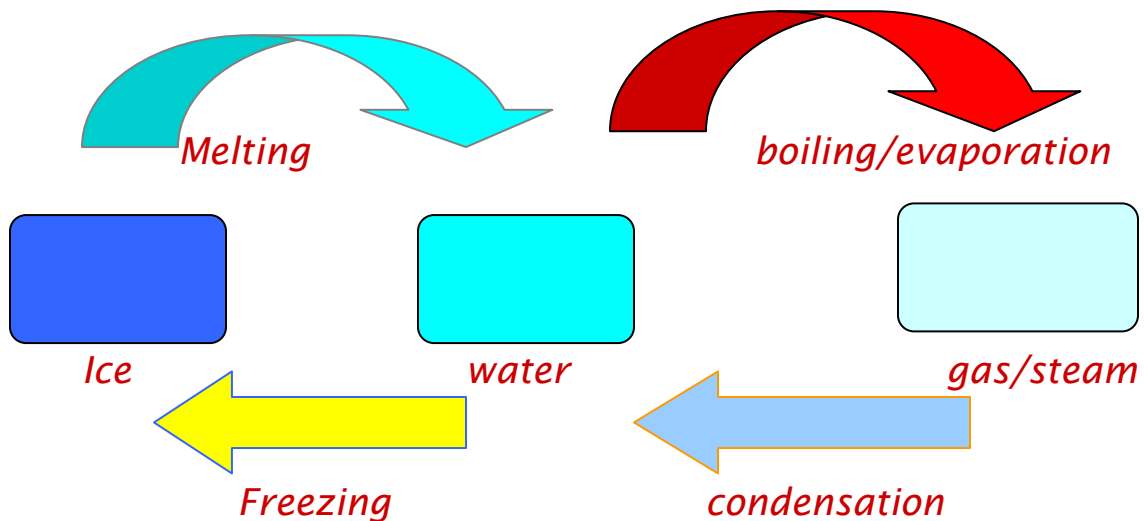


## CHAPTER 5: WATER AND SOLUTIONS

### 5.1 PHYSICAL PROPERTIES OF WATER

1. Water is a colourless, odourless and tasteless liquid.
2. Water exists in three states, which are solid (ice), liquid (water) and gas (steam).
3. Water can change from one state to another.



4. The changes in the state of water occur at specific temperature.
5. The temperature of a substances remains constant, that is it does not rise or drop, during the change of state.
6. The density of water is 1 g per cm<sup>3</sup>. 1 cm<sup>3</sup> of water has a mass of 1 gram. For example, 50 cm<sup>3</sup> of water has a mass of 50 g.
7. Water is a poor conductor of heat.

Draw figure 5.1 page 3 text book volume 2

### The relationship between the freezing and boiling points of water and the Kinetic Theory

1. When water is cooled, the particles lose kinetic energy (heat is released). The particles move more slowly.

2. At freezing point, liquid particles cannot move freely anymore.
3. Liquid particles are pulled together by strong forces of attraction between particles.
4. This is why solid particles cannot move freely. A liquid changes into a solid at freezing point.

Draw figure 5.3 page 4 text book volume 2

5. When heat energy is supplied to a liquid, the liquid particles obtain a lot of kinetic energy and they vibrate faster.
6. At boiling point, the energy obtained enables the liquid particles to overcome and break the forces of attraction between the particles.
7. Boiling is the physical process in which water changes into steam.
8. Liquid particles are feed and change into gas at boiling point.

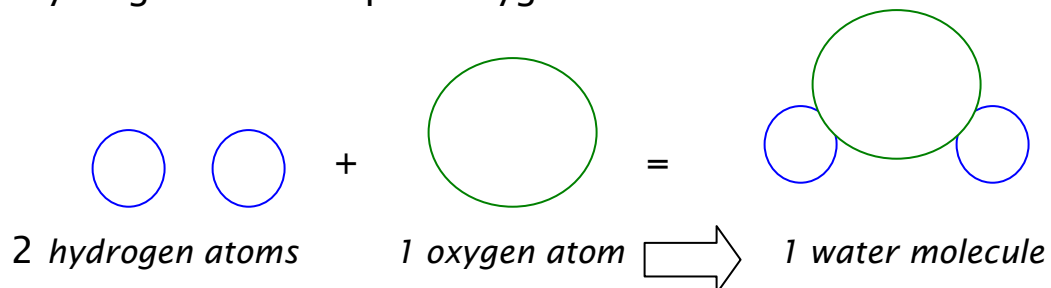
Draw figure 5.5 page 5 text book volume 2

