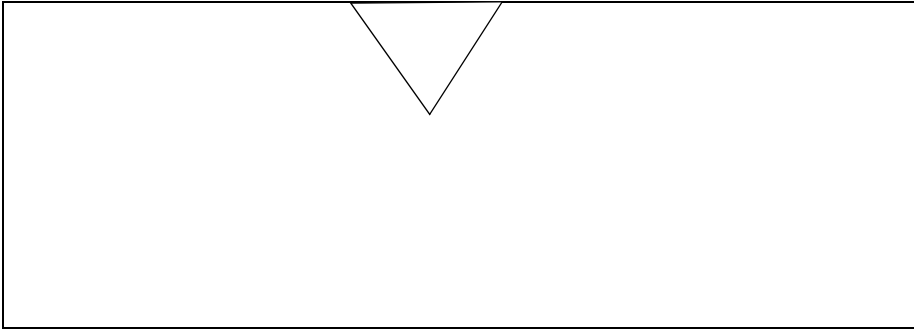
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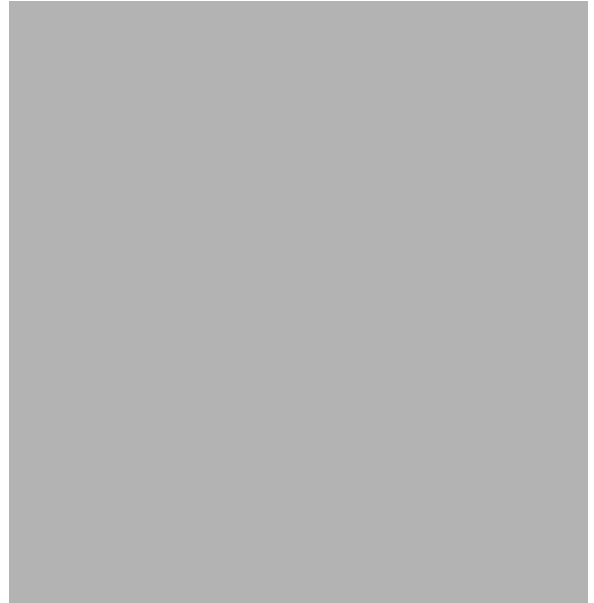
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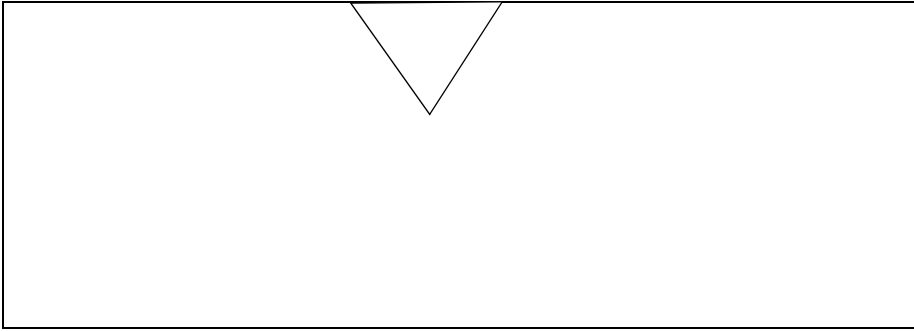
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 - c) nothing
 - d) cop out
5. (8) $C = \frac{M}{2\sqrt{\pi Dt}} \exp\left(\frac{-(x - Vt)^2}{4Dt}\right) \text{Exp}(-kt)$ define each of the variables in the equation with units.



6. (6) Draw the flow paths from the triangular infiltration experiment.



7. (12) In the figure a) circle where the dissolved oxygen is lowest, b) list three forms of dissolved inorganic carbon, c) mark an X where the exchange of carbon dioxide with the atmosphere is greatest, d) tell where (an arrow) and why the pH is lowest



(8) Show the form of the equation & derive the concentration at time = 0 and at infinite time (steady state).

$$C = (C_1 - C_{in}) \exp\left(\frac{-Q_{out}t}{V}\right) + C_{in} \quad (1)$$

where:

C_1 = initial or starting concentration (kg/m³)

C_{in} = input concentration (kg/m³)

C = concentration in pond at time = t (kg/m³)

Open Book Section (60)

1. (20) Find the saturation with respect to oxygen in % in Figure 4-7 at a depth of 150 feet where the temperature and dissolved oxygen lines cross. Show all your work. What is the significance of the lines crossing here? Does it signify anything important or is it just an artifact of the plotting scale? Why are dissolved oxygen, pH, and temperature all constant in the top



40 feet of the lake?

2. (20) John brings a ziploc of drugs back from his trip to La Paz, MX he picked up from a passing boat. The smell of the drug leaks out of the ziploc bag at a rate of 7 micrograms/hour. If the suitcase has an air volume of 0.33 m^3 and an air exchange rate of $0.1 \text{ m}^3/\text{hour}$, what is the steady state concentration in the suitcase. If the customs dog can detect the drug at concentrations of > 150 micrograms per cubic meter when the suitcase is opened for inspection, will John get caught? How does your answer change if John buys a larger suitcase (with all else the same)? How does your answer change if John brings a new, nearly air tight suitcase?

3. (20) How many milligrams of oxygen are required to oxidize the dissolved ferrous iron at a depth of 6 meters in Peacock Hill Lake?