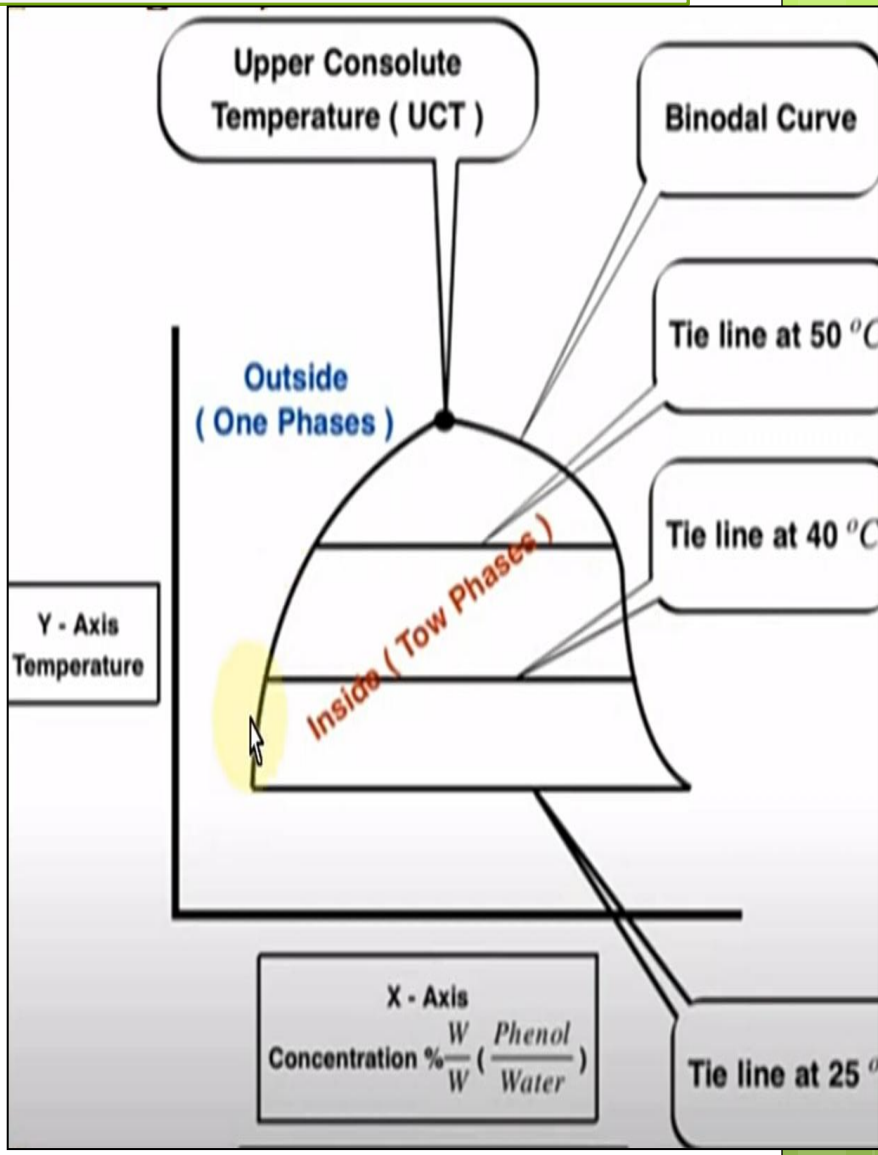
Tie line in Two component systems

2nd stage/ First semester-Lab.3

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Binodal curve (منحنى ثنائي العقدة) :
is a curve that separate two phases area from one phase area, and any system inside the binodal curve is two phases system, while thus outside as one phase system.

