SOMANY INSTITUTE OF TECHNOLOGY AND MANAGEMNET,

REWARI

PRINTING TECHNOLOGY

BASIC SCIENCE FOR PRINTING

UNIT-3

Color theory is both the science and art of using color. It explains how humans perceive color; and the visual effects of how colors mix, match or contrast with each other. Color theory also involves the messages colors communicate; and the methods used to replicate color.

In color theory, colors are organized on a color wheel and grouped into 3 categories: primary colors, secondary colors and tertiary colors. More on that later.

Via unsplash

So why should you care about color theory as an entrepreneur? Why can't you just slap some red on your packaging and be done with it? It worked for Coke, right?

Color theory will help you build your brand. And that will help you get more sales. Let's see how it all works.

Understanding color

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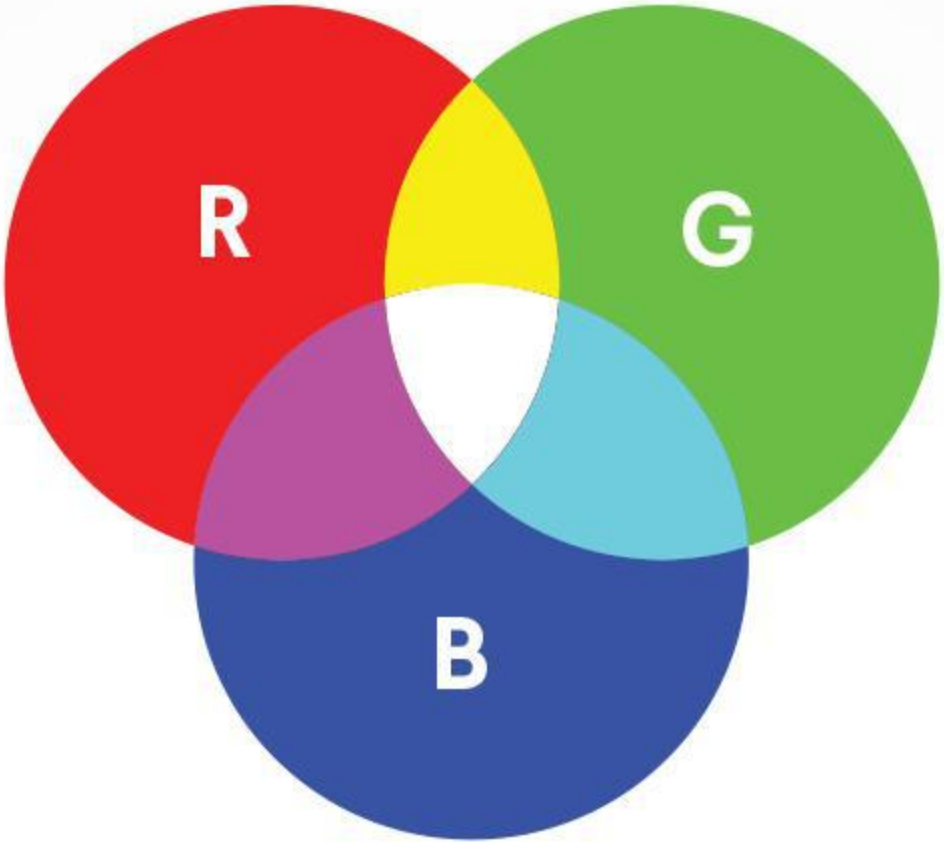
People decide whether or not they like a product in 90 seconds or less. 90% of that decision is based solely on color.

Color is perception. Our eyes see something (the sky, for example), and data sent from our eyes to our brains tells us it's a certain color (blue). Objects reflect light in different combinations of wavelengths. Our brains pick up on those wavelength combinations and translate them into the phenomenon we call color.

When you're strolling down the soft drink aisle scanning the shelves filled with 82 million cans and bottles and trying to find your six-pack of Coke, what do you look for? The scripted logo or that familiar red can?

People decide whether or not they like a product in 90 seconds or less. 90% of that decision is based solely on color. So, a very important part of your branding must focus on color.