## 5.2 WATER COMPOSITION

[http://peer.tamu.edu/curriculum\\_modules/water\\_quality/module\\_4/lesson.htm](http://peer.tamu.edu/curriculum_modules/water_quality/module_4/lesson.htm)

### The electrolysis of water

1. Water is a chemical compound that consists of two parts hydrogen and one part oxygen.



2. The ratio of hydrogen to oxygen in one molecule of water is 2:1.
3. Water can be separated into hydrogen and oxygen through the process of electrolysis. Hand out ms216 new vision - east view

Draw figure 5.9 page 7 text book volume 2

\*name the gas that is discharged at the anode. Oxy - required for burning  
Name the gas that is discharged at the cathode. Hyd - pop sound

### 5.3 THE PROCESS OF WATER EVAPORATION

#### Water evaporation

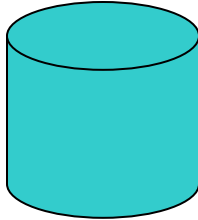
1. Water evaporation is a process in which liquid is slowly lost from surface of the liquid in the form of water vapour into atmosphere.
2. Evaporation occurs at any temperature and at any time.
3. When water evaporates, it changes into gas called water vapour.
4. The amount of water vapour in the air is called its humidity.
5. The rate of water evaporation is influenced by a few factors and can be explained using the Kinetic Theory .
6. The factors that affect the rate of evaporation of water are:
  - a. surface area
  - b. temperature
  - c. humidity
  - d. air movement

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Draw figure 5.15 page 12 text book volume 2

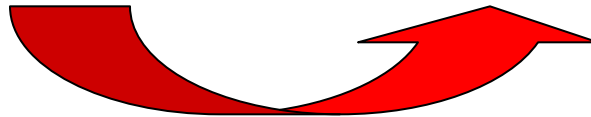
## Evaporation and boiling

### Boiling and evaporation



Water

gas



1. Evaporation takes place at any temperature and at any time.
2. Evaporation occurs only at the surface of the water and is a slow process.
3. Boiling only takes place at boiling point  $100^{\circ}\text{C}$  and all throughout the water.
4. Boiling is a quick process.

Draw photograph 5.2 page 12 text book volume 2

Science info:

Test for presence of water.

- a. anhydrous copper sulphate changes colour from white to blue.
- b. Cobalt chloride paper changes colour from blue to pink.

## 5.4 SOLUTIONS AND SOLUBILITY OF SUBSTANCES

### Solvent, solute and solution

1. A solvent is a liquid that is used to dissolve a substance (solute).
2. A solute is the substance that dissolves in a solvent.
3. A solution is the mixture that is formed a solvent and a solute (solutes dissolved in a solvent).

Draw figure 5.16 page 13 text book volume 2

### Dilute solutions, concentrated solutions and saturated solutions

1. A dilute solution is a solution that has very little solute.
2. A concentrated solution is a solution that has a lot of solute.
3. A saturated solution is a solution that has the maximum amount of solute. A saturated solution cannot dissolve any additional solute that is added to it.

Draw figure 5.17 page 14 text book volume 2

### Suspensions

Go to [www.chemtutor.com/solution.htm](http://www.chemtutor.com/solution.htm) to gain information on the nature of solutions, concentration of solutions and solubility. For easy access, go to [www.icd.com.my](http://www.icd.com.my)

1. A suspension is a liquid that has small particles in it. The small particles are known as suspended substances.
2. The suspended substances do not dissolve in water.
3. When left aside, the suspended substances will sink to the base of the container and the solution formed is clear.

