

Chemical Reactions 2

Unit 9

Le Chatelier's Principle

Equations Review

Topic 1

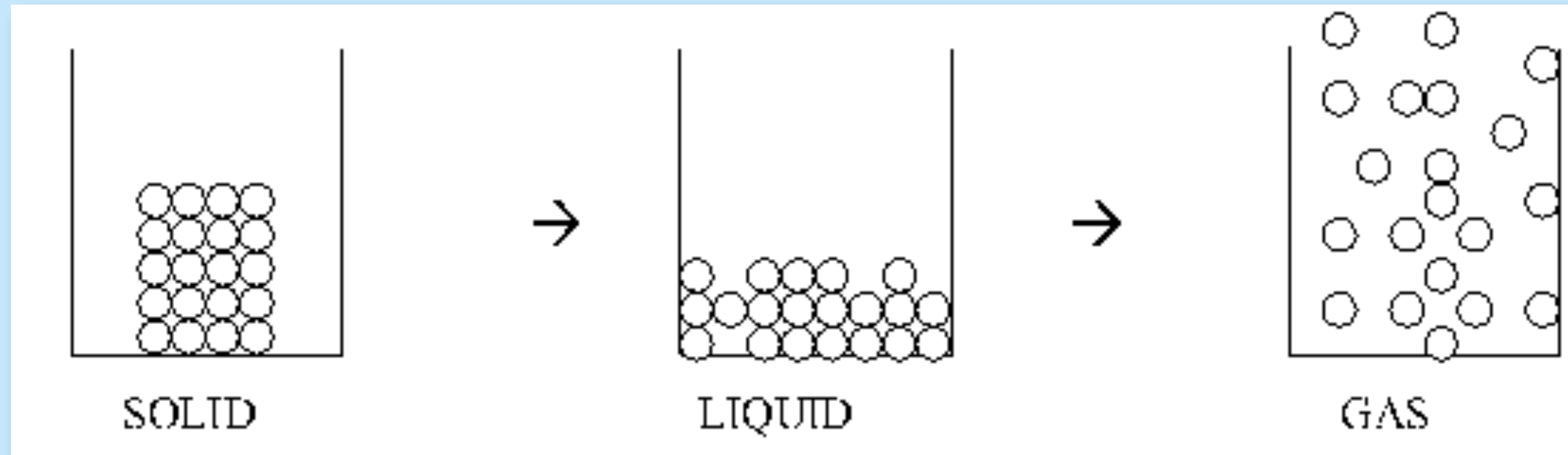


Let's do some review with the Haber process reaction!

Heat of Reaction & Heat Measurement

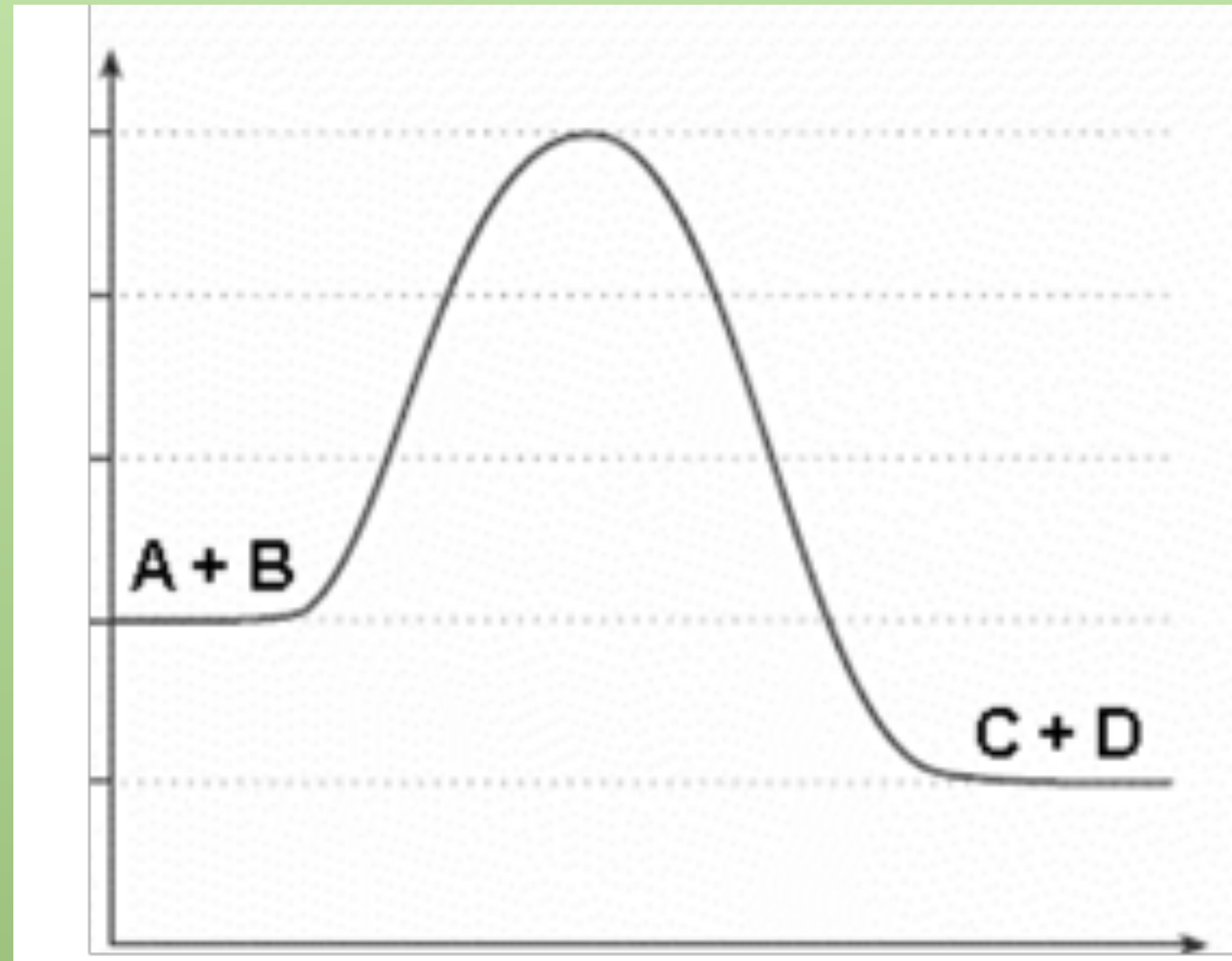
Topic 2

- If added heat causes a phase change, it is adding potential energy to the molecules and is being used to overcome intermolecular forces.



