Lab(2) physical pharmacy

the Phase Rule and Different Components

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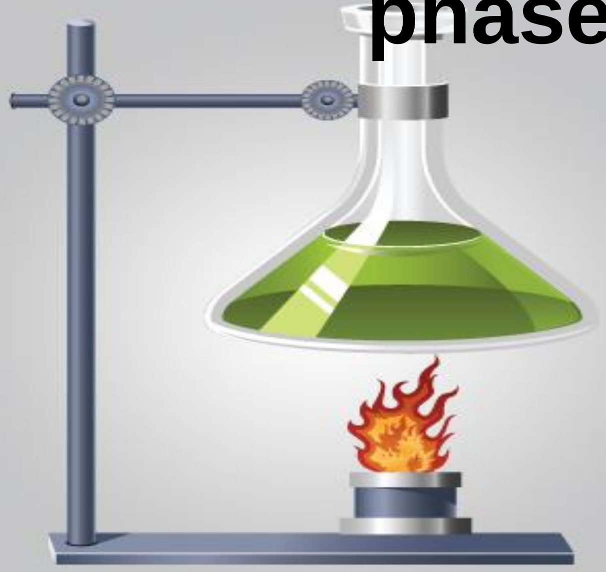
- **phase rule :** is a relationship for determining the least number of variables required to define the state of the system.
- -**phase** :-is homogeneous physically distinct portion of the system which is separated from other parts of the system by bounding surfaces
- (e.g. **water** & its **vapor** is **one component two phase system**)



- **Number of component :**is the smallest number of constituents by which the phase of equilibrium system can be expressed as a chemical formula or equation.

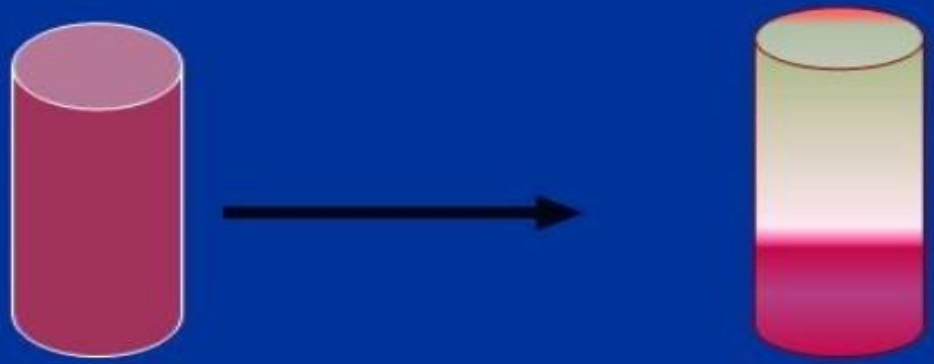
Two component systems containing liquid phase

- -as we know ethyl **alcohol & water** are **miscible** in all proportions , while **water & mercury** are completely ***immiscible*** regardless the amount of each.
- Between these two extremes lie a whole range of system which exhibit a partial miscibility (or immiscibility) such as water & phenol , as their miscibility affected by two factors **conc. & temp**.

Two Component Systems Containing Liquid Phases:

miscible	partially miscible	immiscible
ethyl alcohol and water	phenol and water	water and mercury

<u>Phenol and water system</u>:

