GLY-4822

Assignment 5

1. The following table contains data on the hydraulic conductivity and thickness of four horizontal lithologic units. (a) Compute the equivalent horizontal and vertical hydraulic conductivities. (b) Which unit dominates the horizontal conductivity? (c) Which unit controls the vertical conductivity?

K(m s^{-1})	b(m)
10^{-7}	10
10^{-2}	1
10^{-4}	10
10^{-5}	20

2. A sand-filled column is aligned so that the right end is at an elevation (relative to a reference) of 2 m and the left end is at an elevation of 1m. A tube connected to the right end is connected to a reservoir in which the free water surface is maintained at an elevation of 3 m while a tube connected to the left end is connected to a reservoir maintained at 2.5 m. Draw a diagram of the physical system and next to that draw a potential diagram with z on the vertical axis and h on the horizontal axis. Include lines for the elevation, pressure, and total head on the graph. Indicate the flow direction on the graph and on the diagram of the column.

3. If the ground water flux in an aquifer is $q = 1$ m d^{-1} and the (effective) porosity is 0.5, what is the mean pore water velocity?

4. A 10-m thick confining bed with vertical hydraulic conductivity of 10^{-7} m s^{-1} separates two aquifers. Monitoring wells show that the head in the upper aquifer is 100 m and that the head in the lower aquifer is 95 m. (a) What is the areal flux q between the aquifers? (b) If the aquifers cover an area 10 by 10 km and are bounded so that all the water in the lower aquifer comes from this leakage, how much pumping is probably occurring in the lower aquifer?

5. The following head data are available from three monitoring wells at a gas station:

Well	Easting (m)	Northing (m)	Head (m msl)
MW-1	298745	82360	10.05
MW-2	298732	82369	10.11
MW-3	298730	82353	10.01

(a) Make a scaled map of the well locations. (b) Solve for the ground water flow direction and the gradient magnitude.

5. An exhaustive monitoring program has led to unusually complete knowledge of the head field for a cross-section of a homogeneous, isotropic aquifer. The heads are shown in the following table. (a) Contour the heads (i.e., draw and label equipotentials). (b) Draw streamlines.

0.17	0.22	0.29	0.37	0.45	0.54	0.63	0.72	0.81	0.89	0.98	1.07	1.16	1.25	1.33	1.41	1.48	1.53
0.29	0.32	0.37	0.43	0.50	0.58	0.65	0.73	0.81	0.89	0.97	1.05	1.12	1.20	1.27	1.33	1.38	1.41
0.39	0.41	0.44	0.49	0.55	0.61	0.68	0.74	0.81	0.88	0.95	1.02	1.09	1.15	1.21	1.26	1.29	1.31
0.46	0.47	0.50	0.54	0.59	0.64	0.70	0.76	0.82	0.88	0.94	1.00	1.06	1.11	1.16	1.20	1.23	1.24
0.51	0.53	0.55	0.58	0.62	0.67	0.72	0.77	0.82	0.88	0.93	0.98	1.03	1.08	1.12	1.15	1.17	1.19
0.56	0.57	0.59	0.61	0.65	0.69	0.73	0.78	0.83	0.87	0.92	0.97	1.01	1.05	1.08	1.11	1.13	1.14
0.59	0.60	0.62	0.64	0.67	0.71	0.74	0.78	0.83	0.87	0.91	0.96	0.99	1.03	1.06	1.08	1.10	1.11
0.62	0.63	0.64	0.66	0.69	0.72	0.75	0.79	0.83	0.87	0.91	0.95	0.98	1.01	1.04	1.06	1.07	1.08
0.64	0.64	0.66	0.68	0.70	0.73	0.76	0.80	0.83	0.87	0.90	0.94	0.97	1.00	1.02	1.04	1.05	1.06
0.65	0.66	0.67	0.69	0.71	0.74	0.77	0.80	0.83	0.87	0.90	0.93	0.96	0.99	1.01	1.03	1.04	1.05
0.66	0.66	0.67	0.69	0.71	0.74	0.77	0.80	0.83	0.87	0.90	0.93	0.96	0.99	1.01	1.03	1.04	1.04

6. A ‘partially-penetrating’ well (one that does not derive water from the entire thickness of the aquifer) is installed in the same aquifer and pumped. The resulting heads are shown in the following table. (a) Contour the heads (i.e., draw and label equipotentials). (b) Draw streamlines. For the right balance between pumping and recharge to the aquifer, part of the flow will be ‘captured’ by the well and part of the total flow will discharge elsewhere. We say that the well has a ‘capture zone’. (c) Indicate the well’s capture zone.

0.12	0.17	0.23	0.31	0.39	0.47	0.55	0.63	0.71	0.79	0.86	0.94	1.01	1.08	1.16	1.23	1.30	1.35
0.19	0.21	0.26	0.31	0.37	0.44	0.50	0.56	0.62	0.68	0.73	0.78	0.82	0.87	0.92	0.97	1.02	1.05
0.23	0.25	0.28	0.31	0.36	0.40	0.45	0.49	0.53	0.57	0.60	0.62	0.64	0.65	0.67	0.71	0.75	0.78
0.25	0.26	0.28	0.31	0.34	0.37	0.40	0.43	0.45	0.47	0.47	0.47	0.45	0.43	0.40	0.45	0.50	0.53
0.26	0.27	0.28	0.30	0.32	0.34	0.36	0.37	0.38	0.38	0.36	0.33	0.28	0.20	0.06	0.20	0.28	0.32
0.27	0.27	0.28	0.29	0.30	0.31	0.32	0.32	0.31	0.30	0.26	0.21	0.13	0.02	-0.15	0.00	0.09	0.14
0.27	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.26	0.23	0.19	0.12	0.03	-0.10	-0.29	-0.14	-0.04	0.00
0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.24	0.22	0.18	0.13	0.06	-0.04	-0.17	-0.36	-0.22	-0.13	-0.09
0.27	0.27	0.26	0.26	0.26	0.25	0.24	0.22	0.19	0.14	0.09	0.02	-0.07	-0.19	-0.35	-0.24	-0.18	-0.15
0.26	0.26	0.26	0.26	0.25	0.24	0.22	0.20	0.17	0.12	0.07	0.00	-0.07	-0.16	-0.23	-0.21	-0.19	-0.17
0.26	0.26	0.26	0.25	0.24	0.23	0.21	0.19	0.16	0.11	0.06	0.00	-0.07	-0.14	-0.19	-0.20	-0.19	-0.18