Aim of this assignment

The aim of this assignment is to test your understanding of concepts related to well hydraulics.

What you need to do

1. All answers must be accompanied by correct question number.
2. Make suitable assumptions wherever necessary. State your assumptions clearly.
3. Submit all answers in a single word file. Insert equations using Word's equation editor or Mathtype. You may also draw diagrams in word, if needed. Clarify all symbols in the text along with brief explanation of how you will solve the problem.
4. Your name and roll number should be mentioned on the first page of the file.
5. Name the word file as YourRollNumber_CE626_AS2.docx

Deadline

The assignment is due on 5th September 2018 at 5.30 pm.

Question 1

Imagine you are working in CGWB (Central Ground Water Board) where one of your assigned tasks is to manage groundwater in your area. There is an aluminium industry located in your area and you get complaints from local residents that the groundwater is being polluted by the industry. Based on the geological data, you know that the aquifer is a confined aquifer with hydraulic conductivity 2.5 m/d and 40 m thick. A local water supply plant pumps water at a rate of 760 m^3/d using a well of diameter 20 cm that is screened throughout the depth of the aquifer. The drawdown observed at the pumping well face is 12 m. You observe that due to gradual clogging because of the contaminant, the hydraulic conductivity at a distance of 0.1 m to 1m from the centre of pumping well reduces to 0.25 m/d.

a) Will the drawdown at the well face increase or decrease due to clogging? Compute the percentage change in drawdown at the well face after clogging
b) You clean the well and remove the contaminant deposits as a part of well development programme. Now, you observed that the hydraulic conductivity increases to 25 m/d between 0.1 m to 1 m radial distance from the centre of well. Will the discharge of well increase or decrease if original drawdown is maintained at the well face? Compute the percentage change in well discharge.

Assume discharge remains constant and conditions after clogging are generally similar to those prior to clogging, apart from the change in aquifer's hydraulic conductivity near the pumping well.

(10+10 marks)

Question 2

A well is pumped at a rate of 16 m^3/min that fully penetrates a confined aquifer overlain by a leaky confining layer of 4.2 m thickness. The transmissivity of confined aquifer is 3200 m^2/d and storage coefficient is 0.00365. The permeability of the aquitard is 0.08 m/d. Assume that the confining layer does not release water from storage.

Find the corresponding drawdown values for the time values given in the following table for an observation well 12 m away from the pumping well. The tabulated values of W(u,r/B) for different values of u and r/B is given in the end of the document. Apply linear interpolation if required.

Time (min)	Drawdown (m)
0	0
2	?
4	
6	
8	
10	
15	
20	
25	
30	
40	

Table 1. Time data for question 2.

(10 marks)

Question 3

A pumping well fully penetrates a confined aquifer and is pumped at a constant rate of 2,500 m^3/day. Drawdowns measured at an observation well, which is 60 m away from the pumping well are given in the table below.

a) Determine the aquifer parameters (T and S) using Cooper-Jacob Method.

b) Plot distance vs drawdown curve in case of uncertainty in Q varying from -20% to +20% varying in steps of 5%. Use distance from the well 'r' from 2 m to 200 m, in steps of 5 m. Assume that the parameters calculated in part(a) are representative of the aquifer properties. Estimate the time-drawdown relationship for t = 10 min and for t = 200 min. Show both relationships in the same figure. Comment on the figure. This part should be coded using MATLAB/R. Submit the code along with the plot.

Time after pumping started (min)	Drawdown (m)	Time after pumping started (min)	Drawdown (m)
0	0	24	0.72
1	0.2	30	0.76
2	0.3	50	0.85
4	0.41	80	0.93
6	0.48	100	0.96
8	0.53	150	1.04
10	0.57	180	1.07
12	0.6	210	1.1
14	0.63	240	1.17

Table 2. Time vs. drawdown data for question 3.

(10+20 marks)

Question 4

A well 'P' of diameter 0.3 m fully penetrates a confined aquifer and is being pumped a constant rate of 3,000 m^3/day. Transmissivity and storage coefficient of the aquifer are 470 m^2/day and 0.00002 respectively. A river, which is 2x m away from the pumping well, is hydraulically connected to the aquifer. Determine the steady state drawdown in an observation well 4x m from the pumping well P and x m from the river where x is (last digit of your roll number × 5)

Hint:

i) Assumption of infinite areal extent of the aquifer is NOT valid in this case

ii) Imagine a hypothetical pumping well Q at the same distance as P from the River that recharges the aquifer at the same rate, Q.

iii) Drawdown at the observation well A is obtained using principle of superposition considering the drawdowns due to real well P and imaginary well Q

(20 marks)

