Final Exam
Environmental Science 318

1. Describe the hydrologic cycle.

2. What is the hydrologic equation? Give examples of inputs and outputs.

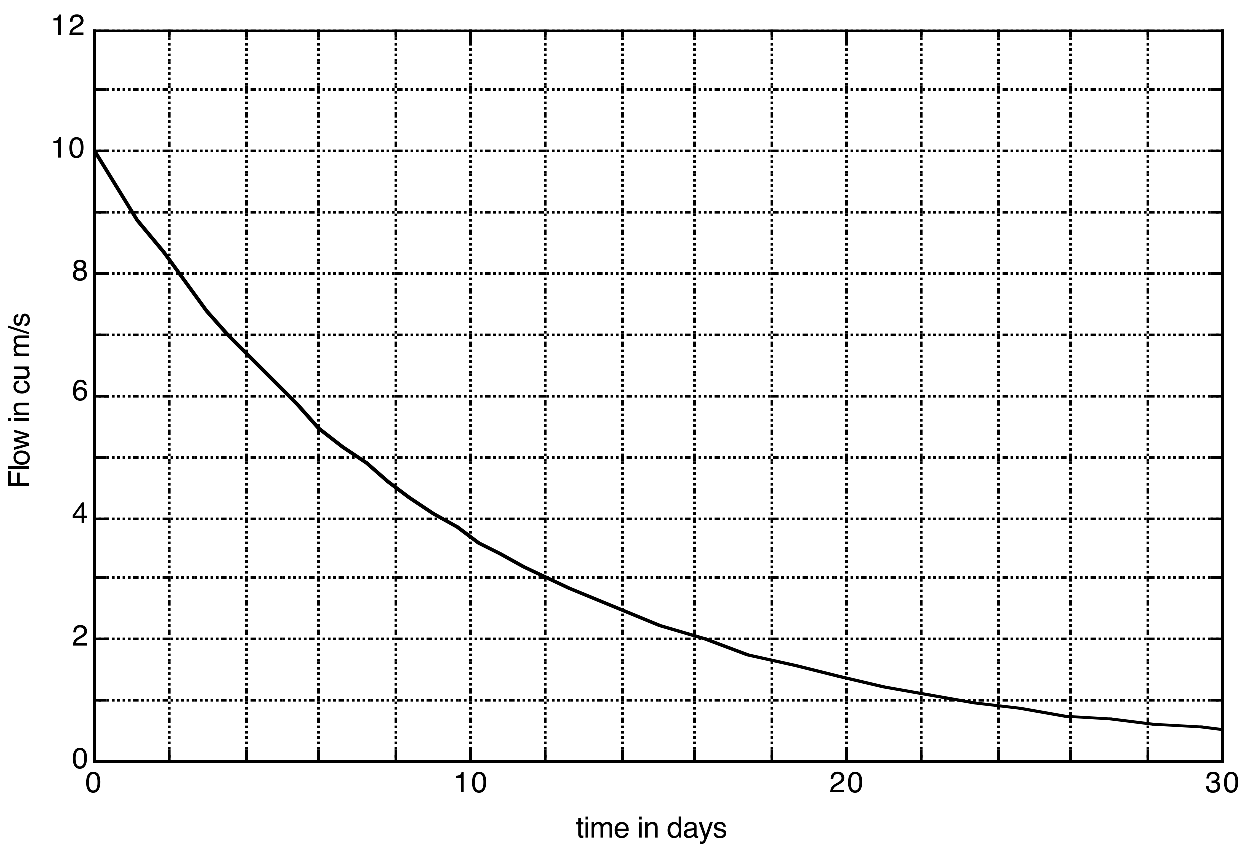
3. The antarctic ice cap has an average thickness of 1.6 Km. We will model it as a disk of radius 2000Km.

a. What volume of ice is contained in the ice cap?
b. Assuming that the ice begins at -30C, what quantity of energy is necessary to melt all of the ice to liquid at 0C?
c. Assuming that the sun provides 1300 J/s m^2, how long would this take?

4. Consider the precipitation map at the end of the exam. Compute the estimated uniform depth of precipitation using:
a. Simple Arithmetic Mean
b. By drawing Thiessen polygons
c. By drawing Isoheytal lines.

5. Consider the stream hydrograph shown below. What equation do we use to describe simple recession. Estimate the recession constant for this graph, and use it to find the baseflow after 40 days of recession.

Stream Hydrograph



5. A V-notch weir is used to measure the flow of a stream. Explain how this is done. If the height of the water in the weir is 2 inches, what is the flow rate in cfs and cu m/s?