RGB: the additive color mixing model



Red

Green

Blue

Additive color mixing. If you (like me) have a hard time wrapping your head around how red and green mix together to make yellow, watch this YouTube video.

Humans see colors in light waves. Mixing light—or the **additive color mixing model**—allows you to create colors by mixing red, green and blue light sources of various intensities. The more light you add, the brighter the color mix becomes. If you mix all three colors of light, you get pure, white light.

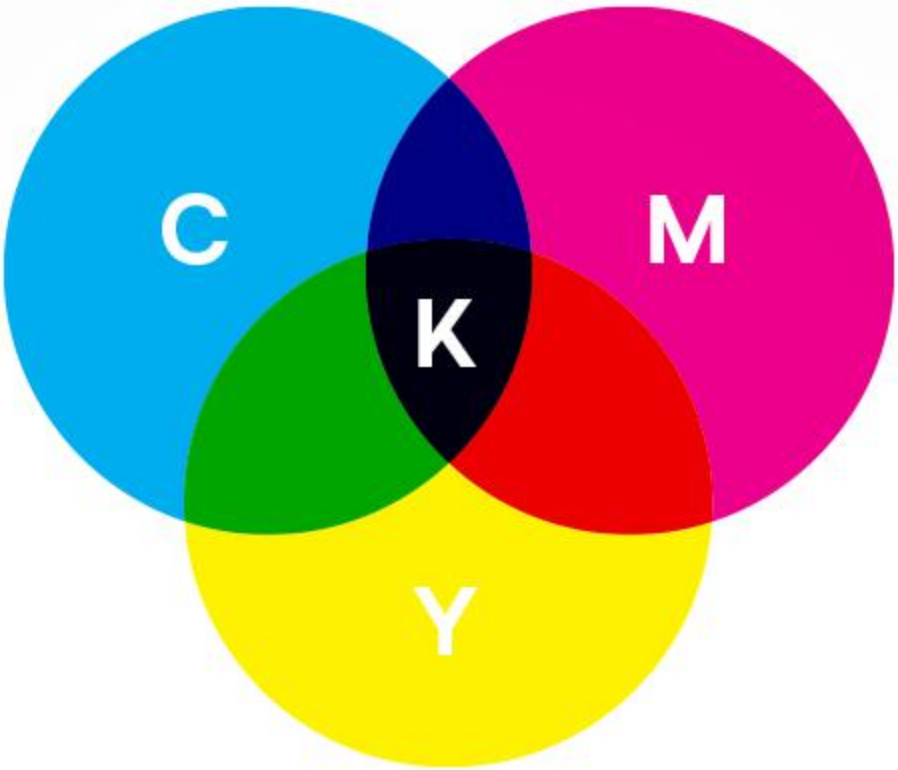
TVs, screens and projectors use red, green and blue (RGB) as their primary colors, and then mix them together to create other colors.

Why should you care?

Let's say you have a very distinct brand with a bright yellow logo. If you post the logo on Facebook, Twitter or your website and don't use the correct color process, your logo will appear muddy instead of that bright yellow. That's why, when working with files for any screen, use RGB, not CMYK.

CMYK: the subtractive color mixing model

Any color you see on a physical surface (paper, signage, packaging, etc.) uses the **subtractive color mixing model**. Most people are more familiar with this color model because it's what we learned in kindergarten when mixing finger paints. In this case, "subtractive" simply refers to the fact that you subtract the light from the paper by adding more color.



Cyan Magenta Yellow

Subtractive color mixing is pretty close to the paint mixing we did in grade school. This video does a great job visualizing the "subtractive" part of it.

Traditionally, the primary colors used in subtractive process were red, yellow and blue, as these were the colors painters mixed to get all other hues. As color printing emerged, they were subsequently replaced with cyan, magenta, yellow and key/black (CMYK), as this color combo enables printers to produce a wider variety of colors on paper.

Why should you care?

You've decided to print a full-color brochure. If you're investing all that money into your marketing (printing ain't cheap!), you expect your printer is going to get the colors right.

