EXERCISE 13

The following stationary heads were measured in a confined porous aquifer after 3 days of continuous pumping at 9 ℓ/s.

Piezometer no.	*1*	*2*	*3*	*4*
distance *r* [m]	0.8	30.0	90.0	215.0
drawdown *s* [m]	2.24	1.09	0.72	0.25

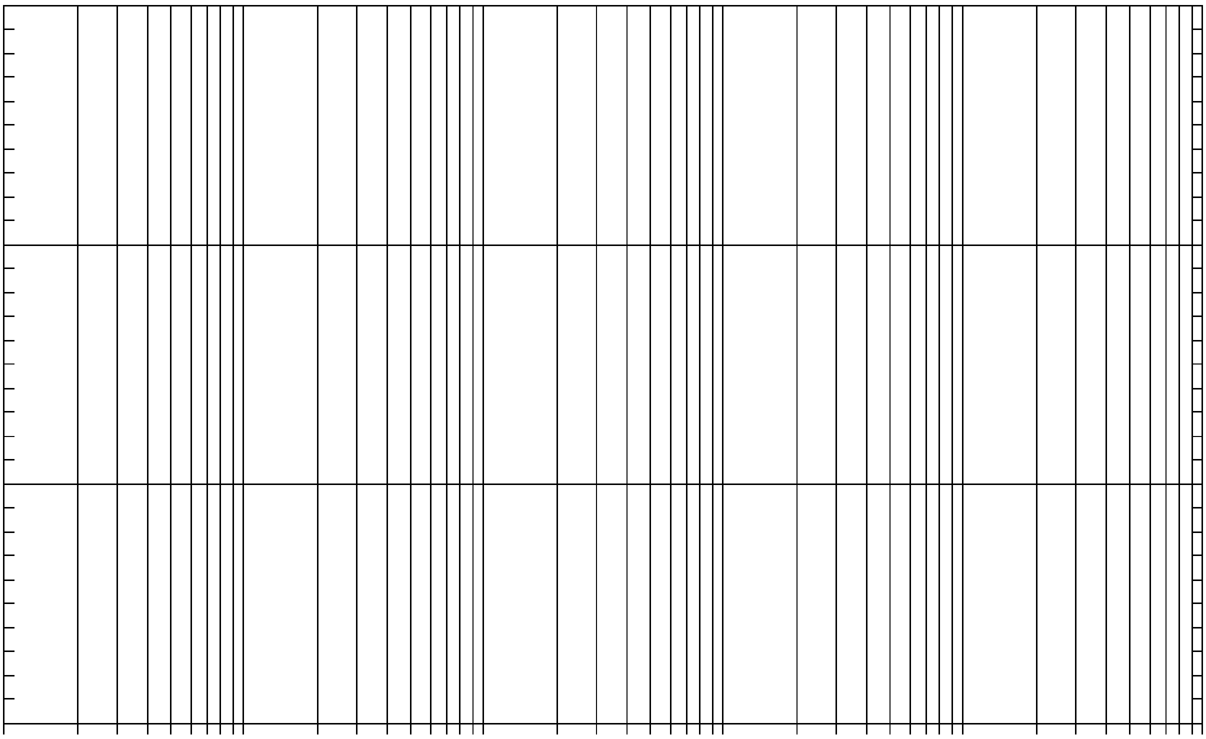
a) Determine the transmissivity of the aquifer (graphical determination of $\Delta h = h_2 - h_1$).

$$T = \frac{Q}{2\pi(\Delta h)} \ln \frac{r_2}{r_1}$$

Hint: For $r_2/r_1 = 10$ → $T = \frac{2.3Q}{2\pi(\Delta h)}$

b) Determine the extent *R* of the cone of depression (graphical and algebraic solution for each piezometer).

