GROUNDWATER GLY 265 – 2009 – PRACTICAL 6

EXERCISE 15

The following concentrations are given for a water samples from the High Atlas (Morocco).
Physico-chemical parameters:

EC: 312 µS/cm pH: 6.98 E_h: 261 mV T: 14° C

Evaluate and discuss the accuracy of the analysis according to electro neutrality (3 decimal places) and plausibility of electrical conductivity.

$$\text{E.N.}[\%] = \frac{\sum cations\ [\text{meq/L}] + \sum anions\ [\text{meq/L}]}{\sum cations\ [\text{meq/L}] - \sum anions\ [\text{meq/L}]} \cdot 100\% < 5\%!$$

$$\text{For } EC < 2000\ \mu\text{S/cm}: \sum anions\ [\text{meq/L}] = \sum cations\ [\text{meq/L}] = EC/100\ [\mu\text{S/cm}]$$

	Form weight. [g]	c [ppm]	c [mmol/L]	meq/l	
Na^+	22.99	15.1	0.657	0.657	
K^+	39.1	2.8	0.072	0.072	
Ca^{2+}	40.08	34.5	0.861	1.722	
Mg^{2+}	24.31	6.1	0.251	0.502	
				2.953	
SO_4^{2-}	96.06	24.3	0.253	- 0.506	
NO_3^-	62.0	27.4	0.442	- 0.442	
Cl^-	35.45	36.7	1.035	- 1.035	
HCO_3^-	61.02		0.96	- 0.96	
				- 2.943	

SOLUTION: $\text{E.N.}[\%] = \frac{2.953 + (-2.943)}{2.953 - (-2.943)} \cdot 100\% = 0.170 < 5\%!$

SOLUTION: $EC/100\ [\mu\text{S/cm}] = 3.12$

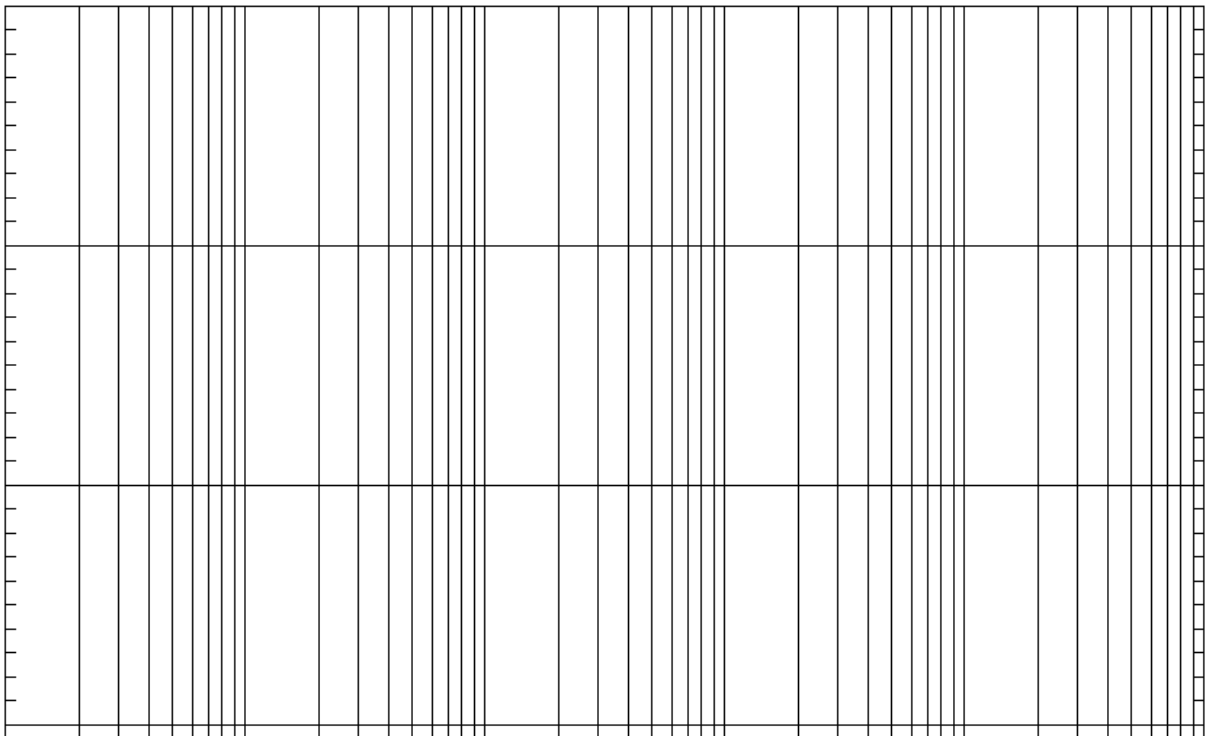
EXERCISE 16

The following drawdowns were measured in a piezometer (distance to pumping well r = 50 m) during a pumping test in a confined porous aquifer (Q=26 ℓ/s).