6. Describe what an infiltration curve is and how it is used.

7. Using the tables provided, find for each

d_{60}: the grain size that is 60% finer by weight
d_{10}: The effective grain size (the grain size that is 10% finer by weight)
C_u: The uniformity coefficient

What does it mean for a sample to be "well sorted" and how can you judge this from the shape of the grains size distribution curve. Are either of these samples well sorted?

8. What is Darcy's Law. Use it relationship to find the Hydraulic conductivity for the following conditions

Cylindrical sample has radius 10cm
Difference in head is 1cm over a length of 1m
Flow is 100 cc

9. Using the information in 8, define the intrinsic permeability of the sample in Darcy. Take

$\rho = 1g / cm^3$

$\mu = 0.02$

Is this a high or low intrinsic permeability.

10. Use the Hazen method and the information in 3, 5, and 6 to find the shape factor for the sample. Comment on this factor if you can.

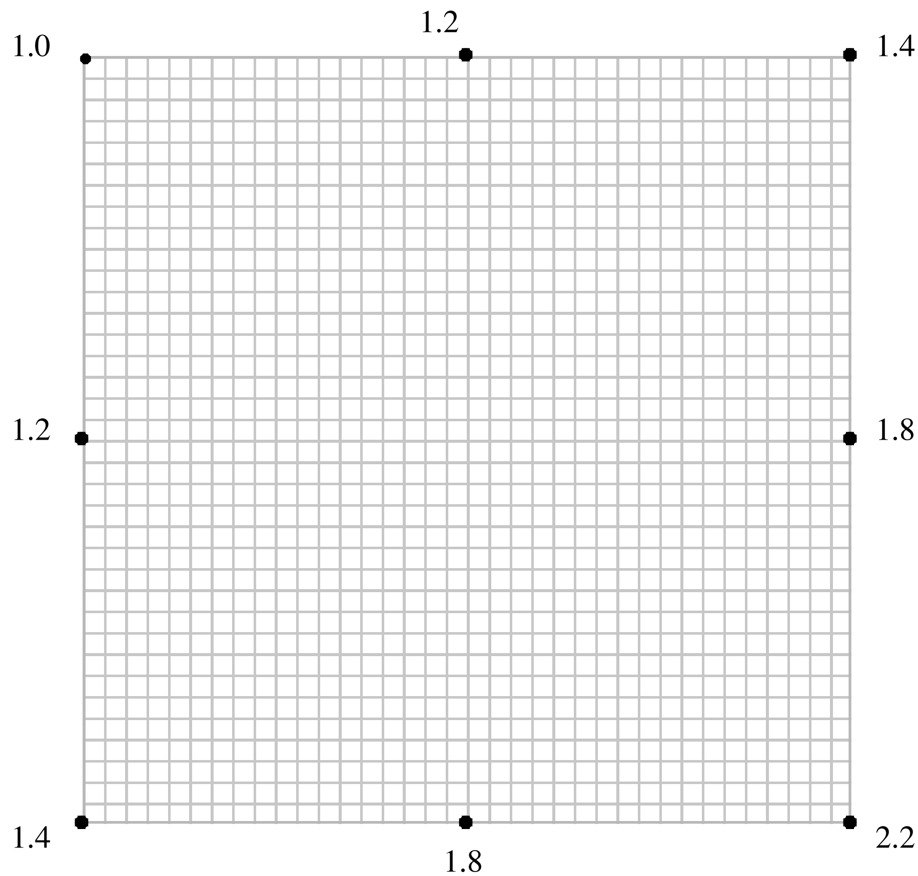
11. At a location that is 250m above sea level, a fluid has a pressure of 1000 N/m^2 and the fluid density is 1.02 x 10^3 kg/m^3. The fluid is flowing with a v = 0.5 x 10^{-6} m/s,

a. What is the total energy per unit mass.

b. How much of this energy is potential energy, "pressure potential energy" and kinetic energy? Would it be reasonable to drop the kinetic energy term?

c. Assuming smooth laminar flow, suppose the elevation dropped to 50 m above sea level If the pressure remains the same, how fast does the fluid now need to flow for the total energy per unit mass to remain constant? What is this speed in meters/year? Does this seem reasonable?

Precipitation Map



Each square represents 100m. Assume the measurements shown are in cm.

Conversions, equations, etc.

$$\rho_{water} = 1 g / cm^3$$

$Q = 2.54\, h^{3/2}$ for a triangular weir.

$$c_{water} = 1 \frac{cal}{g \cdot °C}$$

$$c_{ice} = 0.5 \frac{cal}{g \cdot °C}$$

$$L_{fusion} = 79.7 \frac{cal}{g}$$

$$V_{tp} = \frac{Q_0\, t_1}{2.3026} \quad (potential\ groundwater\ dischg)$$

$$V_t = \frac{V_{tp}}{10^{(t/t_1)}} \ (volume\ of\ dischg\ remaining\ at\ time\ t)$$