1. Label the phase changes associated with the arrows above.
2. Which phase change would be the most difficult to do (most energy)?
3. Explain your answer to #2 in terms of IMFs.

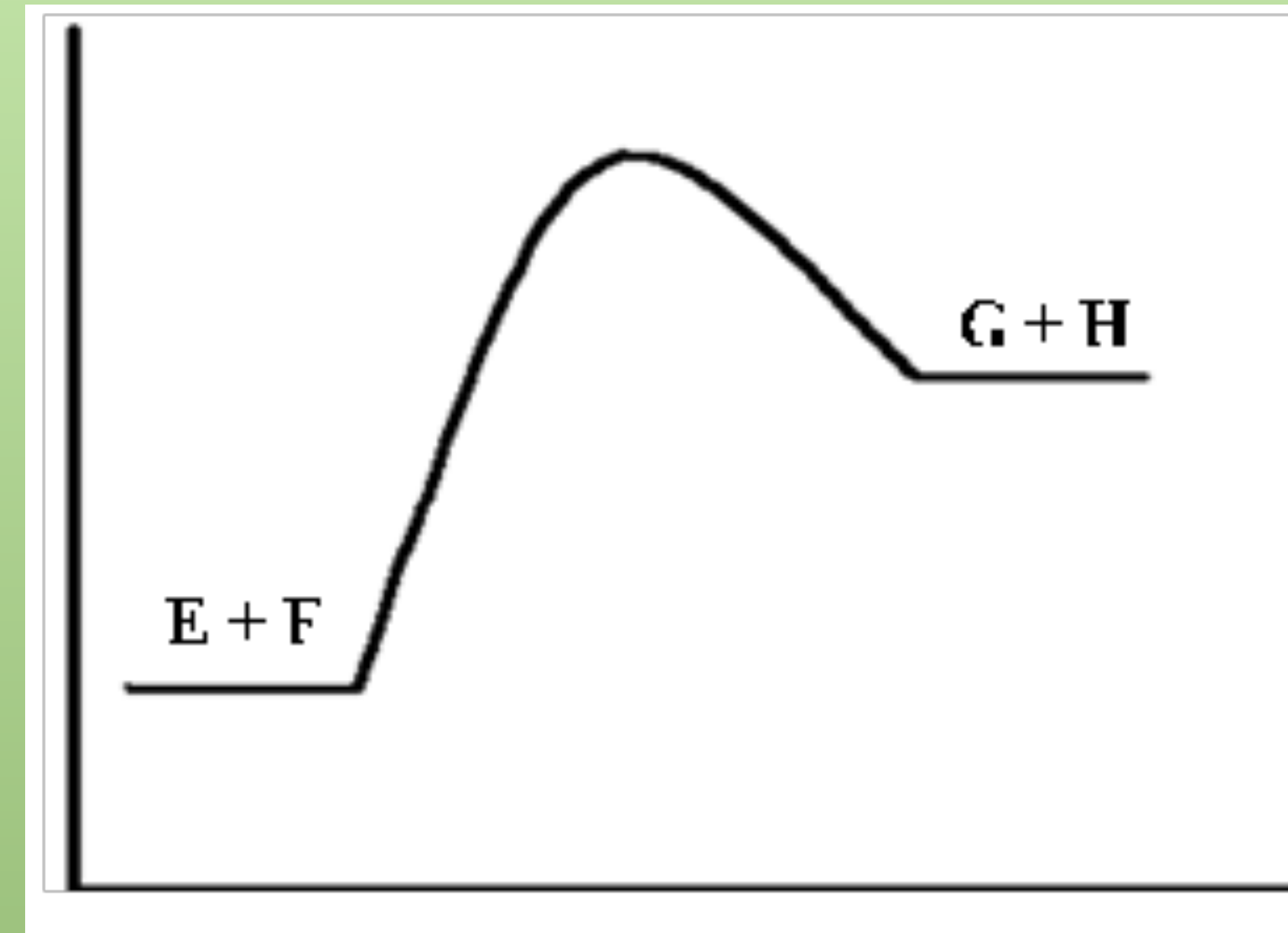
Review: Potential Energy Diagrams



PE Reactants?

PE Products?

Exothermic



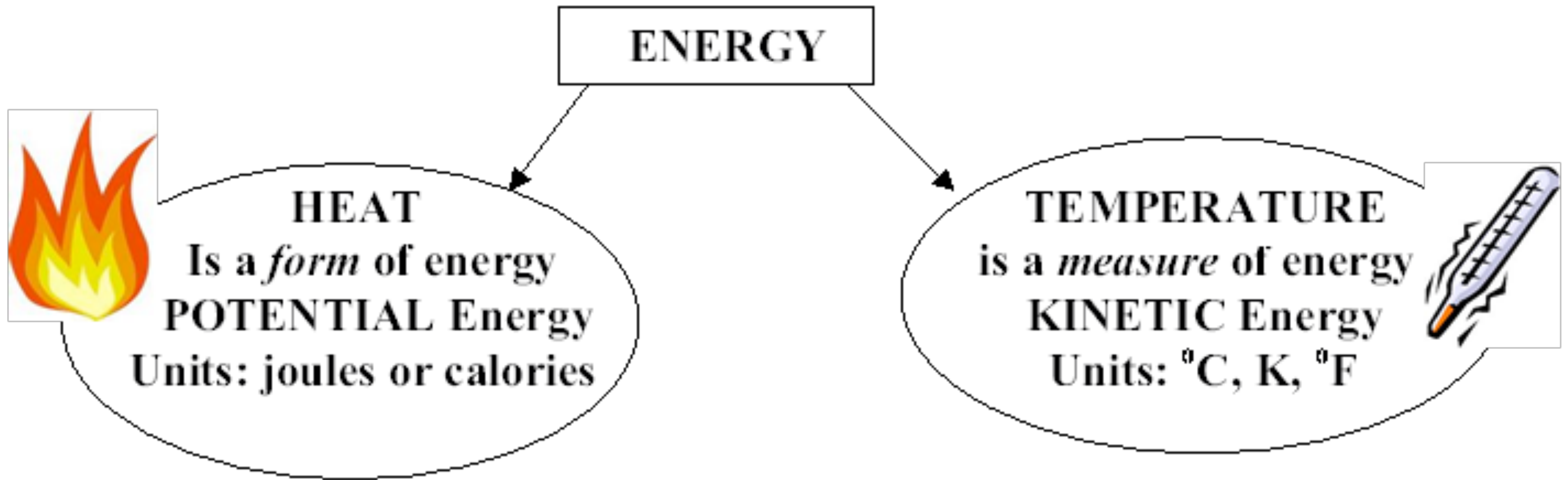
Energy of Activation?

