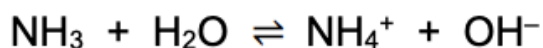


- Outline how nitrogen oxides are involved in the formation of photochemical smog
 - Oxides of nitrogen react/ combine with unburnt hydrocarbons
 - To form PAN (Peroxy Acetyl Nitrate)

- Identify a reagent and conditions required to make $\text{NH}_3(\text{g})$ from $\text{NH}_4\text{Cl}(\text{s})$
 - any Group 1 hydroxide or $\text{Ca}(\text{OH})_2$ / $\text{Sr}(\text{OH})_2$ / $\text{Ba}(\text{OH})_2$
 - heat

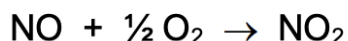
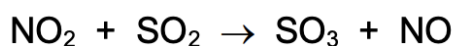
- Construct an equation that shows the behaviour of NH_3 as a weak Bronsted-Lowry base when dissolved in water.



- Identify a natural process that causes formation of atmospheric NO and NO₂
 - Lightning

- Identify a man-made process that causes formation of atmospheric NO and NO₂
 - Internal combustion engines

- NO₂ has a catalytic role in the oxidation of atmospheric sulfur dioxide. Write equations to show the catalytic role of NO₂ in this oxidation



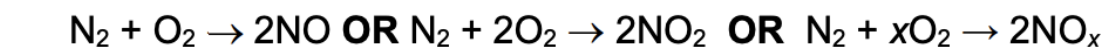
- State why the presence of SO₂ in the atmosphere has environmental consequences. Describe one of the consequences on the environment.
 - (causes) acid rain OR reacts/dissolves with (rain)water (vapour) to form (sulfuric / sulfurous) acid

Consequences

- lowers pH / increases acidity of rivers / lakes / oceans / water supplies / seas / soil / groundwater
 - kills/harms / damages fish
 - kills / harms / damages plants / coral / aquatic life / trees
 - leaches away soil nutrients / soil unfit for agriculture
 - damages / weathers / erodes / destroys buildings / statues
- State the industrial importance of compounds such as $(\text{NH}_4^+)(\text{H}_2\text{PO}_4^-)$
 - Fertilisers

9. Suggest the conditions required for the production of oxides of nitrogen during combustion of hydrocarbons in an internal combustion engine. Use an appropriate equation in your answer.

- high temperature AND high pressure AND N₂



10. Identify the role of NO and NO₂ in the formation of H₂SO₄ from SO₂ in the atmosphere to produce acid rain. Use relevant equations to support your answer.

- NO₂ is the catalyst (for SO₂ → SO₃) OR catalytic oxidation of SO₂ by NO₂



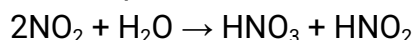
- SO₃ reacts with rain OR moisture/water (in atmosphere) to form sulfuric acid



11. State 2 types of air pollution that is caused by the production of oxides of nitrogen in an internal combustion engine.

- Acid rain
- Photochemical smog/ PAN

12. Write an equation for the reaction between NO₂ and H₂O



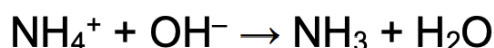
13. Explain the lack of reactivity of nitrogen gas, N₂(g).

- N₂ molecules have a strong triple covalent bond
- N₂ molecules are non-polar

14. An exothermic reaction occurs when NH₄⁺(aq) is added to OH⁻(aq). Identify the type of reaction.

- acid –base reaction

15. Construct an ionic equation for the reaction of NH₄⁺ and OH⁻.



16. Ammonium carbonate undergoes an acid–base reaction with NaOH(aq). Explain this statement.

- NH₄⁺ / ammonium ion is a proton / H⁺ donor
- OH⁻ is a proton / H⁺ acceptor OR NaOH is a stronger base than NH₃

17. NO₂ reacts with unburned hydrocarbons to form photochemical smog. State the product of this reaction that contributes to photochemical smog.

- PAN (peroxyacetyl nitrate)

18. State and explain the effect of nitrogen monoxide gas in contact with moist air.

- NO reacts with water OR NO reacts with oxygen and water
- causing acid rain OR photochemical smog / ground level ozone OR destroy ozone layer