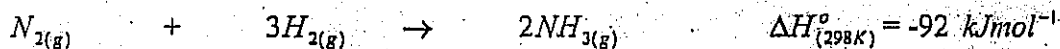


THE OPEN UNIVERSITY OF SRI LANKA
FOUNDATION PROGRAMME / STAND ALONE COURSE IN SCIENCE
LEVEL 1 - 2011/2012
CHEMISTRY I - PSF 1303 / PSE 1303
HOME ASSIGNMENT-II

- (1)(I) What is meant by the term 'Ideal solution'
- (II) State the Raoult's law and write down the mathematical expression for Raoult's law.
- (III) The saturated vapour pressure of Benzene (B) and Toluene (T) are 400 mmHg and 139 mmHg, respectively, at 60°C. Assume that Benzene and Toluene form ideal solutions.
- (a) Calculate the vapour pressure of a solution consisting of 40.0 g of Toluene and 60.0 g of Benzene.
- (b) Calculate the mole fractions of B & T in the vapour phase.
- (IV) Explain with aid of a phase diagram (Temperature vs Mole fraction), the principle of an ideal solution of 2 components, say A & B can be completely separated into its components by fractional distillation.
- (V) An equimolar mixture of two liquids (which forms an azeotropic mixture/ constant boiling mixture) shows a positive deviation from Raoult's law. Draw a phase diagram (Temperature vs Mole fraction) to show this positive deviation and predict whether,
- (a) the total vapour pressure is greater or less than expected?
- (b) the boiling temperature is higher or lower than expected?

(2) This question refers to the Haber process for the synthesis of ammonia. The equation which represents the reaction is given below,



- (I) Write the expression for the equilibrium constant, K_p , for the above process. If the pressure is measured in atmospheres what will be the units of K_p ?
- (II) State Le Chatelier's principle.
- (III) State and explain the effect on the above equilibrium of
- (a) increasing the pressure and
- (b) removing ammonia from the mixture of gases.

(IV) (a) Describe the effect on the equilibrium yield of increasing the operating temperature of the above given exothermic reaction.

(b) Consider your response to (IV) (a) above explain why the ammonia synthesis is operated at a temperature of 400°C .

(V) Name the catalyst used in the Haber process

(VI) (a) Describe the function of a catalyst

(b) Describe the effect of a catalyst on the position of equilibrium.

OPEN UNIVERSITY OF SRI LANKA
FOUNDATION PROGRAMME / STAND ALONE COURSE IN SCIENCE
PSF 1303/PSE 1303 CHEMISTRY I - 2011/2012
ANSWER GUIDE - HOME ASSIGNMENT II

01. (I) Ideal Solution: Solution in which forces of attractions between the different types of species are of same magnitude. $(A-A = A-B = B-B)$

(II) Raoult's Law: Partial vapour pressure due to a component in a solution is directly proportional to the mole fraction of that component in the solution.

$$P_A = X_A \cdot P_A^0$$

P_A - Partial vapour pressure of component A

X_A - Molar fraction of A in the solution

P_A^0 - Saturated vapour Pressure of A

(III) $n_B = 0.768 \text{ mol}$; $n_T = 0.434 \text{ mol}$

$$X_B = 0.639 \quad ; \quad X_T = 0.316$$

where $X_B = \frac{n_B}{n_{\text{Total}}}$ and $X_T = \frac{n_T}{n_{\text{Total}}}$

Applying Raoult's law for each component,

$$P_B = 0.639 \times 400 = 256.00 \text{ mmHg}$$

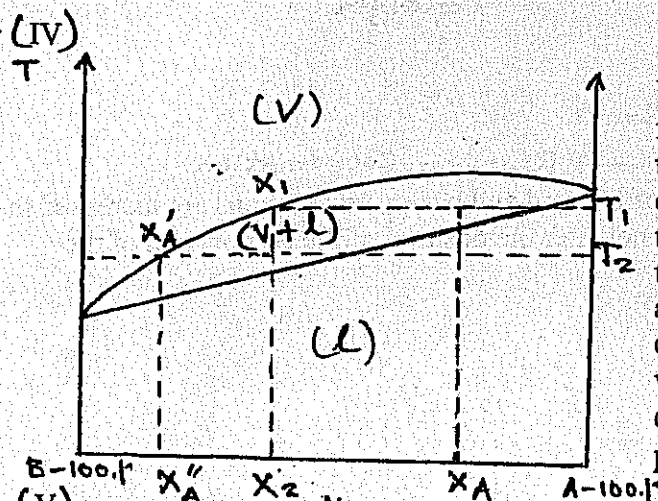
$$P_T = 0.361 \times 139 = 50.2 \text{ mmHg}$$