Heat of Reaction?

Endothermic

Calculating Heat

- REMEMBER: Heat is different from Temperature!



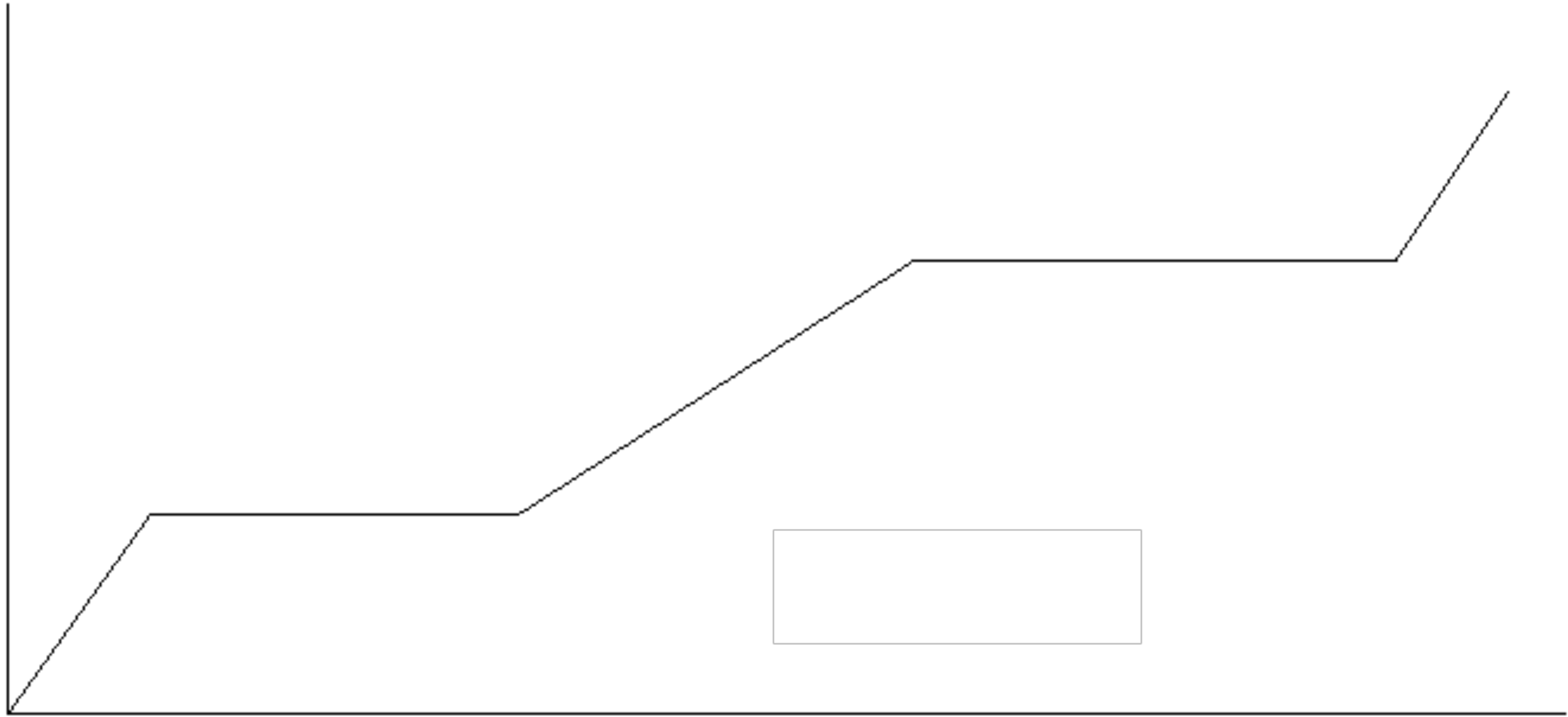
Specific Heat

- **Specific Heat**: the 'specific' amount of heat energy needed to increase the temperature of 1 gram of a substance by 1°C.
- ***Higher Specific Heat = More Energy to heat it***

3 Equations for Calculating Heat (Table T)

- **$q = mH_f$**
- **$q = mH_v$**
- **$q = mC\Delta T$**
- q = heat (joules)
- m = mass (grams)
- C = specific heat (usually for H_2O)
- ΔT = change in temperature
- H_f = heat of fusion (Table B for water)
- H_v = heat of vaporization (Table B for water)
- How do you know which equation to use?
- If temperature is changing, use the equation with ΔT !!

Heating and Cooling Curves



Practice Problems

1. How much heat is required to melt 47 grams of ice (solid water)?

2. How much heat is required to boil off 47 grams of water?

3. Why is your answer to #2 so much higher than answer #1? Answer in terms of IMFs.

More Practice

4. How much heat is required to change the temperature of a 200 g glass of water from 22°C to 50°C ?
5. If 400. Joules of energy are added to 100 g of water, how much will the temperature increase by?