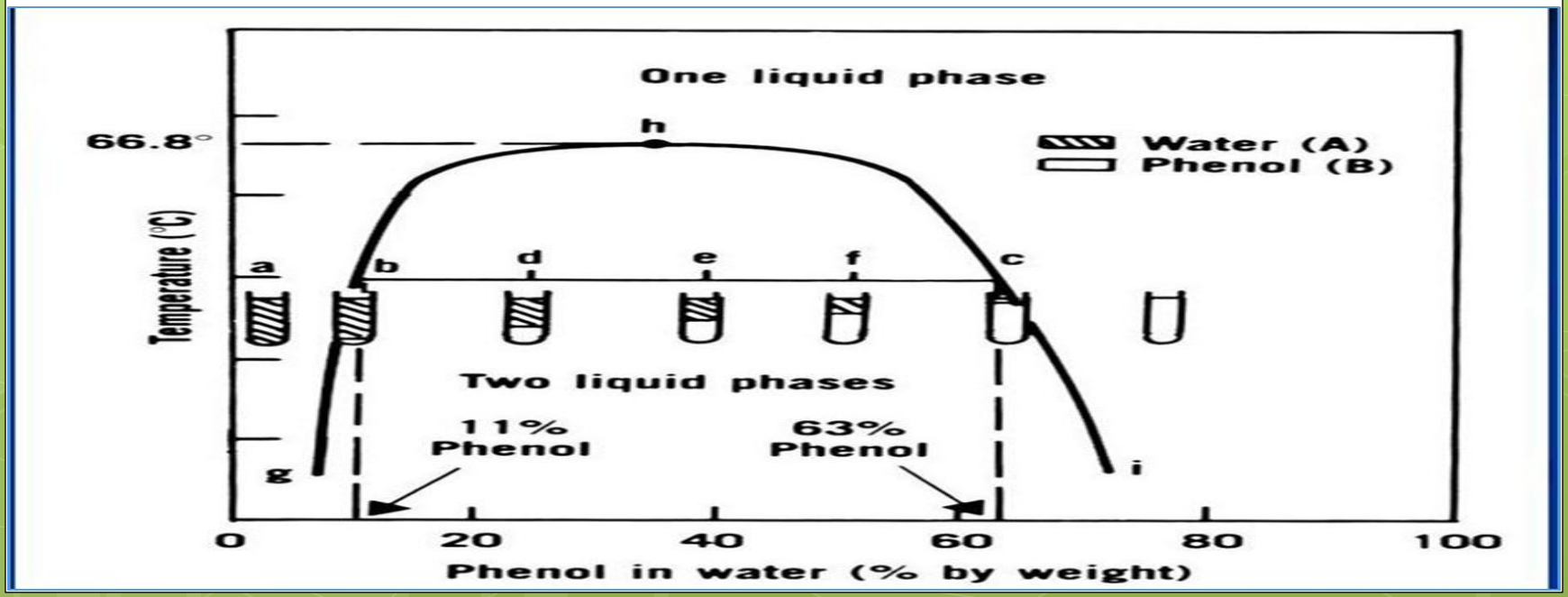
Tie line:
is a line drawn across the phase diagram, any concentration laying on tie line are two phases at equilibrium and will have **constant compositions at certain temperature** as each temperature has its own tie line.



Binodal curve diagram (phase diagram)

Upper Consolute Temperature (UCT): is the temperature above which a miscible liquid (one phase) exists. Also it called critical solution temperature. For example water and phenol system, it is 66.8 °C as all combinations above this temperature is completely miscible and give one phase system.

Conjugated phases: is two phases that existing in equilibrium at certain temperature and has a constant composition.

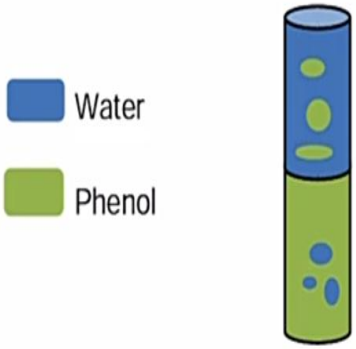


Phase diagram of phenol and water system

Properties of the Tie line in two component systems:

1. It is **parallel** to the **base.**
2. All systems prepared along the Tie line at equilibrium will **separate into phases of constant composition**. These phases are termed conjugated phases.
3. **Cut the binodal curve at two points**, the first represents the concentration of phenol in aqueous layer and the second represents the concentration of phenol in phenolic layer.
4. The phase diagram enables us to **calculate the composition of each phase** in addition to the weight of the phases. Thus, it become a simple matter to calculate the distribution of phenol (or water) throughout the system as a whole.

