PROBLEMS

Answers to odd-numbered problems will appear at the end of the book. Assume $g = 9.81$ m/s^2.

1. A fluid in an aquifer is 4.0 m above a reference datum, the fluid pressure is 2400 N/m^2, and the flow velocity is 1.0×10^{-5} m/s. The fluid density is 1.01×10^3 kg/m^3.
   A. What is the total energy per unit mass?
   B. What is the total energy per unit weight?
2. A fluid in an aquifer is 31.5 m above a reference datum, the fluid pressure is 3750 N/m^2, and the flow velocity is 1.35×10^{-4} m/s^2. The fluid density is 0.999×10^3 kg/m^3.
   A. What is the total energy per unit mass?
   B. What is the total energy per unit weight?

$g = 9.81 \text{m/sec}^2$

3. A piezometer is screened 273.4 m above mean sea level. The point-water pressure head in the piezometer is 23.4 m and the water in the aquifer is fresh at a temperature of 20°C.
   A. What is the total head in the aquifer at the point where the piezometer is screened?
   B. What is the fluid pressure in the aquifer at the point where the piezometer is screened?

HINT:
ρ_w @ 20°C = 0.9982 gm/cm^3 = 998.2 kg/m^3

4. A piezometer point is 23 m above mean sea level. The fluid pressure in the aquifer at that point is 6.45 × 106 N/m^2. The aquifer has fresh water at a temperature of 13°C.
   A. What is the point-water pressure head?
   B. What is the total head?

ρ_w @ 13°C = 999.38 kg/m

8. An aquifer has a hydraulic conductivity of 123 ft/day and an effective porosity of 27% and is under a hydraulic gradient of 0.0003.
   A. Compute the Darcy flux.
   B. Compute the average linear velocity.
9. A confined aquifer is 10 ft thick. The potentiometric surface drops 0.54 ft between two wells that are 792 ft apart. The hydraulic conductivity is 21 ft/day and the effective porosity is 0.17.
   A. How many cubic feet per day are moving through a strip of the aquifer that is 10 ft wide?
   B. What is the average linear velocity?
10. A confined aquifer is 24.5 m thick. The potentiometric surface drops 1.23 m between two wells that are 1023 m apart. If the hydraulic conductivity of the aquifer is 44 m/day, how many cubic meters of flow are moving through the aquifer per unit width?

HINT: USE EQUATION FOR UNIT WIDTH FLOW THROUGH CONFINED AQUIFER

11. An unconfined aquifer has a hydraulic conductivity of 1.7×10^{-3} cm/s. There are two observation wells 328 ft apart. Both penetrate the aquifer to the bottom. In one observation well the water stands 24.6 ft above the bottom, and in the other it is 20.0 ft above the bottom.
   A. What is the discharge per 100-ft-wide strip of the aquifer in cubic feet per day?
   B. What is the water-table elevation at a point midway between the two observation wells?

HINT: USE DUPUIT EQUATION FOR UNCONFINED AQUIFER

12. FROM THE LAST PROBLEM SET, TRY TO CONSTRUCT A SET OF FLOW LINES ON THE GROUNDWATER CONTOUR MAP IN QUESTION 16. USE SIMPLIFIED ASSUMPTIONS. CONSIDER THE LAKE TO BE A CONSTANT HEAD BOUNDARY.