6. If 650 joules of energy are removed from 100 g of water, how much will the temperature decrease by?

7. If the specific heat of aluminum is 0.90 joules/°C-g, how much energy is required to raise the temperature of 150 grams of aluminum from 18°C to 26°C?

8. If the amount of energy from Question #7 is added to 150 grams of water (and no heat is lost to the surroundings), how much will the temperature of the water increase?

9. If the original temperature of the water was 10°C , what will be the new temperature of the water?

10. Which would require less heat in order to cause an increase in temperature of 10°C ? Aluminum or water?

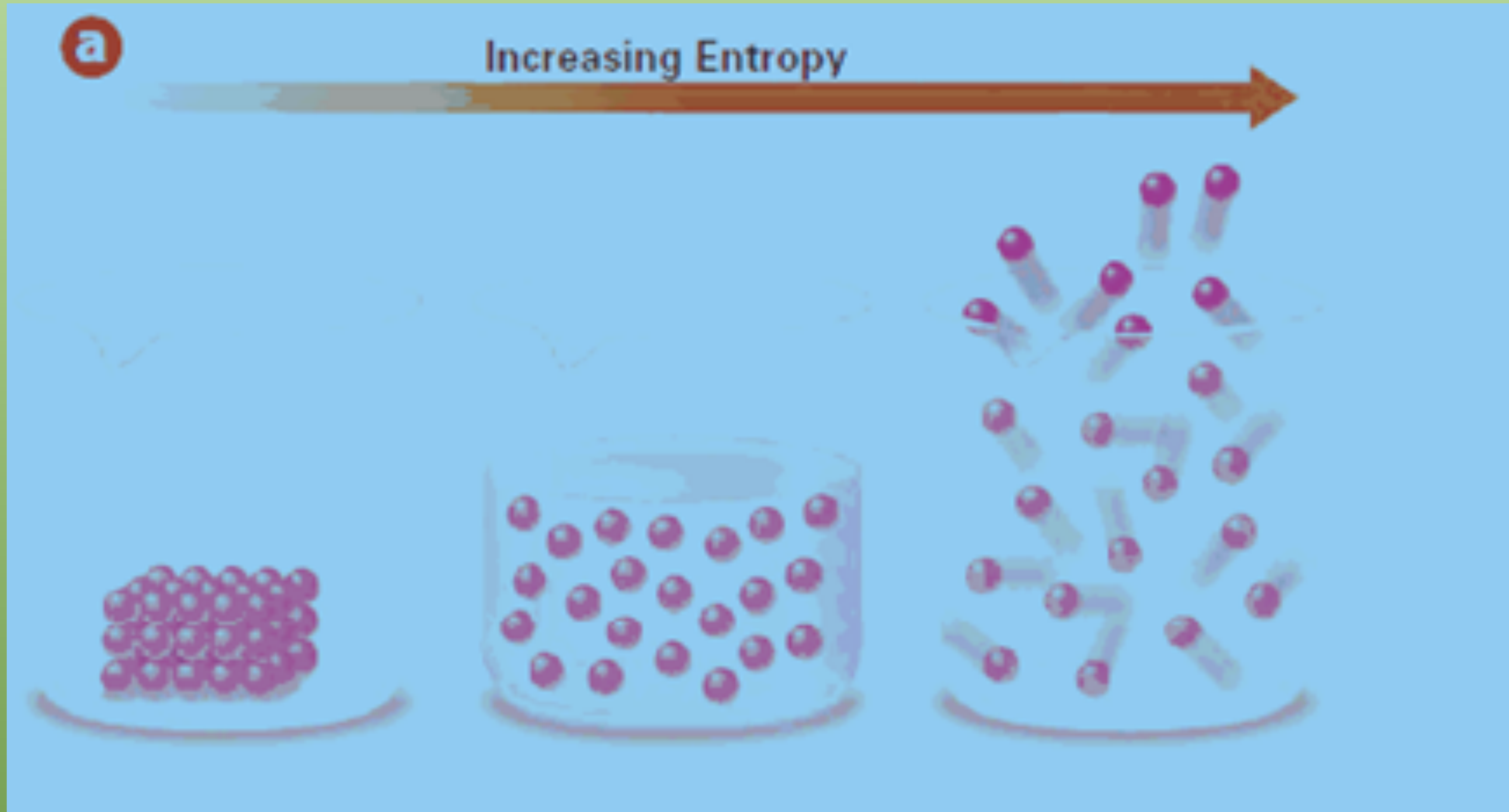
Kinetic Energy & Disorder

Topic 3



What is this disorganization called?

