1 a)

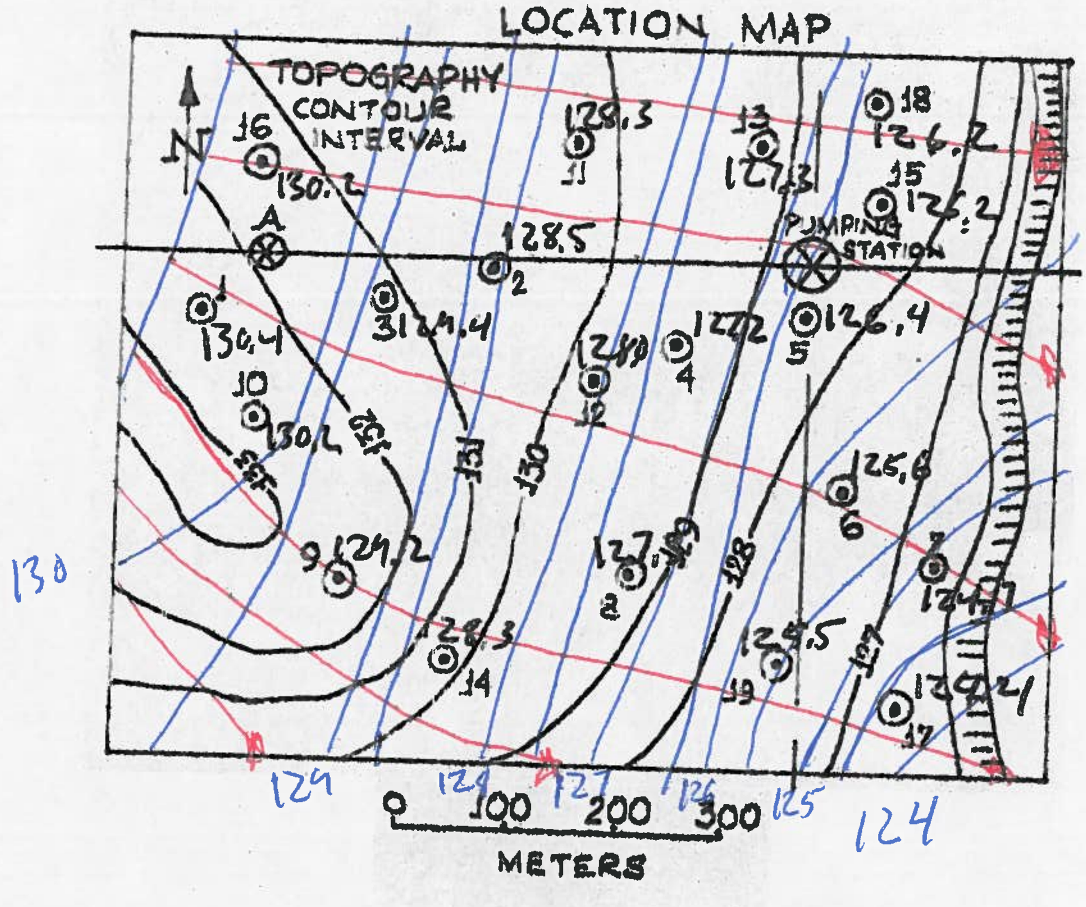

LOCATION MAP
TOPOGRAPHY
CONTOUR
INTERVAL
N
A
PUMPING
STATION
130
129
128
127
126
125
124
0 100 200 300
METERS

Figure: 1.

1 b) A → pumping station

A $\approx$ 130.2m of head

126.5m $\approx$ for pumping station

$$V = \frac{-K}{n} \frac{dh}{dx}$$

$$V = \frac{-4.7 \cdot 10^{-4} \, m/s}{0.3} \cdot \frac{130.2m - 126.5m}{-500m}$$

$$V = 1.2 \cdot 10^{-5} \, m/s$$

$$\frac{500m}{1.2 \cdot 10^{-5} \, m/s} = 4.3 \cdot 10^{7} \text{ seconds}$$

$$\boxed{1.4 \text{ years}}$$

2a) $\alpha = -\frac{1}{V_T}\frac{\Delta V_T}{\Delta \sigma_e}$ $\Delta \sigma_e = -\rho g \Delta h$

$$\alpha = -\frac{1}{40\,m} \cdot \frac{0.07\,m}{-1000\,\frac{kg}{m^3} \cdot 9.81\,\frac{m}{s^2} \cdot 8\,m}$$