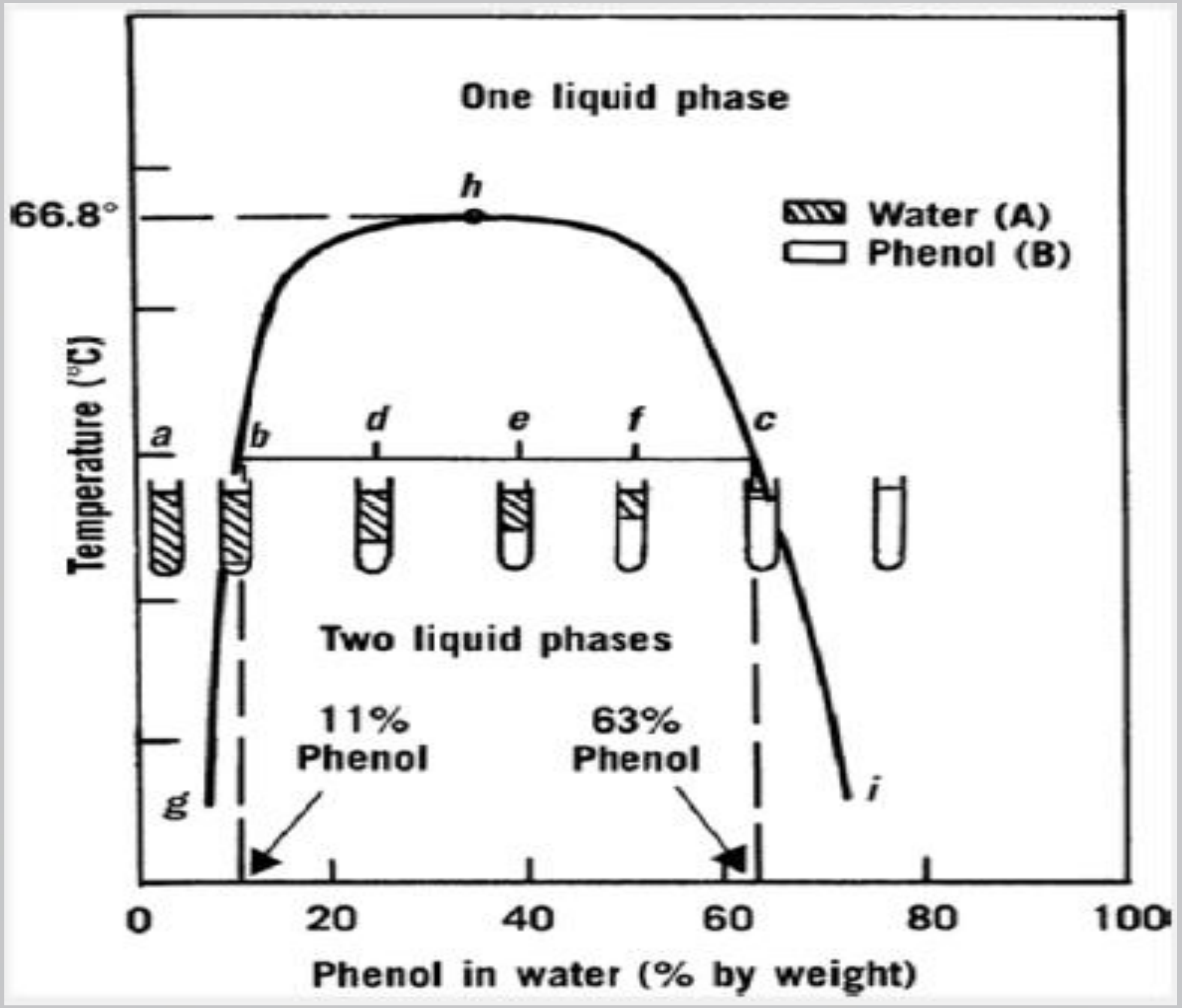


miscible — Partially miscible

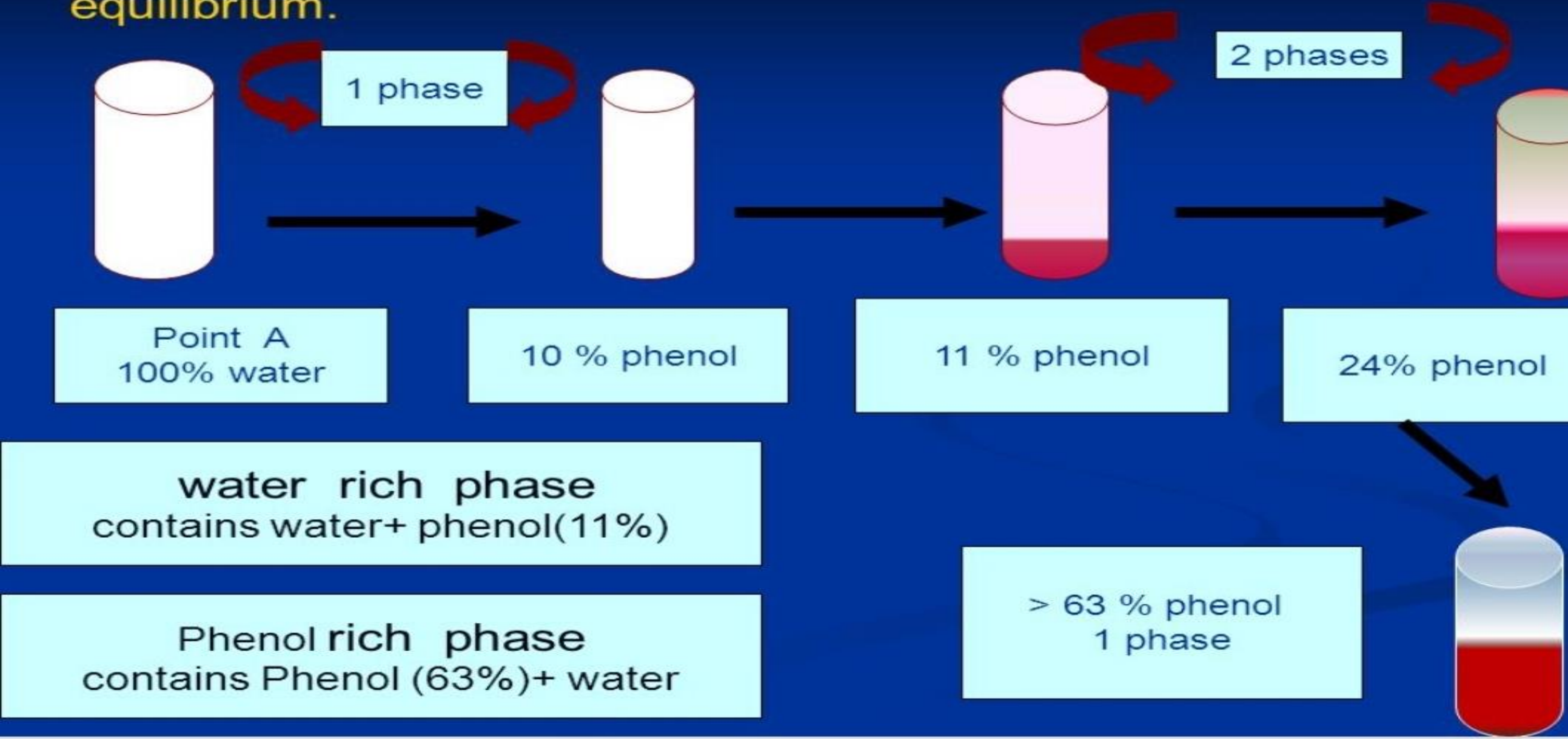
Two factors affecting miscibility

1- **Concentration of phenol in water.**
2- **Temperature.**

To see the effect of temp. & conc. ,we draw graph paper of temp. versus conc.



The curve *g b h c i* shows limits of temperature and concentration within which two liquid phases exist in equilibrium.



binodal curve **:-** is the curve that separates two phase area from one phase area .

-tie line **:- is the line drawn across the region of two phases (conjugate phases) as each temp. has its own tie line.**

-***upper consolute temp. or critical solu. Temp. :-*** is the maximum temp. at which two phase region exists .

Water & phenol system it is 66.8 as all combinations above this temp. is completely miscible & give one phase system.

-mass ratio:**-is the relative amount by wt. of conjugate phase ,it depends on the position in tie line & temp.**

<u>properties of the tie –line in two component systems:-</u>

1-it is parallel to the base line
2-all systems prepared along the tie line at equilibrium separated into two conjugate phases of constant composition.

