Problem 1.

Given: horizontal confined aquifer. $b = 15$ ft.

Before pumping, Water level = 10 ft below ground.

$Q = 180$ gal/min. to steady state.

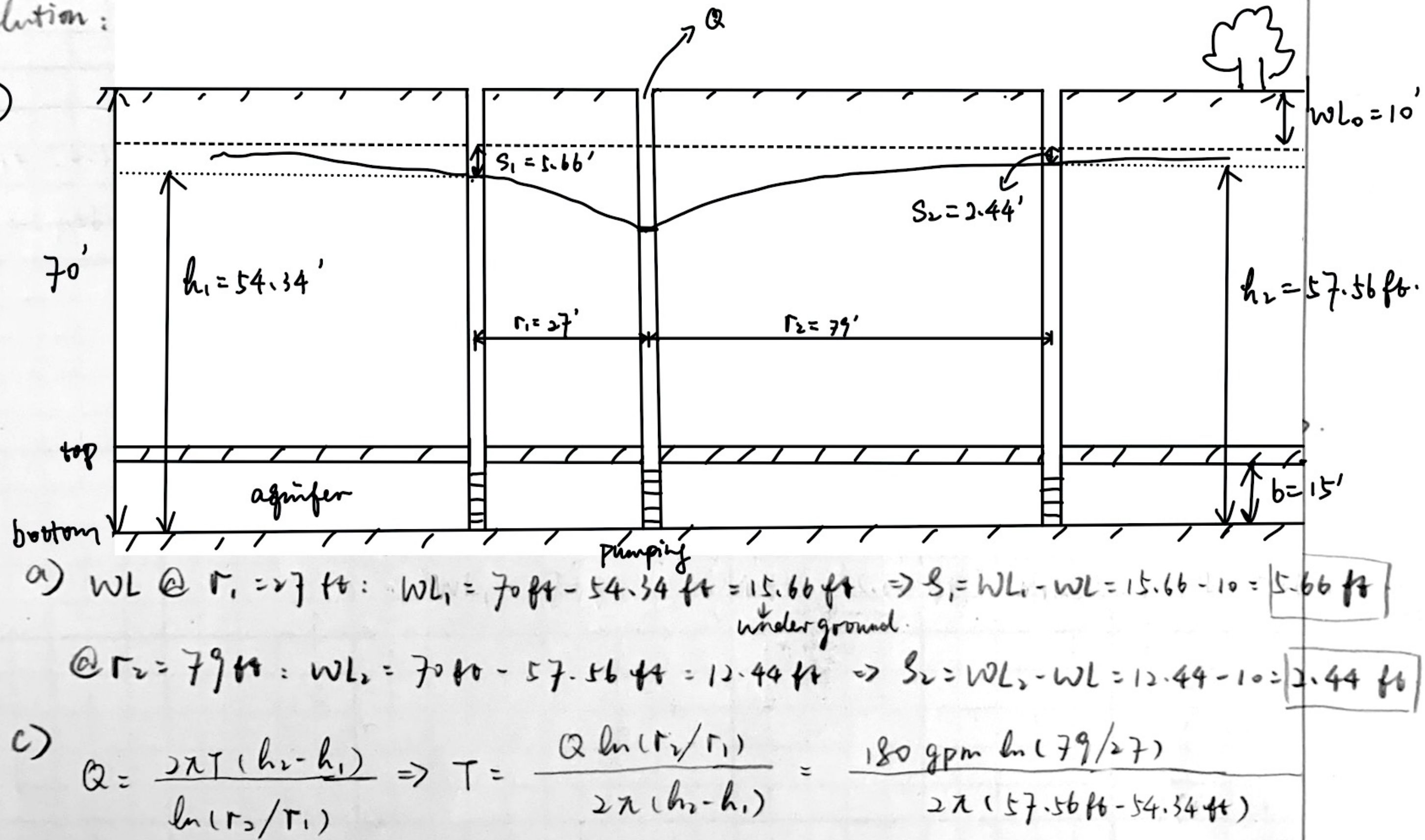
@ $r_1 = 27$ ft, $h_1 = 54.34$ ft.

@ $r_2 = 79$ ft, $h_2 = 57.56$ ft.

find: a) two drawdowns. b) sketch c) hydraulic conductivity gpd/ft² & ft/s. high/low? types of consolidated & unconsolidated sediments.

Solution:

b)



a) WL @ $r_1 = 27$ ft: $WL_1 = 70\text{ ft} - 54.34\text{ ft} = 15.66\text{ ft}$ underground $\Rightarrow S_1 = WL_1 - WL = 15.66 - 10 = \boxed{5.66\text{ ft}}$

@ $r_2 = 79$ ft: $WL_2 = 70\text{ ft} - 57.56\text{ ft} = 12.44\text{ ft} \Rightarrow S_2 = WL_2 - WL = 12.44 - 10 = \boxed{2.44\text{ ft}}$

c) $$Q = \frac{2\pi T(h_2 - h_1)}{\ln(r_2/r_1)} \Rightarrow T = \frac{Q\ln(r_2/r_1)}{2\pi(h_2-h_1)} = \frac{180\text{ gpm}\ln(79/27)}{2\pi(57.56\text{ ft} - 54.34\text{ ft})}$$

$$= 9.55\ \frac{\text{gal/min}}{\text{ft}} \times \frac{1\text{ ft}^3}{7.48\text{ gal}} \cdot \frac{1\text{ min}}{60\text{ s}} = \boxed{0.021\text{ ft}^2/\text{s}}$$

$$= 9.55\ \frac{\text{gal/min}}{\text{ft}} \times \frac{60\times 24\text{ min}}{\text{day}} = \boxed{13700\text{ gpd/ft}}$$

$$K = T/b = \frac{13700\text{ gpd/ft}}{15\text{ ft}} = \boxed{917\text{ gpd/ft}^2} \sim 10^3\text{ gpd/ft}^2$$ high K