$$P_{\text{total}} = 306.2 \text{ mmHg}$$

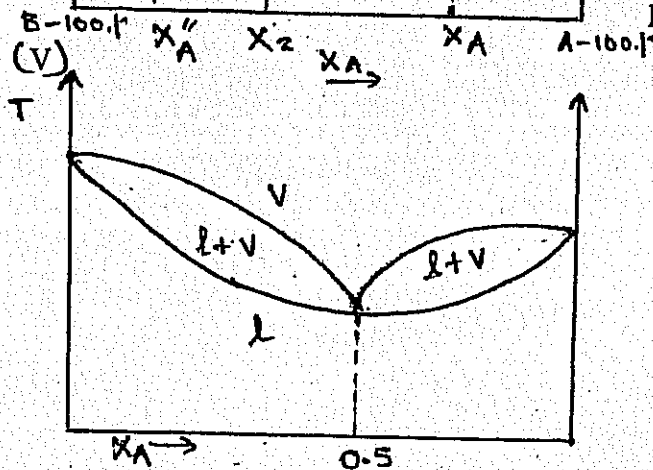
Applying Dalton's Law for the vapour phase

$$P_B' = X_B' \times P_{\text{total}}$$

$$X_B' = 0.837 \quad ; \quad X_T' = 0.163$$



When we do the fractional distillation to a fraction with the composition X_A , and heat that to a temperature T_1 , it forms a vapour with the composition X_1 (more with B) and liquid with the composition X_2 . Then again when we do the fractional distillation for the X_2 fraction, and heated to temperature T_2 , it gives composition of vapour with X_A' and liquid with X_A'' . Similarly after several fractional distillations, we can end up with pure A and pure B.



- a) Total vapour pressure is greater
- b) Boiling point is lower

02(I). $K_p = \frac{P_{NH_3}^2}{P_{N_2} \cdot P_{H_2}^3}$

Units of K_p - atm^{-1}

(II) LeChatelier's Principle ; If a system, in equilibrium is disturbed (by changing pressure, volume, temperature or concentration) the composition of the system will change so as to oppose the disturbance..

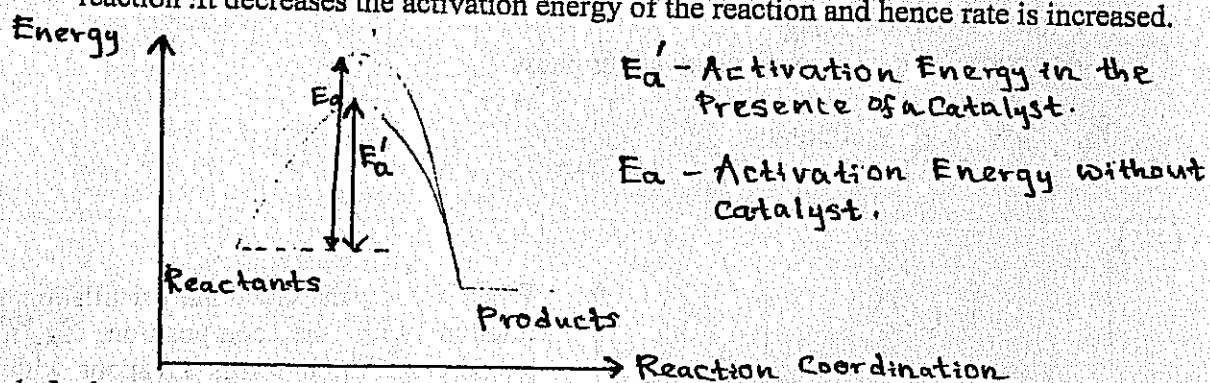
- (III) a. When pressure increases, number of moles also increases. In order to recover the change, system itself is trying to decrease the number of moles, so that forward reaction becomes favourable and hence yield of NH_3 will increase.
- b. When NH_3 is removed from the system, concentration of NH_3 decreases. Therefore system itself starts to increase the NH_3 , and hence forward reaction becomes favourable.