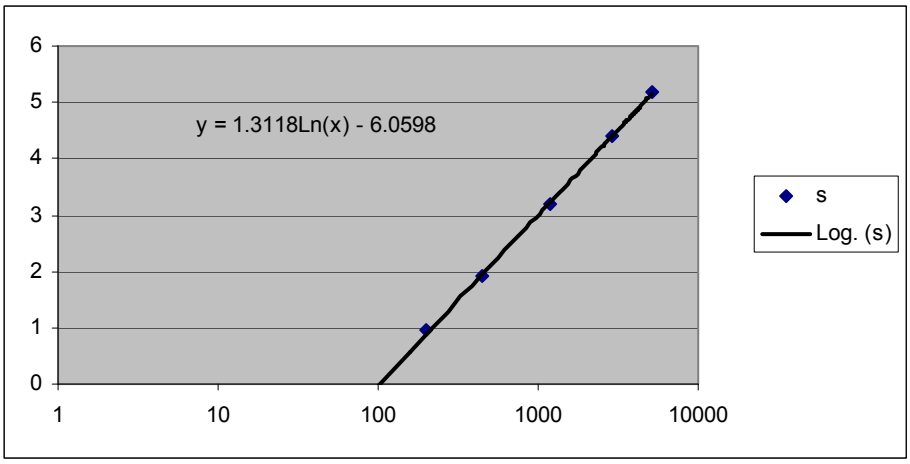
t [s]	s [m]
200	0.95
450	1.90
1200	3.20
2900	4.40
5200	5.20

Determine the transmissivity T and the storage coefficient S of the aquifer using the method of Cooper-Jacob (Graphical solution for s versus t on lin-log paper).

Cooper-Jacob: $s = \frac{2.3Q}{4\pi T} \log\left(\frac{2.25Tt}{r^2 S}\right)$ For t_2/t_1 = 10: $T = \frac{2.3Q}{4\pi\Delta s}$; $S = 2.25T\frac{t_0}{r^2}$



SOLUTION



t0	100	
delta s	**3.020531**	3.001793
		6.022324

$$T = \frac{2.3Q}{4\pi\Delta s}$$ 1.58E-03 m2/s

$$S = 2.25T\frac{t_0}{r^2}$$ 1.42E-04

EXERCISE 17

A well in a 50 m thick, homogeneous phreatic aquifer (effective porosity 30%, uniform recharge rate 0.5 m/yr) draws water from up to 5 km. Calculate the travel time for an ideal solute (no retardation) from a factory situated 3 km from the well.

Hint: Radial converging flow $$\ln\frac{x^2 - r^2}{x_0^2 - r^2} = \frac{Rt}{D\phi_{eff}}$$

SOLUTION:

$$\ln\frac{x^2 - r^2}{x_0^2 - r^2} = \frac{R_{recharge}t}{D\phi_{eff}}$$

$$t = \frac{D\phi_{eff}}{R_{recharge}}\ln\frac{x^2 - r^2}{x_0^2 - r^2} = \frac{50m * 0.3}{0.5m/yr}\ln\frac{0^2 - 5^2}{3_0^2 - 5^2} = 30 * \ln 1.5625 = 13.39 years$$

EXERCISE 18

The following water levels were measured in a 50 m thick homogeneous, isotropic, porous aquifer (representative grain size distribution curve given below, effective porosity 25%).

a. Draw the water table contours (1 m isopiestic lines).

b. Determine the hydraulic conductivity with the method of Hazen and Zieschang, assuming a GW temperature of 15°C.

$$K = Cd_{10}^2\,\frac{0.79 + 0.03T}{86.4} \quad \text{[m/s]}$$

c. Calculate the specific discharge and the discharge per day for cross-section of 100 m width (perpendicular to the isopiestic lines).