Draw/Photostat table 5.3 page 16 text book volume 2

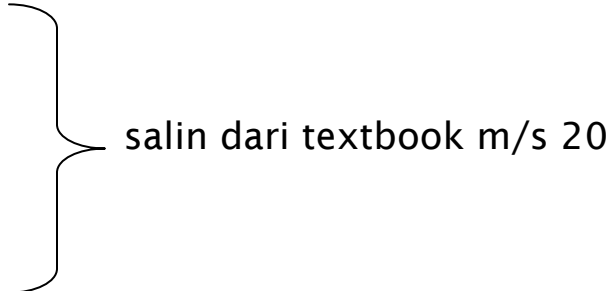
### The solubility of solutes (eksperimen spt m/s 17-19)

1. The solubility is the maximum amount of a solute which can dissolve in a given amount of solvent at a fixed temperature.
2. The solubility of a solute is the quantity of dissolved solute (in grams) in 100 ml of water at a specific temperature, to form a saturated solution.

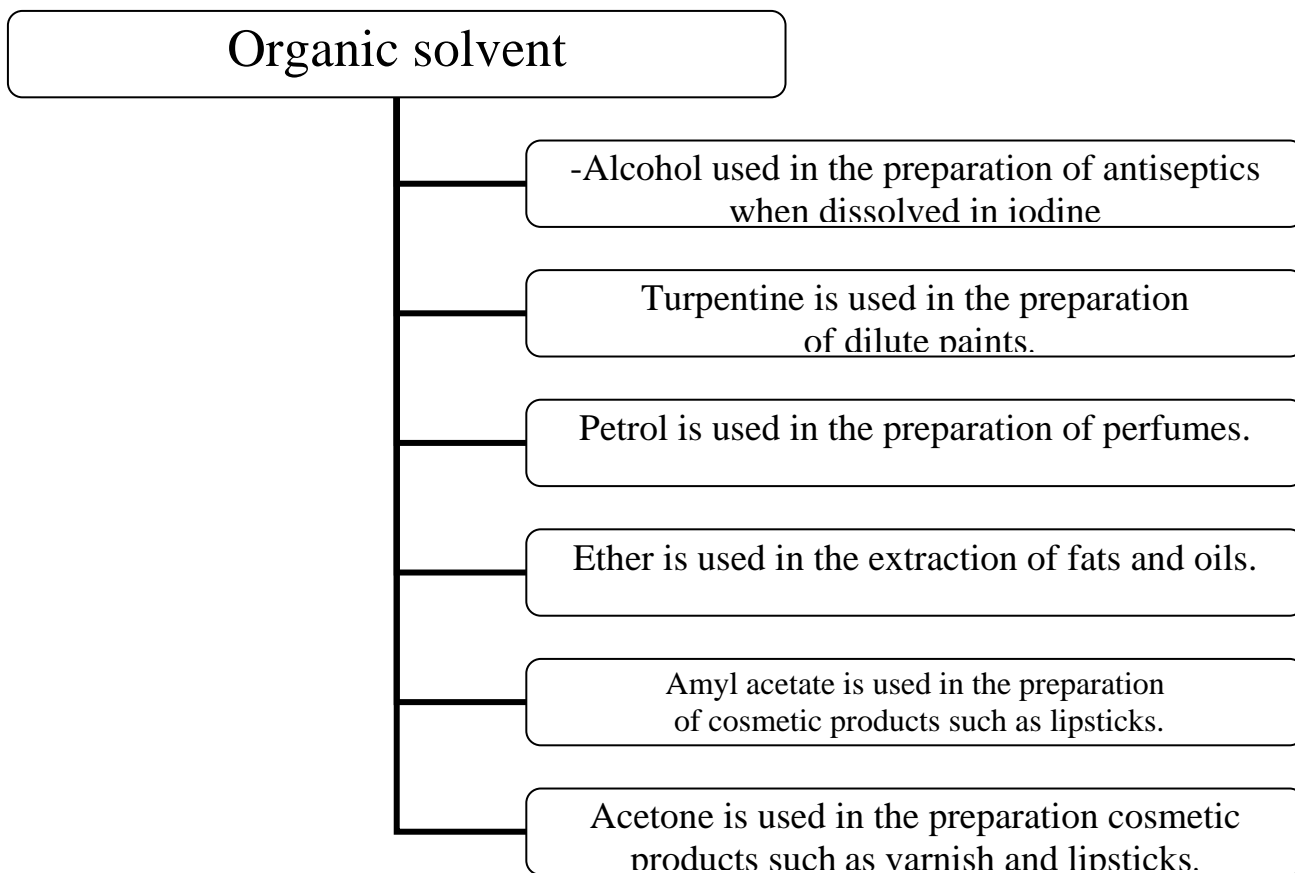
3. For example, the solubility of calcium chloride in water is 120g per 100 ml of water at  $40^{\circ}\text{C}$ . This means that 120g of calcium chloride salt dissolves in 100 ml of water at a temperature of  $40^{\circ}\text{C}$  to form a saturated solution of calcium chloride.
4. The solubility of different solutes in the same volume of solvent, but at different temperatures is different, as shown in Figure 5.13. The graph shows that:
  - (a) The solubility of potassium nitrate increases the most quickly when the temperature increases.
  - (b) The solubility of sodium chloride does not change very much as the temperature increases.
  - (c) At  $200^{\circ}\text{C}$ , the potassium nitrate, potassium chloride and sodium chloride have the same solubilities.
  - (d) At  $700^{\circ}\text{C}$ , calcium chloride and potassium nitrate have the same solubility.
  - (e) The solute of different salts has different solubilities.
  - (f) Solubility increases as the temperature increases.
5. The difference in the solubility rates of solutes at specific temperatures.
6. A few factors affecting solubility of a solute are:
  - a. The nature of the solvent.
    - i. the solubility of a solute depends on the nature of the solvent.
    - ii. Example; soluble in water, less soluble in ethanol and not soluble in diethyl ether.
  - b. The nature of the solute.
    - i. the solubility of a solute depends on the nature of the solute.
    - ii. Example, sugar more soluble than salt.
  - c. The temperature.