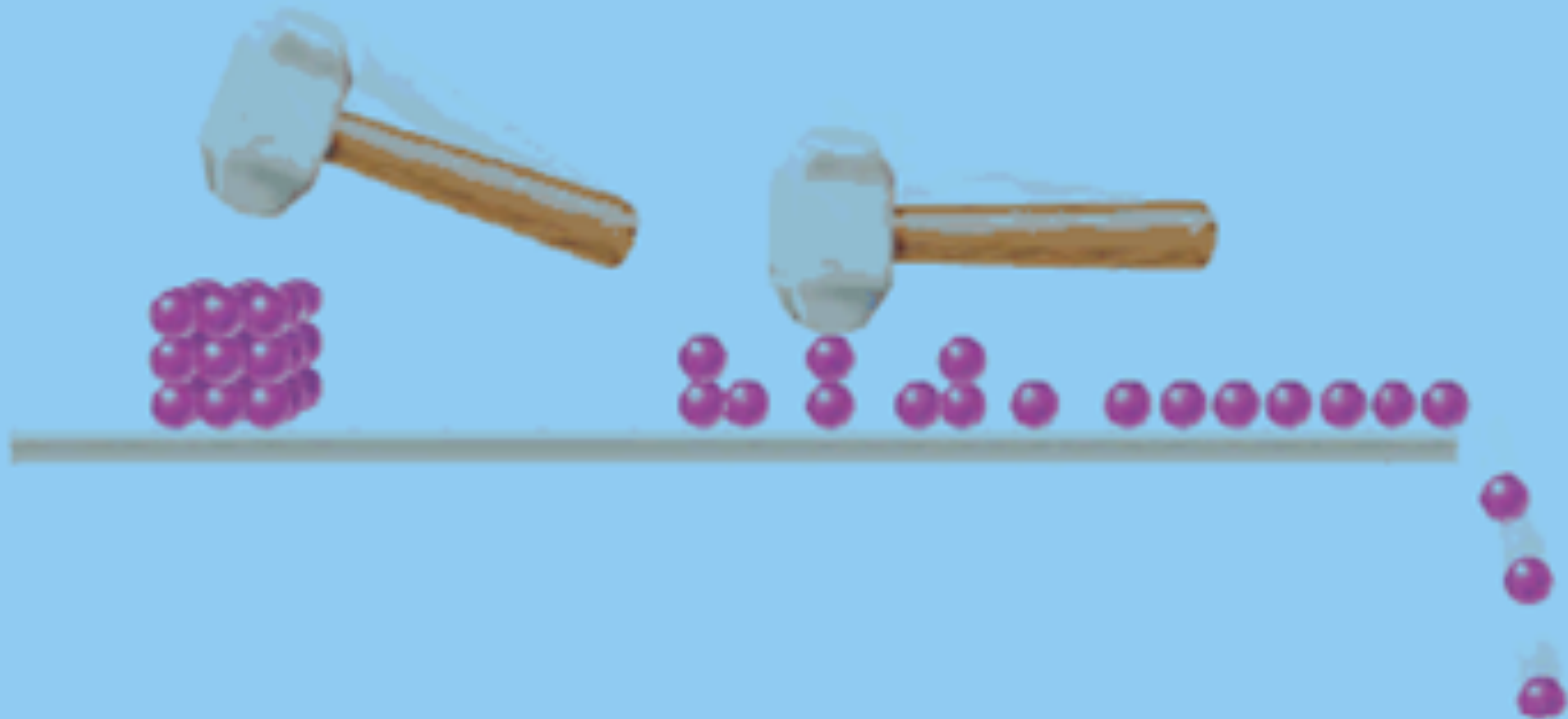
State of Matter Changes



Surface Area

b

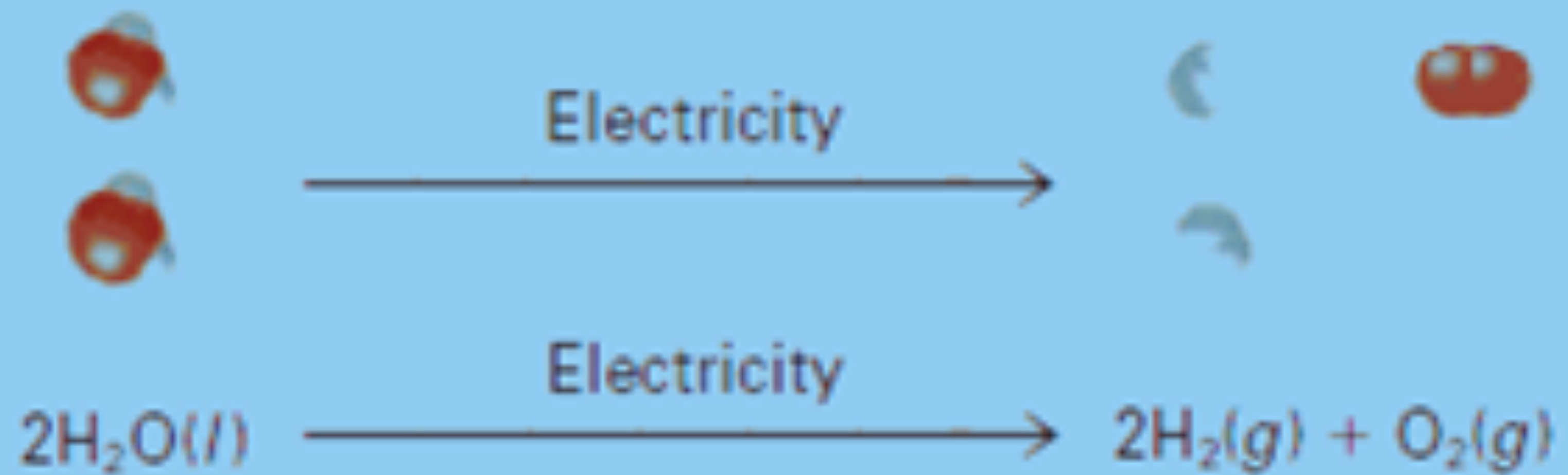
Increasing Entropy



of Product Molecules

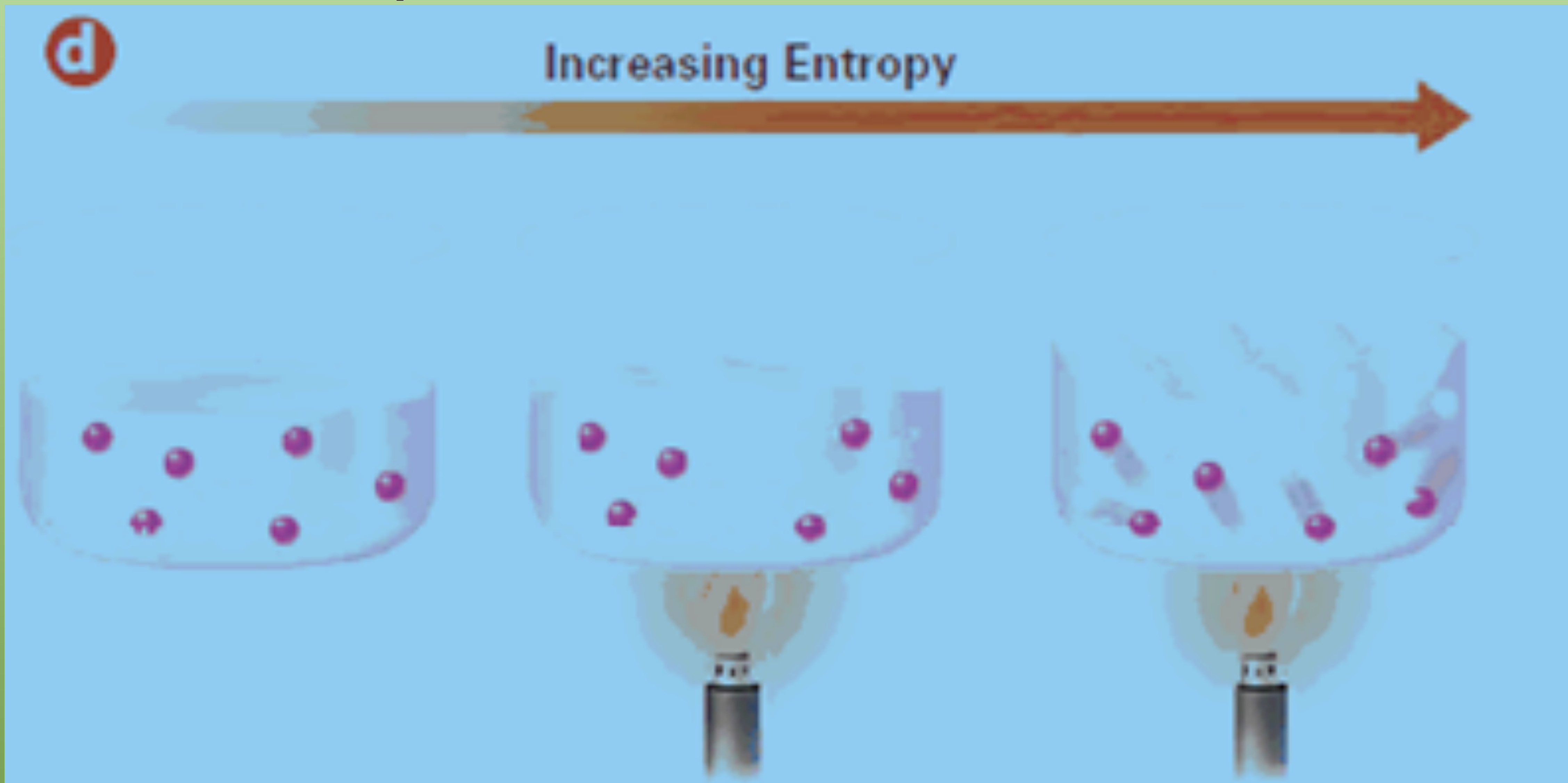
G