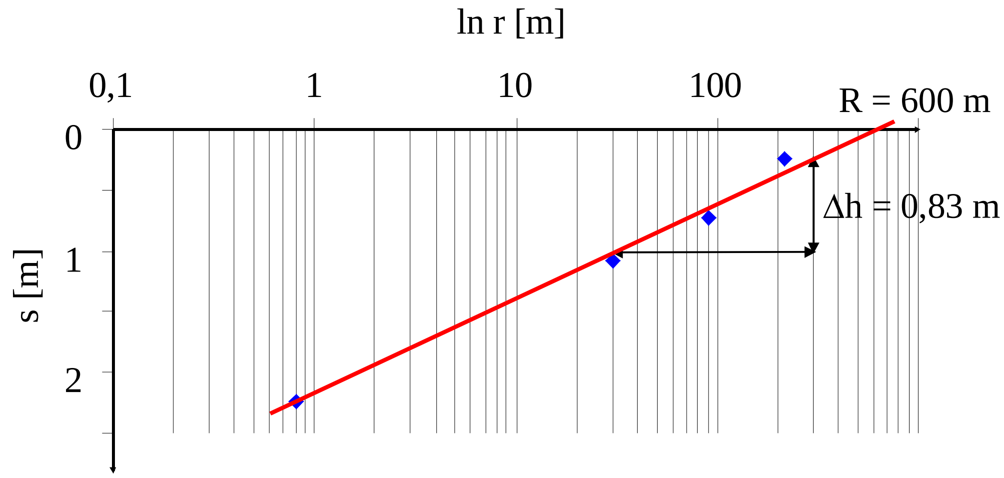
$$H - h = s = \frac{Q}{2\pi T} \ln \frac{R}{r}$$



SOLUTION:

a) Plot drawdown versus log r and get Δh for one decade

R_0 for s = 0 (intercept x-axis)



Δh ≈ 0,83 m.

$$H - h = s = \frac{Q}{2\pi T} \ln \frac{R}{r}$$

$$T = \frac{2.3Q}{2\pi dh} = \frac{(2.3)(0.009)}{2\pi(0.83)} = 4.0 \times 10^{-3} m^2 s^{-1}$$

b) Graphical solution for R: R_0 for s = 0 (intercept x-axis)

R = 600 m

Algebraic solutions:

$$H - h = s = \frac{Q}{2\pi T} \ln \frac{R}{r}$$

$$r_1 \Rightarrow R = r \cdot \exp \frac{2\pi Ts}{Q} = 0.8 \exp \frac{2\pi(4.0 \times 10^{-3})(2.24)}{0.009} = 416m$$

$$r_2 \Rightarrow R = r \cdot \exp \frac{2\pi Ts}{Q} = 30 \exp \frac{2\pi(4.0 \times 10^{-3})(1.09)}{0.009} = 630m$$

$$r_3 \Rightarrow R = r \cdot \exp \frac{2\pi Ts}{Q} = 90 \exp \frac{2\pi(4.0 \times 10^{-3})(0.72)}{0.009} = 672m$$

$$r_4 \Rightarrow R = r \cdot \exp \frac{2\pi Ts}{Q} = 215 \exp \frac{2\pi(4.0 \times 10^{-3})(0.72)}{0.009} = 432m$$

Arithmetic mean: R = 537,5 m.

EXERCISE 14

The following drawdowns were measured in different piezometers during a pumping test in a confined porous aquifer (Q=26.7 ℓ/s).

Piezometer 11 b
r = 7.40 m

t [s]	s[m]
17	0. 30
21	0.40
27	0.50
35	0.70
53	0.93
85	1.03
168	1.20
220	1.28
281	1.35
330	1.40
450	1.47
540	1.50
720	1.56
1080	1.64
1440	1.71
2100	1.79
3000	1.86
3900	1.90
5400	1.99
8300	2.07
14600	2.18

Piezometer 3 b
r = 23.00 m

t[s]	s[m]
18	0.10
22	0.15
36	0.25
54	0.35
81	0.45
122	0.55
226	0.70
346	0.80
434	0.85
549	0.90
689	0.95
861	1.00
1080	1.05
1420	1.11
1800	1.15
2160	1.20
2760	1.25
3480	1.30
4380	1.35
5280	1.39
8100	1.48
11600	1.55
14150	1.50