$$\boxed{\alpha = 2.3 \cdot 10^{-8}}$$

$$S_s = \rho g (\beta_w \cdot n + \alpha)$$

$$S_s = 1000\,\frac{kg}{m^3} \cdot 9.81\,\frac{m}{s^2} \cdot \left(4.7 \cdot 10^{-10}\,\frac{1}{Pa} \cdot 0.30 + 2.3 \cdot 10^{-8}\,\frac{1}{Pa}\right)$$

$$\boxed{S_s = 2.3 \cdot 10^{-4}\,\frac{1}{m}}$$

$$S = S_s \cdot b$$

$$S = 2.3 \cdot 10^{-4}\,\frac{1}{m} \cdot 40\,m$$

$$\boxed{S = 9 \cdot 10^{-3}}$$

2b) Most likely sand

be liberal w/ marking

c) $\forall = S \cdot A \cdot \Delta h$

$\forall = 9 \cdot 10^{-3} \cdot 100\,km^2 \cdot \frac{8m}{1000m}$

$\boxed{\forall = 7.4 \cdot 10^6\,m^3}$

d) $S = S_s \cdot b + S_y$

$S = 2.3 \cdot 10^{-4}\,\frac{1}{m} \cdot 40m + 0.12$

$S = 0.13$

$\forall = S \cdot A \cdot \Delta h$

$\forall = 0.13 \cdot 100\,km^2 \cdot \frac{8m}{1000m}$

$\boxed{\forall = 1.0 \cdot 10^8\,m^3}$

Question 2

A confined aquifer (porosity 0.30) with an initial thickness of 40 m and an area of 100 square km consolidated 7 cm when the pressure head was uniformly lowered by 8 m.

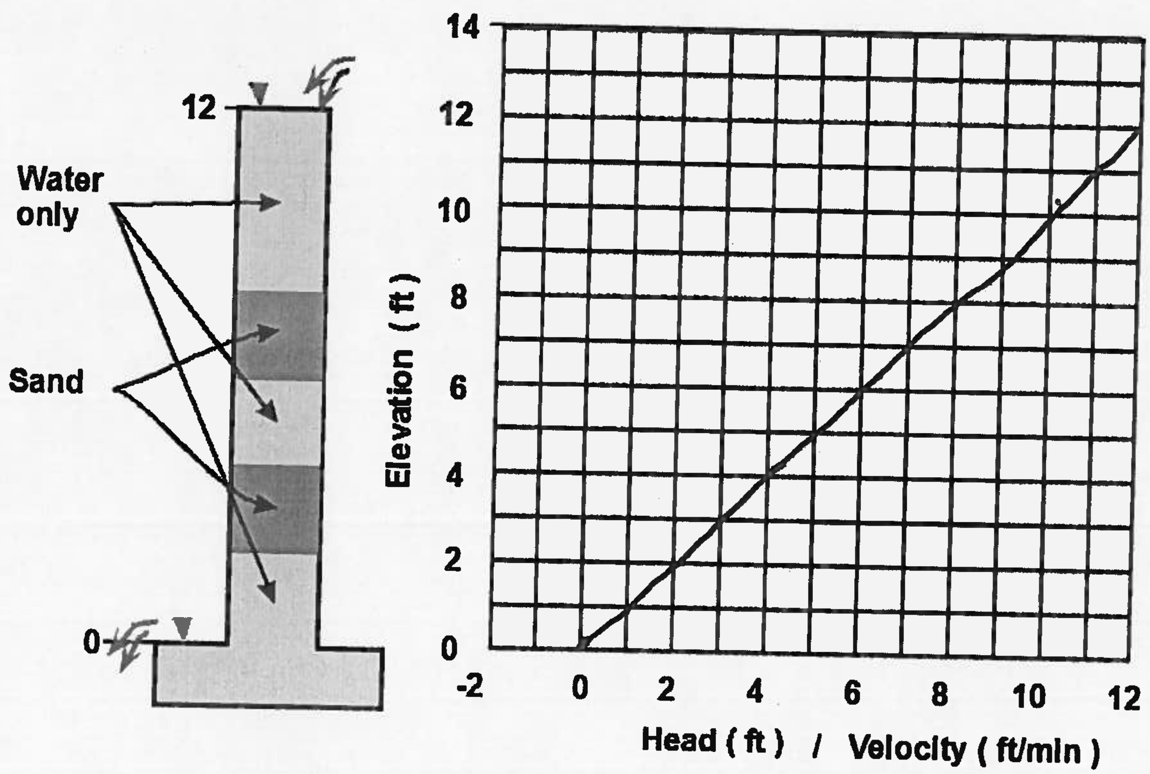
a.) Calculate the compressibility, specific storage, and storativity of the aquifer **(6 points)**
b.) What geological material is the aquifer made of? Explain your reasoning. **(2 points)**
c.) Assuming that the 8 m pressure drop was caused by some kind of pumping, calculate the total volume of water pumped in m^3 (i.e., released from storage) **(2 points)**
d.) If the same 8 m pressure drop from pumping occurred in an unconfined aquifer having the same compressibility and a specific yield of 0.12, what would be the total volume of water pumped (i.e., released from storage)? Is this amount different than the answer from part c.? Explain why or why not. **(5 points)**

