

A. Heating Solids:

- when solids are heated, eventually they **melt**
- the temperature at which they begin to become liquid is called the **melting point (m.p.)**
- when liquids are cooled, eventually they **freeze**
- the temperature at which they begin to become solid is called **freezing point (f.p.)**
- the melting point and the freezing point of any substance are both at the same **temperature**
- some solids turn directly into **gas** when they are heated, without going through the liquid phase
- the change of state from solid to gas is called **sublimation**

B. Making Liquids Boil:

- adding heat is not the only way to make a liquid boil
- the **pressure** on the liquid is another factor
- pressure is the **force per unit area** on the surface of a substance
- water will boil at **100°C** when the pressure of the air on the water is normal
- normal pressure is called **standard** or **atmospheric pressure**
- at high elevations, where the pressure of the atmosphere is low, water will boil before 100°C
- this is because there is less pressure on the surface of the water
- therefore, if you want a liquid to boil sooner, all you need to do is lower the pressure of the air on the surface of the liquid

C. Vaporization:

- liquids change to gases if they are heated enough
- the temperature at which a liquid starts to become a gas is called the **boiling point (b.p.)**
- the boiling point is defined as the lowest temperature at which bubbles of its vapour can exist in the liquid
- the bubbles forming when a liquid boils are not air, but the gaseous form of the liquid that is boiling
- the boiling liquid does not increase in temperature as it continues to boil – it will remain at a fixed point until all of it changes into gas, even though more and more heat is added

D. Fixed Points

- a pure substance has nothing else in it other than the substance itself – for example, tap water is not pure water since it contains additional substances like chloride, fluoride, iron, magnesium, etc.
- if you were to distill tap water you could remove all of its impurities and be left with just water – H₂O

- when a substance is pure, it will always melt, boil, freeze, condense, and sublime at definite temperatures
- these temperatures are called **fixed points**
- table 2-2, p. 61, shows the fixed points for some common substances at standard pressure
- if salt is added to water it is no longer a pure substance, but a solution
- solutions have different physical properties than the pure substances that make them up
- the result is a change in the fixed points
- pure water freezes at 0°C – salt water freezes below 0°C
- this is why we salt our roads in the winter – the salt mixes with the water, making it impure, and in turn, reduces the freezing point
- how would you use fixed points to identify a substance? Record the temperature it freezes, melts, boils, or condenses at, and compare it to known fixed point values of substances in a table.

D. Controlled Experiments:

- a controlled experiment means that only one variable is allowed to change – all other variables are kept constant
- this means that any changes that occur in an experiment are due to the change in the one variable in question – nothing else
- Example:

A scientist wants to know the effects of an acid on various fabrics. However, acid is made of a solution of water and gas. If he/she is to exclude all other variables that might also affect the fabrics, like water, then first the scientist must see if water, alone, has an effect on the fabrics tested. A control experiment in this case would be to soak the same fabrics in just water as well as in the acid overnight. Any differences between the two would have to have been caused by the acid

INVESTIGATING CHANGES OF STATE WORKSHEET

Heating Solids

When solids are heated, eventually they _____. The temperature at which they begin to become liquid is called the _____. When liquids are _____, eventually they _____. The temperature at which they begin to become solid is called _____. The melting point and the freezing point of any substance are both at the same _____. Some solids turn directly into _____ when they are heated, without going through the liquid phase. The change of state from solid to gas is called _____.

Making Liquids Boil

Adding _____ is not the only way to make a liquid boil. The _____ on the liquid is another factor. Pressure is the _____ on the surface of a substance. Water will boil at _____ when the pressure of the air on the water is normal. Normal pressure is called _____ or _____. At _____ elevations, where the pressure of the atmosphere is _____, water will boil _____ 100°C. This is because there is less pressure on the surface of the water. Therefore, if you want a liquid to boil _____, all you need to do is lower the pressure of the air on the surface of the liquid.

Vaporization

Liquids change to _____ if they are heated enough. The temperature at which a liquid starts to become a gas is called the _____. The boiling point is defined as _____.

The bubbles forming when a liquid boils are not air, but the _____ form of the liquid that is boiling. The boiling liquid does not _____ in temperature as it continues to boil. It will remain at a fixed point until all of it changes into gas, even though more and more heat is added.

Fixed Points

A _____ has nothing else in it other than the substance itself. For example, tap water is not pure water since it contains additional substances like chloride, fluoride, iron, magnesium, etc. If you were to distill tap water you could remove all of its impurities and be left with just water; _____ (chemical formula). When a substance is pure, it will always _____, _____, _____, _____, and _____ at definite temperatures. These temperatures are called _____. Table 2-2, p. 61, shows the fixed points for some common substances at _____. If salt is added to water it is no longer a pure substance, but a solution. Solutions have different _____ than the pure substances that make them up. The result is a change in the fixed points. Pure water freezes at 0°C – salt water freezes _____ 0°C . This is why we salt our roads in the winter – the salt mixes with the water, making it impure, and in turn, _____ the freezing point. How would you use fixed points to identify a substance?

Controlled Experiments

A _____ experiment means that only one _____ is allowed to change, while all other variables are kept constant. This means that any changes that occur in an experiment are due to the change in the one variable in question – nothing else. For instance, let's say that a scientist wants to know the effects that an acid will have on various fabrics. But acid is made of a solution of water and gas. If he/she is to exclude all other _____ that might also affect the fabrics, like water, then first the scientist must see if water, alone, has an effect on the fabrics tested. A _____ in this case would be to soak the same fabrics in just water as well as in the acid overnight. Any differences between the two would have to have been caused by the acid.