Can’t Judge a Powder

Answers

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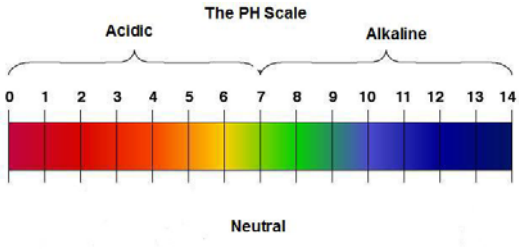
pH Scale

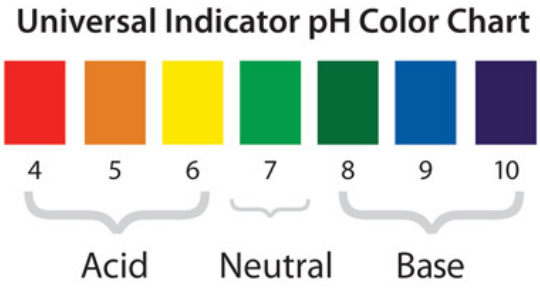


The pH scale is a scale from 0 to 14 that measures the acidity of a solution. It is broken up into acid, base, and neutral.

Acids are things that normally taste sour and contain hydrogen ions, H^+. They are the values from 0 to 6 on the pH scale. Examples are lemon juice and HCl.

Bases are things that normally taste bitter and contain hydroxide ions, OH^-. They are values from 8 to 14 on the pH scale. Examples are ammonia and NaOH.

A neutral compound is neither an acid nor base; it has a pH of 7. The most common neutral is pure water.



We can measure pH using pH paper. The strip of paper is dipped into the solution and it changes color. The color is then compared to a scale on the pH paper container. The color it matches up with has a number next to it; that number is the solution's pH value.

Practice:

1) Write a possible pH value for the type of compound:

a) acid = 0-6 b) base = 8-14 c) neutral = 7

2) Write the type of compound for each pH value:

a) 7 = neutral b) 12 = base c) 3 = acid

3) Write the pH value for the color shown:

a) ▢ = 6 b) ▢ = 7 c) ▢ = 10

4) Write the color the paper would turn for each pH value:

a) 5 = orange b) 7 = light green c) 9 = blue

5) Write the type of compound the solution represented by the color would be:

a) ▢ = base b) ▢ = acid c) ▢ = neutral

6) Write a possible color for each type of compound:

a) acid = red, orange, yellow

b) base = dark green, blue, violet

c) neutral = light green

Endothermic vs. Exothermic

There are two types of reactions: endothermic and exothermic. Endothermic reactions that need energy, in the form of heat to happen. When endothermic reactions happen, the things reacting or reactants seem to get colder. The opposite of this is an exothermic reaction. Exothermic reactions release heat energy, and the reactants get hotter.

You can tell if a reaction is endothermic or exothermic by feeling the bottom of the test tube or well plate that the reaction is occurring in. If it gets cold the reaction is endothermic, but if it gets hot it is exothermic.

Endothermic → absorbs heat → gets cold
Exothermic → releases heat → gets hot

Practice:
Indicate whether the reaction is endothermic or exothermic. Circle one.

1) Ice melting: endothermic / exothermic
2) Lighting a match : endothermic / exothermic
3) Making ice cubes: endothermic / exothermic
4) Boiling water: endothermic / exothermic

Indicate whether the reaction is endothermic or exothermic, and why?

1) When HCl reacts with NaOH, the reaction container gets hot: exothermic – heat is released

2) A commercial non-reusable cold pack: endothermic – in order for the cold pack to get cold, it must take in heat from the air around it

*BONUS*photosynthesis: endothermic – in order for photosynthesis to occur, the plant must take in solar energy

Ionic vs. Covalent & Conductivity

There are two main types of compounds: ionic and covalent. In ionic compounds electrons are transferred from a metal to a nonmetal, creating a positive ion and a negative ion, that are attracted to each other forming a compound because opposite charges attract. Whereas, in covalent compounds electrons are shared between two nonmetals. The shared electrons form a bond between the two nonmetals.

Conductivity is the ability to conduct an electric current. A conductivity tester is used to determine if a substance conducts or not. If it does the little LED on the end of the tester will light up. In order for a substance to conduct electricity it must have a charge, and free-moving particles. Metals and aqueous (dissolved) ions are examples of conductive substances.

We can determine if a substance is ionic or covalent by dissolving it in water, and using a conductivity tester to see if it conducts electricity. If the solution conducts electricity, it is ionic because the ions that make up an ionic compound dissociate (break apart) in the water, but if the solution does not conduct electricity, it is a covalent molecule because they do not dissociate, so there are no charged particles in the solution to conduct electricity.

