Acid Rain Chemistry Questions with Solutions

Q1: Glass containers are not recommended for collecting rainwater samples. Why?
a) Glass containers are expensive
b) Glass containers are not easy to maintain
c) Glass containers affect the pH of the rain water
d) All of the mentioned

Answer: c) Glass containers affect the pH of the rain water

Explanation: Because glass containers can change the pH of rainwater, they are not appropriate for sampling rainwater.

Q2: What does the term “liming” mean?
a) Erosion of calcium carbonate(lime) zones in soil
b) Application of magnesium and calcium-rich substances to soil
c) Excessive growth of lemon trees in acid rain prone regions
d) None of the mentioned

Answer: b) Application of magnesium and calcium-rich substances to soil

Explanation: Liming is used to neutralise acidic soils caused by heavy acidic rainfall, although it is known to impair plant growth.

Q3: Which of the following gases is the primary cause of acid rain?
a) Carbon dioxide and carbon monoxide
b) Sulphur dioxide and nitrous oxide
c) Sulphur dioxide and nitrogen dioxide
d) Sulphur dioxide and carbon dioxide

Answer: b) Sulphur dioxide and nitrous oxide

Explanation: Sulphur dioxide and nitrogen dioxide have a strong tendency for reacting with water to generate sulphurous/sulphuric acid and nitric acid, respectively.

Q4: The acidic air pollutants only reach the Earth’s surface because of wet deposition.
a) True
b) False

Answer: b) False

Explanation: Wet and dry deposition can contribute to the accumulation of acidic air pollution on the Earth's surface. Wet deposition is caused by rain and humid weather, whereas acidic pollutants and dust mixing cause dry deposition.

Q5: What pH is required for aquatic animals and plants to survive?
a) 7
b) 7.5
c) 4.8
d) 6.5

Answer: c) 4.8

Explanation: Aquatic species require a mildly acidic pH of 4.8, and it is hazardous to their life if it drops below this level.

Q6: What chemicals are involved in acid rain?

Answer:

Sulphur dioxide is generated when fossil fuels are burned. Sulphur dioxide generates a sulphate ion when it reaches the atmosphere. The sulphate ion subsequently combines with hydrogen atoms to form sulphuric acid. This then falls as acid rain.

Q7: How acidic is acid rain?

Answer:

A pH scale is used to determine acidity. The scale ranges from 0 to 14, with zero being the most acidic and 14 being the most alkaline. Because it combines with naturally occurring substances, rain is always slightly acidic.

Q8: What can solve acid rain?

Answer:

Scientists have been attempting to limit sulphur oxide emissions. This reduces the amount of clean air produced. Scientists must reduce sulphur oxides by 50% to limit or prevent acid rain.

Q9: What Causes Acid Rain?

Answer:

Sulfur dioxide (SO_2) and nitrogen oxides (NO_X) are released into the air and transferred by wind and air currents, resulting in acid rain. SO_2 and NO_X react with water, oxygen, and other compounds to generate sulfuric and nitric acids. These are then combined with water and other materials before being released to the ground.

While some of the SO_2 and NO_X that generate acid rain come from natural sources like volcanoes, the majority come from fossil fuel combustion. The following are the most significant sources of SO_2 and NO_X in the atmosphere:

- Electricity is generated by burning fossil fuels. Electric power generators account for two-thirds of SO_2 and a fourth of NO_X in the environment.
- Heavy machinery and vehicles
- Industries include manufacturing, oil refineries, and others.

Acid rain is an issue for everyone because SO_2 and NO_X can be carried at great distances and over borders by the wind.

Q10: Briefly describe different forms of acid rain deposition.

Answer:

Wet Deposition

Acid rain is most commonly associated with wet deposition. Sulfuric and nitric acids developed in the sky interact with rain, snow, fog, or hail to fall to the ground.

Dry Deposition

Acidic particles and gases can settle as dry deposition from the environment in the absence of moisture. Acidic particles and gases can settle easily on surfaces (water bodies, vegetation, and structures) or react with larger particles in the atmosphere, posing a health risk. Acidic water surges over and through the ground when deposited acids are rinsed off a surface by the next rain, hurting plants and wildlife, including insects and fish.