Piezometer 6 b
r = 139.60 m

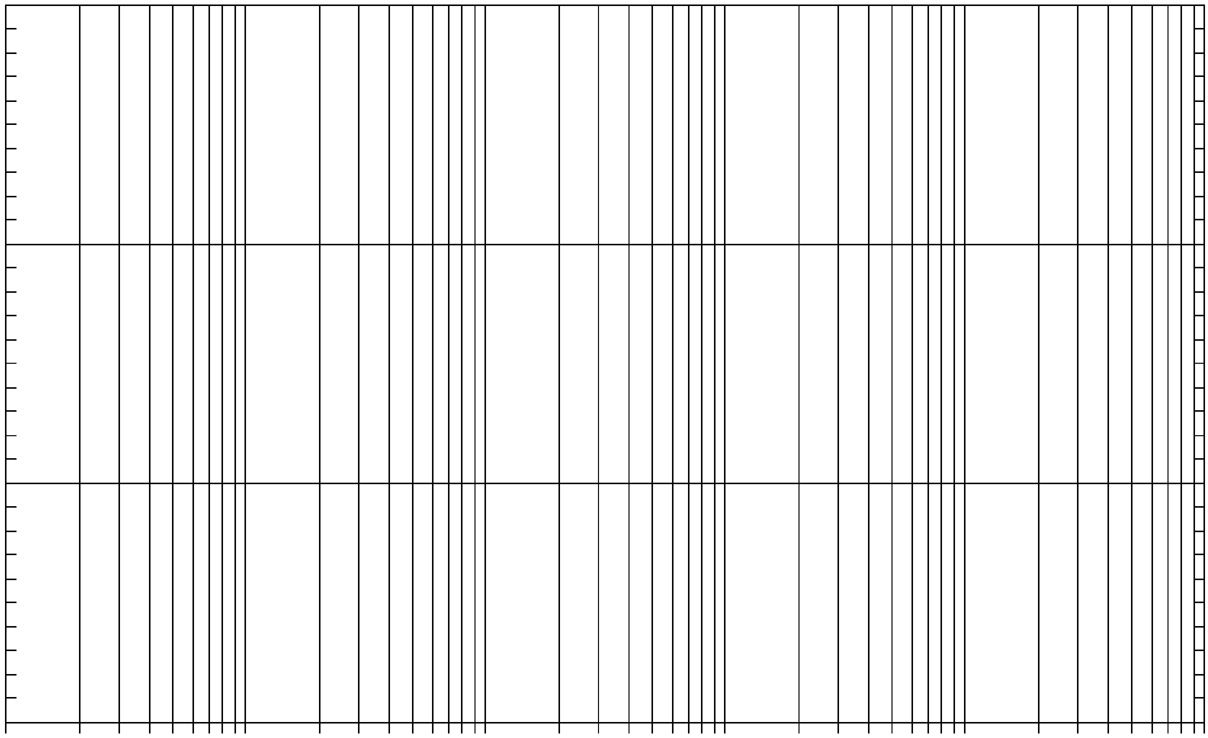
t [s]	s [m]
240	0.14
360	0.20
600	0.25
780	0.29
1140	0.35
1500	0.40
2040	0.45
2760	0.50
3900	0.55
4800	0.59
6450	0.65
8650	0.71
11450	0.76
13900	0.80

Determine the transmissivity T and the storage coefficient S of the aquifer using the method of Cooper-Jacob. Graphical solution for:

a) $s \rightarrow$ log (all piezometers for $t \cong 2100$ s)

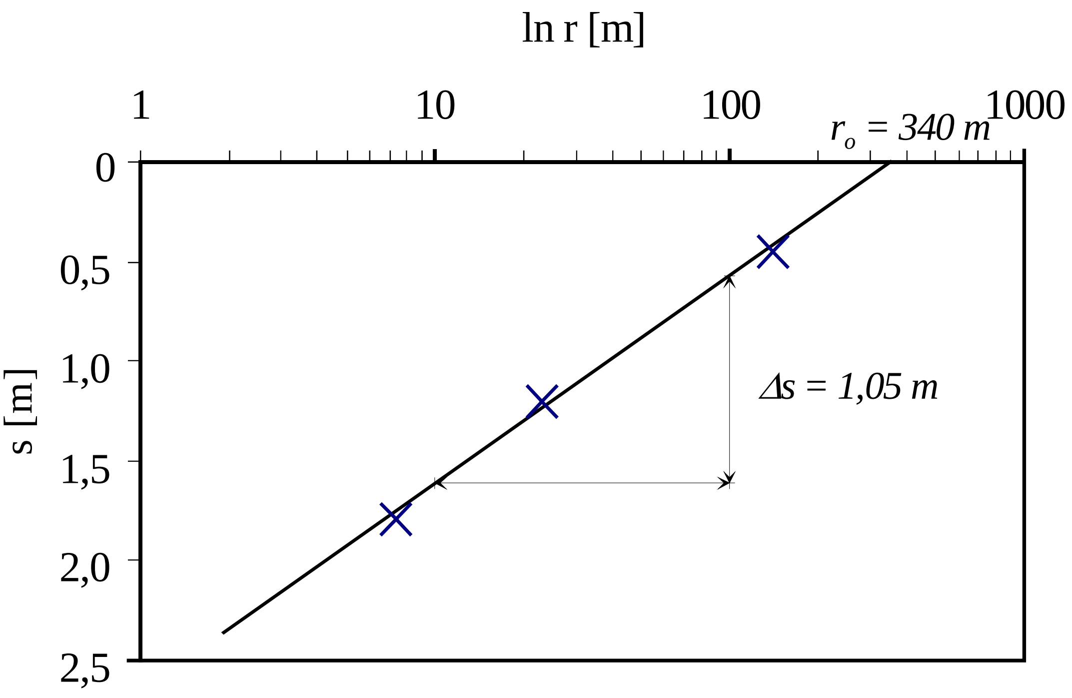
b) $s \rightarrow$ log (all piezometer)