(IV) a. Given reaction is Exothermic. When the temperature of the system is increased, a process will take place, which opposes the change, i.e. by the absorption of heat. Therefore endothermic reaction becomes favourable, and hence yield of NH_3 decreases.

b. At low temperature the rate of reaction is slow. And at higher temperatures a low yield, since it is an exothermic reaction. Therefore optimum (best compromise) temperature is used.

(V) $\text{Pt} / \text{Fe} / \text{Fe}_2\text{O}_3 + \text{K}_2\text{O} + \text{CaO} + \text{Al}_2\text{O}_3$

(VI) a. Catalyst is a substance that increases the reaction rate without itself being used up in the reaction. It decreases the activation energy of the reaction and hence rate is increased.



b. In the presence of a catalyst both rate of forward and backward reactions are increased in the same magnitude. Therefore it does not alter the position of the equilibrium of the reaction.

ශ්‍රී ලංකා විභාග විශ්ලේෂණ මධ්‍යස්ථානය
 විද්‍යා විද්‍යා පදනම ආචාර්යවරයාණන්
 පවුල වසර - 2011/2012
 රසායන විද්‍යාව I - PSF 1303 / PSE 1303
 පැවරුම් පරීක්ෂණය - II

(I) (I) 'පරිපූර්ණ ප්‍රාචූර්ණ' යන පදයෙන් අදහස් වන්නේ කුමක්ද?

(II) රවුල් නියමය සඳහාණ කොට , එ සඳහා ගණිතමය ප්‍රකාශනය ලියා දක්වන්න.

(II) 60°C දී කෝසික් (B) හා තොලයික් (T) වල සංතෘප්ත වාෂ්ප පීඩන පිටවෙලි 400 mmHg හා 139 mmHg වේ. කෝසික් හා තොලයික් පරිපූර්ණ ප්‍රාචූර්ණ සාදන බව උපකල්පනය කරන්න.

(a) තොලයික් 40.0g ක් හා කෝසික් 60.0g ක් සහිත ප්‍රාචූර්ණයක B හා T හි වාෂ්ප පීඩනයන් වෙන වෙනම ගණනය කරන්න.

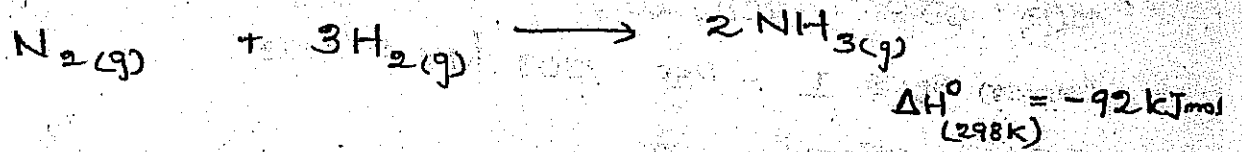
(b) මාදුරය සමානව පවතින B හා T හි වල මාදුර භාගයන් වෙන වෙනම ගණනය කරන්න.

(IV) A හා B යන සංරචක දෙකකින් සමන්විත පරිපූර්ණ ප්‍රාචූර්ණයක සංසන්දන භාගික ආසන්නය බහිත් සංපූර්ණයෙන්ම වෙන් කර ගත හැකිය , යන මූලධර්මය සලාප රූප සටහනක් (ලේස්නිමයට එරෙහි වලුම භාගය) භාගිකයන් විස්තර කරන්න.

(V) ප්‍රාචූර්ණ දෙකකින් සමන්විත සම මුළුමන විඝුර්ණයක් (නියත තාපාංක විඝුර්ණයක් / azeotropic mixture) රවුල් නියමයෙන් බහ ආසන්නයක් පෙන්වයි. මෙ බහ ආසන්නය පෙන්වීම සඳහා සලාප සටහනක් (ලේස්නිමයට එරෙහි වලුම භාගික) ඇඳ පහත එවා අගෝභාගය කරන්න.