CALCULATIONS



- Using the tie line, we can calculate :

1. Weight of aq. Layer
2. Weight of phenolic layer
3. Weight of phenol in aq. Layer
4. Weight of phenol in phenolic layer

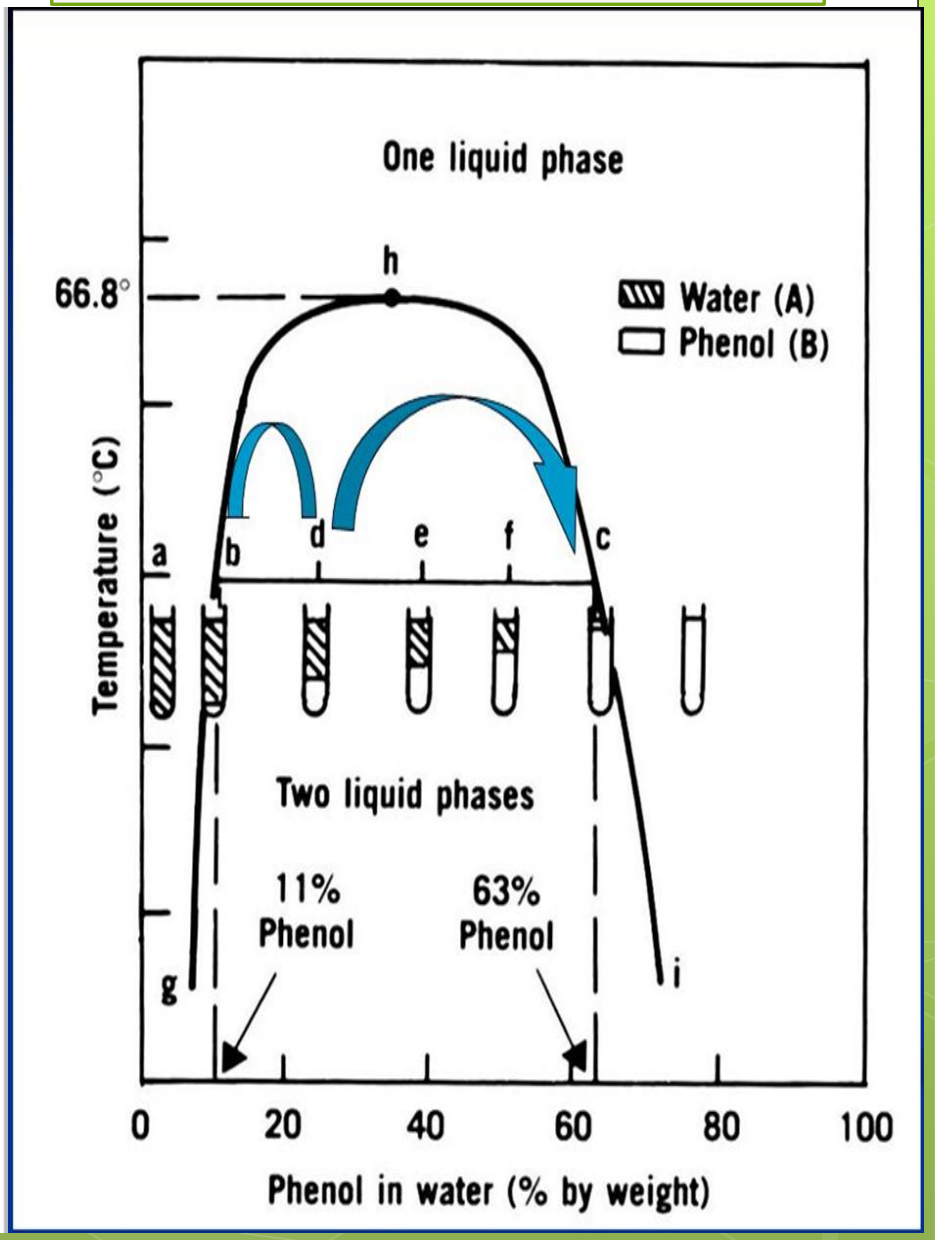
On the Tie line :

If the conc. Of phenol represent the point d then

$$\frac{wt.\ of\ aq.\ layer}{wt.of\ phenolic\ layer} = \frac{length\ dc}{length\ bd} = \frac{c-d}{d-b}$$

b= % of phenol in aq. Layer

c= % of phenol in phenolic layer



PROBLEMS

- A mixture of phenol and water at 20°C has a total composition of 50% w/w phenol. The tie line at this temperature cuts the bi nodal at points equivalent to 8.4% and 72.2% w/w phenol.