Question 3

The figure below shows a tub of soil having a porosity of 0.33 and a hydraulic conductivity of 0.70 ft/min in which water is flowing vertically downward. Atmospheric pressure is maintained at the top of the water reservoir (elevation 12.0 ft) and at the bottom of the tail water (elevation 0.0 ft). Datum is taken at the bottom of the tail water.

Note: Please plot each figure separately.

a) Plot the elevation head (z) vs. elevation. **(2 points)**
b) Plot total hydraulic head (H) vs. elevation. **(3 points)**
c) Plot pressure head (ψ) vs. elevation. **(5 points)**
d) Plot the water velocity (v) vs. elevation. **(5 points)**



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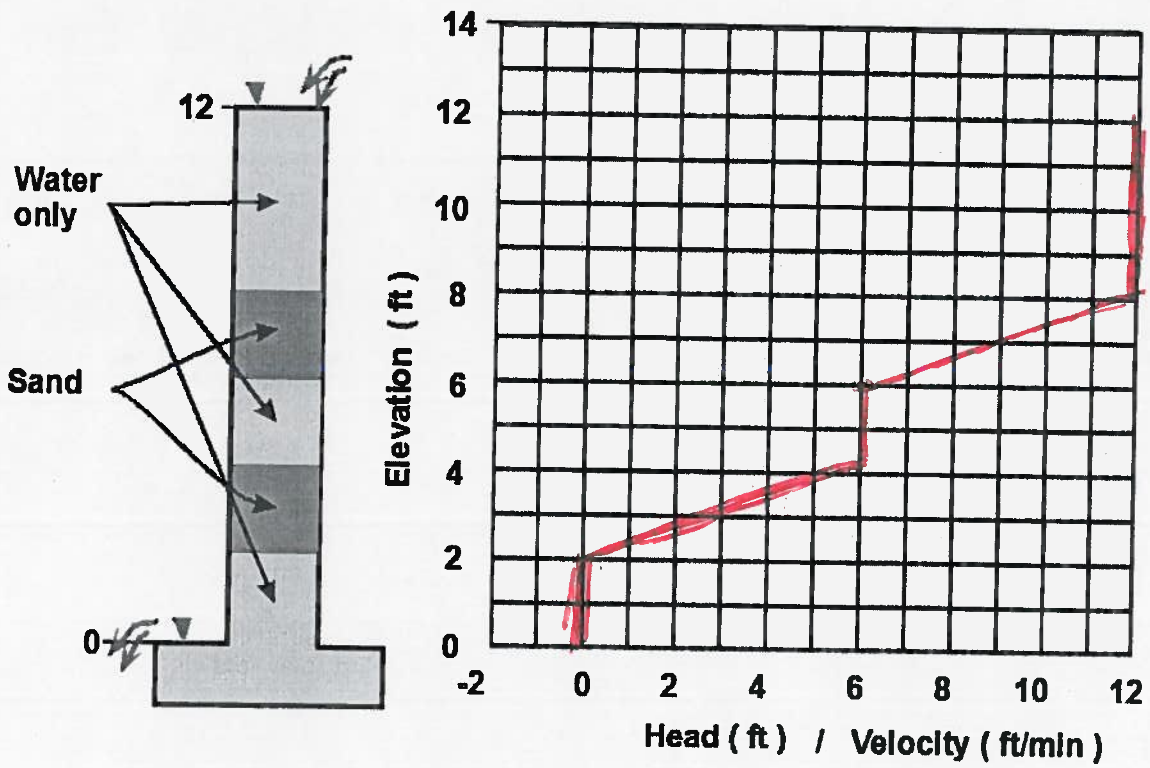

