CHEMISTRY ASSIGNMENT

1.Explain the preparation of nitrogen

2.Identify the physical properties of nitrogen

3.Explain the chemical properties of nitrogen

4.Enumerate 5 uses of nitrogen and four uses of ammonia

5.Explain the preparation of ammonia and identify three chemical properties of the compound.

ANSWERS

**1. Preparation of Nitrogen**

We can get nitrogen gas (N₂) in a few ways:

* **From the Air:** The air we breathe is mostly nitrogen (about 78%!). Industrially, we cool down air until it becomes a liquid. Then, we slowly warm it up. Nitrogen boils at a lower temperature than oxygen, so it evaporates first, and we can collect it. It's like separating different drinks that boil at different temperatures!
* **In the Lab:** We can make small amounts of nitrogen in the lab using chemical reactions. One common way is by heating a solution containing ammonium chloride (NH₄Cl) and sodium nitrite (NaNO₂). This reaction produces nitrogen gas, water, and sodium chloride. It's like mixing ingredients to bake a cake, but instead of a cake, we get nitrogen gas!

**2. Physical Properties of Nitrogen**

Think about what nitrogen gas is like:

* **Colourless:** You can't see it!
* **Odourless:** It doesn't have a smell.
* **Tasteless:** You wouldn't be able to taste it.
* **Non-toxic:** It's not poisonous (though you still need oxygen to breathe!).
* **Very unreactive:** It doesn't easily react with other substances (we'll talk more about this in chemical properties).
* **Slightly less dense than air:** This means a balloon filled with pure nitrogen would float very slightly in air, but not as much as a helium balloon.
* **Poor conductor of heat and electricity:** It doesn't transfer heat or electricity very well.
* **Exists as a gas at room temperature:** That's why we call it nitrogen gas!

**3. Chemical Properties of Nitrogen**

Even though nitrogen is generally unreactive, it *can* react under certain conditions:

* **Inertness:** The strong triple bond between the two nitrogen atoms (N≡N) makes it very difficult to break apart. This is why nitrogen gas doesn't readily react with most substances at normal temperatures. It's like having a really strong LEGO connection that's hard to pull apart!
* **Reaction with Metals:** At very high temperatures, nitrogen can react with some reactive metals like lithium (Li) and magnesium (Mg) to form metal nitrides. For example, with lithium, it forms lithium nitride (Li₃N).
* **Reaction with Hydrogen:** At high temperatures and pressures, and with the help of a catalyst (a substance that speeds up a reaction without being used up), nitrogen can react with hydrogen gas (H₂) to produce ammonia (NH₃). This is a very important industrial process called the Haber process.
* **Reaction with Oxygen:** At very high temperatures, such as in lightning, nitrogen can react with oxygen (O₂) in the air to form oxides of nitrogen, like nitrogen monoxide (NO). These oxides can then contribute to the formation of acid rain.

**4. Uses of Nitrogen and Ammonia**

**Five Uses of Nitrogen:**

1. **Making Ammonia:** As we just mentioned, nitrogen is a key ingredient in the Haber process to produce ammonia, which is super important for fertilizers.
2. **Fertilizers:** Nitrogen compounds are essential for plant growth, so they are a major component of many fertilizers. They help plants grow big and strong!
3. **Inert Atmosphere:** Because nitrogen is unreactive, it's used to create an inert (non-reactive) atmosphere in many industrial processes. This prevents unwanted reactions, like oxidation or explosions. Think of it as a protective blanket. For example, it's used in food packaging to keep food fresh and in electronics manufacturing.
4. **Cryogenics:** Liquid nitrogen is extremely cold (around -196°C or -321°F). It's used for quickly freezing things, like food preservation, medical procedures (like removing warts), and cooling down sensitive equipment.
5. **Making Nitric Acid:** Nitrogen is used to produce nitric acid (HNO₃), which is an important chemical used in the production of fertilizers, explosives, and plastics.

**Four Uses of Ammonia:**

1. **Fertilizers:** Ammonia itself can be used directly as a fertilizer, or it can be converted into other nitrogen-containing fertilizers. It's a vital nutrient for crops.
2. **Production of Nitric Acid:** As mentioned above, ammonia is a key starting material for the production of nitric acid.
3. **Manufacture of Plastics, Explosives, and Synthetic Fibres:** Ammonia is used in the production of various synthetic materials like nylon and other polymers, as well as some explosives.
4. **Household Cleaner:** Diluted ammonia solutions are used as household cleaners, especially for glass and other surfaces.

**5. Preparation of Ammonia**

The most important way to prepare ammonia (NH₃) is through the **Haber process**, which we touched on earlier:

* **Haber Process:** Nitrogen gas (from the air) is reacted with hydrogen gas (usually obtained from natural gas or petroleum) at a high temperature (around 450-500°C) and high pressure (around 150-250 atmospheres). A catalyst, usually iron oxide, is used to speed up the reaction.

The balanced chemical equation is:

N₂(g) + 3H₂(g) ⇌ 2NH₃(g)

The double arrow (⇌) indicates that the reaction is reversible, meaning it can go in both directions. Scientists carefully control the conditions to get the maximum amount of ammonia.

**Three Chemical Properties of Ammonia:**

1. **Basic Nature:** Ammonia is a weak base. When dissolved in water, it can accept a proton (H⁺) from water to form ammonium ions (NH₄⁺) and hydroxide ions (OH⁻). This is why aqueous solutions of ammonia are slightly alkaline and can turn red litmus paper blue.

NH₃(g) + H₂O(l) ⇌ NH₄⁺(aq) + OH⁻(aq)

1. **Reaction with Acids:** Because it's a base, ammonia reacts readily with acids to form ammonium salts. For example, it reacts with hydrochloric acid (HCl) to form ammonium chloride (NH₄Cl), which is a white solid.

NH₃(g) + HCl(g) → NH₄Cl(s)

1. **Formation of Complexes:** Ammonia has a lone pair of electrons on the nitrogen atom, which allows it to form coordinate bonds with metal ions, creating complex ions. These complex ions often have different colours than the original metal ions. For example, copper (II) ions (Cu²⁺) form a deep blue complex with ammonia.

Cu²⁺(aq) + 4NH₃(aq) → [Cu (NH₃) ₄] ²⁺(aq)