c) $s \rightarrow$ log/r^2



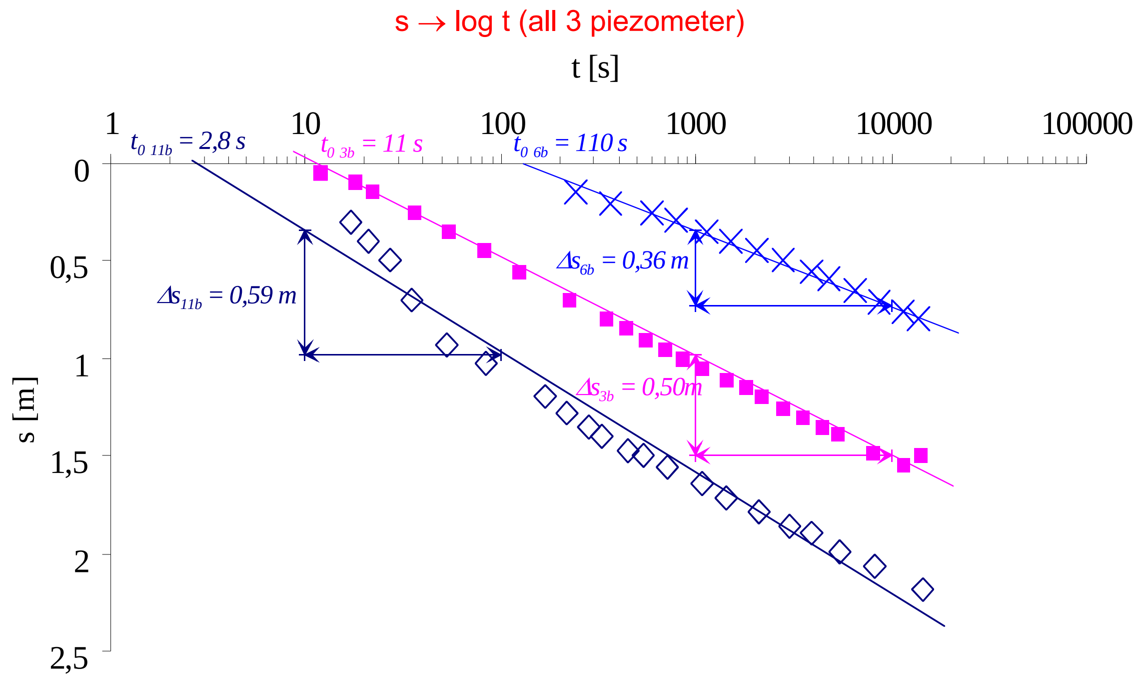
SOLUTION:

a) $s \rightarrow \log r$ (all 3 piezometers for $t \cong 2100$ s)



$$T = \frac{2.3 \bullet Q}{4\pi\Delta s} = \frac{2.3 \bullet 0.0267}{4\pi 1.05} = 0.0046 \text{ m}^2/\text{s}$$

$$S = 2.25 \bullet t \bullet T \frac{1}{r_0^2} \bullet = 2.25 \bullet 2100 \bullet 4.6 \bullet 10^{-3} \frac{1}{340^2} = 1.9 \bullet 10^{-4}$$