The amount of rain that falls in a given area determines the proportion of acidity in the air that falls to earth as a result of dry deposition. For example, desert locations have a higher ratio of dry to wet deposition than areas that receive a few inches of rain each year.

Q11: Explain the effects of acid rain on plants and trees.

Answer:

Dead or dying trees are prevalent in locations affected by acid rain. Aluminium from the soil is leached by acid rain. Both plants and animals might be harmed by aluminium. Acid rain also deprives the soil of essential minerals and nutrients for tree growth.

Acidic fog and clouds at high elevations might deplete the nutrients in tree foliage, resulting in brown or dead leaves and needles. The trees become weaker and less able to survive freezing conditions due to their reduced ability to absorb sunlight.

Nitrogen Pollution

The acidity of acid rain isn't the only factor that might cause issues. Acid rain also contains nitrogen, which can negatively influence certain ecosystems. For example, in some regions, nitrogen contamination in our coastal waterways is contributing to dwindling fish and shellfish populations. Much of the nitrogen produced by human activity reaching coastal waters originate from the atmosphere, agriculture, and sewage.

Buffering Capacity

Acid rain does not affect many forests, streams, and lakes because the soil in those locations can ***buffer*** the acid rain by neutralising the acidity in the precipitation. The thickness and makeup of the soil and the type of bedrock beneath it determine its capacity. The soil in hilly areas of the Northeast United States is thin, and it cannot neutralise the acid in rainwater sufficiently. As a result, these locations are more sensitive, and acid and aluminium can build up in the soil, streams, and lakes.

Episodic Acidification

Episodic acidity can occur due to melting snow and severe rain downpours. When the melting snow or precipitation brings increased volumes of acidic deposits, and the soil can't buffer it, lakes that don't ordinarily have a high level of acidity may experience the consequences of acid rain. This brief period of higher acidity (lower pH) can cause short-term stress on the ecosystem, causing injury or death to animals or species.

Q12: How to prevent or control acid rain?

Answer:

The following are some of the primary steps that must be followed to control acid rain:

1. Sulphur dioxide and nitrogen oxides in the atmosphere should be reduced.

i. Conserve energy (hence less fuel burnt)

ii. Use less polluting fuels

iii. Before release, remove sulphur and nitrogen oxides (Flue gas desulphurisation and Catalytic Converters).

2. Use cleaner fuels

i. Coal with a low sulphur content

ii. "Washing" the coal to remove the sulphur

iii. Natural Gas

3. Flue Gas Desulphurisation (FGD)

i. Sulphur dioxide is removed from flue gas (waste gases)

ii. Contains a wet scrubber and a reaction tower with a fan that extracts hot, smokey stack gases from a power plant.

iii. Lime or limestone (calcium carbonate) is pumped into the tower as a slurry to mix with the stack gases and react with sulphur dioxide. Produces calcium sulphate that is pH-neutral and physically removed from the scrubber.

iv. Sulphates could be used for industrial applications

4. Use alternative power sources (i.e. nuclear power, hydroelectricity, wind energy, geothermal energy, and solar energy)

i. Cost issue

5. Liming to lessen the impact of Acid Rain

i. Acid neutralisation with powdered limestone/limewater added to water and soil

ii. Utilised extensively in Norway and Sweden

iii. Expensive, temporary fix

Q13: Give the effects of SO_2 and NO_X on human health.

Answer:

Humans are no longer at risk from walking in acid rain or swimming in acidic lakes than walking in normal rain or swimming in non-acidic lakes. When pollutants that generate acid rain are present in the air, such as SO_2 and NO_X and sulphate and nitrate particles, they can be dangerous to humans.

Fine sulphate and nitrate particles are formed when SO_2 and NO_X combine in the atmosphere, which individuals can inhale. Many scientific investigations have found a link between these particles and effects on heart function, such as heart attacks that result in mortality in persons who have a higher risk of heart disease and impacts on lung function, such as breathing difficulties in people who have asthma.