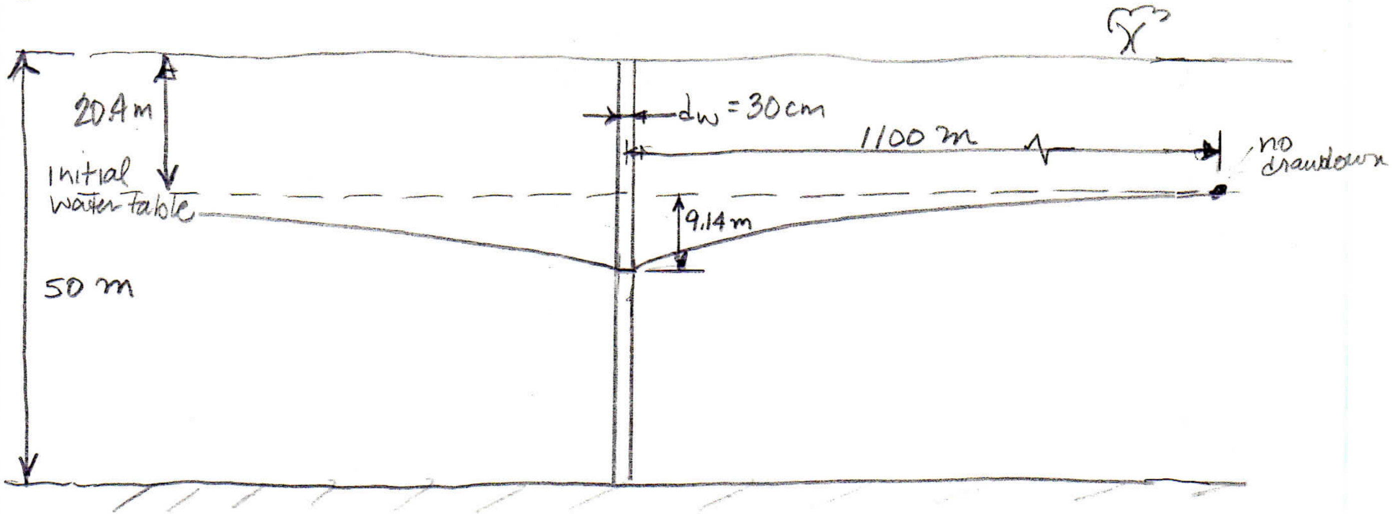
$$= \frac{0.021\text{ ft}^2/\text{s}}{15\text{ ft}} = \boxed{1.4\times 10^{-3}\text{ ft/s}}$$

According to Table 6.1.2: Consolidated: Karst limestone, Permeable basalt, fractured igneous and metamorphic rocks.
unconsolidated: clean sand, gravel.

(2) Given: Unconfined aquifer
bottom 50 m below ground
Initial water table 20.4 m below ground
Well $Q = 6500$ L/min
$d_w = 30$ cm
at $r_1 = 1100$ m $s_1 = 0$ (radius of influence)
$r_w = d_w/2$, $s_w = 9.14$ m
$r_w = 15$ cm $= 0.15$ m

Find:
(a) neat sketch
(b) original thickness
thickness at well @ SS
(c) K
(d) new S_w if Q drops to 1500 L/m.
assume new SS with same radius of influence

(a) Sketch:



NTS

(b) h_0 = orignal thickness $= 50 - 20.4 = \boxed{29.6\text{ m} = h_0}$

after pumping $h_w = 29.6 - 9.14 = \boxed{20.46\text{ m} = h_w}$

(c)
$$Q = \frac{\pi K (h_2^2 - h_1^2)}{\ln(r_2/r_1)} \Rightarrow K = \frac{Q \ln(r_2/r_1)}{\pi (h_2^2 - h_1^2)}$$

for this problem
2 = at well
1 = at radius of infl

$$K = \frac{(6500 \tfrac{L}{min}) \ln(0.15\text{ m}/1100\text{ m})}{\pi (20.46^2 - 29.6^2)\text{ m}^2} \cdot \frac{1\text{ m}^3}{1000\text{ L}} \cdot \frac{1\text{ min}}{60\text{ s}} = \boxed{6.7 \times 10^{-4}\text{ m/s} = K}$$

(d) algebra: $h_2^2 - h_1^2 = \dfrac{Q \ln(r_2/r_1)}{\pi K}$

so $h_2^2 = h_1^2 + \dfrac{Q \ln(r_2/r_1)}{\pi K}$

$$= (29.6\text{ m})^2 + \frac{1500 \tfrac{L}{min} \ln(0.15/1100)}{\pi (6.7 \times 10^{-4}\text{ m/s})} \left(\frac{1\text{ m}^3}{1000\text{ L}}\right)\left(\frac{1\text{ min}}{60\text{ s}}\right)$$

note: used orig. value stored in calculator w/ more sig fig

$$= 876.16 - 105.59 = 770.57$$

$h_2 = \sqrt{770.57} = 27.76$ ft $= h_2 = h_w$

so $s_w = h_0 - h_w = 29.6 - 27.76 = \boxed{1.84\text{ m} = s_w}$

makes sense... lower Q so less drawdown