Practice:

1) Determine whether the following compounds are ionic or covalent

a) H_2O: covalent

b) $FeCl_3$: ionic

BONUS NH_4NO_3: ionic

2) Determine whether the following compounds conduct electricity

a) AlF_3: yes, because it is ionic (the ions dissociate)

b) CO_2: no, because it is covalent (it doesn't dissociate)

BONUS H_2O: yes, because it autoionizes (it ionizes itself)

Density

Density is the mass per unit volume. It is calculated by dividing the mass of a substance by its volume. Common units for density are g/cm^3 and g/ml. relative density of a substance compares its density to the density of another substance. The first substance is either more or less dense than the second substance. In rare cases, both substances have the same density.

For this event you may be asked the relative density of the powder compared to a solvent. We can answer this question using the sink or float test. A small amount of the powder is added to a sample of the solvent. If the powder sinks, it is denser than the solvent, but if it floats, then the powder is less dense than the solvent. If the powder is remains suspended in the solvent then they have relatively equal densities.

You may also be asked to approximate the density of the powder. This can be determined by figuring out the relative density of the powder with water, HCl, and NaOH. If we know the densities of these three solvents, and the relative densities, we can determine the range that the density of the powder falls in.

Densities
Water: 1.0 g/ml, HCl: 1.017 g/ml, NaOH: 1.04 g/ml
Memorize

Practice:

1. Determine the relative densities.
    a) A salt sinks when added to NaOH: the salt is denser than NaOH
    b) A salt is suspended in HCl: the salt has the same density as water
    c) A salt floats when added to water: the salt is less dense than HCl

2. Approximate the density of a salt that sinks in water, floats in HCl and floats in NaOH: >1.0g/ml, <1.017g/ml, <1.04g/ml – 1.017-1.0g/ml

BONUS Which is denser air or water? Water (air floats above water)

Solubility

Solubility, what it is? It is the amount of a solute that can dissolve in a solvent. A solute is what is dissolved; it is usually smaller than the solvent. The solvent is what the solute is dissolved in; is usually a solution (liquid).

So, how do we tell if a substance is soluble in solvent? We add a small amount of the substance to the solvent. If the substance completely dissolves (i.e. disappears), then the substance is soluble, if not then it is insoluble (not soluble).

For this event we will be testing solubility with HCl, NaOH, and water, but other solvents may be used.

Practice:

Determine if the substance is soluble or insoluble

1) You add salt to water, and look away for a second, when you look at the solution again all the salt has vanished: soluble

2) You add PbS to water, and no matter how hard you stir the solution, the lead (II) iodide remains at the bottom of the beaker: insoluble

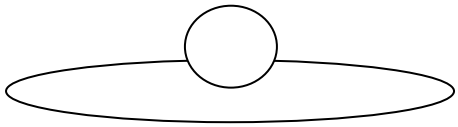
BONUS You dump a whole bag of sugar to glass of water, and part of the sugar disappears: soluble – the solution is saturated, so it can’t dissolve anymore

Hydrophobic v. Hydrophilic

Powders are either hydrophobic or hydrophilic. Hydrophobic means the powder does not mix well with water, whereas hydrophilic means the powder mixes well with water (usually it dissolves as well).

One test to see if a powder is hydrophobic or hydrophilic is relatively easy. First, you take a spoonful of the powder and put it in a glass/plastic dish. Then, you add one drop of water to the center of the pile of powder. If the water drop is readily absorbed by the powder, then the powder is hydrophilic, but if the water drop remains in its drop shape, and is not absorbed, then the powder is hydrophobic.

Hydrophilic



Hydrophobic

Practice:

Identify whether the powder is hydrophobic or hydrophilic

1) When water is added to a pile of powder the water droplet rolls off the pile of powder: hydrophobic

2) A powder dissolves in water: hydrophilic

3) A magic powder says, “I hate water!”: hydrophobic

4) When water is added to a pile of green powder, the powder “drinks” the water up superfast: hydrophilic

BONUS Is water hydrophobic or hydrophilic? hydrophilic

Reactivity

Reactivity is the ability for a substance to undergo a chemical reaction when combined with another compound spontaneously. In this event, you may be asked if there was a reaction when the powder was mixed with water, NaOH, or HCl. How do you know if a reaction has occurred? Some signs that one has happened are a precipitate (a solid) forms on the bottom, the color of the solution changes, bubbles or fizzing occurs, or the temperature changes (it gets hot or cold) NOTE: when recording observations do not say a reaction occurred, write what you saw that indicated a reaction.