Since printing uses the subtractive color mixing method, getting accurate color reproduction can only be achieved by using CMYK. Using RGB will not only result in inaccurate color, but a big bill from your printer when you're forced to ask them to reprint your entire run.

The color wheel

I don't know about you, but when I was a kid, the best part about going back to school in the fall was getting that new, pristine 64-count box of Crayola crayons. The possibilities seemed endless. Until I'd inevitably lose the black crayon.

Understanding the color wheel and color harmonies (what works, what doesn't and how color communicates) is just as exciting as that new box of crayons. No really.

Being able to understand the terms and processes that go along with color will help you knowledgeably communicate your vision with your designer, printer, or even (maybe) an Apple Store Genius.

Color wheel basics

The first color wheel was designed by Sir Isaac Newton in 1666 so it absolutely predates your introduction to it in kindergarten. Artists and designers still use it to develop color harmonies, mixing and palettes.

The color wheel consists of three **primary colors** (red, yellow, blue), three **secondary colors** (colors created when primary colors are mixed: green, orange, purple) and six **tertiary colors** (colors made from primary and secondary colors, such as blue-green or red-violet).

Draw a line through the center of the wheel, and you'll separate the **warm colors** (reds, oranges, yellows) from **cool colors** (blues, greens, purples).

Warm colors are generally associated with energy, brightness, and action, whereas cool colors are often identified with calm, peace, and serenity.

When you recognize that color has a temperature, you can understand how choosing all warm or all cool colors in a logo or on your website can impact your message.

Hue, shade, tint and tone

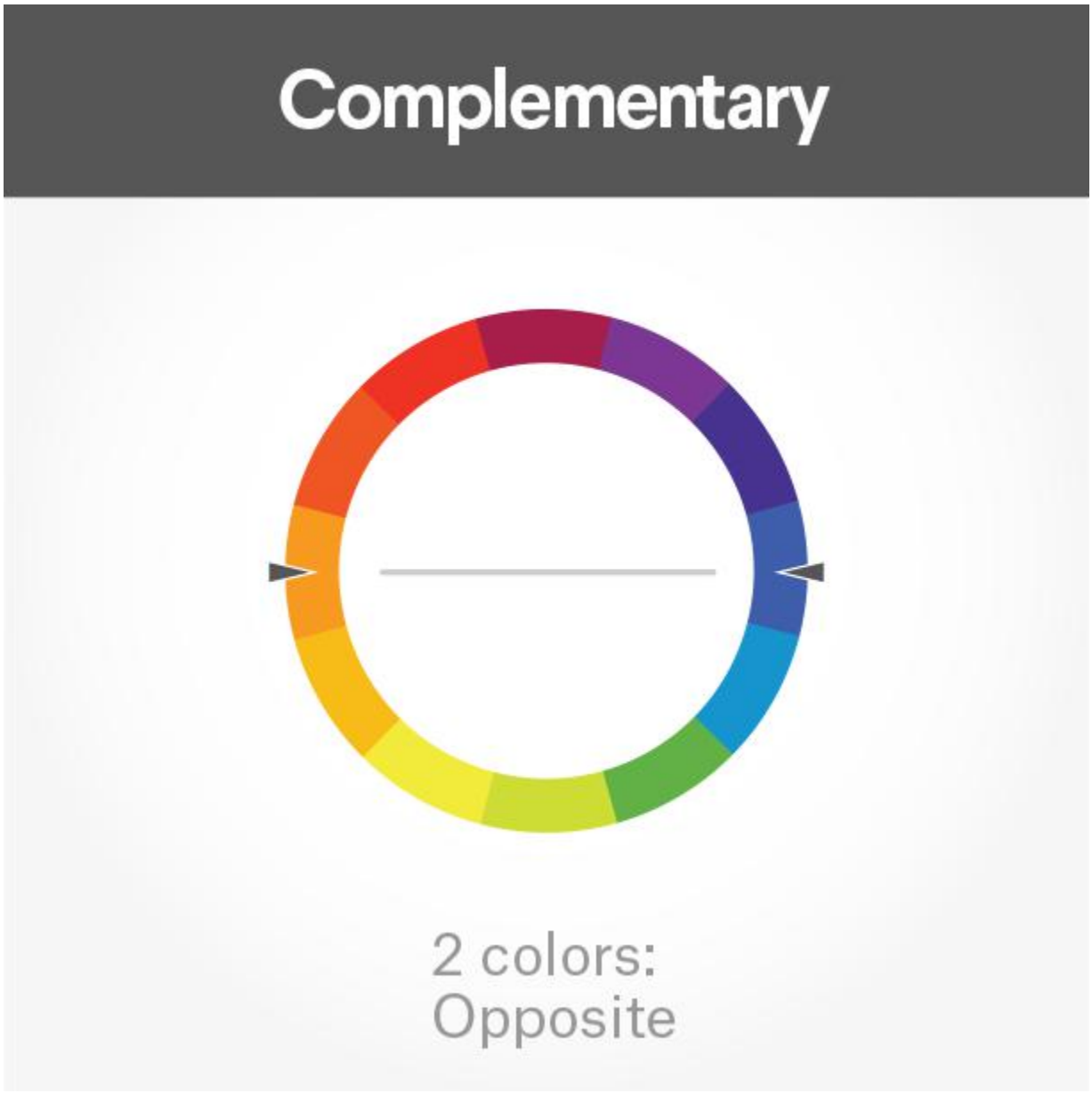
Let's go back to that 64-pack of crayons from our first day of school. (Remember "raw umber"? What is an umber anyway, and is it actually better raw than cooked?) Anyway, you might be wondering, how we got from the twelve colors on our original color wheel to all those crayons? That's where tints, shades, and tones come in.

