**Acid rain**

**1) Chemical equations:**

A) Acid rain

+ Sulfuric acid:

* SO2 + OH → HOSO2
* HOSO2 + O2 → HO2 + SO3
* SO3 + H2O → H2SO4

+ Nitric acid:

* NO2 + H2O → HNO3

+ Hydrolysis:

* SO2(g) + H2O ↔ SO2.H2O
* SO2.H2O → H+ + HSO3-
* HSO3- ↔ H+ + SO3-

B) Ocean Acidification:

* H2O + CO2 ↔ H2CO3
* H2CO3 ↔ H+ + HCO3-
* H+ + HCO3- ↔ 2H+ + CO32-

\*Short: H2O + CO2 ↔ H2CO3 ↔ H+ + HCO3- ↔ 2H+ + CO32-

C) Tropospheric Ozone:

* OH + CO → HOCO
* HOCO + O2 → HO2 + CO2
* HO2 + NO → OH + NO2
* NO2 + hv(light) → NO + O(3P)
* O(3P) + O2 → O3

\*Short: CO + 2O2 + hv(light) → CO2+ O3

**2) Impacts on the environment and humans:**

A) Acid rain

+ Hydrosphere:

* Low pH levels can stop fish eggs from hatching and kill fish.
* Reduced biodiversity.

+ Soil:

* Leaches away essential nutrients: 2H+(aq) + Mg2+(clay) ↔ 2H+(clay) + Mg2+(aq)

+ Trees and forests:

* The soil they grow on is affected.
* High altitude forests are vulnerable to acidic fogs.

+ Human health:

* Sulfur dioxide and nitrogen oxides particles cause lungs and heart issues.

+ Ocean acidification:

* Rise in acidity level makes certain species more vulnerable.
* Causes disruption in food chain.

+ Other:

* Acid rain can heavily damage structures and monuments:

CaCO3(s) + H2SO4(aq) ↔ CaSO4(s) + CO2(g)↑ + H2O(l)

B) Ocean Acidification:

+ Biological:

* The production of shells and plates out of calcium carbonate (vulnerable to dissolution): Ca2+ + CO32- ↔ CaCO3
* Causes ocean oxygenation which limits nutrients and increases metabolic demand.
* Directly or indirectly affect marine life: food chain and reproductive system.

+ Indigenous people:

A disruption in the food chain can have tremendous effects on the communities of people who live near the Arctic. Not only can their diet change dramatically but also damage the economy. Sport fishing is a great tourist attraction, and with the disappearance of the fish the value gained from tourism may decrease significantly.

C) Tropospheric Ozone

+ Irritation of the respiratory system and increased chance of respiratory infection

+ Reduced lung function:

* Hard breathing.
* Reduced body function.

+ Worsen asthma.

+ Damages lung. Long period of exposure to this may lead to permanent lung damage.

**3) Most viable solution**

A) Reduction of CO2 in general:

+ The most effective way to reduce all these problems and general would be to cut down on the amount of fossil fuel used to create CO2 gas from human activities.

+ Small things to a person can do to help in reducing carbon footprint:

* Take public transport instead of driving.
* Turn off the lights or other electronics when not using them.
* Recycle or reuse items.

B) Acid rain

+ Clean coal or clean coal technology is the process used to reduce toxic pollutants released into the environment by industrial activities:

* Pre-combustion capture: gasification of coal to remove CO2 before combustion.
* Post-combustion capture: capture of CO2 after combustion.
* Oxy-fuel combustion: Coal is burned in flue gas and air to remove nitrogen from the process and it makes capturing CO2 much easier.

+ Negatives:

* Questionable effectiveness, high costs.

C) Ocean acidification

+ Climate Engineering: Iron Fertilization:

* Stimulates photosynthesis in phytoplankton which would convert dissolved carbon dioxide into carbohydrate and oxygen gas, which both sinks deeper before oxidizing.
* Negatives: High cost, low effectiveness, may have side effects.

D) Tropospheric Ozone

+ The most effective way to protect yourself is to find out if the level of ozone in your area is high or not then take simple precautions even if no symptoms are showing. Symptoms of tropospheric ozone usually does not appear or goes away after a while but that doesn’t mean your health is not being affected by it.