Practice: Indicate whether a reaction has occurred or not and what observation allows you to make that inference.

1. When a powder is HCl, the solution turns pink: there was a reaction – a color change occurred.

2. When a powder is added to water, nothing happens: there was no reaction – no changes occurred.

3. When a powder is added to NaOH, the solution bubbles and fizzes: there was a reaction – there was bubbling and fizzing

4. When a powder is added to water, the powder catches on fire: there was a reaction – a gas was produced, and the immense heat produced caused the gas to ignite.

5. When a powder is added to HCl, the temperature stays the same: there was no reaction – the temperature did not change.

6. When a pink powder is added to NaOH, a new green powder forms on the bottom: there was a reaction – a precipitate was formed.

Shape

For this event, you may be asked to determine the shape of the particles of the powder. The first thing you must do is determine if the powder is crystalline or not. If it is then you must decide if the if the crystals are uniform shape or irregular shape. You can do this by looking at the powder under a hand lens. In order for a powder to be crystalline, it is made up of tiny grains, like salt or sugar. Crystals that have a uniform shape have right angles, and flat sides – particles are all the same shape; they are ionic. On the other hand, crystals that have an irregular shape have rounded edges, and rounded irregular sides – particles are not all the same shape; they are usually covalent. Shape is another way to determine if the powder is ionic or covalent (conductivity is the other).

Practice:

1) Does the table salt, NaCl, have a uniform or irregular shape? Is it ionic or covalent? **Uniform - ionic**

2) Does table sugar have a uniform or irregular shape? Is it ionic or covalent? **Irregular - covalent**

3) A powder is composed of crystals that are all the same shape; does it have a uniform or irregular shape? Is it ionic or covalent? **Uniform - ionic**

4) A powder is composed of fine ground particles that are not crystalline; does the powder have a uniform shape, irregular, or neither? **Neither**

5) A powder is composed of particles that have rounded edges and sides; does it have a uniform or irregular shape? Is it ionic or covalent? **Irregular - covalent**

BONUS If a solid cube of powder breaks cleanly when hit with a rubber mallet, does it have a uniform or irregular shape? Why? Is it ionic or covalent? Why? **Uniform shape – flat sides & ionic – ions are arranged so opposite charges are next to each other, and when hit by the mallet the bonds break, and the ions move next to ions of the same charge, so they repel each other.**

Hygroscopic

A powder is hygroscopic if it absorbs moisture from the atmosphere. There are two easy ways to test for this.

If the supervisor provides both a balance and a hot plate, you can test for hygroscopicity by massing a small amount of the powder in a ceramic or glass container with the balance. Record the mass, and place the container on the hot plate and heat it for about ten minutes. Next, remove it, let it cool, and remass it. If the powder has significantly lost mass (water has evaporated), then it is hygroscopic because it lost some of the water that it had taken in from the air earlier.

Another method requires just a balance, but is less effective because it only works if the powder can absorb more water (it's not saturated). Mass a small amount of the powder, and record its mass. Wait about 20-30 minutes before remassing. If the new mass is higher, then the powder is hygroscopic because it absorbed water from the air that added to its mass.

Practice:

Determine if the powder is hygroscopic or not:

1) A powder loses mass when heated, but does not change phase: (y) / n

2) A powder doesn't change mass when exposed to air for awhile: (y) / n

3) A powder becomes wettish when its container is left open: (y) / n

How might you determine if a powder is hygroscopic without a balance or hot plate: **Leave some of the powder out in the open, exposed to air for awhile, and observing if it looks wetter or not.**

Physical Characteristics

Physical characteristics are properties that we can see/smell/hear/ taste/feel or measure.

Category	Examples
See	Color, texture, size, etc.
Smell	Odor – strong, fruity, etc.
Hear	Sound – bang, squeak, etc.
Taste	Sweet, salty, bitter, sour
Feel	Soft, rough, squishy, etc.
Measure	Density, length, volume, etc.

For this event you cannot taste the powder, the powder must be wafted in order to smell it, most powders don't make noises, or you must wear gloves or use a utensil to touch it. Most properties that will be observed are one that you can see or measure.

Practice:

Popcorn kernels puff up when they are cooked in a microwave. The puffs give off a buttery smell, and are hot to the touch. When they are eaten the large, yellow puffs taste salty, and crunch when chewed.

List 6 Physical Characteristics of Popcorn:

1. Smell – buttery
2. Feel – hot
3. Taste – salty
4. Hear – crunch
5. See – puffs
6. See – yellow