master COPY

CSUSM
STEM Success Center

Phase Changes

Phase Changes are physical changes which occur when matter changes energy states; however, the chemical bonds DO NOT change. For example, the physical properties of steam, ice, and liquid water are all different despite having the same chemical structure (H_2O). In these substances, there is no difference in their molecular structure. Each phase of a substance is dependent on the amount of energy the atoms contain. All the atoms are in motion; the higher the energy of the atom, the faster the motion and farther apart the atoms move. Though undetectable to the eyes, all solid material is vibrating in place. Liquids allow atoms to roll around each other but not bounce out of their container. A gas has the highest amount of energy, allowing the atoms to bounce out of their container.

1. Fill in the blank for these phase change descriptions:

Melting

The change from _____ to _____.

Freezing

The change from _____ to _____.

Evaporation

The change from _____ to _____.

Condensation

The change from _____ to _____.

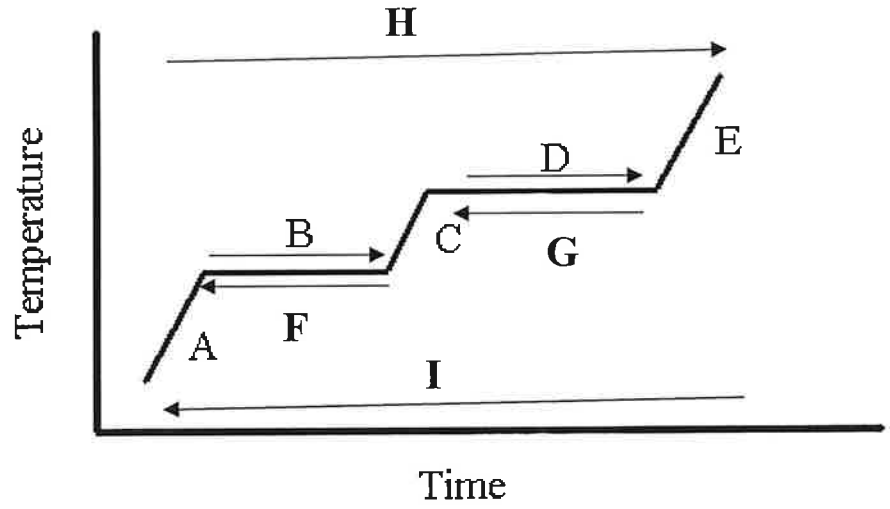
Sublimation

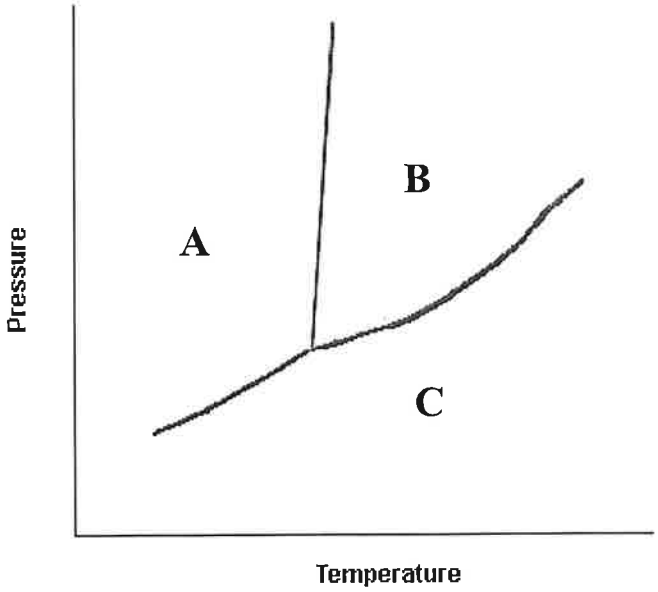
The change from _____ to _____.

Deposition

The change from _____ to _____.

2. Fill in the blank for these phase change diagrams:





3. Is melting endothermic or exothermic? Explain.

4. Is vaporization endothermic or exothermic? Explain.

5. Describe the process of sublimation and provide an example. Is sublimation endothermic or exothermic? Explain.

6. Calculate the amount of heat required to melt 50.0 g of ice at 0°C. Express your answer in Joules.

7. How much energy is released to the environment by 35.0 g of condensing water vapor?

8. How much energy is needed to melt a 20 kg bag of ice at 0°C?

9. Calculate the amount of heat needed to convert 230.0 g of water at -20°C to steam at 18°C.

Master Copy

CSUSM
STEM Success Center

Phase Changes (Solutions)

1. Fill in the blank for these phase change descriptions:

Melting

The change from _____solid_____ to _____liquid_____.

Freezing

The change from _____liquid_____ to _____solid_____.

Evaporation

The change from _____liquid_____ to _____gas_____.

Condensation

The change from _____gas_____ to _____liquid_____.

