

Physical and chemical properties

Melting point (mp.): The temperature at which a substance changes its **solid** state of matter and turns **into a liquid** is called the melting point. A liquid substance turns into a solid at the same temperature (=freezing point).

Boiling point (bp.): the temperature at which a **liquid** changes **into a gas**. At the boiling point, the vapour pressure equals the present air (atmospheric) pressure.

Density is the ratio between mass and volume and is usually measured in gram per cm³. Water has its maximum density at 4°C: 1 g/cm³.

Refraction index: measure of the refraction (=change in direction) of a ray of light when it passes from one optical medium to another, e.g. from a liquid into glass. There are fixed mathematical relations between refraction and concentration. The content of sugar, salt or acids is often measured with a refractometer.

Electrical conductivity: A substance conducts electricity if it is a metal or consists of free charged particles, like salty solutions. Molecules do not conduct electricity (isolators).

Crystal structure: The atoms of the elements in a mineral are joined together to form a **regular** crystal structure. If a substance is built in an irregular way, we call it **amorphous**.

Solubility: tells us about the structure of matter. If a substance is **highly soluble**, this indicates hydrophilic elements (=having an affinity for water). If the substance is **insoluble** it is made up of hydrophobic elements (=lacking affinity for water). In that case we try dissolving them in benzene or in other lipophilic solvents.

Properties of some solid samples:

Substance	mp.°C	crystal structure	solubility in water	solubility in benzine	electrical conductivity	smell
vanillin	81	needle-shaped	+	-	no	typical
urea	132	prisms	+	-	no	—
naphthalene	80	plates	-	+	no	typ
amino benzoic acid	178	needles	+	-	no	—
phenacetin	135	prisms	+	-	no	—
benzoic acid	122	shiny needles	-	-	no	—
hydroquinone	170	needles	+	-	no	typ
menthene	42	needles	-	+	no	typ.
sodium chloride	800	cubic	++	-	no	—
copper chloride aq	110	rhombic, greenish	++	-	yes	—
nickel chloride aq	140*	grassgreen particles * change colour to golden yellow at 140° C)	++	-	yes	—

Properties of some liquid examples:

Substance	bp.°C	δ g/cm ³	n_D	solubility in water	solubility in benzine	smell
acetone	56	0.79	1.36	+	+	nail polish remover
acetic ester	77	0.90	1.37	-	+	glue
ethanol	78	0.79	1.36	+	+	typ
glycerol	290	1.26	1.475	+	-	
methanol	65	0.79	1.33	+	+	typ.
octane	126		1.40	-	+	benzine
pyridine	115	0.98	1.51	+	+	typ., ill-smelling
cyclohexane	81	0.78	1.42	-	+	typ. solvent
1-propanol	97	0.80	1.385	+	+	typ. solvent
Toluene	111	0.867	1.497	-	+	typ. solvent

E1: Identify the physical properties of three unknown samples: what substances are they?

Nr.	description	mp.°C	bp.°C	δ g/cm ³	n_D	soluble*	cond.	substance
1								
2								
3								

* W=water, B=benzine