Problem 1.

Figure 1.1 is a diagram of an unconfined aquifer near a creek. Assume that the average saturated thickness of the aquifer is 49 feet. During a long drought, the flow in the creek decreases by 16 cubic feet per second between the two gaging stations located 4 miles apart. The observation wells on the west side of the creek show that the slope of the water table is 0.0004 ft/ft. The observation wells on the east side of the creek (wells are not shown on the figure – the gaging stations are on the east side of the creek in the picture) show that the water table slopes away from the creek with slope 0.0006 ft/ft. Estimate the transmissivity and hydraulic conductivity of the aquifer.

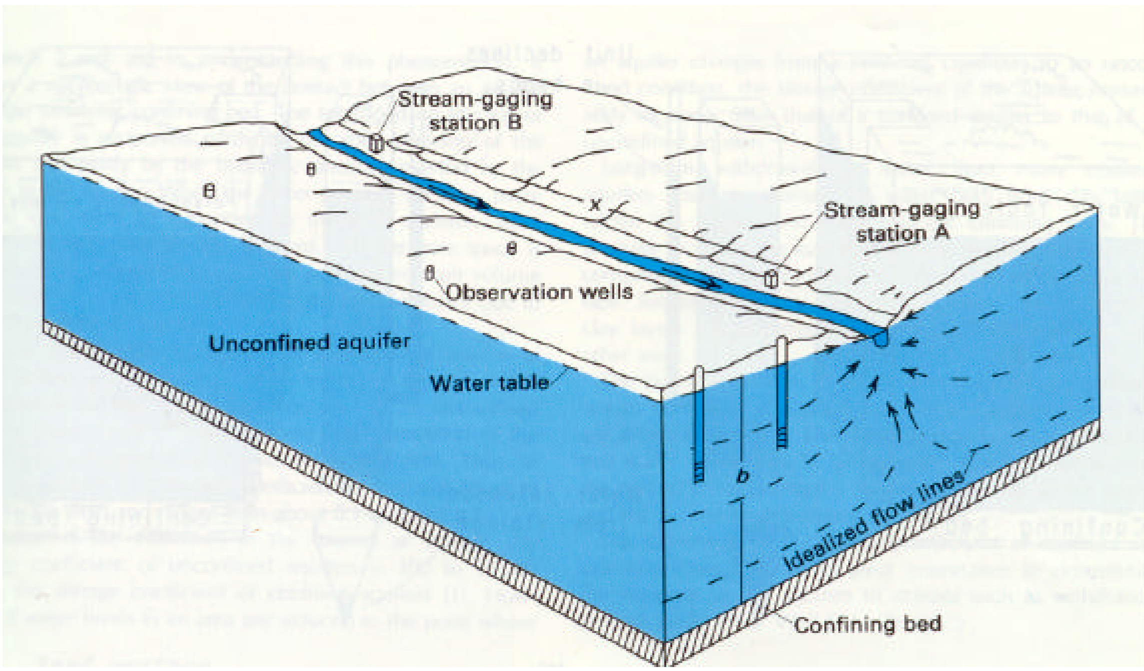

Figure 1.1 Schematic of aquifer-stream system.

Problem 2.

Figure 2.1 is a diagram of a portion of a confined aquifer. Determine the groundwater discharge (cubic meters per day) flowing out the right face of the section of aquifer.

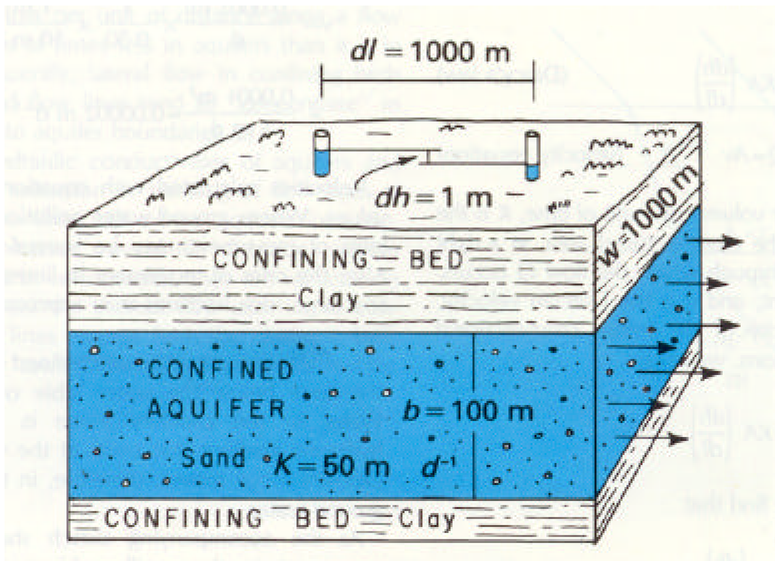

Figure 2.1 Schematic of Aquifer

Problem 3

Figure 3.1 below shows a grid with numbers. The numbers represent the piezometric head in an aquifer located at the center of each grid cell. Figure 3.2 is the same aquifer 90 days later than the earlier figure. Each grid cell is 100 meters x 100 meters. Water was withdrawn from the aquifer at a rate of 1,000 cubic meters per day. Draw a contour map of the water levels at the two times and estimate the storativity of the aquifer.

