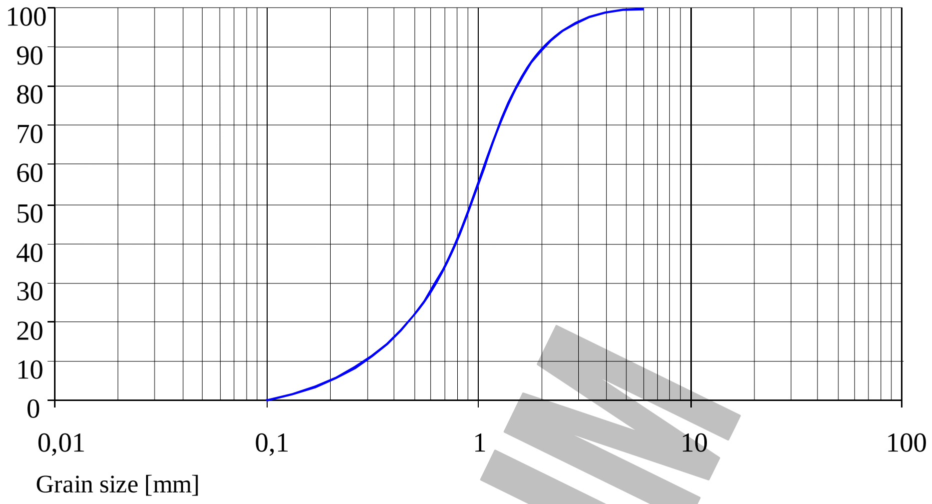
EXERCISE 9

(a) Draw contours

(b) Draw grain size distribution



□x(between 112 m and 111 m isopiestic lines) = 190 m and Δh = -1 m

I = -Δh/Δx = 1/190 m = 0.00526

Hydraulic conductivity:

$K = C * d_{10}^2 * (0.79 + 0{,}03 * T)/86.4$ [m/s] $= 0.0093 * 0.3^2 * (0.79 + 0.03 * 14)/86.4$ m/s = 1.17E-5 m/s

(c) v = K * I = 6.15E-8 m/s

Q = K*A*I=1.17E-5 m/s *100 m*20 m*0.00526 = 1.1231E-4 m^3/s = 10.634 m^3/24 hrs

EXERCISE 13

A well in a 20 m thick phreatic aquifer (effective porosity 30%, recharge rate 0.3 m/yr) draws water from up to 4 km.

a) Calculate the travel time for a non-reactive solute from a factory situated 1 km from the well.

b) Calculate the travel time for a non-reactive solute from a factory situated 1 km from the well, assuming an effective porosity of 45 %. Explain the reason for the deviation from solution a).

D = 20 m	Φ_{eff} = 0.3
R = 0.3 m/yr	r = 4 km
x = 0 (well)	x_0 = 1 km (factory)

$$\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{Rt}{D\phi_{eff}}$$

$$t=\ln\frac{0^2km^2-4^2km^2}{1^2km^2-4^2km^2}\cdot\frac{20m\cdot 0.3}{0.3m/yr}=1.291yrs$$

$$\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{Rt}{D\phi_{eff}}$$

$$t=\ln\frac{0^2km^2-4^2km^2}{1^2km^2-4^2km^2}\cdot\frac{20m\cdot 0.45}{0.3m/yr}=1.936yrs$$

EXERCISE 14

A well in a 50 m thick, homogeneous phreatic aquifer (effective porosity 30%, uniform recharge rate 0.5 m/yr) draws water from up to 5 km. Calculate the travel time for an ideal solute (no retardation) from a factory situated 3 km from the well.

Hint: Radial converging flow $\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{Rt}{D\phi_{eff}}$

SOLUTION:

$$\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{R_{recharge}t}{D\phi_{eff}}$$

$$t=\frac{D\phi_{eff}}{R_{recharge}}\ln\frac{x^2-r^2}{x_0^2-r^2}=\frac{50m*0.3}{0.5m/yr}\ln\frac{0^2-5^2}{3_0^2-5^2}=30*\ln 1.5625=13.39years$$