- i. decrease in temperature decrease the solubility of solids in liquid.
- ii. increase in temperature increase the solubility of solids in liquid.
- iii. increase in temperature decrease the solubility of gases.

### The importance of water as an universal solvent

1. Water is called the universal solvent.
2. This is because a large variety of substances can dissolve in it.
3. Water, as an universal solvent;
  - a.
  - b.
  - c.
  - d.
  - e.
  - f.
  - g.

salin dari textbook m/s 20
4. Substances that do not dissolve in water may be soluble in organic solution such as alcohol, thinner, turpentine, petrol, kerosene.
5. Application of organic solvent in daily life.



## 5.5 ACIDS AND ALKALIS

1. A solution in which water is known as an aqueous solution.
2. Two common types of aqueous solution that we use everyday are acid and alkalis.

### Acids

1. An acid is a chemical substance that has a hydrogen atom, which can be replaced by a metal or ammonium.
2. Acids can be divided into two groups - organic acids and inorganic acids (mineral acids). [Lihat power point](#)
3. Acids exist in three states which are:
  - a. solid - for examples, tartaric acid
  - b. liquid - for examples, ethanoic acid (acetic acid)


c. gas – for examples, hydrogen chloride

## The Properties of Acids

<http://education.yahoo.com/reference/dictionary/entry/acid>

1. Acids have the following properties:

- a. Taste sour
- b. Are corrosive
- c. Change blue litmus paper to red
- d. Have pH values of less than 7
- e. React with carbonates to release carbon dioxide and form salt and water.

Acid + carbonate  salt + water + carbon dioxide

- f. React with active metals (magnesium/aluminium/zinc/lead) to release hydrogen and form salts.

Acid + metal  salt + hydrogen

- g. Reacts with alkalis to form salt and water (neutralisation process)

Acid + alkalis  salt + water

ACIDS	USES
formic acid	Coagulates latex (rubber tree)
acetic acid (vinegar)	1.preserve food like pickles 2.used in food
sulphuric acid	1.used in car battery 2.to make detergent and fertilizer
tartaric acid	to make soft drink
nitric acid	to make chemical substances

	such as fertilizer, plastic and explosives.
hydrochloric acid	to make disinfectants and liquid washing agents
citric acid	used in fruit juices

## Alkalis

1. An alkali is a hydroxide or metal oxide that dissolves in water.
2. An example of alkalis are potassium hydroxide, sodium hydroxide, calcium hydroxide (lime water), and ammonium hydroxide (ammonia solution) solutions.

