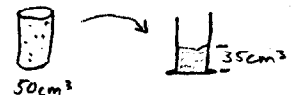
5-37; 5-40, 5-46, 5-48, 5.50, 5.53

5-37)



a) porosity?

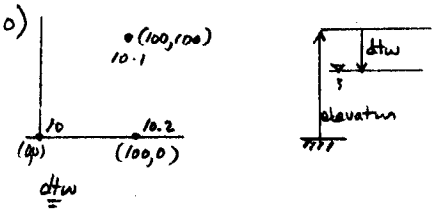
$$n = \frac{\forall_{void}}{\forall_{bulk}} = \frac{\forall_{bulk} - \forall_{solids}}{\forall_{bulk}} = \frac{15\,cm^3}{50\,cm^3} = 0.3$$

b) Solids density

$$\rho_s = \frac{m_{solids}}{\forall_{solids}} = \frac{100g}{35cm^3} = 2.85\,g/cm^3 = 2.85\,\frac{g}{mL}\cdot\frac{1000\,mL}{L}\cdot\frac{1000\,L}{m^3}$$

$$= 2850\,kg/m^3$$

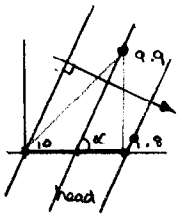
5-40)



let elevation = 20 then

$\alpha = 63.4°$

$\Delta L = 50 \sin 63.4°$

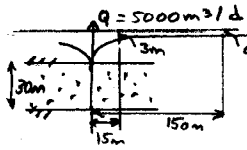


$d_{n-1} = 100m$

$d_{n-m} = \frac{0.1}{0.2}\,100 = 50$

hyd. gradient $= \frac{0.1}{50 \sin 64°} = 0.00$

5-46)



find K $\quad Q = \frac{2K b \pi (h_2 - h_1)}{\ln(r_2/r_1)}$ solve for K

$$K = \frac{Q \ln(r_2/r_1)}{2\pi b (h_2 - h_1)} = \frac{(5000)\ln(150/15)}{2\pi(30)[(h_0 - 0.3) - (h_0 - 3.0)]}$$

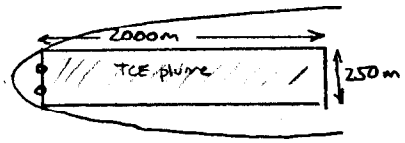
h_0 - drawdown = h (see defn. of ddn) → substitute any value for h_0 ($h_0 > 3.0$) and solve

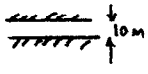
$(h_0 - 0.3) - (h_0 - 3.0) = 3.0 - 0.3$ ← or to obtain $K = 22.6\,m/d$

5-49) $t = \frac{\pi B n}{Q}(R^2 - r_w^2)$ $\quad B = 30m$, $n = 0.3$, $r_w = 0.2m$, $Q = 5000\,m^3/d$

$$t = \frac{\pi(0.3)(30m)(15^2 - 0.2^2)}{5000\,m^3/d} = 1.27\,days$$

5-50)





$0.1\,m^3$ TCE, $n = 0.4$, $\frac{\Delta h}{\Delta \ell} = 0.001$

$K = 0.001\,m/s$

a) $0.1\,m^3\,TCE \cdot 1470\,kg/m^3 = 147\,kg\,TCE$

$$\frac{147\,kg\,TCE}{(2000)(250)(10)(.4)} = \frac{0.0735\,g\,TCE}{m^3} = \frac{73.5\,mg\,TCE}{m^3}\cdot\frac{1\,m^3}{1000\,L} = 0.0735\,mg/L$$

well below solubility
∴ can all dissolve

b) Single well solution $\quad \frac{Q}{VB} = 250m \qquad V = K\frac{dh}{d\ell} = (0.001)(0.001) = 1\cdot10^{-6}\,m/s$

$\therefore Q = 250 \cdot 2 \cdot 10 \cdot 1\cdot10^{-6}\,m/s = 0.005\,m^3/s > 0.003\,m^3/s$ ∴ one well has too high Q

2-wells

$Q = 250 \cdot 10 \cdot 1\cdot10^{-6}\,m/s = 0.0025\,m^3/s < 0.003\,m^3/s$ ∴ two wells will work

c) Optimal spacing $= \frac{Q}{\pi B V} = \frac{0.0025}{\pi(10)(1\cdot10^{-6})} = 79.6m \approx 80\,m$

5-53) Same as example in text; numbers changed, use table 5-12: $t \approx 7.3$ years.