Problem 8.1
Describe the following processes: diffusion, advection and dispersion

Problem 8.2
The bed slope of a wide river changes from S1 to S2, where S2 < S1. Assume the channel substrate is the same in both sections. For steady, uniform flow in both reaches, determine which section has the greater longitudinal dispersion? Consider two cases,

a) the channel depth is constant
b) the channel width is constant

Problem 8.3
The cross-section below corresponds to a long, straight river, and is identical along the entire river. When the flow depth is h1, the channel cross-section is rectangular. When the flow depth is h2, the flood plain becomes part of the channel. Assume that the same flow rate, Q, is observed under both conditions. Will the longitudinal dispersion change as the flow depth changes from h1 to h2? Provide an explanation with sketches.
Problem 8.4
A small slug of tracer is released at mid-channel, shown below. The channel is very deep, such that vertical shear and vertical domain limits can be neglected. The channel width is $B$, and isotropic diffusivity $D$. Describe the evolution of this cloud at $t_1 \ll B^2/4D$ and $t_2 \gg 0.4 B^2/D$. For each time period, describe the shape of the cloud and the rate at which its length increases.