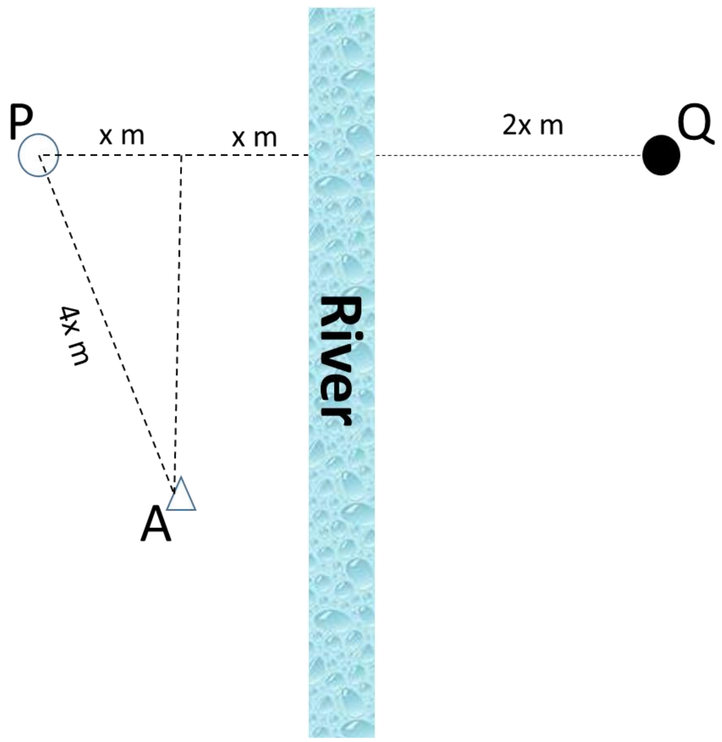

Figure 1. Pumping well 'P' close to a river for question 4. 'Q' is a recharge image well.

W(u, r/B)

u	r/B 1.0×10^{-3}	5.0×10^{-3}	1.0×10^{-2}	2.5×10^{-2}	5.0×10^{-2}
1.0×10^{-6}	13.0031	10.8283	9.4425	7.6111	6.2285
2.0×10^{-6}	12.4240	10.8174	9.4425	7.6111	6.2285
3.0×10^{-6}	12.0581	10.7849	9.4425	7.6111	6.2285
4.0×10^{-6}	11.7905	10.7374	9.4422	7.6111	6.2285
5.0×10^{-6}	11.5795	10.6822	9.4413	7.6111	6.2285
6.0×10^{-6}	11.4053	10.6240	9.4394	7.6111	6.2285
7.0×10^{-6}	11.2570	10.5652	9.4361	7.6111	6.2285
8.0×10^{-6}	11.1279	10.5072	9.4313	7.6111	6.2285
9.0×10^{-6}	11.0135	10.4508	9.4251	7.6111	6.2285
1.0×10^{-5}	10.9109	10.3963	9.4176	7.6111	6.2285
2.0×10^{-5}	10.2301	9.9530	9.2961	7.6111	6.2285
3.0×10^{-5}	9.8288	9.6392	9.1499	7.6101	6.2285
4.0×10^{-5}	9.5432	9.3992	9.0102	7.6069	6.2285
5.0×10^{-5}	9.3213	9.2052	8.8827	7.6000	6.2285
6.0×10^{-5}	9.1398	9.0426	8.7673	7.5894	6.2285
7.0×10^{-5}	8.9863	8.9027	8.6625	7.5754	6.2285
8.0×10^{-5}	8.8532	8.7798	8.5669	7.5589	6.2284
9.0×10^{-5}	8.7358	8.6703	8.4792	7.5402	6.2283
1.0×10^{-4}	8.6308	8.5717	8.3983	7.5199	6.2282
2.0×10^{-4}	7.9390	7.9092	7.8192	7.2898	6.2173
3.0×10^{-4}	7.5340	7.5141	7.4534	7.0759	6.1848
4.0×10^{-4}	7.2466	7.2317	7.1859	6.8929	6.1373
5.0×10^{-4}	7.0237	7.0118	6.9750	6.7357	6.0821
6.0×10^{-4}	6.8416	6.8316	6.8009	6.5988	6.0239
7.0×10^{-4}	6.6876	6.6790	6.6527	6.4777	5.9652
8.0×10^{-4}	6.5542	6.5467	6.5237	6.3695	5.9073
9.0×10^{-4}	6.4365	6.4299	6.4094	6.2716	5.8509
1.0×10^{-3}	6.3313	6.3253	6.3069	6.1823	5.7965
2.0×10^{-3}	5.6393	5.6363	5.6271	5.5638	5.3538
3.0×10^{-3}	5.2348	5.2329	5.2267	5.1845	5.0408
4.0×10^{-3}	4.9482	4.9467	4.9421	4.9105	4.8016
5.0×10^{-3}	4.7260	4.7249	4.7212	4.6960	4.6084
6.0×10^{-3}	4.5448	4.5438	4.5407	4.5197	4.4467
7.0×10^{-3}	4.3916	4.3908	4.3882	4.3702	4.3077
8.0×10^{-3}	4.2590	4.2583	4.2561	4.2404	4.1857
9.0×10^{-3}	4.1423	4.1416	4.1396	4.1258	4.0772
1.0×10^{-2}	4.0379	4.0373	4.0356	4.0231	3.9795

Table 3. Table for W(u,r/B) versus u and r/B.