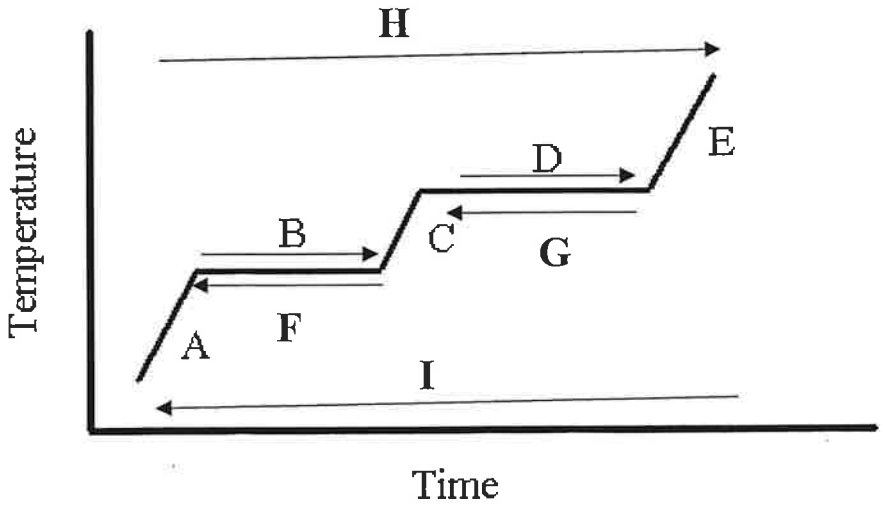
Sublimation

The change from _____solid_____ to _____gas_____.

Deposition

The change from _____gas_____ to _____solid_____.

2. Fill in the blank for these phase change diagrams:



A - Solid

B - Melting

C - Liquid

D - Evaporation

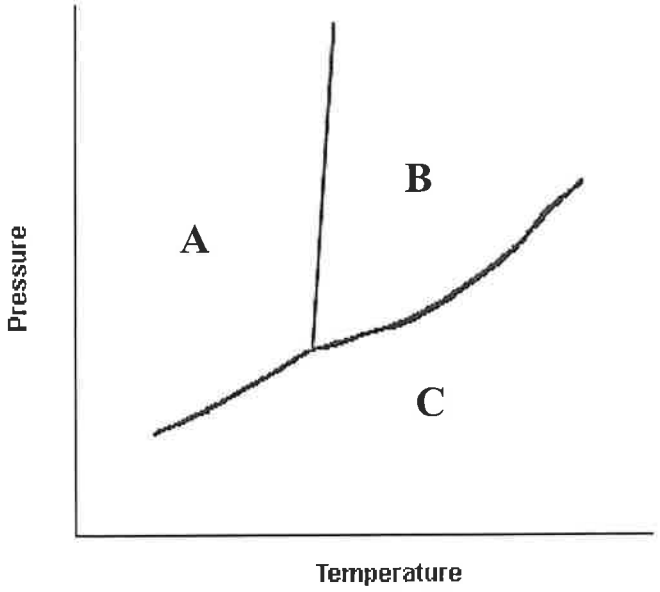
E - Gas

F - Freezing

G - Condensation

H – Sublimation

I - Deposition



A - Solid

B - Liquid

C - Gas

3. Is melting endothermic or exothermic? Explain.

   Endothermic; Energy is being added to the solid for it to melt.

4. Is vaporization endothermic or exothermic? Explain.

   Endothermic; Energy is being added to the liquid for it to vaporize.

5. Describe the process of sublimation and provide an example. Is sublimation endothermic or exothermic? Explain.

   Sublimation is the process of a solid changing to a gas by skipping the liquid phase. An example of this change is snow during late winter. This process is endothermic because energy is absorbed by the solid during sublimation.

6. Calculate the amount of heat required to melt 50.0 g of ice at 0°C. Express your answer in kilojoules. **ANSWER**

$$= 50\text{g } H_2O \times \frac{1\text{ mol } H_2O}{18.02\text{g } H_2O} \times \frac{6.01\text{ kJ}}{1\text{ mol } H_2O}$$

= 16.7 kJ

7. How much energy is released to the environment by 35.0 g of condensing water vapor? **ANSWER**

$$= 35\text{g } H_2O \times \frac{1\text{ mol } H_2O}{18.02\text{g } H_2O} \times \frac{40.7\text{ kJ}}{1\text{ mol } H_2O}$$

= 79.1 kJ

8. How much energy is needed to melt a 20 kg bag of ice at 0°C? **ANSWER**

$$= 20\text{kg } H_2O \times \frac{1000\text{ g}}{1\text{ kg}} \times \frac{1\text{ mol } H_2O}{18.02\text{g } H_2O} \times \frac{6.01\text{ kJ}}{1\text{ mol } H_2O}$$

= 6670 kJ

9. Calculate the amount of heat needed to convert 230.0 g of liquid water at -20°C to steam at 18°C. **ANSWER**

1) Heat Water

$q = mc\Delta t$

$m = 230g$

$c = 4.184\ J/g°C$

$\Delta t = 18°C - (-20°C) = 38°C$

$q = (230g)(4.184\ J/g°C)(38°C)$

$q = 36568\ J \rightarrow 36.568\ kJ$

2) Boil

$$= 230g\ H_2O \times \frac{1\ mol\ H_2O}{18.02g\ H_2O} \times \frac{40.7\ kJ}{1\ mol\ H_2O}$$

$= 519\ kJ$

3) Add

$36.568\ kJ + 519\ kJ = \mathbf{556\ kJ}$