Simply put, tints, tones and shades are variations of **hues**, or colors, on the color wheel. A **tint** is a hue to which white has been added. For example, red + white = pink. A **shade** is a hue to which black has been

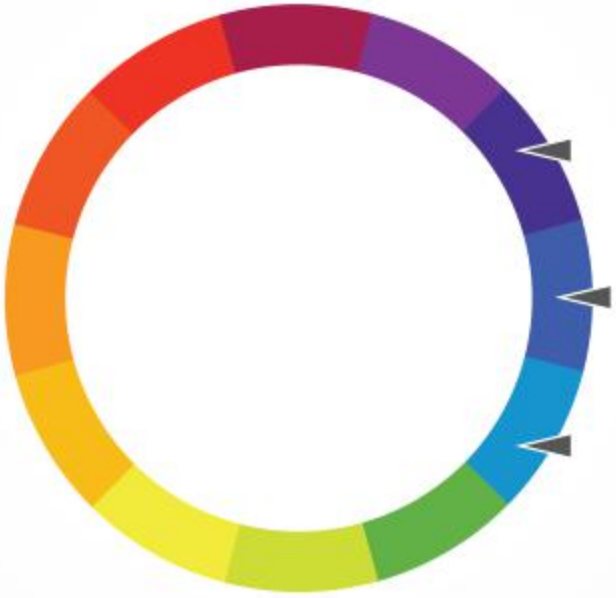
added. For example, red + black = burgundy. Finally, a **tone** is a color to which black and white (or grey) have been added. This darkens the original hue while making the color appear more subtle and less intense.