Increasing Entropy



Electrolysis of water

Temperature



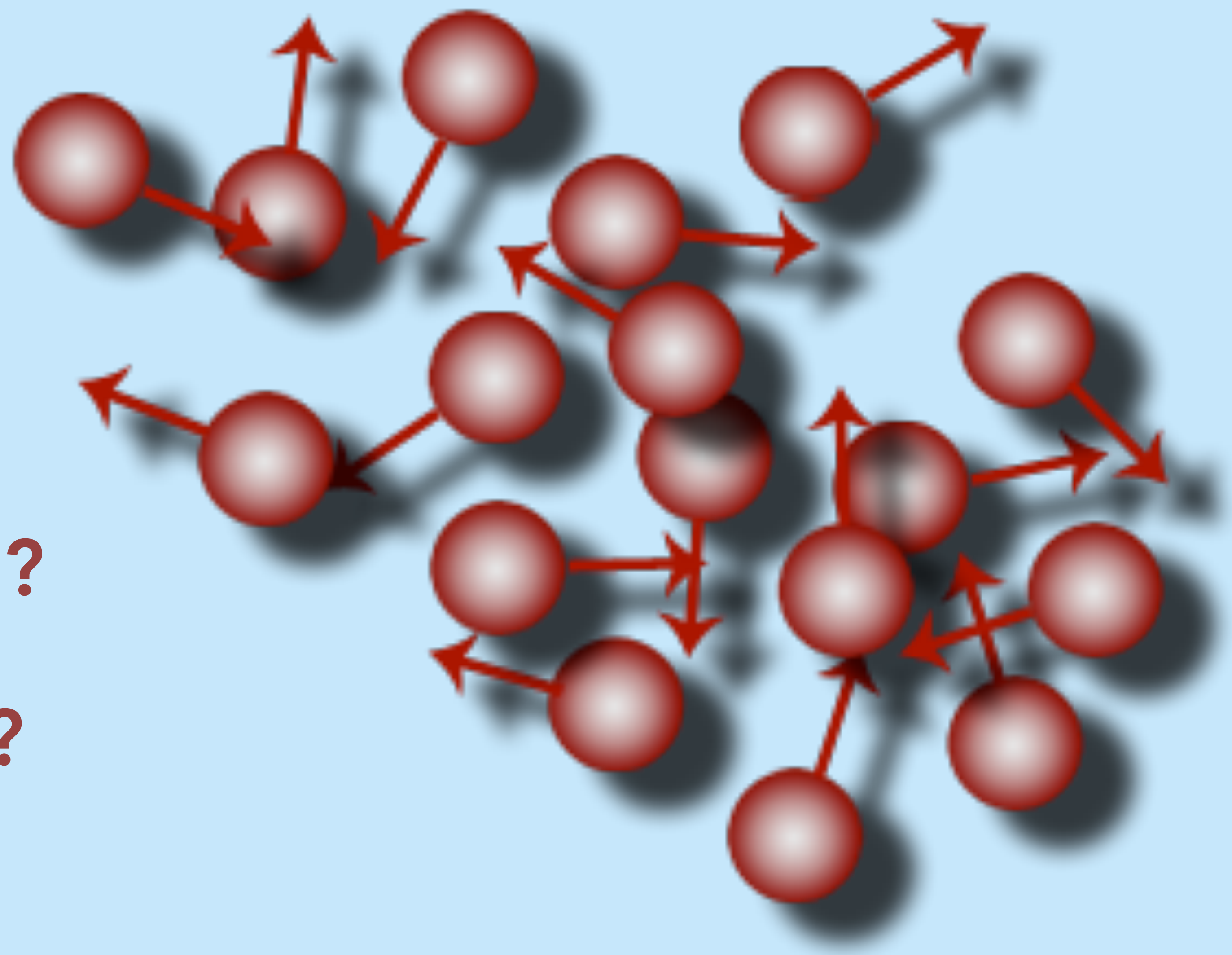
Summary of Increasing Entropy

- ◆ State of Matter (solid, liquid, aqueous, gas)
- ◆ # of moles
- ◆ Particle size

