1st Question:

\[ P = 5000 \text{ and } max \ q_{\text{day}} = 200 \text{ l/ind./day} \]

\[ a) \ max \ Q_{\text{hour}} = 5000 \times 1.5 \times 200 / 86400 = 17.36 \text{ l/s} \]

\[ \Sigma L_i = 1.4 \times 250 + 1 \times 400 = 750 \text{ m} \text{ so, distribution discharge per unit length is:} \]

\[ q = 17.36/750 = 0.0231 \text{ l/s/m.} \]

\[ Q_{\text{con1}} = q \times L_{i1} = 0.0231 \times (1.4 \times 250) = 8.10 \text{ l/s} \]

\[ Q_{\text{con2}} = q \times L_{i2} = 0.0231 \times (1.0 \times 400) = 9.26 \text{ l/s} \]

These are the consumption (distributed) discharges.

When we multiply the consumption discharges for each pipe by 0.577 and add a constant fire discharge as 5.0 l/s, we reach the equivalent (calculation) discharges:

\[ C_1 = 8.10 \times 0.577 + 5.0 = 9.67 \text{ l/s} \]

\[ C_2 = 9.26 \times 0.577 + 5.0 = 10.34 \text{ l/s} \]

\[ b) \text{ If the location of the dead point is right, } |h_{i1} - h_{i2}| \geq 1 \text{ m} \text{ condition must be satisfied.} \]

\[ V_1 = C_1/(\pi D_1^2/4) = 1.21 \text{ m/s} \]

\[ h_{i1} = f \times V_1^2 \times L_1/(\pi D_1^2) = 0.03 \times 1.21^2 \times 250/(0.10 \times 2 \times 9.81) = 5.8 \text{ m} \]

\[ V_2 = C_2/(\pi D_2^2/4) = 1.08 \text{ m/s} \]

\[ h_{i2} = f \times V_2^2 \times L_2/(\pi D_2^2) = 0.03 \times 1.08^2 \times 400/(0.11 \times 2 \times 9.81) = 6.6 \text{ m} \]

\[ \Delta h_i = |h_{i1} - h_{i2}| = 6.6 - 5.8 = 0.8 \text{ m} \geq 1 \text{ m} \quad \checkmark \text{ OK} \]

So the head losses are close enough to be considered as equal. Thus, the location of the dead point is convenient with the diameters.
2\textsuperscript{nd} Question:

C_{ABC} = 0.577 \times 0.05 = 0.0288 \text{ m}^3/\text{s}

**IMPORTANT NOTE:** Under normal operating conditions we take fire discharge as zero. If the fire discharge is not given to you, you can also take it as zero.

V_{ABC} = 0.0288 \times 4/(\pi \times 0.2^2) = 0.92 \text{ m/s} 

h_{1,ABC} = 0.03 \times 0.92^2 \times 450/ (0.2^2 \times 9.81) = 2.9 \text{ m}

Theoretically \( h_{1,ABC} = h_{1,ADC} \), so

\[ h_{1,ADC} = 0.03 \times V_{ADC}^2 \times 800/ (0.3^2 \times 9.81) = 2.9 \text{ m} \]

From here \( V = 0.84 \text{ m/s} \)

So the equivalent discharge of ADC pipe is:

\[ C_{ADC} = 0.84 \times (\pi \times 0.3^2 / 4) = 0.06 \text{ m}^3/\text{s} = 60 \text{ l/s} \]

3\textsuperscript{rd} Question:

\[ h_{1,BA} = 5 \text{ m}, \quad h_{1,CA} = 9.5 \text{ m}, \quad P_{AB} = P_{AC} = 4000 \text{ ind.}, \quad P_{HA} = 6000 \text{ ind.} \]

\[ max \ q_{\text{dayr}} = 300 \text{ l/ind./day}, \quad (P/\gamma)_{\text{min.}} = 20 \text{ m}. \]

\[ Q_{\text{con BA}} = Q_{\text{con CA}} = 1.5 \times 300 \times 4000 / 86400 = 20.83 \text{ l/s} \]

\[ Q_{\text{con HA}} = 1.5 \times 300 \times 6000 / 86400 = 31.25 \text{ l/s} \]

We have to calculate the head loss for AH pipe:

\[ C_{AH} = 2 \times 20.83 + 0.55 \times 31.25 = 58.85 \text{ l/s} \]

\[ V_{AH} = 0.05885 \times 4/ (\pi \times 0.3^2) = 0.832 \text{ m/s} \]

\[ h_{1,HA} = 0.03 \times 0.832^2 \times 500 / (0.3^2 \times 9.81) = 1.7 \text{ m} \]

Now we have to determine the reservoir elevation with respect to all three, A-B-C, and take the maximum of all three as the minimum required reservoir surface elevation.

With respect to A: \( z_H = 120 + 20 + 1.7 = 141.7 \text{ m} \)

With respect to B: \( z_H = 90 + 20 + 5 + 1.7 = 116.7 \text{ m} \)

With respect to C: \( z_H = 80 + 20 + 9.5 + 1.7 = 111.7 \text{ m} \)

Thus, the minimum required reservoir elevation is 141.7 m.