Color schemes

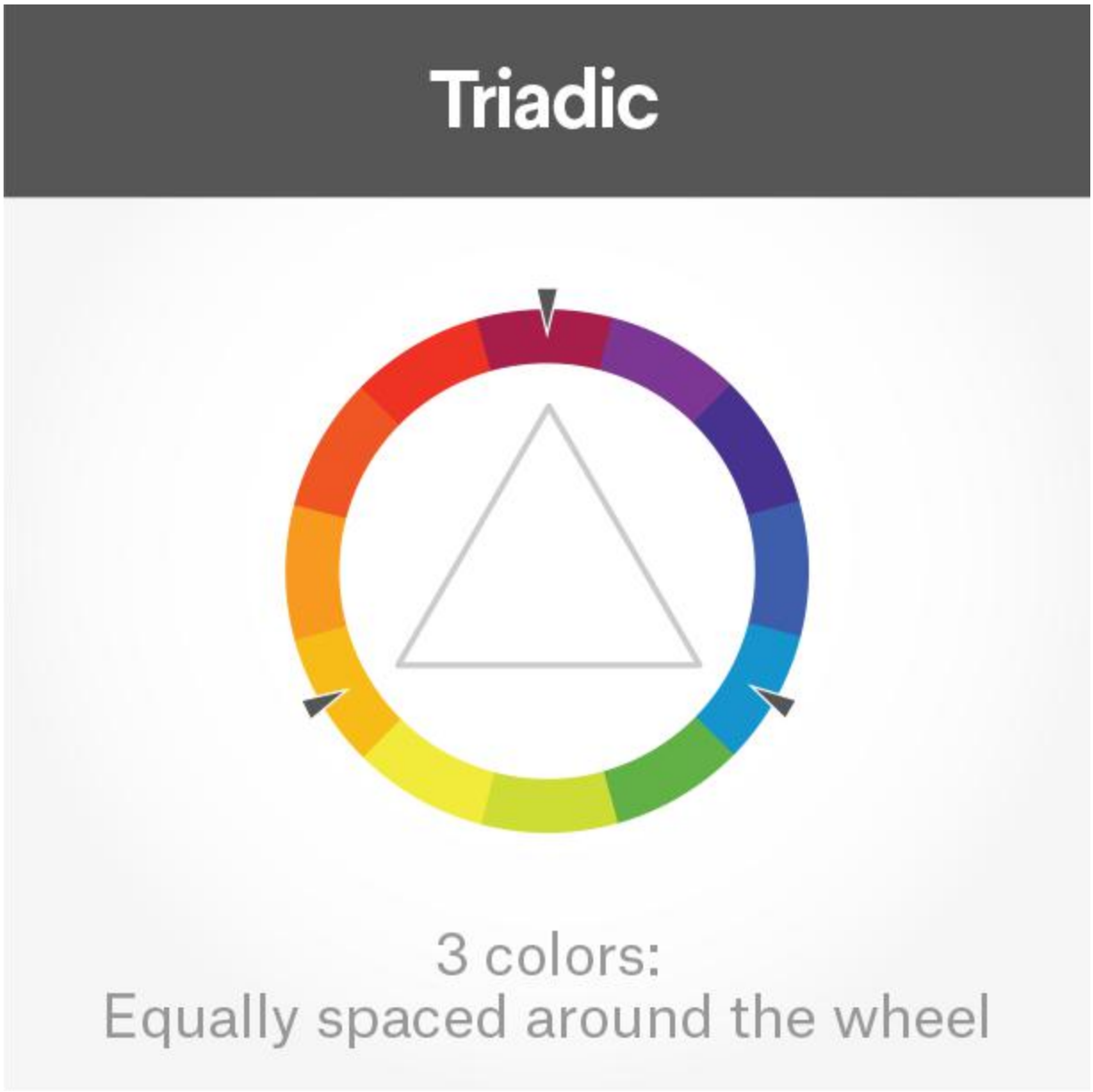
Let's talk schemes… (And not the kind that cartoon villains concoct. Bwahaha!) We're talking color schemes. Using the color wheel, designers develop a color scheme for marketing materials.



Analogous



3 colors:
Side-by-side



Complementary colors

Complementary colors are opposites on the color wheel—red and green, for example.

Because there's a sharp contrast between the two colors, they can really make imagery pop, but overusing them can get tiresome. Think any shopping mall in December. That being said, using a complementary

color scheme in your business marketing offers sharp contrast and clear differentiation between images.

Analogous colors

Analogous colors sit next to one another on the color wheel—red, orange and yellow, for example. When creating an analogous color scheme, one color will dominate, one will support and another will accent. In business, analogous color schemes are not only pleasing to the eye, but can effectively instruct the consumer where and how to take action.

The Tostitos website uses an analogous color scheme. Notice the bright orange navigation bar draws the eye to explore the site, and accent-colored links at the bottom direct hungry consumers with the munchies to “Buy Online.”