  What is the weight of the aqueous layer and of the phenol layer in 500 g of the mixture and how many grams of phenol are present in each of the two layers?

Solution

$$\frac{wt.of\ aq.layer}{wt.of\ phenolic\ layer} = \frac{72.2-50}{50-8.4} = \frac{22.2}{41.6}$$

Wt. % of aq. Layer = $\frac{22.2}{41.6+22.2} x\ 100 = 34.8\%$

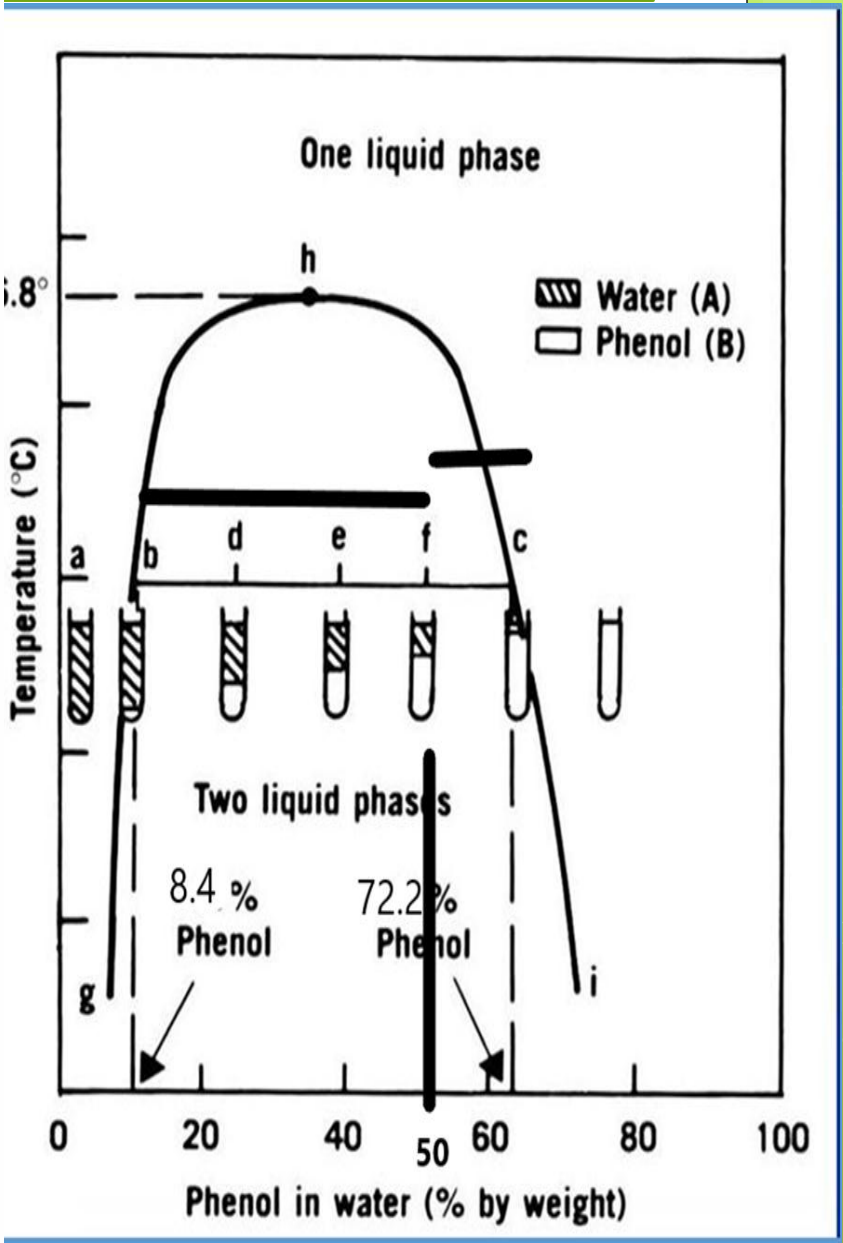
Wt. % of phenolic Layer = $\frac{41.6}{41.6+22.2} x\ 100 = 65.2\%$