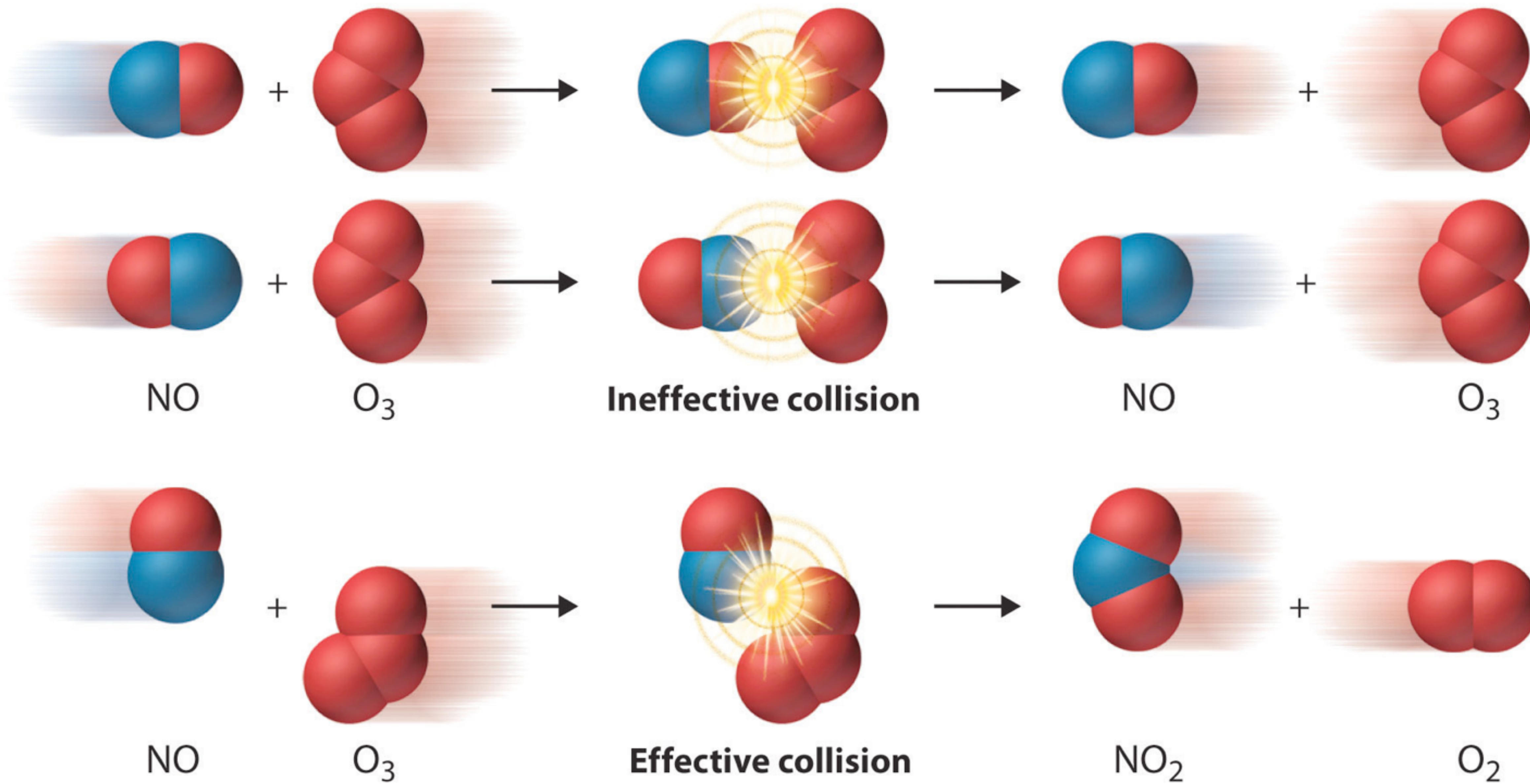
Collision Theory & Rate of Reaction

Topic 4

- ◆ Poppers!! (DoE)
- ◆ Variables in this lab?
- ◆ Effective Collisions?



Review of Collision Theory



Rate Increased by:

- ◆ Increasing temperature
- ◆ Increasing concentration
- ◆ Increasing surface area (break into smaller parts)
- ◆ Add a catalyst (ANGLE of collisions!)
- ◆ Increase pressure (only for gases)

Equilibrium in Chemical Reactions

Topic 5

◆ What is EQUILIBRIUM?

◆ What are the conditions necessary to reach /maintain equilibrium?

