

Acid Rain

The pH of natural rain is 5.6, so natural rain is (1) _____. This pH is the result of the dissolution of carbon dioxide in water, and the reaction between them. The reaction is:

(2)

The term *acid rain* refers to the fact, that this type of rain is more acidic than natural rain, so its pH is (3) _____. The acidity of acid rain is primarily the result of dissolving sulphur oxides and nitrogen oxides from human activities in rainwater. The dissolution results sulphuric acid (formula (4) _____), nitric acid (formula (5) _____) and hydrochloric acid (formula (6) _____). All three are (7) _____ acids. Sulphuric acid rain is mainly caused by the burning of fossil fuels for example in power plants or in cars. Sulphuric acid dissociates into the following ions: (8) _____. The reactions are:

(9) step 1

(10) step 2

(11) net reaction

The $K_{a,2} = 1.1 \times 10^{-2}$ (the (12) _____ of step 2). So the degree of dissociation in the second step is (13) _____. The formula of (13) $K_{a,2} =$

Acid rain can be harmful to some plants, to fish, because if acid rain contaminates lake water it (14) _____, which destroys the ecological balance of lake water. This happens unfortunately in many lakes of the Scandinavian states. But if there are block mountains made of calcium carbonate (formula (15) _____) and magnesium carbonate (formula (16) _____), then the lake waters have small amounts of dissolved ions like (17a) _____ (17b) _____ (17c) _____ (17d) _____ from the soil, as well as ions (18a) _____ (18b) _____ from the air (as a result of the dissolution of carbon dioxide, and the dissociation of the product of your answer in Q2). These dissolved ions in the lake water act as a (19) _____, which (20) _____.

This is the case of Hungary and south-eastern Europe; that is why acid rain is less harmful for lakes there.

However, acid rain can destroy structural materials and monuments as well. For example marble, which is composed of calcium carbonate reacts with the acids in acid rain. For example the reaction between calcium carbonate and nitric acid is (21)

So please, don't pollute the Earth, and live an environmentally conscious life!

Turn the page over!

(22) Categorise the following materials according to their acid-base property!

NaOH, Ca(OH)₂, HSO₄⁻, H₂O, H₂SO₃, KOH, H₃PO₄, CH₃COOH

- 1.
- 2.
- 3.

(23) Give examples of the different types of reactions using the following reactants. (For each reaction you need to pick two reactants only.)

H₂O, NaOH, ZnCl₂, CH₃COONa, KOH, H₂SO₄, K₂CO₃, AgNO₃, KBr, NH₄Br, PbNO₃, KI, CH₃COOH, CaCl₂.

1. neutralisation reaction:
2. hydrolysis of a salt:
3. salt + acid/base:
4. double replacement reaction:

(24) There's 45 mL solution, which contains 0.008 g NaOH.

(a) What is the pOH and pH of the solution?

(b) What volume of pH = 2.4 HBr solution is needed for the complete neutralisation of the NaOH solution?