For instance, consider a system containing 24% by weight of phenol and 76% by weight of water (point d in the diagram). At equilibrium two liquid phases have been presented in the tube. The upper one, A, has a composition of 11% phenol in water (point b on the diagram), whereas the lower layer, B, contains 63% phenol (point c on the diagram). The relative weights of the two phases can be calculated by the equation

11%--------24%----- 63%
b-----------d-----------c

$$\frac{\text{Weight of phase A}}{\text{weight of phase B}} = \frac{\text{Length dc}}{\text{Length bd}}$$

$$\frac{63-24}{24-11} = \frac{39}{11} = \frac{3}{1}$$

advantages of binodal curve :-

Binodal curve or phase diagram is used to formulate systems containing more than component in single liq. phase product

Q: At 25 C a tie line 7%---------70% (w/w)% phenol in water, find the mass ratio and the composition of each phase of 40% w/w phenol by water at this temperature, note that the **total weight is 10 gm**?

7%-------40%------------70%
b-----------d--------------c

$\frac{\text{Wt of A}}{\text{Wt of B}} = \frac{\text{length dc}}{\text{length bd}} \rightarrow \frac{70-40}{40-7} = \frac{30}{33} = \frac{10}{11}$ (mass ratio)

10+11=21 (total parts)

10 21

x 10 (total wt.) x= 4.76 gm wt of phase A(water rich layer)

10-4.76 = 5.24 gm wt of phase B (phenol rich layer)

If we want to know the amount of phenol and water in each phase(composition)

For phase A (water rich layer)

