

Groundwater hydrology (Code: IRH 1784)

- All sketches should be clear, neat and well proportioned
- Any missing data may be reasonably assumed

Total mark = 100 marks

QUESTION (1)

(30 mark)

1) Define the following:

Groundwater velocity "seepage velocity"- Discharge velocity - Aquifer - quifuge
Confining Beds - Confined"artesian" aquifer - Artesian well - water table-
Unconfined"water table" aquifer - water table well-Perched aquifer - Aquitard-
Transmissivity - Storativity - Specific Storage - Specific yield - Effective porosity
- Specific Retention.

2) What is the difference between: Hydraulic conductivity & permeability?

3) Explain the different types of aquifer?

4) Derive darcy's law for anisotropic materials.

5) Derive equation of ground water flow.

6) Why Storativity in unconfined aquifer more than Storativity in confined aquifer ?

7) State the types of boundary conditions.

8) Show how you can determine ground water flow direction.

QUESTION (2)

(20 mark)

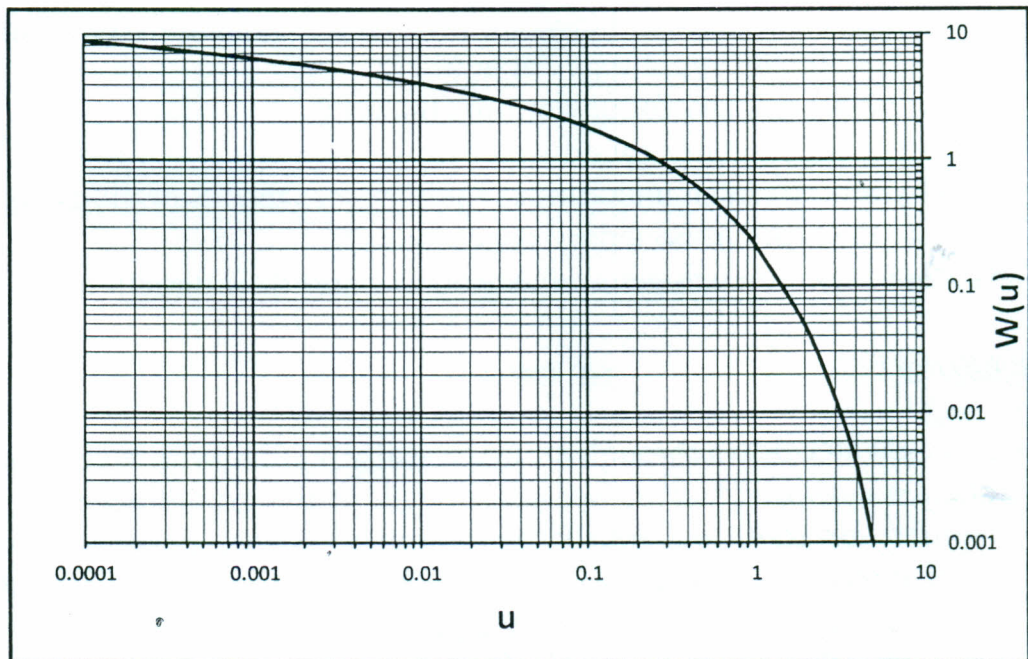
1) Groundwater flows through a buried -valley aquifer with a cross section area $1 \times 10^6 \text{ ft}^2$ and a length of $2 \times 10^4 \text{ ft}$ hydraulic heads at the groundwater entry and points in the aquifer are 1000 and 960 ft, respectively. At the downstream end of the aquifer, groundwater discharge into a stream at a rate of $1 \times 10^5 \text{ ft}^3/\text{day}$. What is the hydraulic conductivity of the buried- valley aquifer in ft/day, m/day? If the effective porosity of the material is 0.30, what is the liner groundwater velocity?

2) After a soil sample is drained by gravity, the weight of the soil sample is 85g. After the sample is oven-dried, the sample weighs 80g. The bulk density of the wet soil is 1.65 g/cm^3 , and the density of water is 1 g/cm^3 . Calculate the specific yield, specific retention, and porosity of the sample. Assume water that was drained by gravity is 20g.

QUESTION (3)

(25 mark)

- 1) A pumping test is conducted on an unconfined aquifer using a discharge rate of $1.5 \text{ m}^3/\text{sec}$ from a full penetrating well. The original thickness of the groundwater body is 10m. After reaching a steady state condition, the water level dropped by 1.5m in the well. At 2 observations by wells located 5.0 m and 20.0m, the water level dropped by 0.55 m, and 0.04m respectively. Calculate the hydraulic conductivity, the radius of the well and the radius of influence.
- 2) The transmissivity and storativity of a confined aquifer are $1000 \text{ m}^2/\text{day}$ and 0.001, respectively. An observation well is located 500 m away from a pumping well. For a pumping period of 220 min, calculate
 - (a) the drawdown at the observation well if the discharge rate is $1000 \text{ m}^3/\text{day}$,
 - (b) The pumping rate required to provide a drawdown of 1m at that well after 220 min.



QUESTION (4)

(25 mark)

- 1) Determine the permeability of an artesian aquifer being pumped by a fully penetrating well. The aquifer composed of medium sand is 130 ft thick. The steady state pumping rate is 1300 gpm. The drawdown in an observation well 65 ft away is 12 ft, and in a second well 500 ft away is 1.2 ft.
- 2) Consider a 300m sequence of inter bedded sandstone and shale that has 75% sandstone. The sandstone has a horizontal and vertical hydraulic conductivity of 10^{-5} m/s , and shale has a horizontal and vertical hydraulic conductivity of $1.92 \times 10^{-12} \text{ m/s}$. Calculate the equivalent conductivity for a system of layer.

With Best Wishes
Khalaf
Dr. Eng. Samy Khalaf