1. Nitrogen gas is unreactive because it has:

   ☐ a strong triple bond and a non-polar molecule

   ☐ an unpaired electron on each atom

   ☐ a weak single bond between two atoms

   ☐ a permanent dipole that repels reagents

2. Oxides of nitrogen (NO_x) are produced by:

   ☐ photosynthesis in green plants

   ☐ burning pure hydrogen in air at low temperature

   ☐ lightning, and the high temperature inside car engines

   ☐ dissolving salt in sea water

3. Ammonia acts as a base because:

   ☐ the lone pair on nitrogen can accept a proton (H^+)

   ☐ it has no lone pair on nitrogen

   ☐ it gains electrons from an acid

   ☐ it donates a proton (H^+) to water

4. In a catalytic converter, NO and CO react to form:

   ☐ ammonia and carbon monoxide

   ☐ more NO and some oxygen

   ☐ sulfur dioxide and water

   ☐ nitrogen and carbon dioxide (harmless gases)

5. The bond formed when NH_3 accepts H^+ is a coordinate bond because:

   ☐ electrons were transferred

   ☐ no electrons are shared

   ☐ both shared electrons came from the nitrogen atom

   ☐ each atom gave one electron

6. Oxides of nitrogen from car engines contribute to acid rain and photochemical smog.

   ☐ True ☐ False

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_____

8. What is the oxidation number of nitrogen in NO_2? (Enter 4 for +4.)

_____

9. Nitrogen is unreactive partly because the N_2 molecule is non-polar.

   ☐ True ☐ False

10. How does NO_2 contribute to acid rain?

    ☐ it neutralises acids already in the rain

    ☐ it removes sulfur dioxide from the air

    ☐ it forms nitric acid directly and catalyses the oxidation of SO_2 to SO_3

    ☐ it has no effect on the acidity of rain

1. **a strong triple bond and a non-polar molecule**

   The N≡N triple bond is very strong, and the symmetrical molecule is non-polar – both make it unreactive.

2. **lightning, and the high temperature inside car engines**

   Lightning (natural) and the heat of internal combustion engines both make N_2 and O_2 combine into NO.

3. **the lone pair on nitrogen can accept a proton (H^+)**

   A Brønsted–Lowry base accepts a proton; ammonia's nitrogen lone pair does exactly that.

4. **nitrogen and carbon dioxide (harmless gases)**

   $2NO + 2CO \rightarrow N_2 + 2CO_2$; the harmful gases become harmless ones.

5. **both shared electrons came from the nitrogen atom**

   Nitrogen supplies both electrons of the new N–H bond, making it a coordinate (dative) bond.

6. **True**

   NO_x are atmospheric pollutants.

7. **proton**

   $NH_3 + H^+ \rightarrow NH_4{}^+$.

8. **4**

   $x + 2(-2) = 0$, so $x = +4$.

9. **True**

   Nothing attracts electrophiles or nucleophiles to it, and the triple bond is very strong.

10. **it forms nitric acid directly and catalyses the oxidation of SO_2 to SO_3**

    NO_2 dissolves to form nitric acid, and it also speeds up $SO_2 \rightarrow SO_3$, which forms sulfuric acid.

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