7 100

X 4.76 x= 0.33gm of phenol in A

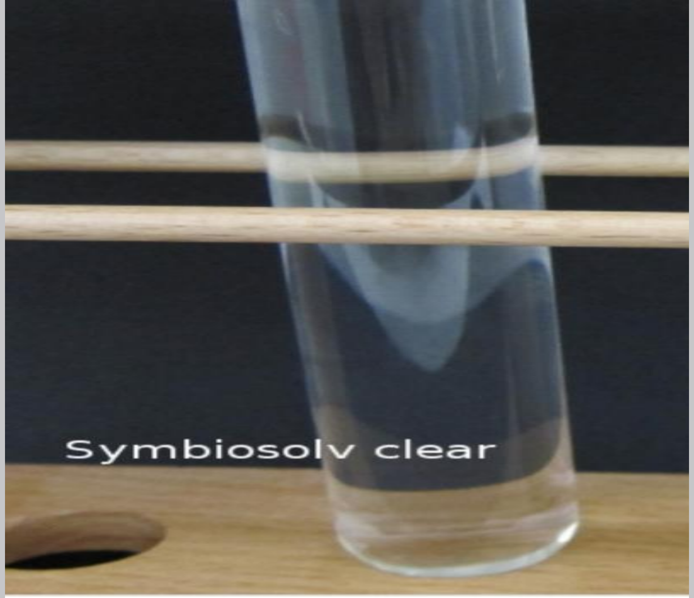
4.76-0.33= 4.42 gm of water in A

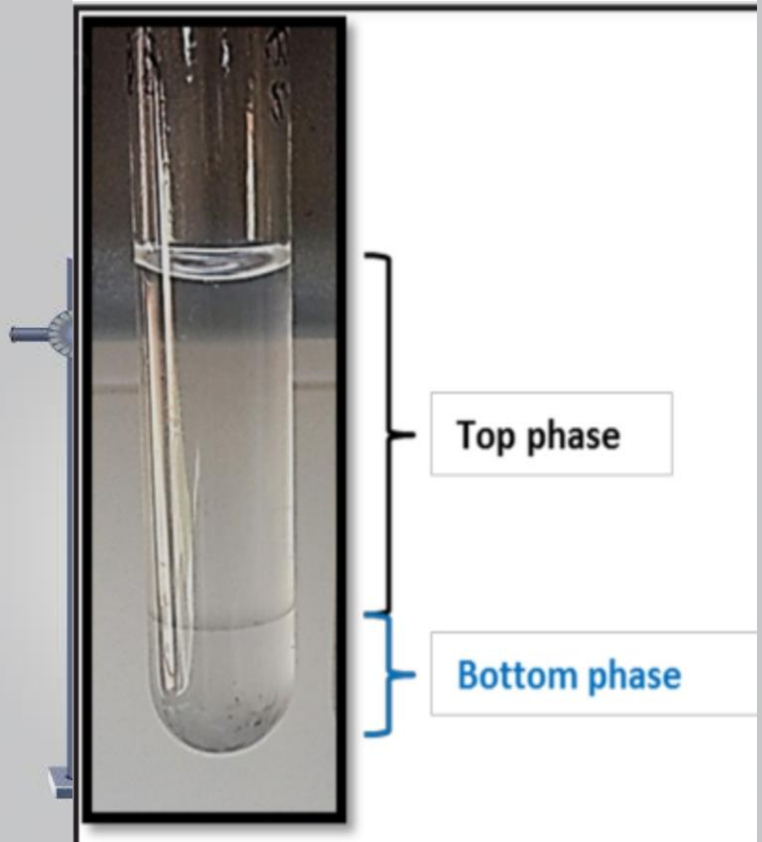
For phase B (phenol rich layer)

70 100

X 5.24 X= 3.6gm of phenol in B

5.24- 3.6= 1.57gm of water in B





Procedure:

Prepare the following percent W/W phenol/water(10 gm total) 2%,7%,9%,11% ,24%,40%,55 %,63%,70%,75%.

Put test tube in a fixed temperature in water bath (25 C^0) or (left test tube at room temp.) and keep it for 10 minutes at that temp.

Take the test tubes out and before their temp has changed record which one has 2 phases and which has one phase.

Repeat the work at higher temp using the following temp.40C^0, 50C^0, 70C^0.

Draw a curve temp verses concentrations showing your 2 phases area and one phase area in the curve.

Draw tie line for each temp.

<u>Take 40% W/W for example to find the mass ratio and the composition of each phase at different temp.</u>

Mention the upper consulate temp

2 gm 100 gm
X 10gm
X=0.2 gm of phenol
10-0.2=9.8gm water

The results of two components (phenol +water)

Temp	2%	7%	9%	11%	24%	40%	55%	63%	70%	75%
25C°										
40C°										
50C°										
70C°										

THANK YOU FOR LISTENING