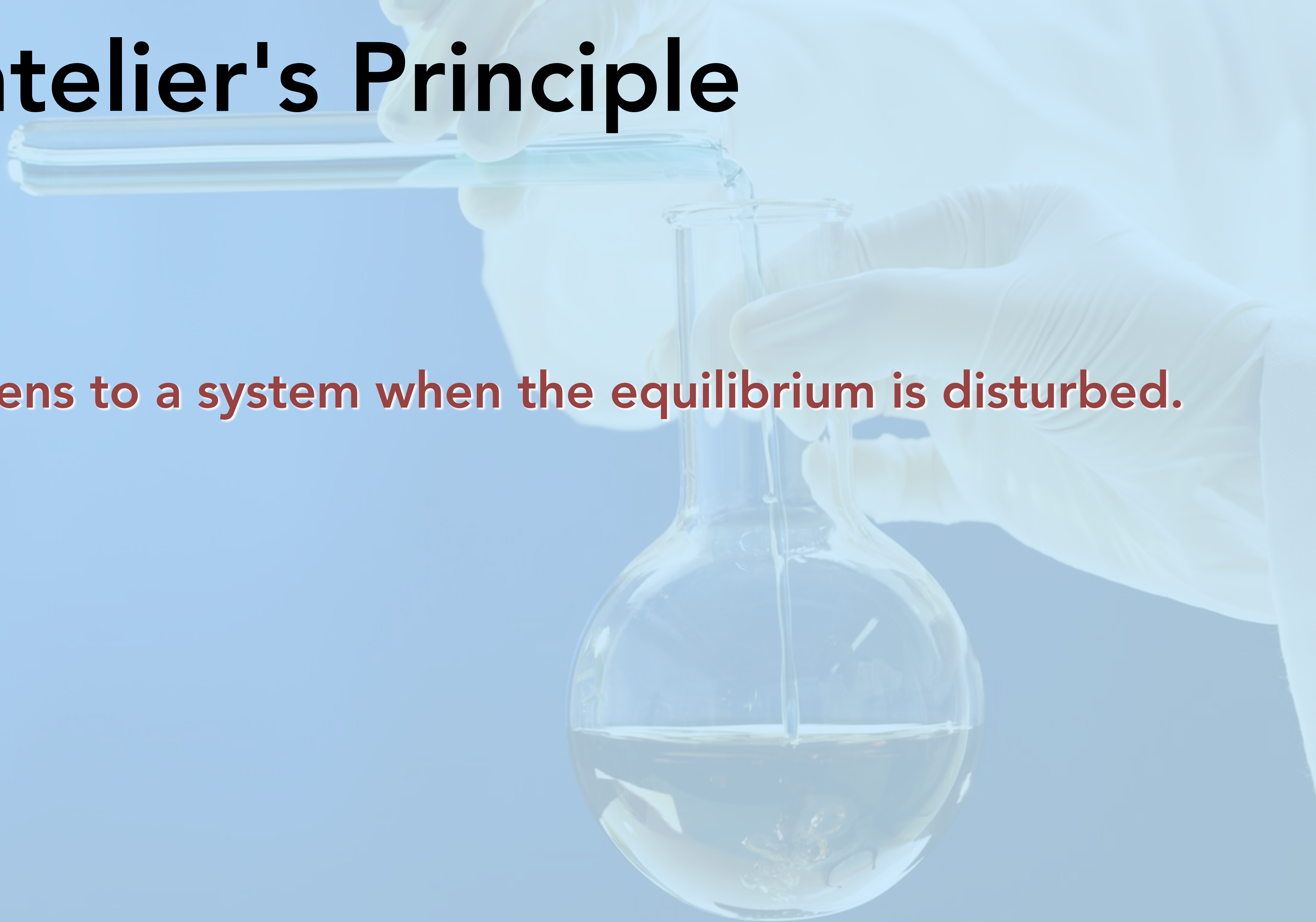
Equilibrium Quiz

- F a.) When a system is in a state of “equilibrium,” what is “equal” are the amounts of products and reactants.
- T b.) When a system is in a state of “equilibrium,” what is “equal” are the rates of a forward and reverse process.
- T c.) When a system is in a state of “equilibrium,” the amounts of products and reactants are “constant,” or in other words, “not changing.”
- F d.) When a system gets into a state of “equilibrium,” then no observable changes are seen, because the forward and reverse processes cease to happen.
- T e.) When a system gets into a state of “equilibrium,” then no observable changes are seen, because any progress made by the forward process is undone by the reverse process.

Le Chatelier's Principle

Topic 6

- **What happens to a system when the equilibrium is disturbed.**

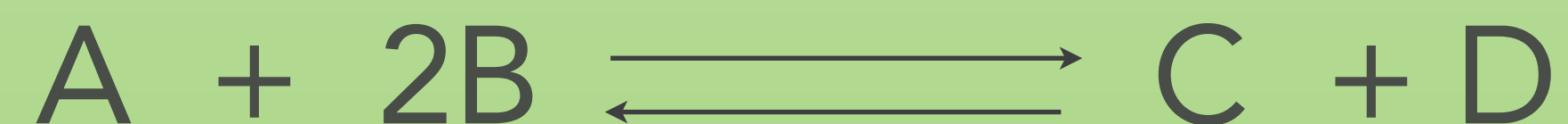


Le Chatelier



1850 - 1936

Le Chatelier's Principle



Equilibrium will shift to counteract a change

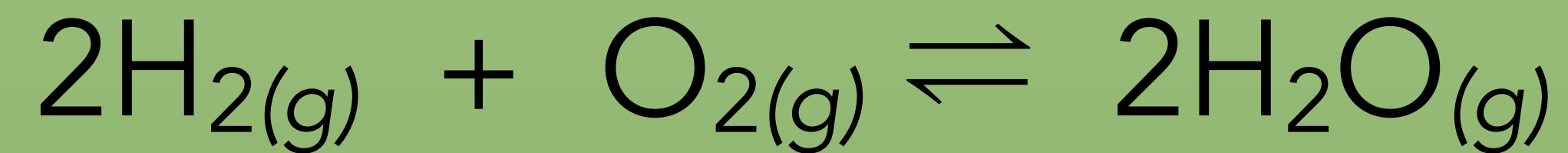
Three 'Shifts'

- Concentration
- Temperature
- Pressure



Concentration

- ◆ Shift right = forward reaction will be dominant.
- ◆ Shift left = reverse reaction will be dominant.



Consider the following 'shifts' to the above equilibrium...

Temperature

◆ Who runs INTO a fire?????



◆ Think of heat just like a reactant or a product



◆ Use Table I



Pressure

- ◆ Changing pressure **ONLY** affects gases.
- ◆ Increasing pressure = shift to side with fewer molecules (moles)
- ◆ Decreasing pressure = shift to side with more molecules (moles)







Concentration

 reactant concentration
 favors product formation



 product concentration
 favors reactant formation


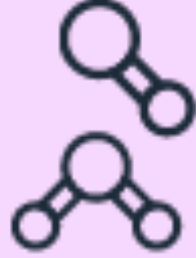
Temperature

 temperature
 favors endothermic reaction

 temperature
 favors exothermic reaction

Pressure

 pressure
 favors side with fewer molecules

 pressure
 favors side with more molecules

Lab: Le Chatelier's Principle