## The properties of Alkalis

<http://education.yahoo.com/reference/dictionary/entry/alkalis>

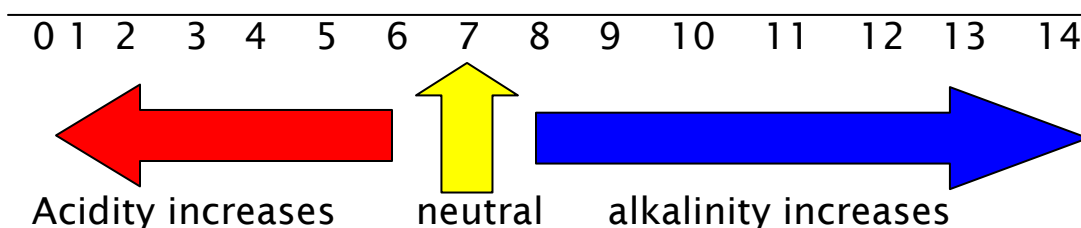
Alkalis have the following properties:

1. taste bitter
2. feel slippery like soap when touched with the fingers
3. are corrosive
4. change red litmus paper to blue
5. have pH values of more than 7
6. react with ammonium salts to release ammonia when heated.
7. react with acids to form salt and water (neutralisation process)

alkalis	uses
Sodium	to make soap
slaked lime, camphor (calcium hydroxide)	1. neutralises acidic soil 2. to make cement
ammonium solutions (ammonium hydroxide)	1. prevent latex from coagulating 2. to make fertilizer

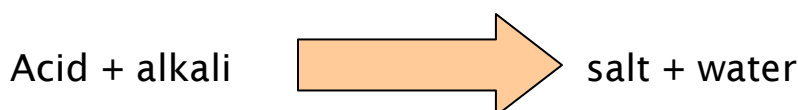
## pH Values (punier Hydrogen)

- The pH value of substances shows if the substance is acidic, neutral or alkaline.
- The pH scale has values from 1 to 14.
  - Acidic conditions (pH 1 – 6): substances with a value of pH 1 is far more acidic than a substance with a value of 6.
  - Neutral condition (pH 7) : neither acidic nor alkaline
  - Alkaline conditions (pH 8 – 14): a substance with a pH value of 14 is far more alkaline than a substance with a pH value of 8.
- The pH values of substances are determined by using pH paper or universal indicator solutions.



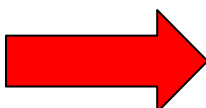
### Neutralisation

- Neutralisation is the reaction that occurs between an acid and an alkali to form salt and water.



- At the neutralisation point, all the acid completely reacts with the alkali. The solution formed does not show acidic or alkaline properties and has a pH value of 7.
- The salt formed from the neutralisation process depends on the type of acid and alkali used, as shown in the following table.
- The method of mixing alkali and acid using a burette to achieve the point of neutralisation is known as the titration method.

Acid	alkali		salt	water
------	--------	--	------	-------



hydrochloric acid	sodium hydroxide		sodium chloride	water
sulphuric acid	calcium hydroxide		calcium sulphate	water
nitric acid	calcium hydroxide		calcium nitrate	water
hydrochloric acid	ammonium hydroxide		ammonium chloride	water

## 5.6 METHODS OF PURIFYING WATER (PMR 2008)

### Filtration (PMR 2008)

1. Filtration makes use of a filter through which liquids such as water and solutions pass through while insoluble solids do not.
2. The liquid that pass through the filter is called the filtrate.
3. The solid that is left on the filter is called the residue.

Draw figure 5.36 page 28 text book volume 2

### Distillation (PMR 2008)

[Http://www.apswater.com/page43.html](http://www.apswater.com/page43.html)

1. When mixture of water and impurities is heated until it boils, only the water changes into steam while its impurities are left behind.
2. The steam is then cooled and condensed to produce pure water.

Draw figure 5.37 page 29 text book volume 2

### Sedimentation

1. A mixture of water and heavy insoluble solids will separate after a while.

2. The solids will settle or sink to the bottom as sediments due to gravity.

### Boiling (PMR 2008)

1. Boiling water kill most, if not all, micro-organisms present in the water.
2. All drinking water must be boiled.
3. Some of the bacteria may be harmful. (diarrhoea and cholera)

### Chlorination (PMR 2008)

Go to [www.dcs.ex.ac.uk/water](http://www.dcs.ex.ac.uk/water) to gather information about water and how it is treated. For easy access, go to [www.icd.com.my](http://www.icd.com.my)

1. Chlorination is a gas which an kill micro-organisms.
2. When chlorine is added into water, most micro-organisms are killed and the dissolved gas will leave the water after some time.

