Haber's Process Chemistry Questions with Solutions

Q1: Which of the given metals can be used in the manufacturing of ammonia?

a. Aluminium
b. Iron
c. Nickel
d. Platinum

Answer: (b.)

Explanation: Finely divided iron particles are used as catalysts in ammonia preparation by the Haber's process.

Q2. Ammonia is used majorly in:

a. Fertilizers
b. Cooking
c. Engine oil
d. Combustion

Answer: (a.)

Explanation: Ammonia binds the air-borne nitrogen and makes it available for the green plants.

Q3. Pick the correct equation for the formation of ammonia by reaction with hydrogen.

a. $N_2 + 3H \rightarrow 2NH_3$
b. $N + 3H \rightarrow NH_3$
c. $N_2 + H_2 \rightarrow NH_3$
d. $N_2 + 3H_2 \rightarrow 2NH_3$

Answer: (d.)

Explanation: 1 mole of nitrogen reacts with 3 moles of hydrogen to form 2 moles of ammonia.

Q4. Hydrogen to be used for the Haber's process is mostly obtained from

a. Fractional distillation of air
b. Fractional distillation of acids
c. Fractional distillation of crude oils
d. Methane

Answer: (d.)

Explanation: The methane gas is mixed with superheated steam to produce hydrogen gas.

Q5. Is the Haber process exothermic?

Answer: Yes, the Haber process is exothermic. This implies that when the temperature is increased, the equilibrium of the reaction moves to its left. Hence, the amount of ammonia produced decreases.

Q6. Why is the temperature around 450 ^{o}C chosen for the Haber's process?

Answer: As the Haber's process is an exothermic process, increasing the temperature would move the equilibrium constant to the left. This will decrease the yield of ammonia obtained from the reaction. However, if the temperature is decreased, the rate of this reaction is also decreased. Hence, a temperature in the range of 400 ^{o}C to 500 ^{o}C is taken i.e. 450 ^{o}C. This temperature is high enough to keep the rate optimum for the reaction and low enough to achieve an acceptable yield.

Q7. How is the nitrogen obtained for the Haber's process?

Answer: The air from the atmosphere is liquefied. The nitrogen is then separated from liquefied air by the means of fractional distillation.

Q8. Write three disadvantages of Haber's process.

Answer: The list of 3 disadvantages of the Haber's process are:

a. The soil based fertilizers are readily water-soluble. Hence, these fertilizers get washed off from the soil into the running water. When this water containing some amount of ammonia fertilizers reaches large water bodies, eutrophication takes place. The Eutrophication results in algae growth that absorbs oxygen from the water and hence causing the death of the aquatic animals.
b. The Haber's process is one of the largest energy consuming processes on earth. It consumes around 1%-2% of the global energy.
c. When the nitrogen fertilizers get mixed with groundwater, this causes some amount of nitrates to get mixed with drinking water. In such cases, the Blue Baby Syndrome has been observed occurring to the infants.

Q9. What happens if the pressure is increased during the Haber's process?

Answer: On increasing the pressure, the equilibrium of the reaction moves to its right. Hence, the yield of ammonia will increase. However, to apply high pressures, heavy and large equipments are required which are very expensive. Hence, pressure is set at a compromisable unit of 200 atm.

Q10. State the effect of pressure change by the Le-Chatelier's principle.

Answer: As the Le-Chatelier's principle states, the equilibrium of the reaction moves as to oppose the effect of change in pressure and temperature. Thus, if the pressure increases, the equilibrium moves to the right in the direction of fewer gas particles and resulting in the formation of more gaseous products.

Q11. What effect does a catalyst have on the equilibrium concentrations of the reactants?

Answer: The catalyst does not affect the equilibrium concentrations of the reactants in the reversible processes. The catalyst only reduces the time taken for the conversion of reactant to the products. In Haber's process, the catalyst used is iron. Iron is a cheap metal and helps to achieve acceptable yield in an acceptable amount of time.

Q12. Why is Iron used in the Haber's process?

Answer: Iron is cheap and gives acceptable yield in the Haber's process. It decreases the reaction time without itself getting used up in the reaction.

Q13. What are the important reaction conditions for the Haber's process?

Answer: Haber's process takes place in extreme conditions. It occurs at a temperature of around 450 ^{o}C and pressure 200 atm along with use of a catalyst. Haber's process is quite a very long process.

Q14. Why is the Haber's process a hazardous reaction?

Answer: This is because the Haber's process produces a very large amount of CO_2 emissions. It accounts for 1.2% of the global CO_2 emissions as for every 1 ton of ammonia produced through this process, 1.87 tons of CO_2 are also released into the atmosphere which is harmful for the global temperature.

Q15. What is green ammonia?

Answer: Green ammonia is when the process of making ammonia is 100% renewable and does not produce any carbon dioxide into the atmosphere. This process is carbon-free.

Practise Questions on Haber's Process

Q1. How is blue ammonia produced?

Answer: The low carbon method of producing ammonia is called the blue ammonia. It is formed by the method of steam methane reformation. The hydrogen used to react with nitrogen is derived from the natural gas feedstocks. This hydrogen is blue in colour and the CO_2 produced as a byproduct in this reaction is captured and stored. The hydrogen reacts with nitrogen to form ammonia.

Q2. How is ammonia toxic to the body?

Answer: The concentrated ammonia can lead to burns and injuries upon coming in contact with the skin. Also, if an excess amount of ammonia enters the body, it affects the central nervous system and the brain's defences are also impacted. This results in a complex chain reaction in the brain. Excess ammonia also short-circuits the potassium transport to the brain. Hence, it can cause confusion, disorientation and even coma.

Q3. How is ammonia neutralized?

Answer: As ammonia is basic in nature with a pH in the range 11-13, the ammonia is neutralized by vinegar. Vinegar also neutralizes the pungent smell of ammonia.

Q4. Name an alternative method to produce ammonia other than the Haber Bosch process.

Answer: The Samarium water ammonia production (SWAP) process is the alternative method developed to produce ammonia. This method is cost-effective and carbon-free. The SWAP method has an efficiency of around 90% and requires only recyclable chemicals and readily available lab equipments.

Q5. What kind of a reaction is Haber's process?

Answer: The Haber's process is a reversible reaction that gives off heat along with the production of ammonia.