HAVE IT YOUR WAY®

Triadic colors

Triadic colors are evenly spaced around the color wheel and tend to be very bright and dynamic.

Using a triadic color scheme in your marketing creates visual contrast and harmony simultaneously, making each item stand out while making the overall image pop.

Burger King uses this color scheme quite successfully. Hey, is it lunchtime yet?

What is Surface Chemistry?

It is the study of the chemical phenomena that occur at the interface of two surfaces which can be solid-liquid, solid-gas, solid-vacuum, liquid-gas, etc. Some applications of surface chemistry are known as surface engineering. There are various phenomena taking place on the surface of a substance and out of them some are:

- Adsorption
- Heterogeneous Catalysis
- Corrosion
- Crystallization

Applications of Surface Chemistry

In a wider perspective, surface chemistry deals with the interaction of surfaces of one system with that of the other system. Some phenomena work on this principle such as:

- Catalysis
- Colloid Formation
- Electrode Reactions
- Chromatography

Surface Chemistry has a major role in various chemical processes such as:

- Enzymatic reactions at the biological interfaces found in the cell walls and membranes
- In the electronics industry, the use in the surface and interface of microchips used in computers.
- In automobile exhausts, the heterogeneous catalysts found in the catalytic converter for cleaning emissions.

Role of Adsorption in Surface Chemistry

Accumulation of species on higher concentration on the surface of a substance due to intermolecular force is known as adsorption. For Example, gases such as H2, O2, N2 adsorbs on the surface of activated charcoal.

Also Read: Difference between Adsorption and Absorption

Enthalpy of Adsorption: Amount of heat energy liberated when one mole of gas is adsorbed on the unit surface area of adsorbent is known as enthalpy of adsorption.

Types of Adsorption

Due to the force of interaction between adsorbate and adsorbent, adsorption in surface chemistry is classified into two types.

Physical Adsorption or Physisorption

There exists a weak van der Waals force between adsorbate and adsorbent.

Characteristics:

- **Nature of forces:** weak van der Waals forces
- **Specificity:** It is not specific in nature
- **Reversibility:** The process is reversible
- **Layer:** It is a multi-layered process
- **Enthalpy of adsorption:** Low enthalpy of adsorption [20 – 40 KJ/mole]
- **The energy of activation:** Very low
- **Desorption:** Very easy
- **Factors affecting:** Surface area of adsorbent nature of adsorbate, pressure, temperature.

Chemical Adsorption or Chemisorption

It is due to strong chemical forces between adsorbate and adsorbent.

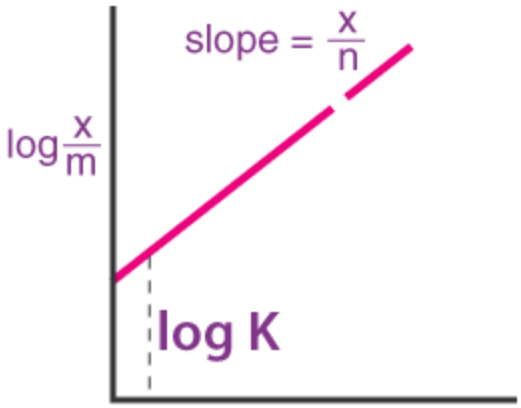
Characteristics:

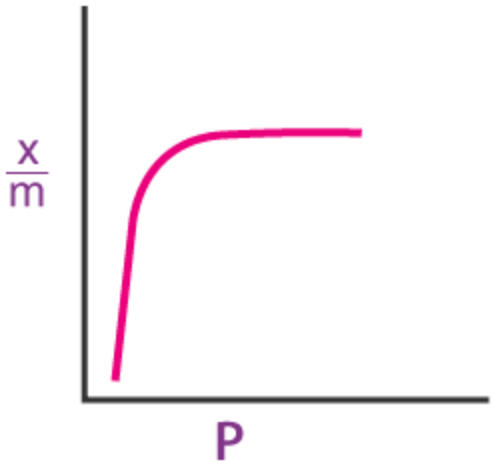
- **Nature of forces:** Strong chemical forces
- **Specificity:** Highly specific nature
- **Reversibility:** It is irreversible
- **Layer:** It is a single layered process
- **Enthalpy of adsorption:** High enthalpy of adsorption [40 – 400 KJ/mole]
- **The energy of activation:** Very high
- **Desorption:** Very difficult
- **Factors affecting:** Surface area of adsorbent, nature of adsorbate Temperature.

