EXERCISE 19

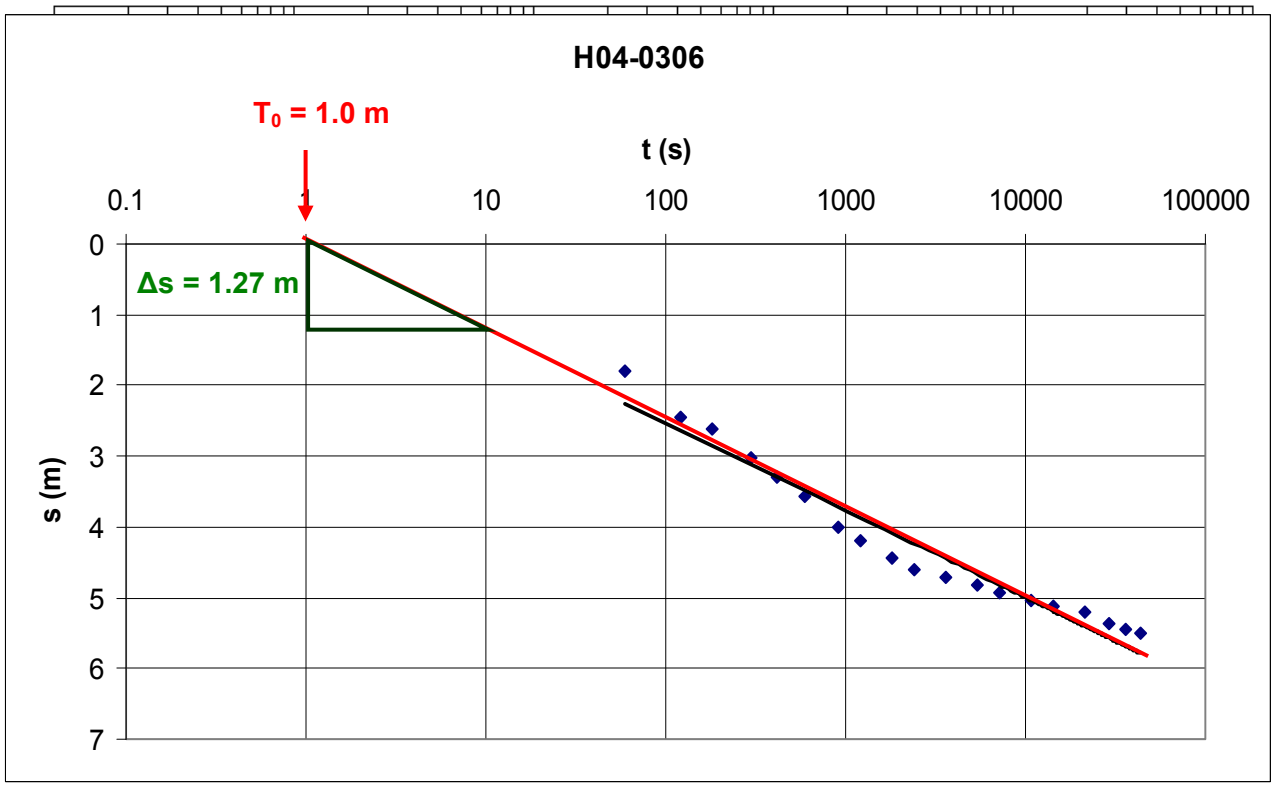
The following drawdowns were measured in borehole H04-0306 during a pumping test conducted in a confined porous aquifer (pumping rate = 15.1 ℓ/s; distance from pumped borehole = 6.00 m). Use the method of Cooper-Jacob and round all answers to three decimals.

t (s)	*s (m)*	*t (s)*	*s (m)*
60	1.8	2400	4.6
120	2.46	3600	4.7
180	2.62	5400	4.83
300	3.01	7200	4.93
420	3.29	10800	5.03
600	3.58	14400	5.11
900	4.01	21600	5.2
1200	4.2	28800	5.36
1800	4.44	36000	5.44
		43200	5.5

$$s = \frac{2.3Q}{4\pi T}\log\left(\frac{2.25Tt}{r^2S}\right)$$

For t_2/t_1 = 10: $T = \frac{2.3Q}{4\pi\Delta s}$; $S = 2.25T\frac{t_0}{r^2}$

a. Determine the transmissivity.
b. Determine the storage coefficient.



