#### CHEM3520 - Spring 2023

Focus 1: Properties of gases

Focus 2: The First Law

- Focus 3: The Second and Third Laws
- Focus 4: Physical transformation of pure substances
- Focus 5: Simple mixtures

Focus 6: Chemical equilibrium

Focus 16: Molecules in motion

Focus 17: Chemical kinetics

Focus 18: Reaction dynamics

Focus 19: Processes at solid surfaces

# Focus 5: Simple mixtures

- TD description of mixtures
- **Properties of solutions**
- Phase diagrams of binary systems
- Phase diagrams of ternary systems
- Thermodynamic activity











The eutectic mixture formed by 23% NaCl and 77% H<sub>2</sub>O by mass melts at -21.1 °C



cooling curves at different compositions



cooling curves at different compositions



Eutectic halt: A period where the temperature doesn't change – similar to the phase change of a pure substance

A +B ----> C

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A phase transition in which a substance undergoes a change from a solid state to a liquid state while maintaining the same composition throughout the process



```
A +B ----> C
```

At this temperature:

- The compound C melts to form a liquid with exactly the same composition as the solid.
- No other solids (like pure A or B) appear during the melting.
- The melting process is clean and direct, like melting pure ice to water.



**Congruent melting** 

A phase transition in which a substance undergoes a change from a solid state to a liquid state while maintaining the same composition throughout the process

#### **Congruent melting**

Throughout the melting process, the composition of the liquid it forms is the same as that of the solid compound

### $Ga + As \rightarrow GaAs$

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in which a compound melts into its components and does not itself form a liquid phase.



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#### **Incongruent melting**

in which a compound melts into its components and does not itself form a liquid phase.

Unstable liquid



Focus 5: Simple mixtures

TD description of mixtures

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Phase diagrams of binary systems

Phase diagrams of ternary systems

Thermodynamic activity





Can treat this as three binary systems, AB, BC, and AC





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Ternary phase prism or temperature–composition phase diagram.



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Ternary phase prism or temperature–composition phase diagram.



Ternary phase prism or temperature–composition phase diagram.



Phase separation

Ternary phase prism or temperature–composition phase diagram.



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Thermodynamic activity