Effects of Pressure and Temperature on Adsorption

Effect of pressure on the adsorption of a gas on a solid

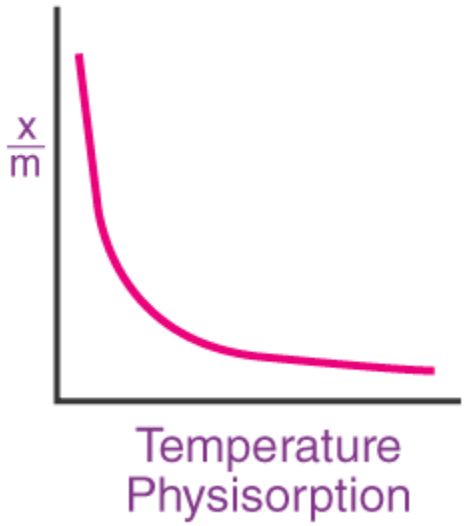
The fraction of gas adsorbed is proportional to the pressure of the gas. Adsorption increase with pressure reaches the maximum and becomes constant.

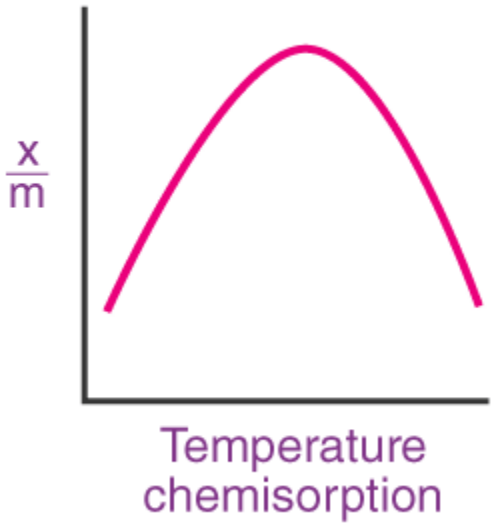




Effect of temperature on adsorption of gases on solid

- Adsorption of gases on solid is always exothermic.
- Physical adsorption follows Lechatlier Principle, the amount of gas adsorbed decrease with the increase of temperature.
- Chemisorption increases with increase in the temperature. It reaches the maximum and then decreases.
- The curve obtained by plotting fraction of gas adsorbed and temperature at constant pressure is adsorption isobars.





Surface Chemistry Adsorption Isotherms

Freundlich Adsorption Isotherm

x/m = K [P^(1/n)]

‘x’ is mass of adsorbate on the mass of adsorbent

⇒ log K/m = 1/n (log P + log K)

It does not apply for the adsorption of gases on solids at a higher pressure

Langmuir Adsorption Isotherm

- The layer of gas adsorbed on the solid adsorbent is one-molecule thick.
- The adsorbed layer is uniform all over the adsorbent.
- There is no interaction between the adjacent adsorbed molecules.

Emulsions in Surface Chemistry

The colloidal solutions in which both dispersed phase and dispersion medium are liquids are called as Emulsions.

Example: Paints, dyes, milk, vanishing cream. On the basis of dispersion medium emulsions in surface chemistry are classified into two types:

Oil in Water Emulsions

In this, the oil or fat droplets are dispersed in water. **Example:** Milk.

Water in Oil Emulsions

In this, the water droplets are dispersed in oil. **Example:** Vanishing cream.

Emulsions are unstable, to increase the stability another substance called as emulsifiers are added. **Example:** Milk contains natural emulsion casein.

Applications of Emulsions

- These are used in syrups
- Paints
- Toothpaste
- Digestion of fats
- Pigment and dye