This problem illustrates the use of steam tables to determine the properties of water.

<table>
<thead>
<tr>
<th>T (°C)</th>
<th>P (kPa)</th>
<th>u (kJ/kg)</th>
<th>x</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>?</td>
<td>200</td>
<td>?</td>
<td>0.6</td>
</tr>
<tr>
<td>2.</td>
<td>125</td>
<td>?</td>
<td>1600</td>
<td>?</td>
</tr>
<tr>
<td>3.</td>
<td>?</td>
<td>1000</td>
<td>2950</td>
<td>?</td>
</tr>
<tr>
<td>4.</td>
<td>75</td>
<td>500</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>5.</td>
<td>?</td>
<td>850</td>
<td>?</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**State:** L

Given, \( P = 200 \text{kPa} \) \& \( x = 0.6 \) (quality, \( x \)).

Since the quality is specified, the mixture has to be a saturated liquid-vapor mixture, which means if you think of a \( P-V \) diagram, the following is true.

\[ P \] \hspace{1cm} \[ V \] \hspace{1cm} \[ L \] \hspace{1cm} \[ V \] \hspace{1cm} \[ L+V \] \hspace{1cm} \[ L+V \]: Liquid-Vapor mixture.

\[ P \] \hspace{1cm} \[ V \] \hspace{1cm} \[ L \] \hspace{1cm} \[ V \] \hspace{1cm} \[ L+V \] \hspace{1cm} \[ L+V \]: Liquid-Vapor mixture.

\[ \therefore \text{For the 2-phase mixture, } T = T_{sat} \text{ } @ \text{ } P = 200 \text{kPa} \]

Table A-5 (saturated water-pressure table) gives \( T = 120.23 \text{°C} \)
And \( u \) may be found as follows:

\[
\begin{align*}
    u &= u_f + x (u_g - u_f) = u_f + x u_{fg} \quad u_g - u_f = u_{fg} \\
    &= 504.49 + 0.6 (2425.0) \text{kJ/kg} \\
    &= 1719.49 \text{kJ/kg}.
\end{align*}
\]

If \( v \) is required, it may be found as,

\[
\begin{align*}
    v &= v_f + x v_{fg} = v_f + x (v_g - v_f) \quad \text{Table A-5 gives:} \\
    v_f &= 0.001061 \text{m}^3/\text{kg} \\
    &= 0.001061 + 0.6 \times (0.8857 - 0.001061) \quad v_g = 0.8857 \text{m}^3/\text{kg} \\
    &= 0.5318 \text{m}^3/\text{kg}.
\end{align*}
\]

**Note:** In this case, the fact that \( v_f < v < v_g \) re-emphasizes the observation that the state is indeed a saturated liquid-vapor mixture. This observation could be useful in solving problems. For instance, if you are given \( P \) (pressure in kPa) and \( v \) (specific volume in \( \text{m}^3/\text{kg} \)), you would need to first identify the state. One way to do it is, to first make the assumption that the given pressure equals the saturation pressure i.e.,

Assume, \( P = P_{sat} \), then use Table A-5, the saturated water table (pressure table) and look up \( v_f \) and \( v_g \) corresponding to \( P = P_{sat} \).

If \( u_f < v < u_g \) then the initial assumption that \( P = P_{sat} \) is CORRECT. Otherwise, if \( v < u_f \) at \( P = P_{sat} \) then the state is compressed liquid. OR If \( v > u_g \) at \( P = P_{sat} \) then the state is superheated vapor.
State 3: Given \( P = 1000 \) kPa, \( u = 2950 \) kJ/kg.

This case is similar to 2, except we are given the Pressure and internal energy. Again, let us make the assumption

\[
P = P_{\text{Sat}}
\]

Then, IF \( u_f \leq u \leq u_g \rightarrow \) 2-Phase mixture.

IF \( u < u_f \rightarrow \) Compressed Liquid

IF \( u > u_g \rightarrow \) Superheated Vapor

Now, Table A-5 gives:
\[
u_f = 761.68 \text{ kJ/kg} \]
\[
u_g = 2583.6 \text{ kJ/kg}
\]

Therefore, clearly \( u > u_g \) @ \( P = P_{\text{Sat}} = 1000 \) kPa.

\[
\begin{align*}
2950 \text{ kJ/kg} & \rightarrow 2583.6 \text{ kJ/kg} \\
\text{(given)} & \quad \text{(Table A-5)}
\end{align*}
\]

Therefore, the state 3 is Superheated Vapor and our assumption that \( P = P_{\text{Sat}} \) is INCORRECT. So, to find the temperature we head to the Superheat table, Table A-6.

By linear interpolation, we find:

\[
T \approx 396^\circ C
\]

And at superheated state does \textit{quality} has no meaning, \( \therefore \) we don't determine it.
State 5:

Given $P = 850 \text{kPa}$ and $x = 0.0$.

Since $x = 0.0$, state 5 is a saturated liquid at the specified pressure of $P = 850 \text{kPa}$.

Therefore,

$$T = T_{\text{sat}} @ P = 850 \text{kPa}$$

or $T = 172.96 \degree \text{C}$ (Table A-5).

And,

$$u = u_f @ T = 172.96 \degree \text{C}$$

or, $u = 731.27 \frac{\text{kJ}}{\text{kg}}$ (Table A-5).

Note:

The procedures used in this problem to estimate the states are applicable to determine the properties of other substances like R-134a, too.