13.22) Describe each part of this centrifugal pump designation: 1½ x 3 - 6

1½ - describes a 1½ inch discharge connection

3 - describes a 3 inch suction connection

-6 - 6 in impeller or less to fit into casing

13.34) a) 500 gal/min of water with 80 ft total head

From pump selection chart.

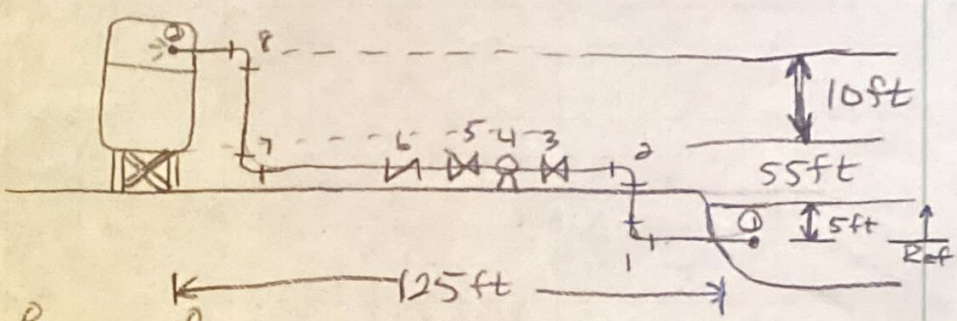
use reciprocating pump.

b) 500 gal/min. water. 800 ft head

use reciprocating pump

Design Problem 3: Design system to pump water @ 90°F from river to tank elevated 55ft above the water surface.
minimum flow rate is 1500 gal/min
Tank is 125ft from river bank.

$Q = 1500 \text{ gal/min}$
$= 3.34 \text{ ft}^3/\text{s}$
SCH80 3inch pipe
$D = 2.9 \text{ in} = 0.2417 \text{ ft}$
$A = 0.04590 \text{ ft}^2$
$z_1 = 0 \text{ ft}$
$z_2 = 70 \text{ ft}$
$\varepsilon = 1.5 \times 10^{-4} \text{ ft}$
Pipe = 195ft total
$f_T = 0.017$
$T = 70°F$
$\nu = 1.05 \times 10^{-5} \text{ ft}^2/\text{s}$



$$h_A + \frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 - h_L = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2$$

$$h_A = \frac{V^2}{2g} + z_2 + h_L$$

$$h_L = 2h_{L\,\text{Elbow}} + 2h_{L\,\text{gate}} + h_{L\,\text{Check}} + 2h_{L\,\text{Elbow}} + h_{L\,\text{Pipe}}$$

$$h_{L\,\text{Elbows}} = K_{EL}\frac{V^2}{2g} \qquad K = 30 f_T = 30(0.017) = 0.51$$

$$= 0.51\,\frac{72.77^2}{2(32.2)} = \boxed{41.94 \text{ ft}}$$

$$h_{L\,\text{gates}} = K_{\text{gate}}\frac{V^2}{2g} \qquad K = 8 f_T = 8(0.017) = 0.136$$

$$= 0.136\,\frac{72.77^2}{2(32.2)} = \boxed{11.18 \text{ ft}}$$

$$h_{L\,\text{check}} = K_{\text{check}}\frac{V^2}{2g} \qquad K = 100 f_T = 100(0.017) = 1.7$$

$$h_{L\,\text{check}} = \boxed{139.79 \text{ ft}}$$

$$h_{L\,\text{Pipe}} = f_A\frac{L}{D}\frac{V^2}{2g}$$

$$(0.0175)\left(\frac{195}{0.2417}\right)\frac{V^2}{2g}$$

$$h_L = \boxed{1161 \text{ ft}}$$

$$\frac{D}{\varepsilon} = 1611$$

$$Re = \frac{VD}{\nu} = \frac{(72.77)(0.2417)}{1.05 \times 10^{-5}}$$

$$Re = 1.675 \times 10^6$$

$$f_A = 0.0175$$

$h_L = 41.94 + 11.18 + 139.79 + 1161$

$h_L = 1353.91 ft$

$h_A = \frac{72.77^2}{2(32.2)} + 70 + 1353.91$

$h_A = 1506.14 ft$

$P = \frac{\gamma Q h_A}{\eta}$

$\eta = 100\%$

$Q = 3.34 ft^3/s$

$h_A = 1506.14 ft$

$\gamma = 62.1 lb/ft^3$

$P = \frac{(62.1 lb/ft^3)(3.34 ft^3/s)(1506.14 ft)}{1}$

$P = 312395 \frac{lb\,ft}{s}$

$\frac{312395}{550} = 567.99 HP$

?