

**EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING**

**SCIENCE SKILLS
pH SCALE**

**AN ACADEMIC SKILLS MANUAL
for
The Hairstylist Trades**

*Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities*

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In preparing these Academic Skills Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

SCIENCE SKILLS

pH SCALE

*An academic skill required for the study of the
Hairstylist Trade*

INTRODUCTION

As a hairstylist, you work with many different types of material. You have to know how these products will react with your clients' hair and skin. Some materials must be handled carefully because they can pose a safety risk. For example, formaldehyde is used in soaps, nail polish, and as a disinfectant. However, it must be used with care because it can be toxic and it can cause health problems. Ammonia can irritate the eyes and membranes of the nose. It should be used only in well ventilated area.

The products you use for washing, conditioning, colouring, curling, and straightening hair all contain chemicals, as do the products for skin and nail care. These chemicals, if used properly, will do all those things successfully and safely for you and your clients. Your ability to choose the right product and to understand health warnings is important. You need to be well informed about these substances.

In this skills manual, we will look at how some of the common compounds found in a hair salon are classified. We will look especially at compounds known as acids and bases. This skills manual describes the following:

- ◆ Basic subdivisions of matter
- ◆ Acids and bases
- ◆ The pH scale

BASIC SUBDIVISIONS OF MATTER

Matter is the term used in science to describe anything that has mass and takes up space. This term is so broad that it has been divided into smaller categories. The first division of matter is into elements and compounds.

Atoms are the building blocks of matter. They in turn are composed of subatomic particles, which include protons, neutrons and electrons.

- Each kind of atom has a specific number of subatomic particles.
- The number of protons in an atom determines what element an atom forms.
- For example, oxygen has eight protons and iron has twenty-six

Elements

An **element** is a substance that can't be broken down further into other substances.

- An element is made from one kind of *atom*.
- Examples include nitrogen, oxygen, hydrogen, carbon, iron, zinc, and aluminum.
- Elements can exist in their pure form or they can combine with other elements to form molecular compounds.

Compounds

When atoms combine, they form **molecules** that are held together by chemical bonds that do not easily break. A **compound** is composed of molecules of two or more elements which are **chemically combined** in a definite proportion.

- A compound has different characteristics than the elements that form it.
 - For example, hydrogen and oxygen are colourless, odourless gases that exist in the air around us.
 - But, when two atoms of the element hydrogen join with one atom of oxygen, the compound water is formed.
 - Water is completely different from either hydrogen or oxygen.

It takes a very large number of atoms or molecules to form an amount that can be seen by the naked eye. A bottle of water contains an immense number of water molecules.

Some compounds can be dissolved in water to form a solution. A **solution** is a uniform mixture of small particles of two or more substances.

- One substance in a solution is the dissolving agent or the **solvent**.
 - Water is called the universal solvent because it can dissolve many different substances.
- The other substance is the **solute**.
- Usually there is a lot more solvent than solute.

ACIDS AND BASES

Acids and bases are two classes of chemicals that have generally opposite characteristics. Both acids and bases are often found in solutions with water.

- If they are in a strong solution, they are caustic or corrosive.
- They will damage skin, fabric, metals and some plastics.
- If they are in properly prepared weak solutions we can use them to do many useful things.

Acids taste sour. You can test a substance to see if it is acidic by using a material called litmus paper. Acids turn litmus paper red.

Bases taste bitter and feel slippery. We often refer to bases as **alkaline**. Alkaline substances, or bases, turn litmus paper blue.

Neutral solutions are neither acidic or basic. A neutral solution will not change litmus paper, nor will it damage other materials.

If a water solution of an acid is combined in a specific proportion with a solution of a base, a chemical reaction will occur.

- The molecules of the base and the molecules of acid will break apart and reform into a new solution.
- The new solution will not be acidic nor will it be basic.
 - It will usually be a mixture of water and a salt.
- It will not be caustic or corrosive.
- This solution will be **neutral**.

Several useful substances are described as being neutral, acidic or a basic (alkaline).

- Shampoos can be either neutral, acidic or basic.
- A basic shampoo has a stronger cleaning action.
- Adding citric, lactic or phosphoric acid to a shampoo will make it more acidic.
 - This makes the shampoo gentler and less drying to the hair.
- These acids are also used in rinses that remove soap buildup on hair.

Alkaline and acid-balanced perms rely on acidic and basic substances.

- Thioglycolic acid is one of the main compounds in an alkaline perm.
- Ammonia is a base.
- Ammonia and thioglycolic acid are combined to form the main reducing agent in the alkaline perm.
- The resulting compound is a base.
- The main ingredient in acid-balanced perms is glyceryl monothioglycolate.