Wt. of aq. Layer = $\frac{34.8}{100}\ x\ 500 = 174\ g$

Wt. of phenolic Layer = $\frac{65.2}{100}\ x\ 500 = 326\ g$

Wt. of phenol in aq. Layer = $\frac{8.4}{100} x\ 174 = 15\ g$

Wt. of phenol in phenolic Layer = $\frac{72.2}{100} x\ 326 = 235\ g$



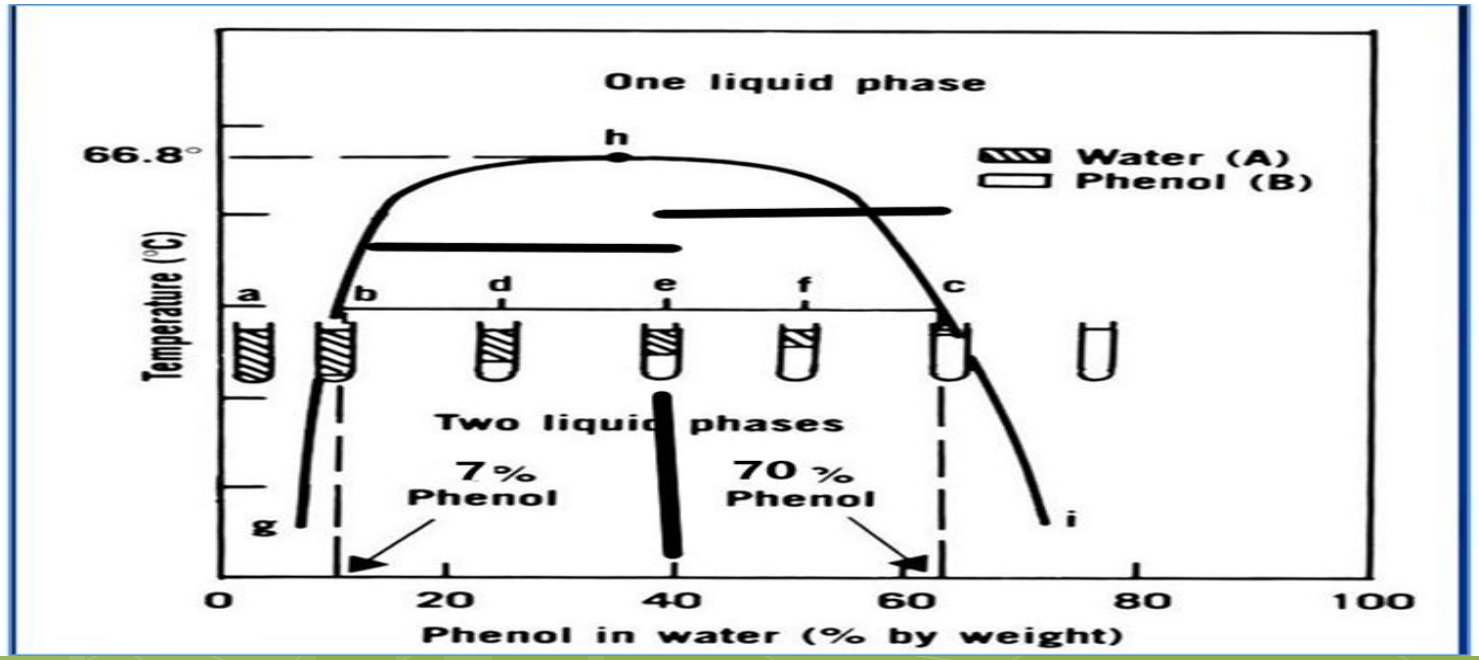
Example:

At 25 C a tie line 7% …… 70%, the mixture has a total composition of 40% w/w phenol by water at this temperature, note that the total weight is 10gm, Calculate the following:

Weight of phenol at 40% w/w phenol

Mass ratio of each phase

Weight of phenol in aqueous layer



Solution:

1. **Weight of phenol** = $\frac{40 \times 10}{100}$ = **4g**

2. $\frac{weight\ of\ aqueous\ layer}{weight\ of\ phenolic\ layer} = \frac{70-40}{40-7} = \frac{30}{33}$

   $\%\ of\ aqueous\ layer = \frac{30}{30+33} \times 100 = 47.6\%$

   $\%\ of\ phenolic\ layer = \frac{33}{30+33} \times 100 = 52.4\%$

   Weight of aqueous layer = $\frac{47.6}{100} \times 10 = 4.8g$

   Weight of phenolic layer = $\frac{52.4}{100} \times 10 = 5.2g$

3. **Weight of phenol in aqueous layer** = $\frac{7}{100} \times 4.8 = 0.4g$

4. **Weight of phenol in phenolic layer** = $\frac{70}{100} \times 5.2 = 3.6g$

Experiment

Title:

Tie line of two component system

Aim:

To calculate the weight of each phase of the two component system. And calculate the weight of phenol in each phase.

