Surface Water Hydrology
Homework #3
Due on Wednesday, March 7, 2012

Problem 1. Using the hydrostatic equation to solve the following questions.

A. What is the gage pressure (P) at a depth of 15.0 m in a lake with a water temperature of 10°C?
B. Would the pressure change significantly if the water temperature was 18°C instead?
C. At what depth (m) is the gage pressure 350 kPa?
D. What depth (m) of mercury, with a unit weight of 133 kN m^{-3}, would be required to produce a pressure of 350 kPa?

Properties of water as function of temperature

Temperature, °C	Viscosity μ, Pa × Second	Density ρ, kg/m^3
5	1.519×10^{-3}	999.99
10	1.307×10^{-3}	999.73
15	1.139×10^{-3}	999.13
20	1.002×10^{-3}	998.23

Problem 2. A plat is pulled over a horizontal layer of water that is 20.0 mm deep. The temperature of the water is 10°C. If the plate exerts a shear stress of 0.02 N/m^2 on the upper surface of the water, what is the speed (m/s) of the plate?

Problem 3. Surface temperature in a river is measured by a thermometer drifting with the water at a rate of 0.8 km/hr. The water in the river as a whole is warming at a rate of 0.3°C/hr, and the temperature along the stream increases by 0.2°C every kilometer in the downstream direction. What change in temperature (°C) does the thermometer record in 8 hours?

Problem 4. A tank is filled to a constant level of 1 m. The center of the outflow opening near the bottom is 0.2m above the bottom of the tank. What is the velocity (m/s) of flow exiting form the outflow opening?

Problem 5. The pressure drop through a well-designed constriction can be used to measure the velocity of flow through a pipe. If the pressure drop from a 0.2-m diameter cross section to a 0.08-m diameter cross section is 8.0 kPa, what is the velocity (m/s) in the 0.2-m diameter section of the pipe?

Problem 6. A steady discharge of 1.0×10^{-4} m^3/s is flowing through a 10-mm diameter hose. The viscosity of the water is 1.0×10^{-3} Pa×Second, and the density of the water is 1000.0 kg/m^3.

A. Calculate the Reynolds number. Is he flow laminar or turbulent?
B. What is the friction factor and the head loss per unit length for this flow (both are dimensionless)?
C. What is the change in pressure (Pa) over a 5-m length if the hose?