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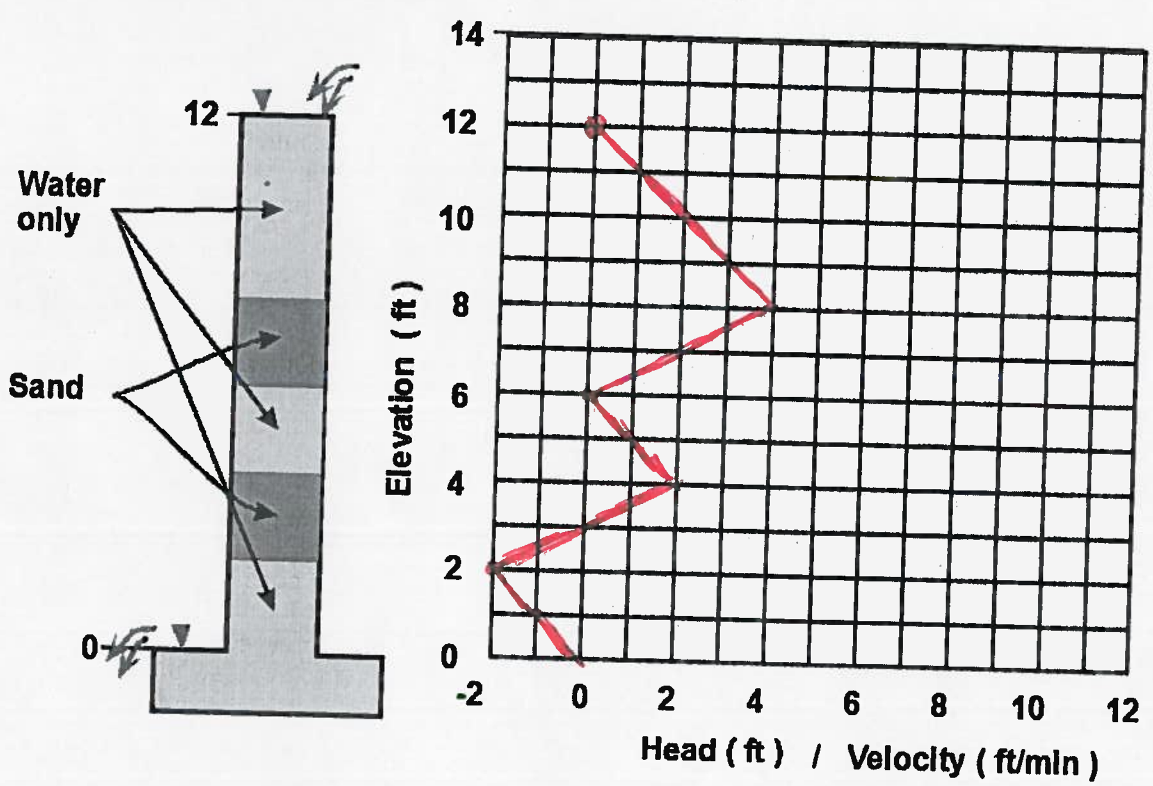

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Question 3

The figure below shows a column of soil having a porosity of 0.25 and a hydraulic conductivity of 0.5 ft/min in which water is flowing vertically downward. Atmospheric pressure is maintained at the top of the water reservoir (elevation 12.0 ft) and at the bottom of the tail water (elevation 0.0 ft). Datum is taken at the bottom of the tail water.

$$q = -K \frac{\partial h}{\partial x}$$

Note: Please plot each figure separately.

$$q = -0.5 \, \frac{ft}{min} \cdot \frac{6 \, ft}{2 \, ft}$$

$$q = 1.5 \, ft/min$$

a) Plot the elevation head (z) vs. elevation. **(2 points)**
b) Plot total hydraulic head (H) vs. elevation. **(3 points)**
c) Plot pressure head (ψ) vs. elevation. **(5 points)**
d) Plot the water velocity (v) vs. elevation. **(5 points)**

$$V = \frac{q}{n}$$

$$V = \frac{1.5 \, ft/min}{0.25}$$

$$V = 6 \, ft/min$$