Q14: Describe the effects of acid rain on man-made materials.

Answer:

Acid rain erodes stone, metal, paint, and practically any other object that has been exposed to the environment for a long time. Human-made things gradually decay even when exposed to unpolluted rain, but acid rain accelerates the process. Acid rain can corrode metals and erode the features of marble sculptures sculpted centuries ago. This occurs because marble is composed of a calcium carbonate component that acids can dissolve.

Limestone contains calcium carbonate as well. Acid rain damages many buildings and monuments composed of marble and limestone. It can cost billions of dollars to repair acid rain damage to structures and monuments. Historical monuments and structures, such as Washington, D.C.'s Lincoln Memorial, can never be restored.

Q15: Explain the Acid Rain Program.

Answer:

Congress established the Acid Rain Program as part of the Clean Air Act Amendments of 1990. It mandates that the electric power industry reduce sulphur dioxide (SO_2) and nitrogen oxides (NO_x) emissions, which cause acid rain. By 2010, power plants must have cut their emissions of these pollutants by half compared to 1980 levels. In 1990, power plants emitted 35% less SO_2 and 46% less NO_x than today.

The Acid Rain Program has been so successful because it uses a **CAP and TRADE** policy to cut emissions. A **CAP** and trade scheme is a policy that regulates huge volumes of emissions from several different sources. The strategy begins by establishing an overall CAP, or the maximum quantity of emissions allowed for all pollution sources covered by the program. The CAP was adopted as a means of achieving an environmental goal. The CAP refers to the total amount of SO_2 and NO_x that all power plants can produce in this situation.

ALLOWANCES, or permits to pollute a specific amount, are provided to power plants. Individual power plants are free to choose how to reduce their emissions, but the total quantity of emissions from all power plants in the country must be less than the CAP.

A **SCRUBBER** device eliminates sulphur from the smoke by spraying a mixture of water and powdered limestone into the smokestack. This mixture retains the sulphur, preventing it from escaping into the atmosphere.

Practise Questions on Acid Rain

Q1: Which of the following gases is responsible for the Taj Mahal's yellowing?
a) Organic carbon
b) Brown carbon
c) Black carbon
d) All of the mentioned

Answer: d) All of the mentioned

Explanation: The Taj Mahal's yellowing is caused by light-absorbing particles such as organic carbon, black carbon, and brown carbon (all of which are produced by biomass combustion).

Q2: Who discovered the phenomenon of acid rain?
a) George Brown
b) James T. Stewart
c) Charles David
d) Robert Angus Smith

Answer: d) Robert Angus Smith

Explanation: The concept of acid rain was discovered by Robert A. Smith during the industrial revolution.

Q3: How can we reduce acid rain caused by automobile exhaust gases entering the atmosphere?
a) By burning more fuels
b) By using old engine vehicles
c) By using ignition
d) By using catalytic converters

Answer: d) By using catalytic converters

Explanation: Gases are passed through metal-coated beds in catalytic converters, which convert toxic compounds into less dangerous ones. These are used in automobiles to lessen the harmful impact of exhaust fumes on the environment.

Q4: When did the " Clean Air Act " in the United States come into force?
a) 1950
b) 1960
c) 1970
d) 1980

Answer: c) 1970

Explanation: The Clean Air Act of 1970 and its Amendments in 1990 resulted in a reduction in acid deposition in the United States. The regulation of coal-fired power plant emissions was the starting point for these amendments. Sulphuric dioxide levels in the United States were significantly reduced due to this research.

Q5: Which one of the ways can prevent acid rain?
a) Increase the emission of sulfur dioxide and nitrogen oxides
b) Decrease the emission of sulfur dioxide and nitrogen oxides
c) Increase the emission of hydrochloride and phosphate
d) Decrease the emission of hydrochloride and phosphate

Answer: b) Decrease the emission of sulfur dioxide and nitrogen oxides

Explanation: Reduced emissions of sulphur dioxide and nitrogen oxides into the atmosphere are one strategy to prevent acid rain from occurring. This may be accomplished by using far less fossil-fuel-based energy in power plants and industry.