SOLUTION:

$$T = \frac{2.3Q}{4\pi\Delta s} = \frac{(2.3)(0.0151m^3/s)}{(4)(3.14)(1.27m)} = 2.177\times10^{-3}m^2/s = 188.118m^2/d$$

$$S = \frac{2.25T}{r^2}t = \frac{(2.25)(2.177\times10^{-3}m^2/s)}{(6.00)^2} = 1.361\times10^{-4}$$

EXERCISE 19

The following field measurements were taken during sampling of a borehole to the west of Bocchum in Limpopo Province (23.28860° S 29.13944° E):

EC = 228 μS/cm pH = 8.23 T = 15° C

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

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

$$K = \frac{[H^+][HCO_3^-]}{[H_2CO_3]} = 10^{-6.3} \qquad pH = -\log[H^+] \qquad SI = \log\frac{IAP}{K} = \log IAP - \log K$$

a. The laboratory analyses are supplied below. Evaluate and discuss the accuracy of the analysis according to electro neutrality (3 decimal places) and plausibility of electrical conductivity.
b. Calculate the saturation index for $CaSO_4$ (K = $10^{-4.6}$).
c. Is it possible to evaluate the accuracy for the pH determined in the field?

	c (ppm)	***c (mg/l)***	***M (g/mol)***	***mmol/l***	***charge***	***meq/l***	
Ca	83	**83**	**40.078**	**2.070962**	**2**	**4.141923**	
K	19.23	**19.23**	**39.0983**	**0.491837**	**1**	**0.491837**	
Mg	131.6	**131.6**	**24.305**	**5.414524**	**2**	**10.82905**	
Na	172.2	**172.2**	**22.98977**	**7.490288**	**1**	**7.490288**	
					Σ =	**22.9531**	
Cl	410	**410**	**35.459**	**11.56265**	**-1**	**-11.5626**	
F	0.16	**0.16**	**18.9984**	**0.008422**	**-1**	**-0.00842**	
NO_3	23.838	**23.838**	**62.0049**	**0.384453**	**-1**	**-0.38445**	
PO_4	0.031	**0.031**	**94.9676**	**0.000326**	**-3**	**-0.00098**	
SO_4	121.3	**121.3**	**96.0626**	**1.262718**	**-2**	**-2.52544**	
HCO_3	468	**468**	**61.0168**	**7.670019**	**-1**	**-7.67002**	
					Σ =	**-22.1519**	

SOLUTION (a):

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

$$= \frac{22.9531 meq/\ell + (-22.1519 meq/\ell)}{22.9531 meq/\ell - (-22.1519 meq/\ell)}$$

$$= \frac{-0.8012 meq/\ell}{45.104 meq/\ell} = 0.01776$$

$$= 1.776\% < 5\%$$

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

$$EC/100 = 2.28 \neq \sum anions\ [\text{meq/L}] \neq \sum cations\ [\text{meq/L}]$$

EC not plausible

SOLUTION (b): $SI = \log \frac{IAP}{K} = \log IAP - \log K$

$$IAP = \left[\frac{83 mg/\ell}{1000 mg/g * 40.078 g/mol}\right]\left[\frac{121.3 mg/\ell}{1000 mg/g * 96.0626 g/mol}\right]$$

$$= 0.002071 * 0.001263 = 2.616 \times 10^{-6}$$

$$SI = \log \frac{IAP}{K} = \log \frac{2.616 \times 10^{-6}}{10^{-4.6}} = 0.104$$