### Ozone

1. Ozone is another gas that can kill micro-organisms in water.
- 2.. It is now used in swimming pools to replace chlorine, as it does not have a strong smell or bleaching effect like chlorine.

### Ultraviolet Light

Ultraviolet Light can kill micro-organisms in water.

It is now used to sterilise the water in fish ponds and the food processing industries.

### 5.7 WATER SUPPLY SYSTEM (PMR 2008)

1. The main source of water in our country is rainwater and river water.
2. Before it is purified, rainwater and river water is collected in reservoirs/dam. The water is then pumped to water purification plants to be purified.
3. The following are the different stages of water purification at the waterworks.

Draw figure 5.38 page 31 text book volume 2 (PMR 2008)

Salin stage 1, stage 2, stage 3, stage 4, stage 5 dari textbook ms 31-32

### Water purification and supply system

1. In some places, fluoride is added to reduce tooth decay.

#### Step to save water,

- a. bathe by showering
- b. Wash clothes in big quantities.
- c. Wash vegetables in a basin.
- d. Repair all water pipe leaks immediately.
- e. Turn off the tap when not in use.
- f. Use a watering can to water plants.

### 5.8 PRESERVING WATER QUALITY

Water pollution occurs when water is dirtied by waste thrown into it. Polluted water is no longer suitable for living things.

## Water pollutants

[http://en.wikipedia.org/wiki/water\\_pollution](http://en.wikipedia.org/wiki/water_pollution)

[http://www.ec.gc.ca/water/en/manage/poll/e\\_poll.htm](http://www.ec.gc.ca/water/en/manage/poll/e_poll.htm)

1. There are various water pollutants:
  - a. Domestic waste such as rubbish, animal carcasses and faeces.
  - b. Industrial waste such as chemical residual (acid and alkaline solutions) and radioactive substances.
  - c. Chemical substances in agriculture such as pesticides, chemical fertilisers and agriculture waste (latex and oil palm)
  - d. Mud and silt caused by the construction industries and logging.

Draw figure 5.4 page 33-34 text book volume 2
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## The effect of water pollution on living things.

1. Water pollution brings about adverse effects on the equilibrium in nature.
2. the effects of water pollution on living things include:
  - a. polluted water cannot be used for drinking or bathing. Polluted water causes diseases such as skin diseases and cholera.
  - b. Aquatic life such as fish, prawn will die. This reduces the fisherman's catch and the human food supply.
  - c. Aquatic life that are poisoned by chemicals such as lead or mercury will cause adverse effects if eaten.

## Dictionary

Aqueous solution - larutan berair

Boiling	- pendidihan
Bonds	- terikat
Coagulate	- menggumpal
Colourless	- tidak berwarna
Compound	- sebatian
Concentrated solution	- larutan pekat
Condenses	- memeluap
Dilute solution	- larutan cair
Discharge	- terhasil
Distillation	- penyulingan
Filtration	- penurasan
Humidity	- kelembapan
Impurity	- bendasing
Marine product	- hasil laut
Melting point	- takat lebur
Metal oxide	- oksida logam
Mud and silt	- Lumpur dan mendapan
Nature of solute	- sifat zat terlarut
Nature of solvent	- sifat pelarut
Neutralisation	- penueutralan
Odourless	- tidak berbau
Occurs	- terjadi
Oil spill	- tumpahan minyak
Particles	- zarah
Potassium	- kalium
Precipitate	- mendakan
Preservation	- pengawetan
Properties	- sifat
Residue	- baki/sisa
Saturated solution	- larutan tepu
Sedimentation	- pegenapan
Silt	- lodak
Sodium	- natrium
Solubility	- kelarutan
Solute solution	- zat larutan
Solvent	- pelarut
Stronger	- kuat
Suspension	- ampaian/bahan terampai
Titration	- pentitratan

Universal solvent      - pelarut universal  
Weaker                    - longgar