110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180
110	120	130	140	150	160	170	180

Figure 3.1 Head at t=0 days

122	126	133	140	148	155	162	167
128	131	135	141	146	152	156	159
133	134	137	140	144	148	152	153
135	136	137	139	143	146	149	150
137	137	138	137	142	144	146	147
138	138	139	139	142	144	145	146
138	139	139	140	142	143	144	145
139	139	140	141	142	143	144	145

Figure 3.2 Head at t=90 days

Problem 4.

Three wells monitor an aquifer as shown in Figure 4.1. The head in each well is listed in the table below. Determine the magnitude and direction of the hydraulic gradient in this aquifer. If a tracer released near well 1 arrives near well 2 in 23 days, and the aquifer has porosity of 30%, what is the hydraulic conductivity of this aquifer?

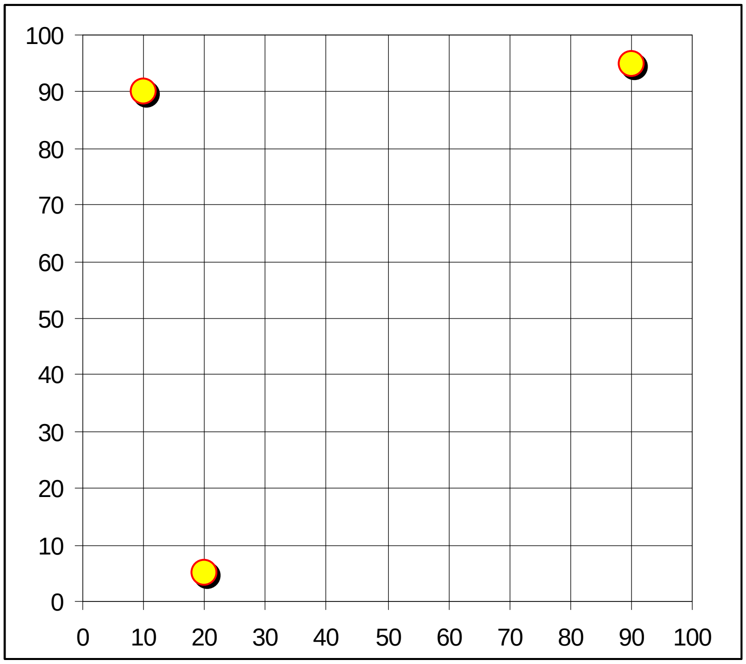

Figure 4.1 Plan view of monitoring wells

Well	X	Y	Head
#1	10	90	93.2
#2	20	5	88
#3	90	95	90

Problem 5

Two boreholes are located at points A and B along the same flowline. The soil between them has a hydraulic conductivity of 3.0 x 10^{-5} ft/sec and a porosity of 40%. Water flows from B to A in the water table. A 500 foot x 100 foot waste cell is planned to be built between points A and B as shown on Figure 5.1. The bottom of the waste cell must be at least 5 feet above the water table at all points. Find the hydraulic gradient between points A and B and the minimum elevation of the waste cell. Estimate the travel time for waste to reach point A if the protective liner of the cell fails and the waste material reaches the groundwater.

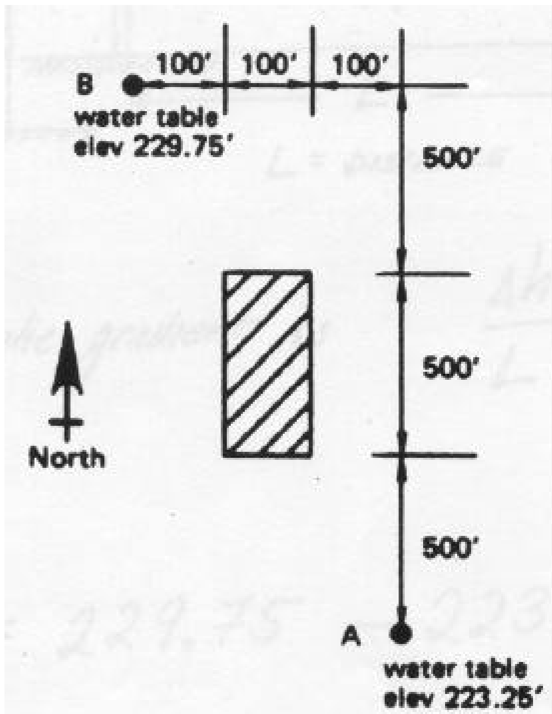

Figure 5.1 Plan view of proposed waste cell.

Problem 6 (Hard!)

An artificial recharge pond is located in a sandy area (K=10 m/day; n=0.30). The pond covers a large area. A flood wave fills the pond within a very short time up to a water level of 5.5 m above the sandy bottom. By controlling the inflow the water level is maintained at this elevation. During previous operations, the bottom of the pond was covered by a layer of fines of thickness 0.5 meters, K=0.1 m/day; n=0.50.

Assuming infiltration is only vertically downward, and under practically saturated flow conditions, show the rate of advance of the wetting front from the recharge pond into an assumed dry soil as a function of time. Assume a very deep water table. What will be the rate of infiltration after a very long time?