Calculations:

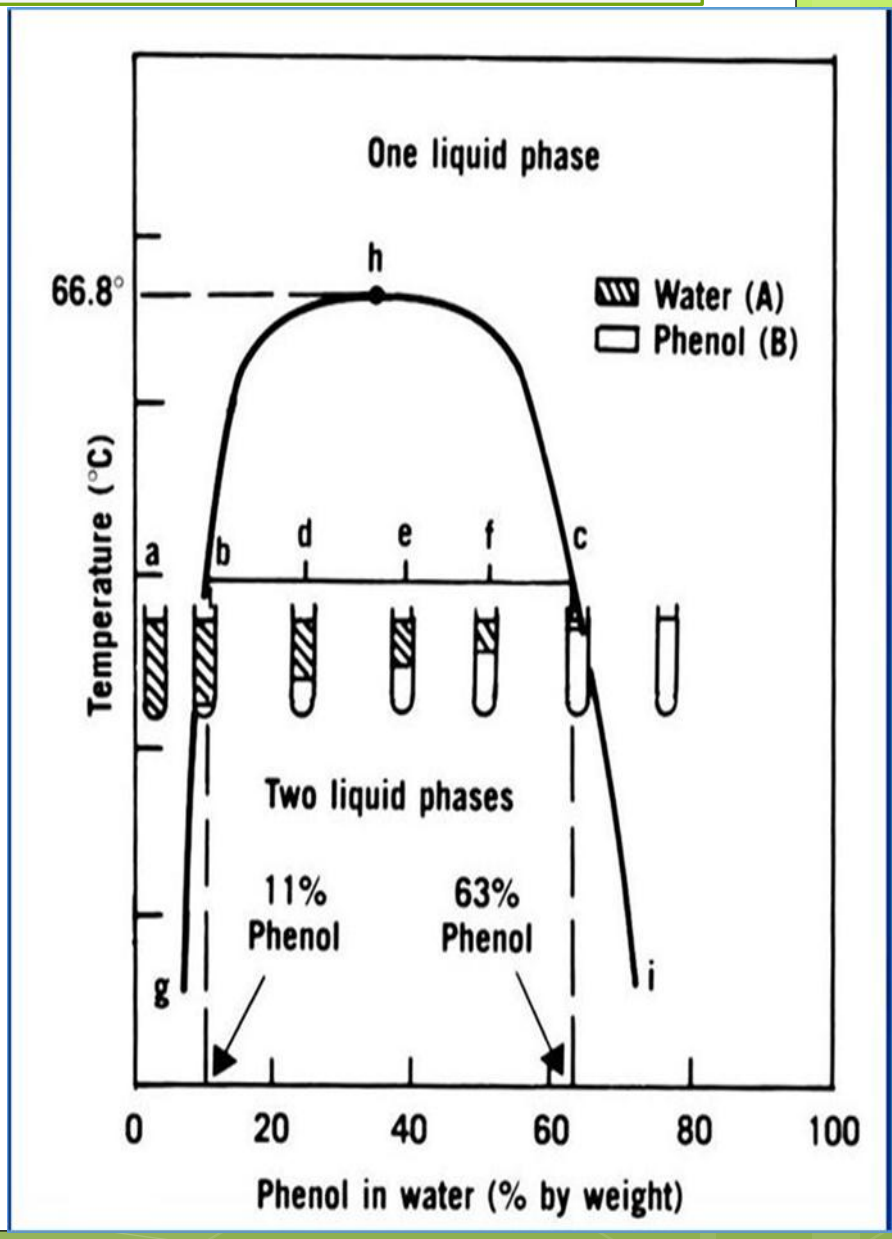
1- Draw a curve temp. verses conc.

2- Showing your 2 phases area and one phase area in the curve.

3- Draw tie line for each temp.

4- Take 40% w/w for example to find the weight of each phase and component at different temp.

5- Mention the upper consulate temperature.



Thank You