- (a) මුළු මාදුර පීඩනය සමානව පවතින විට මාදුර මෙන් අඩුදා
- (b) තවත් ලේස්නිමය සලාපයක් වූ විට මාදුර වැඩි මෙන් අඩුදා

(2) මෙම ගැටළුව ඇමෝනියා නිෂ්පාදනය සඳහා හේබර් ක්‍රමයේ අදාළ ප්‍රතික්‍රියාව සඳහා සවිච්චර්යාය පහත දැක්වේ



(I) ඉහත ප්‍රතික්‍රියාව සඳහා සමතුලිතතා නියතය, K_p , සඳහා ප්‍රකාශනය ලියන්න. ජීව්‍යය චාලකයේ මට්ටම වෙනස් වූ විට K_p හි වෙනස තොරවන්න.

(II) ඵලදායීවම මූලධර්මය සඳහන් කරන්න.

(III) ඉහත සමතුලිතතාවය සඳහා පහත තොරතුරු ඇතිව ඇති විට ඔබගේ ඔබගේ සමතුලිතතාවය සඳහන් කර විස්තර කරන්න.

(a) ජීව්‍යය වැඩි කරමින්

(b) චාලකය වැඩිකරමින් ඇමෝනියා ඉවත් කරමින්

(IV)(a) ඉහත සඳහන් තත්ත්වයක ප්‍රතික්‍රියාව සිදුකරන ප්‍රතික්‍රියාවේ චාලකය වැඩිකරමින් සමතුලිතතාව වෙනස් වන සිදුවන විට ඔබගේ සමතුලිතතාවය සඳහන් කරන්න.

(b) ඉහත (IV)(a) තොරතුරු මත මූලධර්මය ඇමෝනියා නිෂ්පාදනය 400°C දී සිදු කරමින් හේබර් ක්‍රමයේ සමතුලිතතාවය සඳහන් කරන්න.

(V) හේබර් ක්‍රමයේදී භාවිත කරන ප්‍රතික්‍රියාවේ තත්ත්වය සඳහන් කරන්න.

(VI) (a) ප්‍රතික්‍රියාවේ චාලකය වැඩිකරමින් සමතුලිතතාවය සඳහන් කරන්න.

(b) සමතුලිතතාවය ඇමෝනියා වැඩිකරමින් සමතුලිතතාවය සඳහන් කරන්න.

மலர்ச்சிப் பத்திரிகை

விஞ்ஞானத்தில் அறிவார் பாலாற்றி

மட்டம் I - 2011/2012

கிரகாயணவியல் I - PSF1303/PSE1303

விடிக் மதிப்பீடு - II

- Q. (i) திடவியக் காரணம் எனும் பதத்தால் விளங்குவது என்ன?
- (ii) கிரகவால்புடன் விதியைக் கூறி, அதன் கணித வடிவக் கோவையை எழுதுக.
- (iii) 60°C கல் ரென்சன்(B), ரென்சன்(T) கல் ஆவியடுக்கங்கல் ழுறைபு, 400 mmHg , 139 mmHg ஆகும். ரென்செயும், ரென்செயும், ரென்செயும் திடவியக் காரணம் உருவாக்குகின்றது எனக் கருதி,
(a) 40g ரென்செய், 60g ரென்செய்க் கோண்ட காரணின் ஆவியடுக்கங்கல் கணி்க.
(b) ஆவியடுக்கங்கல் B, T கல் ழுப்பின்னங்கல் கணி்க.
- (iv) A, B எனும் காரணங்கல் கோண்ட திடவியகாரணலொன்றினை பருதிபு ராய்ச்சி வடித்தல் ழும் ரெவ்வெறு காரணங்கல் பிரித்தெடுக்க ழுடியும். கினை அவுக்கல் வரையுத்தின் (வெப்பநிலை எதிர் ழுப்பின்னம்) உருவியுடன் விளக்குக.
- (v) சமழில் கோண்ட கருதிவாங்கல் கலவையானது, ழுறாங்கல் கோதிநிலை கலவையு (Azeotropic) கிரகவால்புடன் விதிக்கு எதிர் விலகலாக் காட்டுகின்றது. கிந்தெதிர்விலகலாக் காட்டுவதற்கான அவுக்கல் வரையுத்தல் வரையுடன், (வெப்பநிலை எதிர் ழுப்பின்னம்) பின்வருவனவற்றை உயுத்திக்.
(a) எதிர்பார்க்கப்படுவதவிட மொத்த ஆவியடுக்கம் பெரிதாக கருக்குமா அல்லது சிறுதாக கருக்குமா?
(b) எதிர்பார்க்கப்பட்டதவிட கோதிநிலை பெரிதாகவா அல்லது சிறுதாக கருக்கும்?

