

# Phase Changes

## Aim

- to describe and explain phase changes

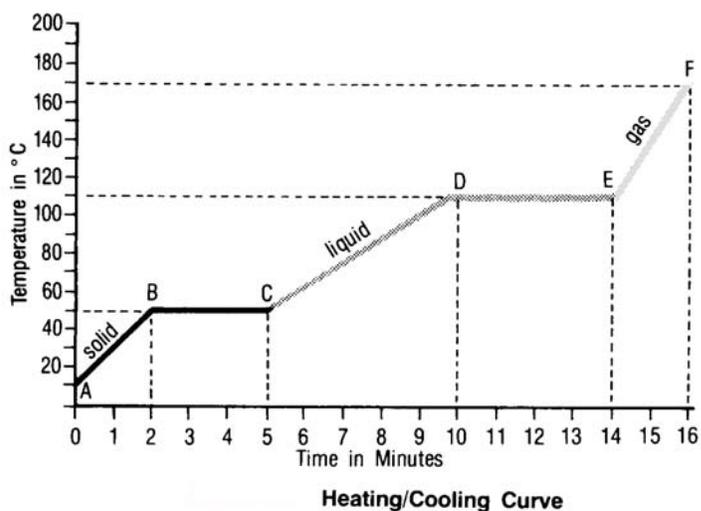
## Notes

### Why phase changes

- ★ Heating a substance in a given phase causes the temperature to increase
- ★ Increasing the temperature causes particles to move faster and collide harder
- ★ Harder faster collisions cause particles to rebound harder moving them further apart
- ★ Larger distances between particles weakens the forces of attraction between them
- ★ When the forces of attraction are weak enough, the distance between the particles increases markedly and the phase changes
  - ☆ Solid melts
  - ☆ Liquid evaporates
- ★ The reverse happens when a substance cools
  - ☆ Gas condenses
  - ☆ Liquid freezes

### What occurs during a phase change

- ★ the temperature does not change
  - ☆ The heat energy absorbed or lost does not result in a change in kinetic energy
  - ☆ Instead, there is a change in potential energy due to the change in distance between the particles
- ★ Freezing/Melting
  - ☆ Freezing/Melting point - temperature at which the solid and liquid phase exist in equilibrium
  - ☆ Heat of fusion - amount of heat needed to change a unit mass of a substance from a solid to a liquid at a constant temperature and 1 atm of pressure
    - ★ Water 333.6 J/g
- ★ Evaporation/Condensation
  - ☆ Boiling point - temperature at which the vapor pressure is equal to the surrounding pressure
  - ☆ Heat of vaporization - amount of heat needed to change a unit mass of a substance from a liquid to a gas at a constant temperature and 1 atm of pressure
    - ★ Water 2259 J/g

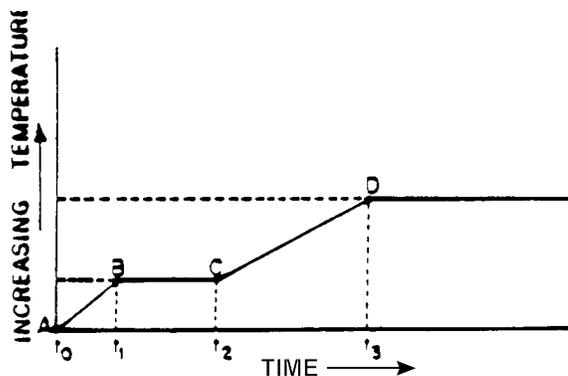


Answer the questions below by circling the number of the correct response

- As ice melts at standard pressure, its temperature remains at  $0^{\circ}\text{C}$  until it has completely melted. Its potential energy (1) decreases (2) increases (3) remains the same
- When water freezes, each gram loses an amount of heat equal to its heat of (1) fusion (2) vaporization (3) sublimation (4) reaction
- As the temperature of a liquid increases, its vapor pressure (1) decreases (2) increases (3) remains the same
- Which change of phase represents fusion? (1) gas to liquid (2) gas to solid (3) solid to liquid (4) liquid to gas
- Which substance readily sublimates at room temperature? (1)  $\text{H}_2\text{O}(\ell)$  (2)  $\text{O}_2(\text{g})$  (3)  $\text{Fe}(\text{s})$  (4)  $\text{CO}_2(\text{s})$
- Which change of phase represents sublimation? (1)  $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\ell)$  (3)  $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$  (2)  $\text{H}_2\text{O}(\ell) \rightarrow \text{H}_2\text{O}(\text{s})$  (4)  $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\ell)$
- Which change of phase is exothermic? (1) gas to liquid (2) solid to liquid (3) solid to gas (4) liquid to gas
- The heat of fusion for ice is 333.6 joules per gram. Adding 333.6 joules of heat to one gram of ice at STP will cause the ice to (1) increase in temperature (2) decrease in temperature (3) change to water at a higher temperature (4) change to water at the same temperature
- Which term represents the change of a substance from the solid phase to the liquid phase? (1) condensation (2) vaporization (3) evaporation (4) fusion
- When the vapor pressure of a liquid in an open container equals the atmospheric pressure, the liquid will (1) freeze (2) crystallize (3) melt (4) boil

- The energy required to change a unit mass of a solid to a liquid at constant temperature is called its heat of (1) formation (3) combustion (2) vaporization (4) fusion

Base your answers to questions 12 and 13 on the diagram below which represents a substance being from a solid to a gas, the pressure remaining constant



- The substance begins to boil at point (1) E (2) B (3) C (4) D
- Between points B and C the substance exists in (1) the solid state, only (2) the liquid state, only (3) both the solid and liquid states (4) neither the solid nor the liquid state
- Which sample contains particles arranged in regular geometric pattern? (1)  $\text{CO}_2(\ell)$  (2)  $\text{CO}_2(\text{s})$  (3)  $\text{CO}_2(\text{g})$  (4)  $\text{CO}_2(\text{aq})$
- The heat of fusion of a substance is the energy measured during a (1) phase change (2) temperature change (3) chemical change (4) pressure change