THE pH SCALE

The acidity or alkalinity of a substance is rated on a scale called the **pH scale**. The pH scale rates the acidity and alkalinity of a substance. The pH scale ranges in value from 0 (very acidic) to 14 (very basic). See Figure 1.

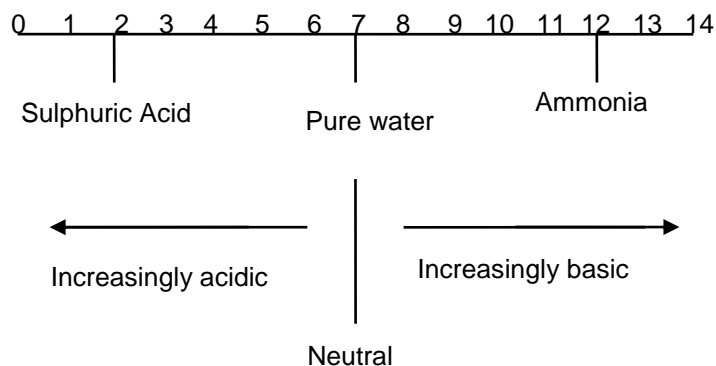


FIGURE 1: The pH Scale

- ◆ Pure water is considered **neutral**: neither acidic nor basic. Its pH, 7, is right in the middle.
- ◆ Any substance with a pH less than 7 down to 0 is acidic.
 - The smaller the number, the greater the acidity.
 - Sulphuric acid is a very strong acid, with a pH value of around 2.
- ◆ Any substance with a pH greater than 7 is considered basic.
 - The closer the number is to 14, the greater the alkalinity.
 - Ammonia is a strong base, with a pH of 12.

Application

Shampoos

Wet hair normally has a pH of around 5, so it is slightly acid. Shampoos have a pH of around 8, which is slightly alkaline, except for acid -balanced shampoos, which have a pH of around 5.

Permanent solutions

Alkaline perms have a pH of around 9.

Neutralizers and conditioners

Neutralizers for alkaline products have a pH of about 3. Conditioners have a pH that varies from 3.5 to 6. They can restore the pH balance to the hair after an alkaline treatment if a neutralizer has not been used.

Colour rinses

Colour rinses are quite acidic, with a pH of 2.

General guidelines

In general, an alkaline hair product causes the hair to soften and become fuller. An acidic substance in a hair product contracts and hardens hair. If you are not sure what product to use, pick the product that is closest to neutral or with a pH close to 7.

The following table shows the pH of some common substances and of the products you work with.

TABLE 1: Table of Average pH Values

Acid	0	Hydrochloric acid	
	1		
	2	Lemon juice	
	3	Vinegar	
	4	Hydrogen peroxide	
	5	Hair / Skin	
	6	Urine	
Neutral	7	Distilled water	
	8	Blood	
	9	Soaps	
	10	Lighteners	
	11	Depilatories	
	12	Ammonia	
Base	14	Lye	

↑	Conditioners
	Acid waves
	Neutral waves
	Semi-permanent color
	Cold Wave lotion
	Tints
↓	Relaxers

CONCLUSION

The world of hair care is affected in a large way by the chemistry of the products that a hairstylist uses. It is important to understand the effects of the chemicals you use every day.

A significant chemical characteristic of these products is the degree of acidity or alkalinity. The degree of acidity and alkalinity is measured on a scale called the pH scale. Water is considered a neutral substance. Its pH is 7 on the scale. An acidic substance ranges in pH from just below 7 to 0. An alkaline substance ranges in pH from just above 7 to 14. It is important to choose products with the correct pH for each client's hair, as the pH level will affect the results you get.

Answer the following questions on acids and bases. The answers are on the next page.

1. If a substance turns blue litmus paper red, it is an _____ .
2. If a substance turns red litmus paper blue, it is a _____ .
3. A base is soapy, bitter, and can _____ the skin in strong concentrations.
4. A neutral solution can be made by mixing a(n) _____ with a(n) _____.
5. The pH scale ranges in value from 0 to _____.
6. Pure water is considered _____. It has a pH of _____.
7. Any substance with a pH less than 7 is _____.
8. Any substance with a pH greater than 7 is _____.
9. A shampoo with a pH of 5 is slightly _____.
10. Ammonia has a pH of 12. It is a strong _____.
11. To neutralize an alkaline hair treatment, you would apply a neutralizer that is _____.

ANSWER PAGE

1. acid
2. base
3. burn
4. an acid with a base
5. 14
6. neutral, 7
7. acidic
8. basic or alkaline
9. acidic
10. base
11. acidic