$$T = \frac{2.3 \bullet Q[m^3/s]}{4\pi\Delta s[m]}$$

$$T_{11b} = \frac{2.3 \bullet 0.0267}{4\pi\ 0.59} = 0.0082\ m^2/s;$$

$$T_{3b} = \frac{2.3 \bullet 0.0267}{4\pi\ 0.50} = 0.0097\ m^2/s$$

$$T_{6b} = \frac{2.3 \bullet 0.0267}{4\pi\ 0.36} = 0.0135\ m^2/s;$$

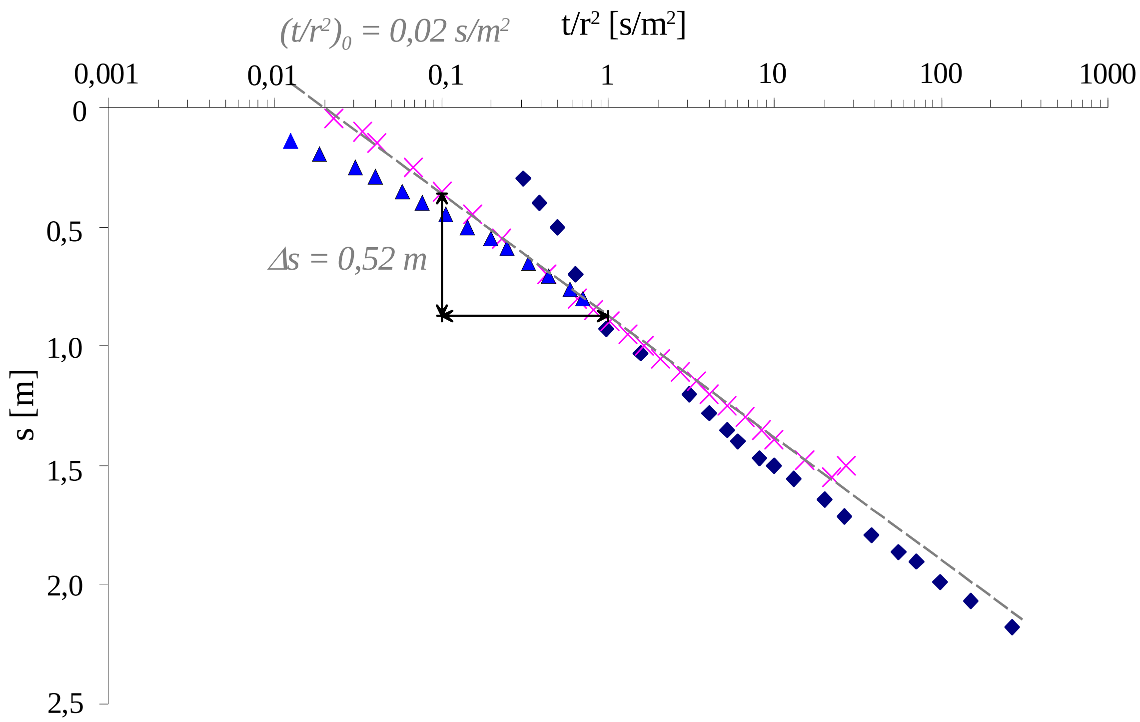
$$S = \frac{2.25 \bullet T\ [m^2/s]}{r^2[m^2]} \bullet t_0\ [s]$$

$$S_{11b} = \frac{2.25 \bullet 0.0082}{(7,4)^2} \bullet 2.8 = 9.4 \bullet 10^{-4}$$

$$S_{3b} = \frac{2.25 \bullet 0.0097}{(23)^2} \bullet 11 = 4.5 \bullet 10^{-4}$$

$$S_{6b} = \frac{2.25 \bullet 0.0135}{(139.6)^2} \bullet 110 = 1,7 \bullet 10^{-4}$$

$s \rightarrow \log t/r^2$ (all 3 piezometer)



$$T = \frac{2.3 \bullet Q}{4\pi\Delta s} = \frac{2.3 \bullet 0.0267}{4\pi\ 0.52} = 0.0094\ m^2/s$$

$$S = 2.25 \bullet T \frac{t}{r^2}_0 \bullet = 2.25 \bullet 0,0094 \bullet 0.02 = 4.2 \bullet 10^{-4}$$